SAS® Decision Manager 3.3: User's Guide

3.3*

* This document might apply to additional versions of the software. Open this document in SAS Help Center and click on the version in the banner to see all available versions.

SAS® Documentation
February 28, 2024

The correct bibliographic citation for this manual is as follows: SAS Institute Inc. 2019. *SAS® Decision Manager 3.3: User's Guide*. Cary, NC: SAS Institute Inc.

SAS® Decision Manager 3.3: User's Guide

SAS Institute Inc., SAS Campus Drive, Cary, NC 27513-2414

February 2024

3.3-P1:edmug

Contents

PART 1 Getting Started with SAS Decision Manager 1

PART 2 Working with Business Rules

PART 4 Evaluating Models and Monitoring Performance

PART 5 Deploying and Publishing Models

PART 6 Using SAS Workflow with SAS Decision Manager

PART 7 Working with Decisions

PART 8 Appendixes

PART 1

Getting Started with SAS Decision Manager

1

Introduction to SAS Decision Manager

Enterprise Decision Management Systems

Enterprise decision management systems can transform the way businesses make decisions. They enable businesses to use the information they already have to make better decisions—decisions that are based on predictive analytics rather than on past history. Decision management systems automate the process of making

decisions, particularly day-to-day operational decisions. They improve the speed, efficiency, and accuracy of routine business processes, in part by reducing the need for human intervention. By automating decisions, organizations in every industry can improve interactions with customers, partners, suppliers, and employees. In addition, organizations that are highly regulated, such as financial services, health care, and insurance, can more easily achieve compliance as a result of repeatable, traceable decisions.

SAS Decision Manager helps organizations manage data, business rules, analytical models, and optimization techniques. Rule management, model management, and data management are integrated into a consistent interface for easier accessibility.

Data Management

SAS Decision Manager enables you to manage your list of data tables from within the application. You can create new Base SAS libraries, add and remove tables, view table data and metadata, create and delete table summaries, and associate attachments and comments with tables. The application uses data tables when it needs to access data, such as for rule discovery, rule flow testing, and testing, scoring, training, and performance monitoring of models.

Business Rule Management

About Managing Business Rules

Business rules capture the logic of business decisions and are one of the core components of decision management systems. Business rules make the decision-making process transparent and adaptable, allowing organizations to respond quickly to new information about customers and markets. They allow organizations to identify and deal with fraud, avoid unnecessary risk, and find opportunities hidden in customer data.

You can use SAS Decision Manager to create a database of business rules, connect those rules together into rules flows, and publish the rule flows for use by other applications. SAS Decision Manager provides the following capabilities:

business rule authoring

A business rule specifies conditions to be evaluated and action to be taken if those conditions are satisfied. For example, you can create a rule that determines whether a customer has a mortgage. That same rule can then add the outstanding balance of the mortgage to a running total of the customer's debt. With SAS Decision Manager, you define the conditions and actions for each rule. You can use the Equation Editor to create the expressions for the rule.

The rule authoring features of SAS Decision Manager make creating rules easier and more accurate. For example, the list of allowable values for a term help

avoid incorrect rules. The lists of allowable values can be updated as needed, and the lists do not prevent you from providing new values manually.

lookup table
: A lookup table is a table of key-value pairs. You can use a specific lookup key to retrieve the associated data value. For example, you can retrieve a part name based on a part number or retrieve the full name of a country based on its abbreviation. You can import data into a lookup table from a comma-separated-values (CSV) file. In a rule set, you can retrieve data from a lookup table by using the LOOKUP and LOOKUPVALUE functions.

rule flow authoring and publishing
: A rule flow is a logical collection of rule sets. A rule flow defines a set of rule sets and the order in which they will be executed. A single rule flow frequently corresponds to a single decision. For example, a rule flow can initially execute the rule set that determines a customer's asset balance. Next, the rule set that determine a customer's debt level is executed. Finally, the rule set that assigns a customer's loan application status is executed.

  SAS Decision Manager makes it easy to combine rules sets into a rule flow and to publish those rule flows to the metadata server. After a rule flow has been published, it is available for use by other applications.

rule set management
: A rule set is a logical collection of rules. A single rule set can have many rules. For example, you might have a rule set that determines a customer's asset balance and another rule set that determines a customer's debt level. SAS Decision Manager displays rules sets as lists of rules with each entry defining conditions and actions for one rule. By using SAS Decision Manager, you can easily create new rule sets, reorder the rules in a rule set, add new rules to existing rule sets, and more.

  You can also manage rule flows. When a rule flow is published, the versioning features of SAS Decision Manager create a static version of the rule flow. This static version helps you to enforce integrity and governance over the rule sets and rule flows that are put into production.

vocabulary management
: A business vocabulary defines entities and terms. An entity is an object in a business domain, and it contains terms. A term is an attribute of an entity. Terms are the building blocks that you use to construct business rules. SAS Decision Manager enables you to easily create and edit entities and terms. For individual terms, you can create a list of allowable values, which makes creating rules even easier.

Create and Publish Business Rules

To create and publish business rules using SAS Decision Manager:

1. Add data tables to your list of data sources.
2. Create business rule folders where you want to save the business rules.
3. Create vocabularies.
4. Create entities and terms.

5 Create rule sets and rules.

6 Create rule flows.

7 (Optional) Test rule flows.

8 Publish rule flows.

After a rule flow has been published, it is available for use by other applications such as SAS Data Integration Studio. These applications map objects in the SAS Decision Manager database to objects in the input data. For example, terms are mapped to table columns or to data set variables. The output generated when a rule flow is executed is written to a data set. The location of the data set is specified by the application.

Model Management

About Managing Models

Using SAS Decision Manager, you can store models, organize them within projects or folders, validate candidate models, assess candidate models for champion model selection, publish and monitor champion models in a production environment, and retrain models. All model development and model maintenance personnel, including data modelers, validation testers, scoring officers, and analysts, can use SAS Decision Manager.

Here are some of the services SAS Decision Manager provides:

- Use a single interface to access all of your business modeling projects. All models are stored in a central, secure model repository. Models can also be accessed in one place using the models list in the Models category.
- Track the progress of your project's version by creating processes, definitions, and tests. You create custom processes, definitions, and tests to meet your business requirements and to match your business processes.
- Use data tables that are registered in the SAS Metadata Repository.
- Import SAS Enterprise Miner models, SAS/STAT linear models, SAS/ETS COUNTREG and SEVERITY models, models that you develop using SAS code, PMML models, and R models. You can also import a generic model and its model's files into a folder. You can create custom model templates for SAS code models so that SAS Decision Manager knows exactly what files and metadata are associated with a model.
- You can schedule and run scoring tests, performance monitoring, and retraining to validate models.
- Run several reports to compare and assess candidate models. You can also write your own SAS reporting programs to run and assess candidate models. The aggregated reporting facility enables you to combine multiple reports into a single report. Dashboard reports enable you to monitor the state of projects using performance monitoring reports and can be viewed in a web browser.

- Publish models to the SAS Metadata Repository or a SAS channel. You can also publish the champion model and challenger models to a database for scoring. The SAS Scoring Accelerator is used by SAS Decision Manager to publish models to a database or Hadoop.

Data tables are an integral part of the modeling process. You can use project input and output prototype tables, as well as scoring input and output prototype tables to define variables. Data tables are used for scoring, testing, and performance monitoring. Performance data can be created from your operational data, provided that it has the required structure (for example, the data contains a target variable).

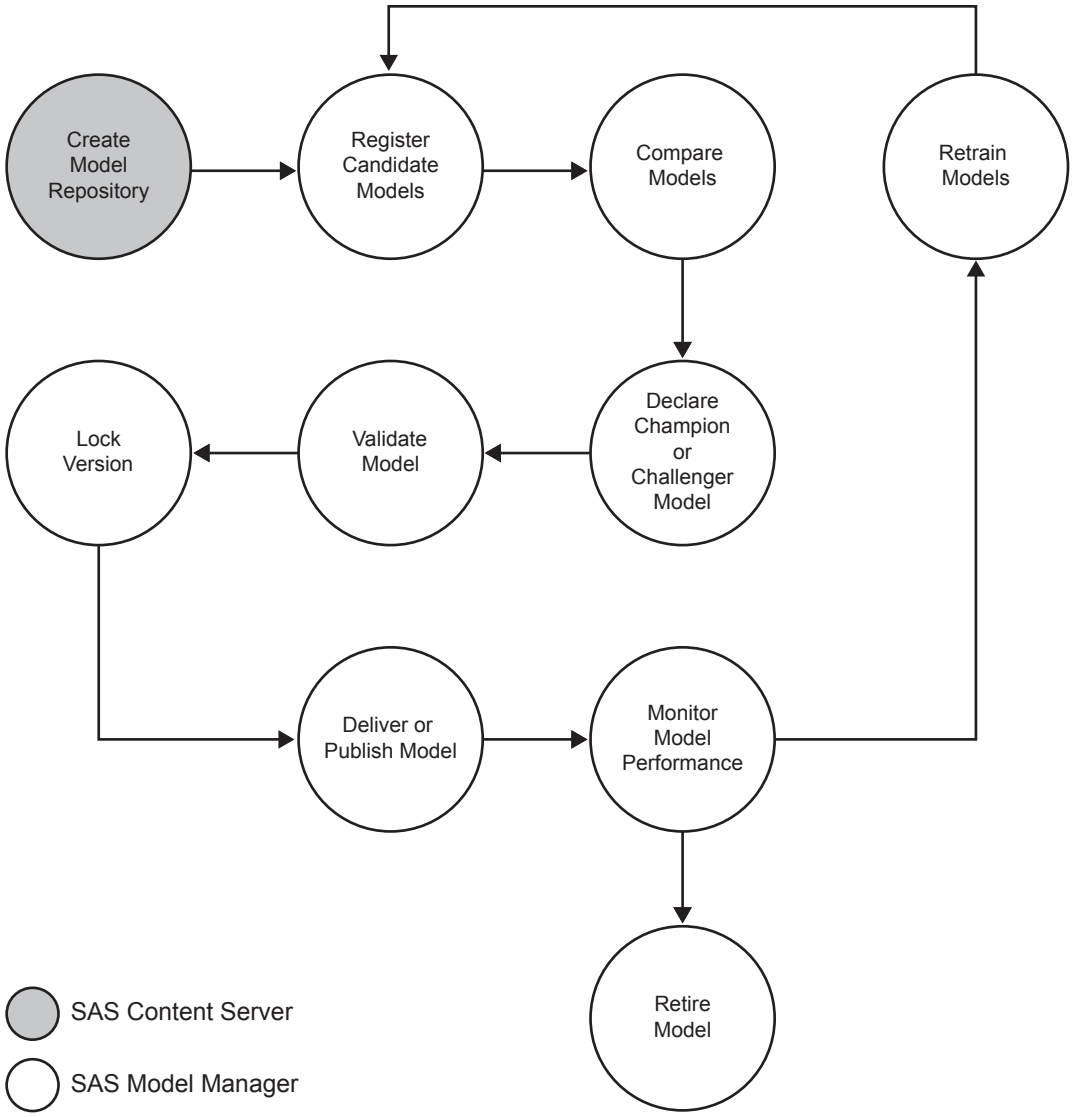
You can also create multiple projects in a portfolio. Additional versions can then be created for all projects within the portfolio. Champion models for all projects within the portfolio can be monitored for performance, and published to the SAS Metadata Repository. SAS Factory Miner models can also be registered to the SAS Decision Manager model repository. The SAS Factory Miner projects are managed as portfolios in SAS Decision Manager. The project segments and models are available within a portfolio and can be managed from the Portfolios category within SAS Decision Manager.

Any user who is registered in SAS Management Console can be assigned to a SAS Decision Manager group, and can then work in SAS Decision Manager. For more information, see “Configuring Users, Groups, and Roles” in *SAS Model Manager: Administrator’s Guide*.

Model Management Process

The following diagram illustrates the model management process:

Figure 1.1 *The Model Management Process*



Here is a summary of the model management process:

- **Create Model Repository**: create a secure model repository on the SAS Content Server where SAS code, input and output files, and metadata that is associated with a model can be stored.
- **Register Candidate Models**: register input and output files, and then import and configure a model.
- **Compare Models**: perform scoring tests and create comparison reports for the models by using test data sources.
- **Declare Champion or Challenger Model**: declare the model as champion or challenger to use for testing and production phases of the workflow.
- **Validate Model**: perform scoring tests and create validation reports for the champion model and challenger models by using test data sources.
- **Lock Version**: lock a version when the champion model is approved for production.

- **Deliver or Publish Model**: publish a champion or challenger models to a SAS publish channel, to a database, or to the SAS Metadata Repository.
- **Monitor Model Performance**: provide comparative model performance benchmarking.
- **Retrain Models**: select models to retrain in response to data or market changes.
- **Retire Model**: retire a model from production.

Here is an example of the model management process for comparing a challenger model to the champion model to determine the best champion model:

1. Register candidate models in the version that is under development.
2. Create a Dynamic Lift report and compare the model to the champion model. Flag the model as a challenger based on the results of the Dynamic Lift report.
3. Perform scoring tests with the champion and challenger models in real time or in batch. This step can be performed outside SAS Decision Manager.
4. Publish the challenger model to a database or to the SAS Metadata Repository.
5. Prepare performance data sources, which include both the actual outcome variable and predicted variable.
6. Create and execute the performance monitoring for the champion and challenger models to create reports to compare and validate the champion model and challenger models. One of the reports that is available for this comparison is the Champion and Challenger Performance report.
7. Set the challenger model as the project champion if the challenger is good enough to be promoted. Go to step 3, or consider building another model as a challenger with existing or a new input training data source.
8. Publish the new project champion model with or without a new challenger model.

High-Level Support Matrix by Model Score Code Type

Here is a high-level summary, arranged by model score code type, of the primary functions that are supported by SAS Decision Manager.

Product or Tool	Model Score Code Type	Importing	Scoring	Publishing	Performance Monitoring	Reporting	Retraining
Base SAS or other code editor	SAS program	Yes	Yes	No	Yes	Yes	Yes
SAS Enterprise Miner	DATA step	Yes	Yes	Yes	Yes	Yes	Yes
	PMML	Yes	No	No	No	No	No

Product or Tool	Model Score Code Type	Importing	Scoring	Publishing	Performance Monitoring	Reporting	Retraining
	Analytic store	Yes	Yes	Yes **Note:** Only for Hadoop and Teradata.	Yes	Yes	No
	Note: Applies only to SAS analytic store (SASAST) files. SAS package (SPK) files are not supported.						
SAS Factory Miner	DATA step	Yes	Yes	Yes	Yes	Yes	No
	Analytic store	Yes	Yes	Yes **Note:** Only for Hadoop and Teradata.	Yes	Yes	No
SAS HPFOREST and HPSVM procedures	Analytic store	Yes	Yes	Yes **Note:** Only for Hadoop and Teradata.	Yes	Yes	No
SAS/STAT linear model procedures	DATA step	Yes	Yes	Yes	Yes	Yes	Yes
PMML	DATA step	Yes	Yes	Yes	Yes	Yes	No
	PMML	Yes	No	No	No	No	No
R	DATA step	Yes	Yes	No	Yes	Yes	Yes
SAS Visual Data Mining and Machine Learning modeling procedures	DATA step	Yes	Yes	Yes	Yes	Yes	No
	Note: For more information, see "Using SAS Viya Models with SAS Decision Manager" in *SAS Decision Manager: Macro Guide* and "SAS Viya Procedures" in *SAS Procedures by Name and Product*.						

About Decision Management

SAS Decision Manager enables you to combine analytical models, rule flows, and conditional logic into decisions. You can investigate various scenarios, test and refine the decision logic, and then publish the decisions for use in batch applications and online transactions. You can automate the decision-making process by operationalizing your analytics and business rules. Automating decisions with SAS Decision Manager provides a streamlined mechanism for controlling and monitoring the rules and processes used by your organization.

Sign In

To sign in to SAS Decision Manager:

1. In the address bar of your web browser, enter the URL for SAS Decision Manager and press **Enter**. The Sign In page appears.

   Note: Contact your system administrator if you need the URL for SAS Decision Manager. The default URL is http://*host_name*:*port*/SASDecisionManager.

2. Enter a user ID and password. Your user ID might be case sensitive, depending on the operating system that is used to host the application server. Your password is case sensitive.

   Note: To schedule jobs in a Windows environment, you must include the domain name when entering your user ID (for example, *domain\myuserID*).

3. Click **Sign In**.

Managing Global Settings

Setting Global Settings

Global settings provide a way for you to customize the user interface. Global preferences for each user are stored in metadata and are retained if your deployment is migrated or reconfigured. Global preferences apply to all SAS web

applications. When you set a global preference, it applies only to the user that you are logged on as.

You set global preferences in the Settings window. To access the Settings window, click the user button ( ) on the application bar and select **Settings**. The user button changes depending on which user is logged on.

In the Settings window, you can set the following global preferences:

- General
- Region and Language
- Accessibility

Locked Settings

Your administrator can use the Configuration Manager to configure settings that apply to your application. After the settings are configured, the administrator can lock them, and you cannot override them. Your administrator can lock the following settings:

- Theme
- Regional settings

See "Set Global Properties for SAS Applications" in *SAS Intelligence Platform: Middle-Tier Administration Guide*.

Viewing Help and Documentation

SAS Decision Manager provides the following types of Help and documentation:

Embedded Help
: Help pop-up menus and tooltips provide brief descriptions of various fields.

  To access a Help pop-up menu for a field, click the Help icon ( ) when it appears next to a field. You can also place the mouse pointer over an element in the SAS Decision Manager windows to view the associated tooltip.

Help Center
: The Help Center provides all of the information that you need in order to use the application. The Help Center provides quick instructions to help you complete tasks in the application. In addition, the Help Center also provides general information about many of the features of the application. To access the Help Center, click the user button in the application bar and select **Help Center**.

  The Help Center is also available from the product's Learn and Support page at https://support.sas.com/en/software/decision-manager-support.html#documentation.

  The following documents are available in the Help Center:

SAS Decision Manager: User's Guide
provides detailed information about the concepts and tasks that are related to using SAS Decision Manager.

SAS Decision Manager: Administrator's Guide
contains information about the administration tasks that are required to set up and configure the SAS Decision Manager.

Using Sample Data

The SAS Decision Manager Quick Start tutorial is an introduction to some of the primary features of SAS Decision Manager. The tutorial covers basic tasks for creating and publishing rule flows, managing models, and creating and deploying decisions. For more information, see *SAS Decision Manager: Quick Start Tutorial*.

You can also use additional SAS Decision Manager sample data to perform basic and advanced model management tasks. For more information, see Appendix 6, "Sample Data and Models," on page 411.

2

Managing Data Tables

About Managing Data Tables

The Data category enables you to manage your list of data tables from within SAS Decision Manager. You can add and remove registered tables, view table data and metadata, create and delete table summaries, and associate attachments and comments with tables. The application uses these data tables whenever it needs to access data. The data is used for things such as for importing terms, rule discovery, rule flow testing, decision testing, and for testing, scoring, retraining, and performance monitoring of models.

You can view the list of tables by clicking ⛁. There are two ways to add tables to the list.

- You can use SAS Visual Data Builder to create new tables and add them to the list. See “Add Tables Using SAS Visual Data Builder” on page 17 for more information.

- If the table is already registered in the SAS Metadata Repository, you can add the table to the list of data sources as described in "Add Registered Tables from Metadata" on page 16.

  Note: If a table is not already registered in the SAS Metadata Repository, an administrator can register the table as described in "Register Tables" in *SAS Decision Manager: Administrator's Guide*.

When you are working with data tables, the following limitations and requirements apply:

- SAS Decision Manager cannot access tables in a SAS LASR Analytic Server instance.
- If you do not have the appropriate permissions to access a SAS folder in the SAS Metadata Server, then the tables and libraries that are in that folder are not listed in the Data category view.
- You can view tables with double-byte characters (DBCS) in the table name or in variable names, and you can use them to create summary tables. You can use them in models, model projects, and model portfolios, as well as their associated tasks. You cannot use them in business rules or decisions. To use these tables, support for DBCS characters must be enabled as described in "Extend Support for Double-Byte Characters in Table and Variable Names" in *SAS Decision Manager: Administrator's Guide*.
- Special characters and blanks are not supported in table names or in variable names.

Add Registered Tables from Metadata

Note: For information about registering tables in metadata, see "Register Tables" in *SAS Decision Manager: Administrator's Guide*.

Folders in a custom metadata repository are not available from the **Add Registered Tables** feature.

If a data table has already been registered in the SAS Metadata Repository, you can add it to the list of data sources. To add one or more tables:

1. Click ⛁ to navigate to the Data category view.
2. Click **Add Registered Tables**. The Choose an Item window appears.
3. Select the tables that you want to add, and click **OK**.

Add Tables Using SAS Visual Data Builder

SAS Visual Data Builder enables analysts and data administrators to perform data preparation for analytics. If SAS Visual Data Builder is installed at your site, ou can design queries to perform joins, add calculated columns, and subset and sort data. Several productivity features speed the creation of columns based on common aggregation functions.

Once you design your queries, you can reuse them as subqueries for more sophisticated queries, export them as jobs for scheduling, or schedule them directly from the user interface.

The application has data import features that enable you to access data from spreadsheets, delimited files, and SAS data sets. Once you import the data, you can prepare it for analysis or join it with existing data.

The application provides a series of features that you can use to extract and transform data from multiple sources and create new data tables.

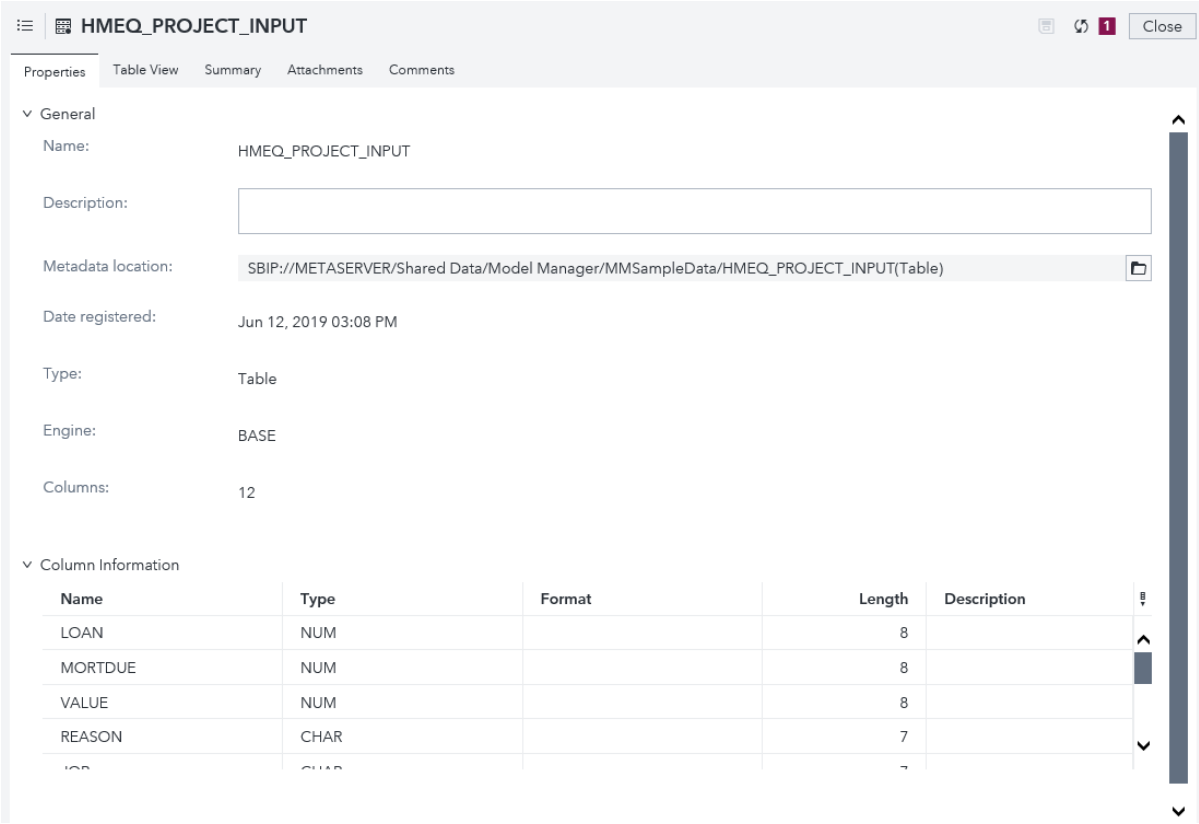
To access SAS Visual Data Builder, click ☰ and select **Data Preparation**. For more information, see *SAS Visual Data Builder: Preparing Data* and *SAS Visual Data Builder: Accessing Data*.

Edit Table Properties and View Table Metadata

The **Properties** page displays table metadata. On this page, you can edit the data source description and change the table associated with the data source name.

1. Click ⛁ to navigate to the Data category view.
2. Click on the table whose properties you want to edit. The **Properties** tab appears.

   The **Properties** tab displays table metadata such as the number of columns, the table location, and information about each column in the table.



3 Edit the data source description, or click 🗀 to select a different table as the data source.

4 Click 💾 to save the changes.

View Table Data

1 Click 🛢. The Data category is displayed with a list of tables.

2 Click on the table that you want to view.

3 Click the **Table View** tab.

On the **Table View** tab, you can control the display by clicking ⚙. The Manage Columns window is displayed.

You can select which columns are displayed or hidden in the table.

HMEQ_SCORE_PROB_OUTPUT

Properties | Table View | Summary | Attachments | Comments

ID	LOAN	MORTDUE	VALUE	REASON	JOB	YOJ	DELINQ
ID_000000000004	1500	.	.			.	.
ID_000000000005	1700	97800	112000	HomeImp	Office	3	0
ID_000000000006	1700	30548	40320	HomeImp	Other	9	0
ID_000000000007	1800	48649	57037	HomeImp	Other	5	2
ID_000000000011	2000	22608	.			18	.
ID_000000000012	2000	20627	29800	HomeImp	Office	11	1
ID_000000000013	2000	45000	55000	HomeImp	Other	3	0
ID_000000000014	2000	64536	87400		Mgr	2.5	0
ID_000000000018	2200	23030	.			19	.
ID_000000000019	2300	28192	40150	HomeImp	Other	4.5	0
ID_000000000020	2300	102370	120953	HomeImp	Office	2	0
ID_000000000021	2300	37626	46200	HomeImp	Other	3	1
ID_000000000025	2400	.	17180	HomeImp	Other	.	0
ID_000000000026	2400	34863	47471	HomeImp	Mgr	12	0
ID_000000000027	2400	98449	117195	HomeImp	Office	4	0
ID_000000000028	2500	15000	20200	HomeImp		18	0
ID_000000000032	2800	50795	63100	HomeImp	Self	26	15
ID_000000000033	2800	4000	60850	HomeImp	Other	16	0

To sort the table based on the values in a particular column, click on the column heading. If the column is sorted in ascending order, a ↑ appears beside the column heading. When the column is sorted in descending order, a ↓ appears.

Filter Data in the Table View

You can filter the rows that are shown on the **Table View** tab in either of the following ways:

- Right-click any column heading, and select **Sort** ⇨ **Sort (ascending)** or **Sort (descending)**. If the column is sorted in ascending order, a ↑ appears beside the column heading. When the column is sorted in descending order, a ↓ appears.
- Right-click a column heading to display the column actions menu. Enter a value in the **Filter** text box and press Enter. The value that you enter in the text box must be a value from the column that you selected.

A filter icon (▽) is displayed next to the column name signifying that there is a filter on the column.

To clear the filter:

- Right-click the column name and select **Sort** ⇨ **Remove sort**.

- Right-click the column name, delete the text in the **Filter** text box, and press Enter.

Create a Table Summary

To create a new table summary:

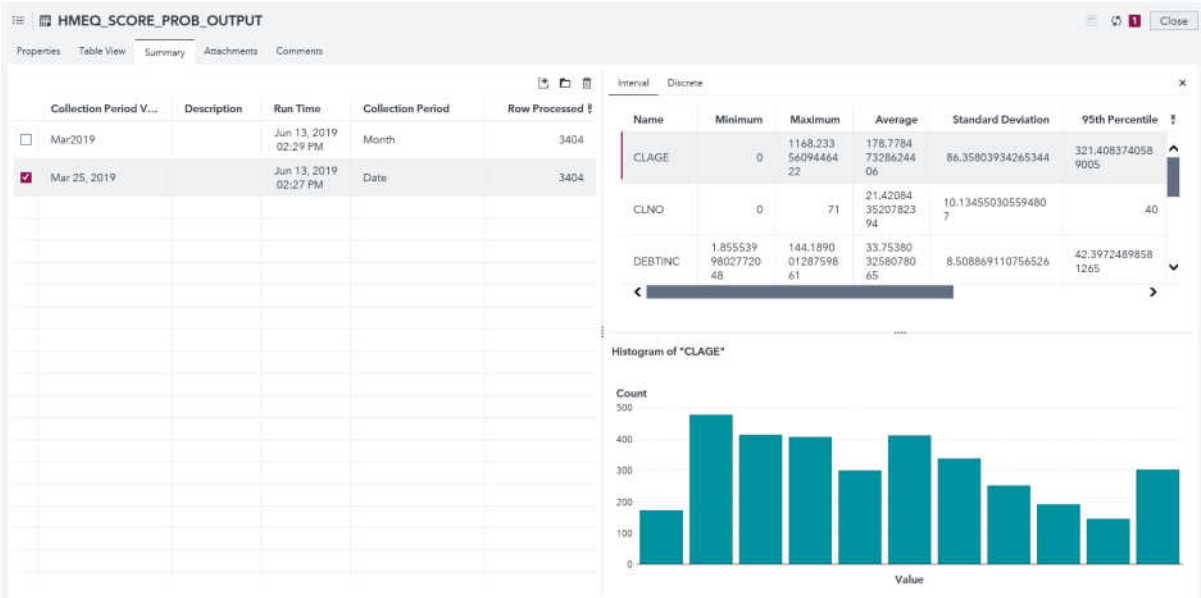
1. Click ⛁, and then click the table name for which you want to create a summary.
2. Click the **Summary** tab, and then click ✳.
3. In the New Summary window, select the **Collection Period** and the specific date or time values for the collection period that is represented by the data in the table.

   Note: The **Collection Period** is not used to filter the data.

4. (Optional) Specify a summary description.
5. Click **Run**. SAS Decision Manager runs a process to summarize the data and adds the new summary to the **Summary** page.

Double-click the summary to open it.

The following display shows the **Summary** page for the HMEQ_SCORE_PROB_OUTPUT table with CLAGE highlighted. The collection period represented by the data in the table is March 25, 2019.



Delete a Table Summary

To delete a table summary:

1 Click ⛁ and then select the table for the summary that you want to delete.

2 Click the **Summary** tab.

3 Select the summary that you want to delete.

4 Click 🗑.

Add Attachments

To add an attachment such as a document file or an image file:

1 Click the **Attachments** tab.

2 Click +, and select the file to attach.

3 Click **Open**.

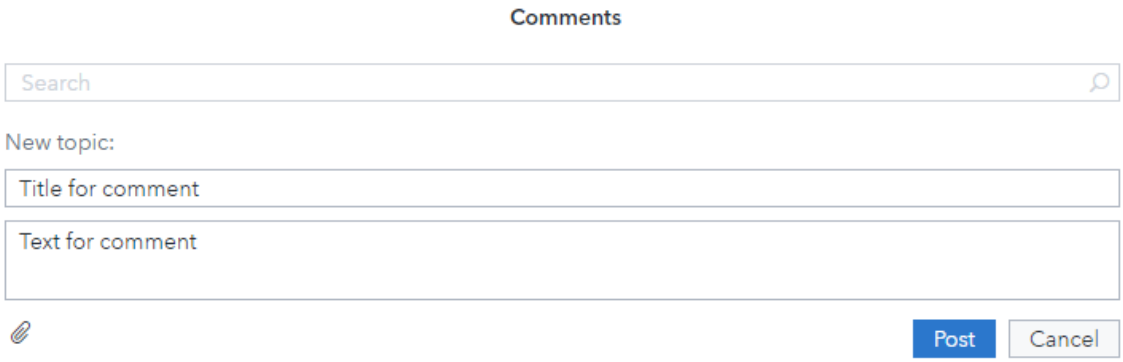
Note: You can delete an attachment by selecting the attachment and clicking 🗑.

Add Comments

You can add new comments or reply to existing comments. To add a new comment:

1 Click the **Comments** tab.

2 Enter a topic title and enter the comment. The topic title is required, and the **Post** button is not enabled until you enter the topic title.



Note: The green circle with a circular arrow inside it indicates that your comments are being checked for grammatical errors.

3 (Optional) Click to add an attachment such as an image or a document.

Note: You cannot attach executable files to a comment.

4 Click **Post**.

To reply to an existing comment, enter your reply in the field immediately below the topic title for the existing comment, and click **Post**.

Click to see comments that have been posted by others.

To search for text in the comments, enter text in the search field at the top of the **Comments** page.

Note: The Comments: Administrator role enables users to edit and delete comments. For more information, see "Roles and Capabilities" in *SAS Decision Manager: Administrator's Guide*.

To edit a comment that you made, click .

To delete a comment that you made, click .

Remove a Table

Removing a table from the list of data sources does not delete the table from file system. To remove a table from the list of data sources:

1 Click to navigate to the Data category view.

2 Select the table that you want to remove from the list.

3 Click and select **Remove**.

PART 2

Working with Business Rules

3

Managing Business Rule Folders

About Managing Business Rules Folders and Folder Administration

All vocabularies, lookup tables, rule sets, and rule flows are stored in folders. By default, a folder named DCM_Folder is created for you. You can use this folder as the starting point for creating other top-level folders.

Note: Decisions are not contained in folders.

If folder administration is enabled at your site, only folder administrators can create top-level folders, move folders, and rename folders by using the **Manage folders** ⇨ **Rename** menu option. All users can create subfolders, delete empty folders, and edit the names and descriptions of folders by using the **Manage folders** ⇨ **Edit top-level folder** menu option. If folder administration is not enabled, all users can perform all folder management tasks. For more information, see "Enable Business Rules Folder Administration" in *SAS Decision Manager: Administrator's Guide*.

The **Manage folders** option is available from the Actions menu (⋮ icon) in each category view except the My Tasks and Data views. This menu is enabled after you have created business rules content.

You can also manage folders in the Choose a Location window. You access this window from the **Location** field when you are defining new business rules content.

Create New Top-Level Folders

Note: If folder administration is enabled for your site, the ability to create top-level folders is limited to folder administrators. For more information, see "Enable Business Rules Folder Administration" in *SAS Decision Manager: Administrator's Guide*.

If you are a folder administrator, you must specify the permissions for the folder, and you can specify locations for test information.

To create a new top-level folder:

1. In any category view except the Decisions category view, click ⋮, and select **Manage folders**.

   Note: If this icon is not available, you can create new folders in the Choose a Location window that is available from the **Location** field when you create new content.

2. Right-click a top-level folder and select **New top-level folder**. The New Folder window appears.
3. In the New Folder window, enter the name of the new folder. Folder names are limited to 100 characters.
4. (Optional) Enter a description for the new folder. Descriptions are limited to 256 characters.
5. If you are a folder administrator, complete these steps:
   a. Select the group that you want to have access to the new folder.
   b. (Optional) Select the folder that contains test data for rule flows in the new folder.
   c. (Optional) Select the folder where you want the tests library saved for rule flows in the new folder.
6. Click **OK**.

Create New Folders

To create a new folder within another folder:

1 Select the parent folder in which you want to create a new subfolder, and click ✱.

2 Enter the name of the new folder. Folder names are limited to 100 characters.

3 Press Enter, and then click **OK**.

Move Folders

Note: If folder administration is enabled for your site, the ability to move folders is limited to folder administrators, and you cannot move a top-level folder into another folder. For more information, see "Enable Business Rules Folder Administration" in *SAS Decision Manager: Administrator's Guide*.

You cannot move a folder up to the level of a top-level folder. A folder cannot be moved into one of its own folders.

To move folders:

1 In any category view except the Decisions category view, click ⋮ and select **Manage Folders**.

   Note: If this icon is not available, you can create new folders in the Choose a Location window that is available from the **Location** field when you create new content.

2 Select the folder that you want to move, right-click and select **Move to folder**. The Choose a Location window appears.

3 Select a new location for the folder, and click **OK**.

Rename Folders

Note: If folder administration is enabled for your site, the **Rename** option is limited to folder administrators. For more information, see "Enable Business Rules Folder Administration" in *SAS Decision Manager: Administrator's Guide*.

To rename a folder:

1 In any category view except the Decisions category view, click ⋮ and select **Manage Folders**.

Note: If this icon is not available, you can create new folders in the Choose a Location window that is available from the **Location** field when you create new content.

2 Right-click the folder and select **Rename**.

3 Enter a new name for the folder and press Enter.

4 Click **Close**.

Delete Folders

Note: If there is only one top-level folder, you cannot delete it.

A folder must be empty before you can delete it. To delete folders, select the folders that you want to delete, and then click 🗑.

Edit Top-Level Folders

To edit the name or description of a top-level folder, complete these steps:

1 In any category view except the Decisions category view, click ⋮ and select **Manage Folders**.

2 Right-click the folder that you want to edit, and select **Edit top-level folder**.

3 Edit the name and description, and click **OK**.

4

Managing Vocabularies

Introduction to Vocabularies, Entities, and Terms

Vocabularies, entities, and terms are the basic building blocks of a SAS Decision Manager database. Vocabularies contain entities, and entities contain terms.

Object	Description
Vocabulary	Vocabularies contain one or more business entities. Vocabularies categorize and structure the entities and terms needed to create a rules database.
Entity	An *entity* is an object in a business domain. For example, an entity could be Customer, Transaction, or Account. Entities contain terms. They group terms into logical units. Entities are not mapped to tables or to table columns when rules flows are published.
Term	A term is an attribute of an entity. For example, a customer entity might have terms such as name, address, and income. A transaction entity might contain terms for date, time, transaction amount, and account number. Terms are the objects with which you build business rules. A business rule can have *condition terms* and *action terms*. Suppose your rule is `if balance>1000 then account="premium"`. The term `balance` is a condition term, and `account` is an action term. Terms are mapped to table columns by the applications that use published rule flows that are within metadata.

Tips for Creating Entities and Terms

- Before you define vocabulary entities and terms, review the structure of the tables that input values will come from. Vocabularies should be structured similarly to these tables to ensure that terms are mapped correctly to input columns. Coordinate your work with the groups that will use the vocabulary. Coordination helps ensure that the vocabulary structure meets their requirements.
- Boolean data can be represented with terms that are defined either as Boolean data types or as Character data types. In some cases, Boolean values might be better represented by using terms defined as Character. For example, if your data already uses `yes` and `no` for Boolean data, then you might want to use a Character term to process these values rather than try to translate those values to `true` and `false`.

Create a Vocabulary

1. Click to navigate to the Vocabularies category view, and then click **New Vocabulary**. The New Vocabulary window appears.

2 Enter the name of the new vocabulary. Vocabulary names can contain up to 32 characters and must be unique within a folder. Vocabulary names are case insensitive. For example, SAS Decision Manager considers `name` to be equal to `NAME`.

3 (Optional) Enter a description for the new vocabulary. Descriptions are limited to 256 characters.

4 Enter a **Location** for the new vocabulary.

> **TIP** To create a new top-level folder, see "Create New Top-Level Folders" on page 26.
>
> To create a new folder inside an existing folder, highlight the existing folder, click ✱, and enter a name for the new folder.

5 Click **Save**.

Create an Entity

To create a new entity:

1 Open the vocabulary in which you want to create an entity.

2 Click **New Entity**. The New Entity window appears.

3 Enter the name of the new entity. Entity names can contain up to 32 characters and must be unique within a vocabulary. Entity names are case insensitive. For example, SAS Decision Manager considers `name` to be equal to `NAME`.

4 (Optional) Enter a description for the new entity. Descriptions are limited to 256 characters.

5 Click **Save**.

Create a Term

1 Open the vocabulary where you want to create the new term.

2 Check the box next to the entity for which you want to create the new term, click ⋮, and select **New Term**. The New Term window appears.

3 Enter the name of the new term. Term names can contain up to 32 characters and must be unique within a vocabulary. Term names are case insensitive. For example, SAS Decision Manager considers `name` to be equal to `NAME`.

Note: Do not use any of these operators or keywords as term names: AND, OR, IN, NOT, LIKE, TRUE, or FALSE. Do not use `_N_` or any DS2 reserved word as a term name. See "Reserved Words in the DS2 Language" in *SAS DS2 Programmer's Guide*.

4 (Optional) Enter a description for the new term. Descriptions are limited to 256 characters.

5 Select the data type for the new term.

6 Select the domain type for the new term. Numeric domain values can be discrete or continuous. A domain value is discrete if it is an individual value such as 5.3 or 18JUL2012:10:25:00. A domain value is continuous if it specifies a range such as >5 or <18JUL2012:10:25:00.

7 (Optional) Specify the domain values for the new term. Domain values are the set of expected values for a term. See "Specify Domain Values" on page 33 for more information.

8 (Optional) Select **Exclude from input** if you do not want the term to be mapped to a column in an input data set. (The application expects all terms to be mapped to columns in an input data set.)

9 (Optional) Select **Exclude from output** to exclude a term from the output data sets that are generated by rule flows.

> **TIP** To create a temporary term for use only while a rule flow is executing, select both **Exclude from input** and **Exclude from output**.

10 Click **Save**.

Import Terms from a Data Source

1 Create a new vocabulary or open an existing vocabulary. For information, see "Create a Vocabulary" on page 30.

2 Click **Import Terms**. The Import Terms window appears.

3 Select the data source from which you want to import terms. SAS Decision Manager displays the terms, their type, and domain information.

4 Enter the name of the entity to which you want to import the new terms.

5 (Optional) Enter a description for the entity.

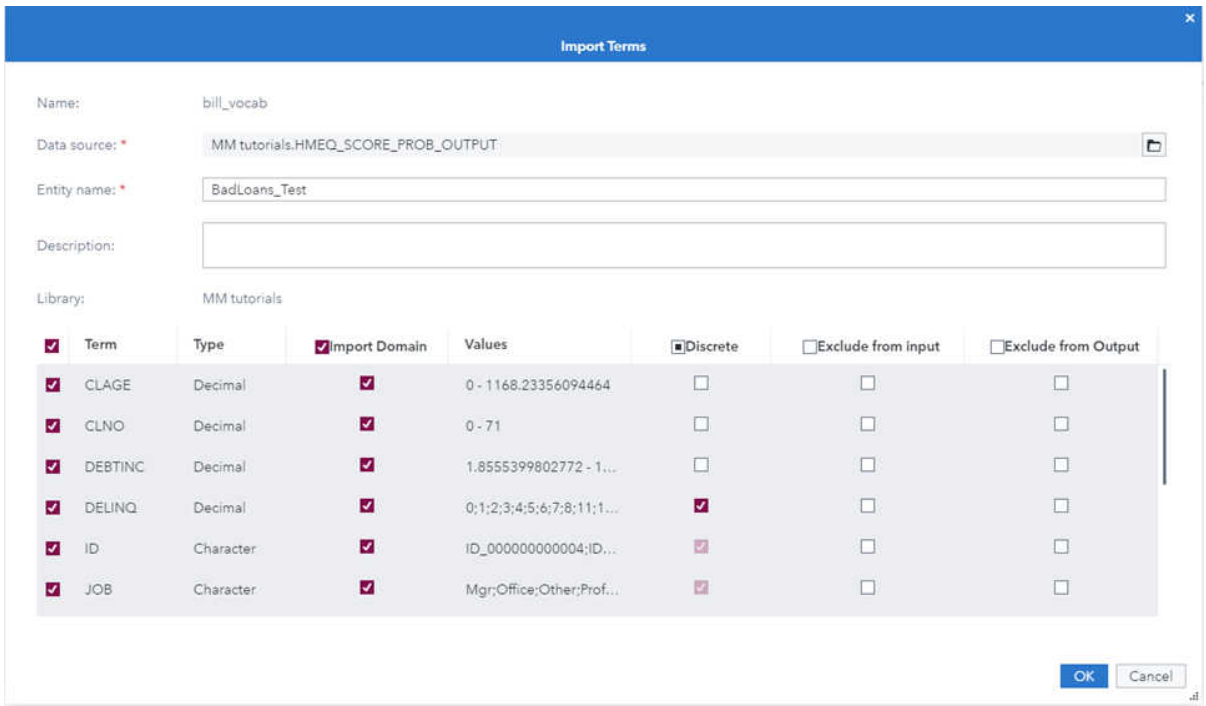
6 Select the check boxes for the terms and domain values that you want to import.

> **TIP** To select all of the items in a column, select the box beside the column heading.

7 Select the **Discrete** box for terms that have a discrete set of values. For more information, see "Specify Domain Values" on page 33.

8 All of the imported terms are included in both the input and the output unless you exclude them. Select any terms that you want to exclude. See Step 8 and Step 9 of "Create a Term" on page 31 for more information.

9 Click **OK**.



Specify Domain Values

Domain values are the set of expected values for a term. Domain values are not used to validate rules. They are used to enable faster and easier rule authoring. They are displayed in the Equation Editor, which enables you to add a value to an expression by double-clicking on the value.

Domain values can include term or variable names. For continuous values, you can use the greater than (>), less than (<), and equal (=) signs to set limits for ranges. You cannot include a semi-colon (;) within a domain value. You do not need to enclose Character values in quotation marks unless the value itself contains an apostrophe (').

Separate individual domain values with a semi-colon (;).

Note: To enter continuous Date and Datetime values, enclose the values in single quotation marks, followed by a `d` or `dt` as shown in the following table.

The following table shows examples of domain values.

Table 4.1 *Examples of Domain Values*

Data Type	Domain Type	Examples
Character	Discrete	`high risk;low risk` `"d'oscail";"d'fhill"`
Integer	Discrete	`0;800;3500`
	Continuous	`>100;<=myterm`
Decimal	Discrete	`3.14;12.98`
	Continuous	`>1.25;<=N1`
Date	Discrete	`01jul2012;31jul2012`
	Continuous	`>='01jan2013'd;<='31dec2013'd`
Datetime	Discrete	`01jul2012:10:52:00;31jul2012:23:00:00`
	Continuous	`<='01jul2012:00:00:00'dt;>'31jul2012 :23:00:00'dt`
Boolean	By default, Boolean values are set to `True` and `False` and cannot be changed.	

Edit Existing Vocabularies, Entities, or Terms

1. To edit a vocabulary, select the check box for the vocabulary in the Vocabularies category view.

   To edit an entity or term, open the vocabulary, and select the check box for the entity or term.

> **TIP** To display all of the terms in all of the entities, click ⩔.
>
> To hide the terms, click ⩓.

2 Click ⋮, and select **Edit**.

3 Edit the item properties as needed. The properties that you can edit depend on the type of item that you selected.

4 Click **Save**.

Delete Vocabularies, Entities, or Terms

Note: You cannot delete a vocabulary, entity, or term if it is used in a rule set or in a decision.

You can delete multiple vocabularies or terms at the same time. You can delete only one entity at a time.

To delete a vocabulary, select the check box for the vocabulary in the Vocabularies category view, click ⋮, and select **Delete**.

To delete entities or terms, open the vocabulary, select the check box for the entity or terms, click ⋮, and select **Delete**.

Move Vocabularies, Entities, Terms

Note: You cannot move an entity or term if it is used in a rule set or in a decision.

You can move multiple vocabularies or terms at the same time. You can move only one entity at a time.

1 Do one of the following, depending on what you want to move:

- To move vocabularies, select the check boxes for the vocabularies in the Vocabularies category view.
- To move an entity or one or more terms, open the vocabulary, and select the check box for the items that you want to move.

2 Click ⋮, and select **Move**. The Open window appears.

3 Select a new location for the items, and click **Open**.

- If you are moving a vocabulary, select a folder for the location.
- If you are moving an entity, select a vocabulary for the location.

- If you are moving a term, select an entity for the location.

When you move multiple terms, and terms with the same name already exist in that destination entity, SAS Decision Manager also appends an underscore, a number, and `Move` to the term names.

Duplicating Vocabularies, Entities, or Terms

You might want to duplicate a vocabulary when, for example, your company starts a new initiative similar to a previous one, and you need a similar vocabulary to work with. Duplicating terms is useful when the same actions that must be performed by different entities.

You can duplicate multiple vocabularies or terms at the same time. You cannot duplicate multiple entities at the same time.

Duplicate Vocabularies and Entities

To duplicate multiple vocabularies, select the check boxes for the vocabularies in the Vocabularies category view, click ⋮, and select **Duplicate**.SAS Decision Manager appends an underscore, a number, and `Copy` to the names.

1. Do one of the following, depending on what you want to duplicate:
   - To duplicate a single vocabulary, select the check box for the vocabulary in the Vocabularies category view.
   - To duplicate an entity, open the vocabulary, and select the check box for the entity.
2. Click ⋮, and select **Duplicate**. The Duplicate window appears.
3. Enter a name for the duplicate item, and click **Open**.
4. (Optional) Enter a description for the vocabulary.
5. Click **Duplicate**.

Duplicate Terms

To duplicate a single term:

1. Open the vocabulary that contains the term, and select the check box for the term.
2. Click ⋮, and select **Duplicate**. The Duplicate window appears.

3 Edit the properties of the duplicate term as needed, and click **Duplicate**. For more information about the properties of terms, see "Create a Term" on page 31.

To duplicate multiple terms:

1 Open the vocabulary that contains the terms, and select the check boxes for the terms.

2 Click ⋮, and select **Duplicate**. The Open window appears.

3 Select the entity where you want the duplicate terms to be saved, and click **Open**. When you duplicate multiple terms and save the duplicates in a different folder than the original, SAS Decision Manager appends an underscore, a number, and `Move` to the names.

Search for Rule Sets by Term

To find all of the rule sets that use a specific term:

1 Click to navigate to the Vocabularies category view, click ⋮, and then select **Search for Rule Sets**. The Search for Rule Sets window appears.

2 Enter the name of the term for which you want to search.

3 Select the usage that you want SAS Decision Manager to search for.

Anywhere
finds terms that are used as condition terms, action terms, or in expressions

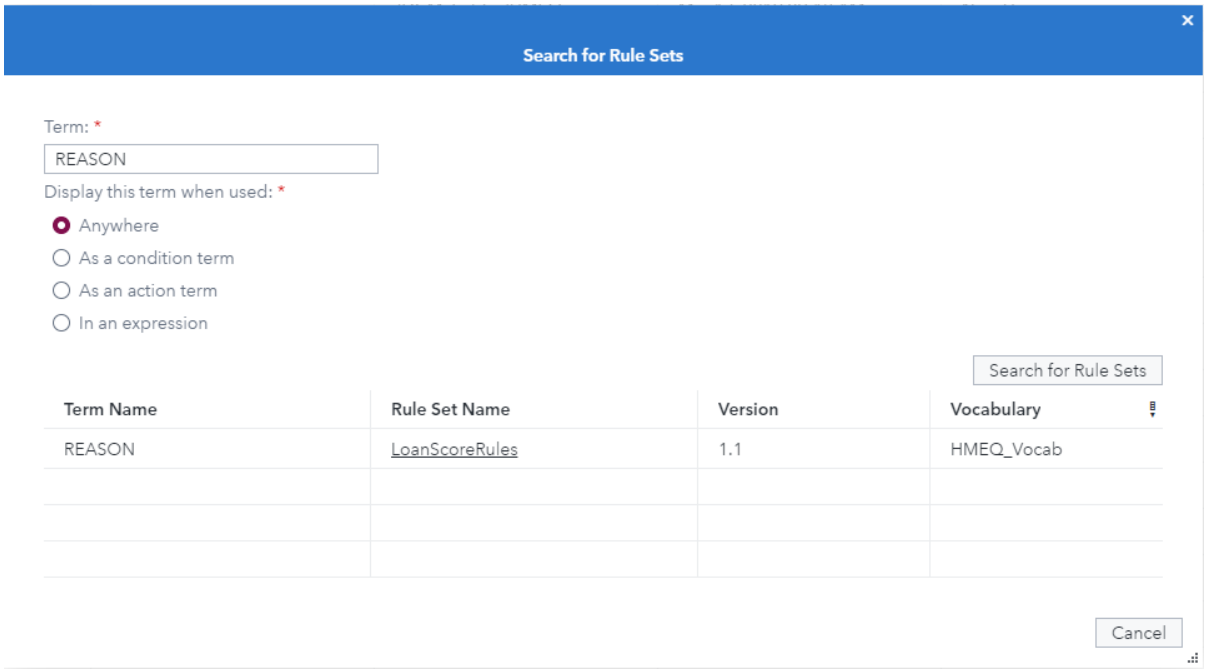
As a condition term
finds terms that are used only as condition terms (terms that have been added to the column or row headings of the decision table)

As an action term
finds terms that are used only as action terms (terms that have been added to the column or row headings of the decision table)

In an expression
finds terms only when they are used in rule expressions

4 Click **Search for Rule Sets**. If the search returns results, SAS Decision Manager displays all of the rule sets and versions in which it found the term.

To open one of the rule sets, select the rule set in the Rule Set Name column.



Note: If a term is referenced implicitly in an expression, then selecting **In an expression** and searching for that term does not find it. For example, if you enter the expression `+10` into the rule set editor for the term `myterm`, then the resulting expression for **myterm** is `=myterm+10`. Because the expression that you entered into the rule set editor did not explicitly reference `myterm`, the search was not successful.

5

Using Lookup Tables and Functions

Using Lookup Tables and Functions

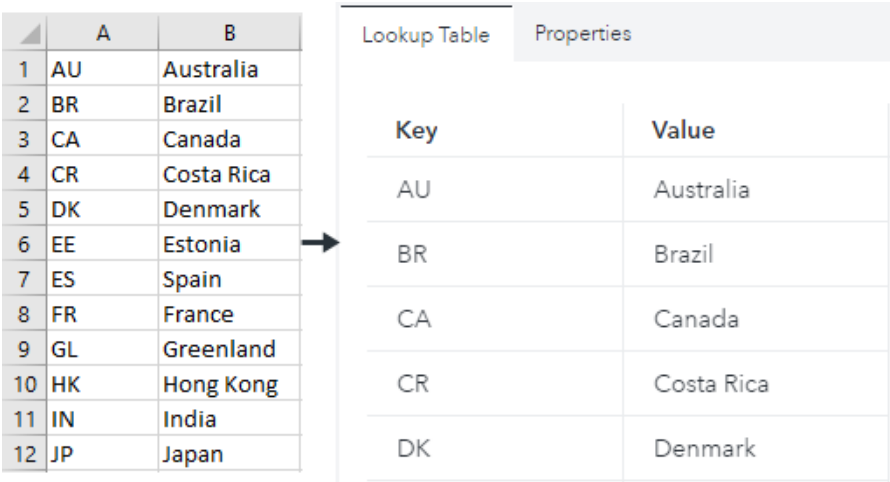
SAS Decision Manager provides the ability to import lookup tables and reference them from rules. Lookup tables are tables of key-value pairs. For example, you can use a lookup table to retrieve a part name based on the part code number. Or use a lookup table to retrieve the full name for a country based on its abbreviation.

You can import lookup data from comma-separated-values (CSV) files such as those created by Microsoft Excel into lookup tables in SAS Decision Manager. You can re-import updated CSV files as needed to refresh the lookup tables.

Note: SAS Decision Manager does not support CSV files that contain signature lines.

Note: You can configure the character that is used as a separator in CSV files that are imported through the SAS Decision Manager interface. See Step 4 of "Review Application Properties in SAS Management Console" in *SAS Decision Manager: Administrator's Guide* for more information.

Figure 5.1 *CSV File Imported Into SAS Decision Manager*



	A	B
1	AU	Australia
2	BR	Brazil
3	CA	Canada
4	CR	Costa Rica
5	DK	Denmark
6	EE	Estonia
7	ES	Spain
8	FR	France
9	GL	Greenland
10	HK	Hong Kong
11	IN	India
12	JP	Japan

Lookup Table | Properties

Key	Value
AU	Australia
BR	Brazil
CA	Canada
CR	Costa Rica
DK	Denmark

In a lookup table, each *lookup key* is associated with a *lookup value*. Lookup keys must be unique within each lookup table. Character strings in lookup tables are limited to 512 characters.

SAS Decision Manager provides two functions, LOOKUP and LOOKUPVALUE, that enable you to determine whether a lookup key exists in a lookup table and to retrieve a lookup value from a lookup table.

Create a New Lookup Table

You create a new lookup table by importing a CSV file.

1. Click ▦ to navigate to the Lookups category view, and then click **New Lookup Table**.
2. Enter a name for the new lookup table. Names are limited to 32 characters and can contain only alphanumeric characters and underscores. Lookup table names must be unique within the SAS Decision Manager database. Lookup table names are case insensitive. For example, SAS Decision Manager considers `NAME` to be equal to `name`.
3. (Optional) Enter a description for the new lookup table. Descriptions are limited to 256 characters.

> **TIP** To modify this description at any time, click ✎ next to the **Description** field on the **Properties** tab.

4 Select a **Location** where you want to create the new lookup table.

To create a new folder, see "Create New Top-Level Folders" on page 26. To create a new folder inside an existing folder, see "Create New Folders" on page 26.

5 Click in the **Source file location** field, and select the CSV file that contains the lookup table data.

6 Click **Save**.

Note: The data is automatically sorted in ascending order, if it was not already sorted.

Import or Refresh Lookup Table Entries

Note: A single lookup table should contain no more than 5000 entries.

You can import entries into an empty table, and you can refresh an existing lookup table by re-importing the same table.

1 Open the lookup table into which you want to import entries.

2 Click **Import**. A message window appears that tells you that the imported data replaces the existing key-value pairs. Click **Replace**.

3 Click **Replace**. The Import Lookup Table window appears.

4 Click , and select the CSV file that contains the lookup data.

5 (Optional) In the **Encoding** field, select the encoding. The default is UTF-8.

6 Click **Import**.

Note: You can also import a lookup table by using the %BRM_IMPORT_LOOKUP macro. See "%BRM_IMPORT_LOOKUP Macro" in *SAS Decision Manager: Macro Guide* for more information.

Delete Lookup Tables

Note: You cannot delete a lookup table if it is referenced in a rule.

To delete lookup tables:

1 Select the tables that you want to delete.

2 Click ⋮ and select **Delete**.

Duplicate Lookup Tables

To duplicate a single lookup table:

1 Select the lookup table, click ⋮, and select **Duplicate**. The Duplicate Lookup window appears.

2 Enter a name for the duplicate lookup table. Names are limited to 32 characters and can contain only alphanumeric characters and underscores. Lookup table names must be unique within the SAS Decision Manager database. Lookup table names are case insensitive. For example, SAS Decision Manager considers `NAME` to be equal to `name`.

3 (Optional) Enter a description for the duplicate table. Descriptions are limited to 256 characters.

4 Click **Duplicate**.

   If you do not enter a new name for the duplicate table, SAS Decision Manager appends `_Copy` to the name.

To duplicate multiple lookup tables, select the tables, click ⋮, and then select **Duplicate**. SAS Decision Manager appends `_Copy` to the duplicate table names

Move Lookup Tables

You cannot move a lookup table if it is open.

1 Select the tables that you want to move, click ⋮, and select **Move**. The Choose a Location window appears.

2 Select a new location for the tables, and click **OK**.

Rename a Lookup Table

You cannot rename a lookup table if it is open.

1 Select the table that you want to rename, click ⋮, and then select **Rename**. The Rename window appears.

2 Enter a new name and click **Rename**.

LOOKUP Function

Determines whether a lookup key exists in a lookup table.

Restrictions:

- You can specify the LOOKUP function in condition expressions only.
- If an expression contains the LOOKUP function, then the expression cannot contain anything else.

Returned data type:

Boolean

Syntax

LOOKUP ('*lookup_table_name*')

lookup_table_name

specifies the name of the lookup table that you want to search.

Example

Suppose you have a Country_Codes lookup table that uses two-letter abbreviations for countries as the lookup key and country names as the lookup values.

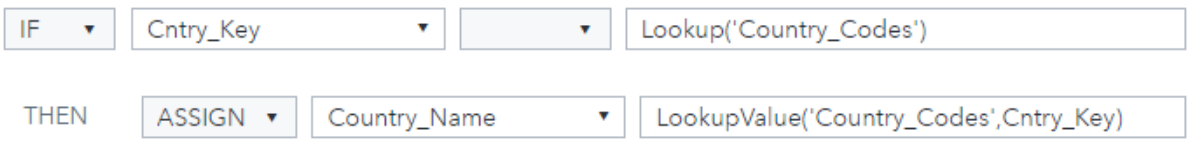
Key	Value
AU	Australia
BR	Brazil
CA	Canada
CR	Costa Rica

To verify that the value of the variable Cntry_Key exists as a lookup key in the table Country_Codes, you can use the following expression:

```
Cntry_Key = LOOKUP('Country_Codes')
```

If the value of Cntry_Key exists as a lookup key, the LOOKUP function returns the value `True`.

In the following rule, a key is specified by the variable Cntry_Key. If this key exists in the lookup table Country_Codes, then the value that is associated with this key is assigned to the variable Country_Name.



LOOKUPVALUE Function

Retrieves a lookup value from a lookup table.

Restrictions:

- You can specify the LOOKUPVALUE function only in action expressions.
- If an expression contains the LOOKUPVALUE function, then the expression cannot contain anything else.

Returned data type:

Lookup tables are stored as character data. However, you can assign the results of the LOOKUPVALUE function to the following types of variables: Character, Integer, Decimal, Date, Datetime, or Boolean. The LOOKUPVALUE function converts the results to match the type of the variable.

Syntax

LOOKUPVALUE ('*lookup_table_name*', *variable*)

lookup_table_name

specifies the name of the lookup table that you want to search.

variable

specifies the lookup key for the value that you want to retrieve.

Example

You can have a Country_Codes lookup table that uses two-letter abbreviations for countries as the lookup key and country names as the lookup values. The Country_Codes lookup table contains the lookup key `CA`, and the lookup value that corresponds to that key is `Canada`.

Key	Value
AU	Australia
BR	Brazil
CA	Canada
CR	Costa Rica

Take, for example, a Cntry_Key variable in the current input record that contains the value `CA`. You can use the following expression to retrieve the lookup value that is associated with that key from the table Country_Codes:

```
LOOKUPVALUE('Country_Codes',Cntry_Key)
```

In the following rule, you specify a variable Cntry_Key. If this key exists in the lookup table Country_Codes, then the value that is associated with this key is assigned to the variable Country_Name.

IF	Cntry_Key		Lookup('Country_Codes')
THEN	ASSIGN	Country_Name	LookupValue('Country_Codes',Cntry_Key)

6

Managing Rules and Rule Sets

About Rules, Rule Sets, and Expressions

A rule specifies conditions to be evaluated and actions to be taken if those conditions are satisfied. Rules are grouped together into rule sets. Rule sets are logical collections of rules that are grouped together because of interactions or dependencies between the rules or because they are processed together when they are published.

Most rules correspond to this form:

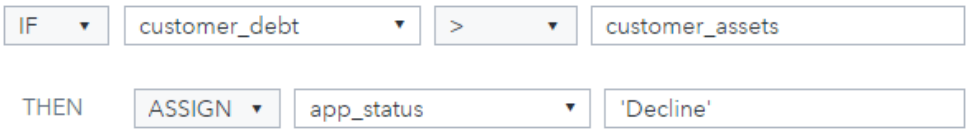
```
if condition_expressions then action_expressions
```

For example, suppose you have the following rule:

```
if customer_debt > customer_assets then app_status = 'Decline'
```

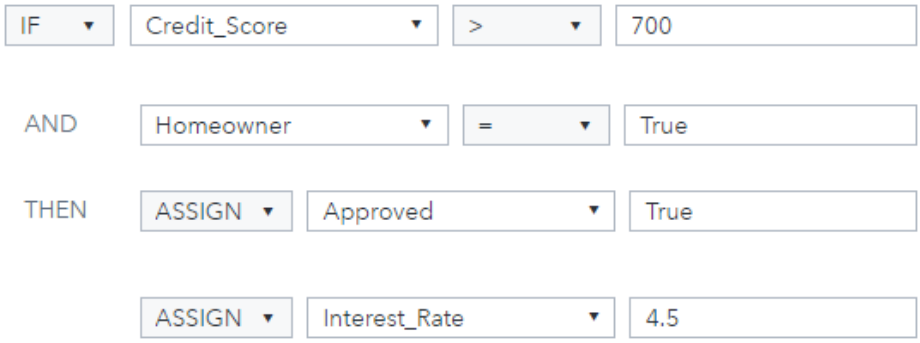
In this case, `customer_debt` is a condition term, and `customer_debt > customer_assets` is a condition expression. The term `app_status` is an action term, and `app_status = 'Decline'` is an action expression. To enter this rule in the rule set editor, you first need to add the terms `customer_debt` and `app_status` to the appropriate vocabulary, and then enter the rule and expressions in the rule set editor.

For example, the following figure shows the rule above as it appears in the rule set editor:



Condition expressions are not required. Rules that have only action expressions are always executed.

A single rule can have multiple terms, conditions, and actions. Multiple condition expressions within the same rule are joined together with the AND operand. For example, suppose you define the following rule in SAS Decision Manager:



SAS Decision Manager generates the following rule condition:

```
(Credit_Score > 700) AND (Homeowner = True)
```

It generates the following assignments:

```
Approved=True
Interest_Rate=4.5
```

Action expressions are always assignment statements.

You can view how a rule is interpreted by clicking ˅ to collapse the rule set. For example, when you collapse the above rule set, you get the following expression:

IF Credit_Score >700 AND Homeowner =True THEN Approved=True AND Interest_Rate=4.5

Create a New Rule Set

1. Click to navigate to the Rule Sets category view, and then click **New Rule Set**. The New Rule Set window appears.
2. Enter a name for the new rule set. Rule set names are limited to 100 characters and must be unique within a folder.
3. (Optional) Enter a description for the new rule set. Descriptions are limited to 256 characters.
4. Select a location for the new rule set.
   - To create a new top-level folder, see "Create New Top-Level Folders" on page 26.
   - To create a new folder inside an existing folder, highlight the folder and click . Then, enter a name for the new folder.
5. Select the vocabulary that is associated with the new rule set.

   Note: If a rule set has a locked version, you cannot change the vocabulary associated with the latest version of the rule set.

6. Click **Save**. SAS Decision Manager opens the new rule set and displays the **Rule Set** page.

7 Add rules to the rule set. For more information, see "Add a Stand-Alone Assignment Statement" on page 50 and "Defining New Rules in a Rule Set" on page 50.

Add a Stand-Alone Assignment Statement

Stand-alone assignment statements always execute. Rule-fired data is not generated for stand-alone assignment statements.

1 On the **Rule Set** tab, click **Add assignment** if the rule set is empty or, if the rule set contains at least one statement, select **Add** ⇨ **Add assignment**. The application adds an assignment statement to the top of the rule set, below any existing assignment statements.

2 Select the term to which you want to assign a value.

3 Enter the expression for the variable in the expression field. See "Defining Expressions in Rules and Assignment Statements" on page 54 for more information.

4 (Optional) Move the assignment statement to a different position in the rule set. To move the statement, click ↑ or ↓.

5 Click 🖫 to save the rule set. SAS Decision Manager validates the syntax of the expressions. If it does not detect any problems, it saves the rule set.

Defining New Rules in a Rule Set

Add a New Rule

To add a new rule:

1 Create or open the rule set where you want to add the new rule.

2 Click **Add Rule** if the rule set is empty or, if the rule set contains at least one statement, select **Add** ⇨ **Add rule**. SAS Decision Manager adds a new IF-THEN rule to the end of the rule set.

3 Define the condition expression for the rule.

   a In the field to the left of the expression operator, select the term for the left side of the expression.

b Select the expression operator.

c Enter a literal value or term in the field to the right of the expression operator. Enclose literal character strings in single quotation marks.

Alternatively, you can use the Expression Editor to enter expressions. For more information, see "Using the Expression Editors" on page 55.

For examples of rules in the rule set editor, see "About Rules, Rule Sets, and Expressions" on page 48.

> **TIP** To add additional conditions to a rule, select the condition expression, then select **Add** ⇨ **Condition**.

For more information, see "About Defining Expressions" on page 54.

4 (Optional) Define the action expression for the rule. Select the term to which you want to assign a value, and then enter a term name or literal value in the expression field.For more information, see "About Defining Expressions" on page 54.

5 (Optional) Change the rule operator to ELSE or OR. If the rule is the first rule in a rule set, the rule operator must be IF.

When you change the operator on a rule from IF to ELSE or OR, the condition expression is preserved, and the rule becomes an ELSE or OR clause with an IF condition. See "Controlling Which Conditions Are Evaluated" on page 52 for more information.

6 (Optional) Select **Add** ⇨ **ELSE rule** to add an ELSE clause to the currently selected rule. The ELSE clause does not have a condition, but you can add one by selecting **Add** ⇨ **Condition**.

7 (Optional) Define the condition and action expressions for the ELSE clause.

8 (Optional) Change the order of the new rule. The rule order, in addition to the IF, ELSE, or OR keyword (see "Controlling Which Conditions Are Evaluated" on page 52), controls how rules are evaluated within the rule set.

> **TIP** You can also change the order of the rules later by right-clicking on a rule and selecting either **Move the selected item up** or **Move the selected item down**. See "Change the Order of Rules" on page 66 for more information.

9 (Optional) Change the name of the rule. Rule names are limited to 100 characters and must be unique within a rule set. For more information, see "Rename a Rule" on page 66.

> **TIP** Assigning logical names to rules makes it easier to determine which rules fired when you review rule-fired data.

10 (Optional) Clear the **Record rule-fired data** check box if you do not want a rule-fired record to be written each time this rule fires.

Note: If the input data for the rule set is a snowflake table or a Google BigQuery table, rule-fired data cannot be generated for the rule set. See "How Rules Are Evaluated and When Rule-Fired Records Are Generated" on page 53 for more information.

11 Click to save the rule set. SAS Decision Manager validates the syntax of the expressions. If it does not detect any problems, it saves the rule set. See "Validate the Expressions in a Rule Set" on page 65 for more information.

Controlling Which Conditions Are Evaluated

You add conditional processing within a rule set by using the IF, ELSE, and OR operators. By default, rules are assigned the keyword IF, which means that the rule's condition is evaluated regardless of the results of previous rules. You can change this outcome by changing the operator for a rule to ELSE or OR.

If you set a rule's operator to ELSE, then the rule's condition is evaluated only if the previous rule's condition evaluated to false. Review the following rule set. If Order_Quantity is 12, then the condition for rules 1 and 2 evaluates to false. The condition for rule 3 evaluates to true. Therefore, the action for rule 3 is executed. The conditions for rules 4 and 5 are not evaluated.

Use the OR operator to break up very long condition expressions into multiple condition expressions or to execute the same action expression for each of the several conditions. If you assign the OR operator to a rule, then you cannot enter an action expression for the rule. If any of the conditions evaluate to true, SAS Decision Manager executes the action of the last rule that was assigned the IF or ELSE operator. When you have several consecutive rules that are all assigned the OR operator, only the action for the first rule whose condition evaluates to true is executed. The conditions for the remaining consecutive OR rules are not evaluated.

An IF block is a series of rules that begins with an IF operator and extends up to but does not include the next IF operator.

How Rules Are Evaluated and When Rule-Fired Records Are Generated

By default, the condition expressions for all rules in a rule set are evaluated sequentially regardless of the results of previous rules. However, you can use the ELSE and OR operators to control whether the condition expression for a rule is evaluated. See “Controlling Which Conditions Are Evaluated” on page 52 for more information.

If a rule's condition expression evaluates to True, SAS Decision Manager executes the rule's action expression.

If a rule's condition evaluates to True, the rule is said to have *fired*.

By default, every time a rule fires, it generates a rule-fired record. However, you can control when rule-fired records are generated by using the **Record rule-fired data** check box. See Step 10 of "Add a New Rule" on page 50.

Note: If the input data for the rule set is a snowflake table or a Google BigQuery table, rule-fired data cannot be generated for the rule set. In this case, turn off the generation of rule-fired data in one of the following ways:

- Clear the **Record rule-fired data** check box for each rule in the rule set editor.
- When you execute a rule flow by using the %BRM_RULE_FLOW macro, specify the RULEFIRE=N argument.
- When you configure the Business Rules transformation in SAS Data Integration Studio, specify `No` for the **Generate rules fired table** advanced option.

Note: Stand-alone assignment statements always execute. Rule-fired data is not generated for stand-alone assignment statements.

Defining Expressions in Rules and Assignment Statements

About Defining Expressions

Expressions can be up to 1024 characters long. They can contain numeric constants, character strings, vocabulary terms, operators, and SAS DS2 functions. Condition expressions can contain the LOOKUP function, and action expressions can contain the LOOKUPVALUE function. However, if the expression contains the LOOKUP function or the LOOKUPVALUE function, then the expression cannot contain anything else. You can enter expressions directly into the expression fields, or you can use the Expression Editor to create and edit expressions.

For more information about entering expressions, see the following topics:

- "Using the Expression Editors" on page 55
- "Punctuation for Data Values" on page 57
- "Operators for Use in Expressions" on page 58
- "Using the LIKE Operator" on page 59
- "Using Functions in Expressions" on page 61
- "Working with Missing Values" on page 61

- “Terms and Operators Added by SAS Decision Manager” on page 61
- “Leading Plus and Minus Operators” on page 62
- “Examples of Expressions” on page 62
- “LOOKUP Function” on page 43
- “LOOKUPVALUE Function” on page 44

Using the Expression Editors

SAS Decision Manager provides two different expression editors:

- The Expression Editor enables you to build expressions that do not use any functions and expressions that use DS2 functions.
- The Lookup Expression Editor enables you to enter expressions that use the LOOKUP or LOOKUPVALUE functions.

Using the Expression Editor

To open the Expression Editor, select a condition or action in the rule set editor, and click ✎.

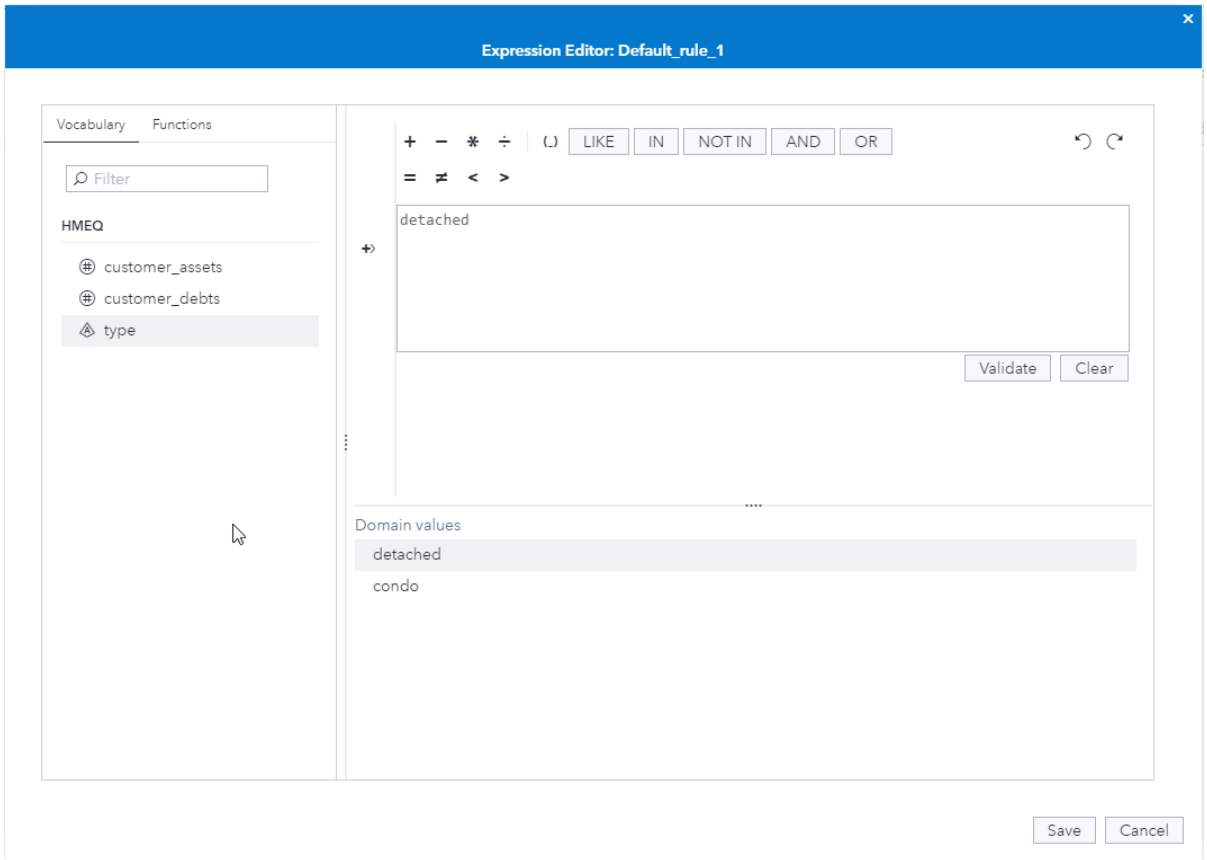
To build an expression, single-click on operators, or double-click on vocabulary terms and domain values as needed to add them to the expression. To add numeric constants or character strings to the expression, enter them directly into the editor. (Remember to use the correct punctuation. See “Punctuation for Data Values” on page 57.)

To add a reference to a DS2 function to your expression, click the **Functions** tab, select the function, then click +›.

Click **Validate** at any time to check the syntax of the expression that you are building.

When you are finished building the expression, click **Save**. The Expression Editor validates the syntax of the expression. If the validation is successful, a green check mark is displayed with the message `The expression is valid`.

Figure 6.1 *Expression Editor*



Specify the LOOKUP or LOOKUPVALUE Function in the Lookup Expression Editor

You can enter the LOOKUP function only in condition expressions, and you can enter the LOOKUPVALUE function only in action expressions. When you open the Lookup Expression Editor, the tabs and the function syntax that you see depend on whether you invoked the editor for a condition expression or for an action expression.

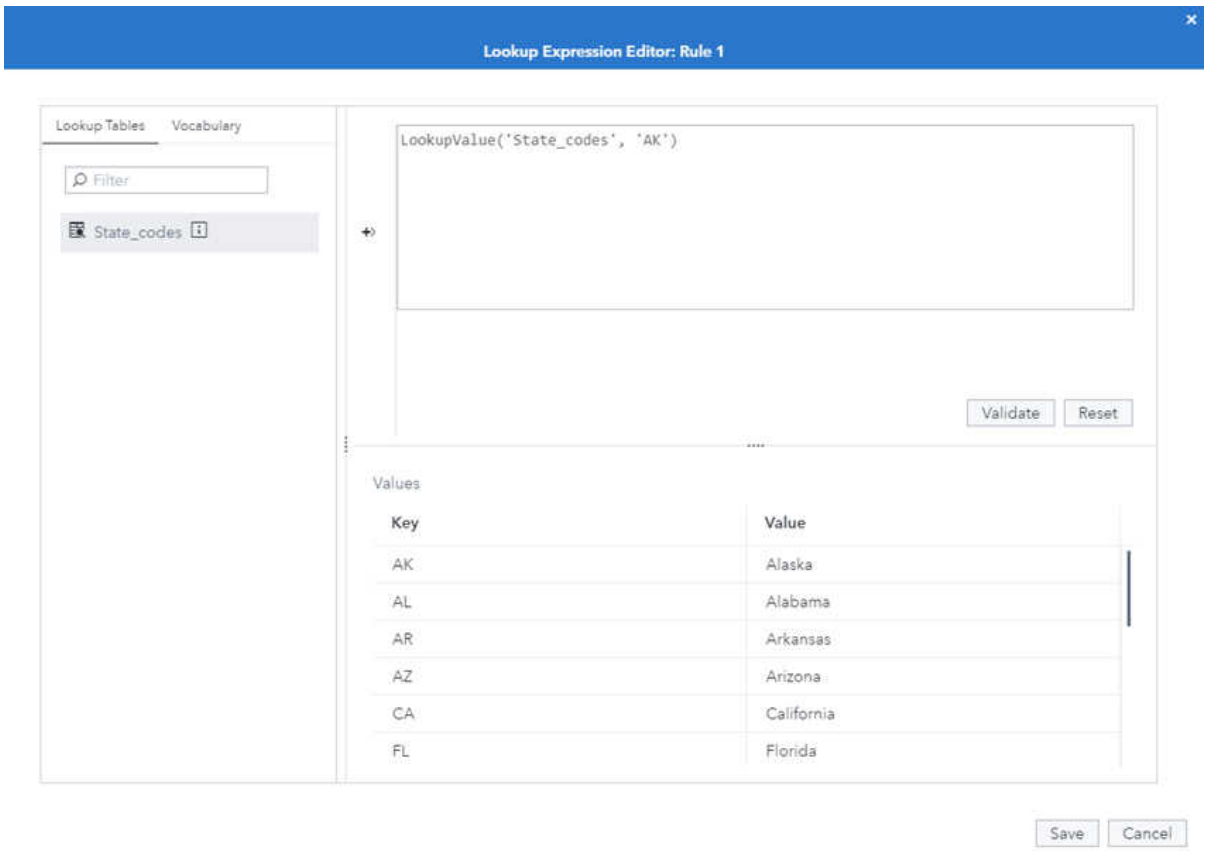
To enter an expression in the Lookup Expression Editor:

1. Select a condition or an action in the rule set editor, and click . SAS Decision Manager opens the editor and displays the **Lookup Tables** tab.
2. Double-click on the lookup table name to add it to the expression.
3. If you opened the editor for an action expression, specify the term name or the character string that contains the lookup key value. To specify a term, double-click on the term on the **Vocabulary** tab. To specify a character string as the lookup key value, enter the character string directly in the expression field. Enclose the string in single quotation marks.
4. (Optional) Click **Validate** to check the syntax of the expression.

5 Click **Save**.

For more information, see "LOOKUP Function" on page 43 and "LOOKUPVALUE Function" on page 44.

Figure 6.2 *Lookup Expression Editor for an Action Term*



Punctuation for Data Values

Values for some data types might need to be enclosed in quotation marks, as shown in the following table. Date and Datetime values must be followed with `d` and `dt`, respectively.

Table 6.1 *Punctuation Needed for Data Values*

Data Type	Punctuation Needed	Example
Character	Enclose character strings in either single or double quotation marks.	`='Gold Account'` `="Ineligible"`

Data Type	Punctuation Needed	Example
		`="d'oscail"`
Date	Enter Date values by using the format DDMMMYYYY. Enclose each value in quotation marks followed by `d`.	`='01AUG2015'd` `>='31AUG2015'd`
Datetime	Enter Datetime values by using the format DDMMMYYYY:HH:MM:SS. Use 24-hour clock notation. Enclose each value in quotation marks followed by `dt`.	`='01AUG2015:15:00:00'dt` `<='31AUG2015:15:00:00'dt`
Boolean	Boolean values are not enclosed in quotation marks. Enter only `True` or `False`.	`=True` `=False`

Operators for Use in Expressions

The following table lists the operators that you can use in an expression. Do not enter a space between the elements of the operators <=, >=, or ^=. Some mnemonic equivalents for these operators cannot be used in SAS Decision Manager expressions. See "Operators in Expressions " in *SAS DS2 Programmer's Guide* for more information about the operators shown in the table.

Table 6.2 *Operators*

Operator	Definition	Example
*	Multiply	`0.085 * sales`
/	Divide	`amount / 5`
+	Add	`num + 3`
–	Subtract	`sale - discount`
=	Equal to	`= maxTriesAllowed`
+*value*	Leading plus[1]	+60
^=	Not equal to	`insufficientFunds ^= True`
>	Greater than	`daysLate > 5`

Operator	Definition	Example
<	Less than	`num < 8`
>=	Greater than or equal to	`balance >= 1000`
<=	Less than or equal to	`balance <= 250`
IN (*value-list*)	Equal to an item in *value-list*	`in ('high','medium','low')`
NOT IN (*value-list*)	Not equal to an item in *value-list*	`not in (10,20,30)`
LIKE '*pattern-matching-expression*' LIKE ('*pattern-matching-expression*','*pattern-matching-expression*')	If the term's value matches *pattern-matching-expression*, the result is true.	`like 'HS%PP'` `like ('_976%','_223%')`
expression AND *expression*	If both expressions are true, the result is true.	`dateExpired >= '01AUG2015'd AND dateExpired <= '31AUG2015'd`
expression OR *expression*	If either expression is true, the result is true.	`dateEnrolled >= '01JAN2015' OR member = True`

1 The application supports the leading plus (+) operator in action expressions only.

Using the LIKE Operator

Note: The LIKE operator does not work if the code type is set to DS1. See "Generating DATA Step Code for a Rule Flow" on page 90 for more information.

The LIKE operator determines whether the value of a term matches a pattern-matching expression. The syntax of an expression that uses the LIKE operator is as follows:

LIKE '*pattern-matching-expression*'

LIKE ('*pattern-matching-expression*'<,'*pattern-matching-expression*'>)

If a term's value matches the pattern that is specified by *pattern-matching-expression*, the expression evaluates to true (1). Otherwise, the expression evaluates to false (0).

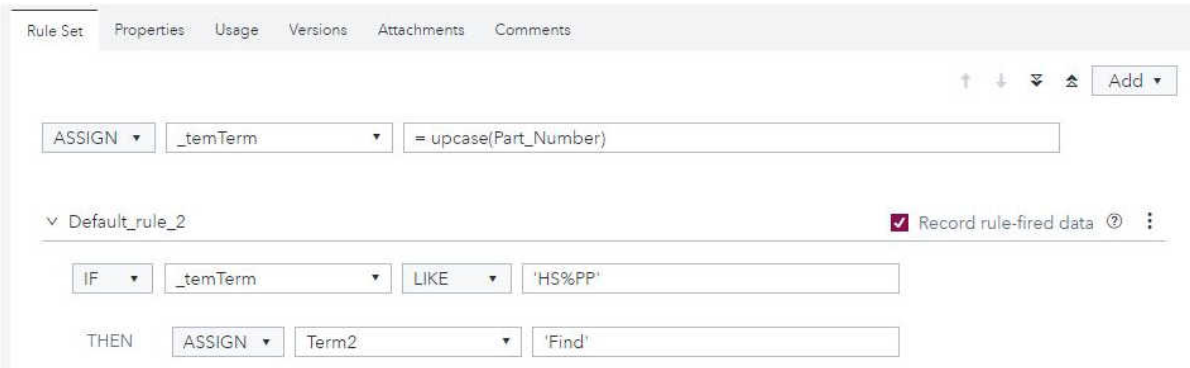
There are three classes of pattern-matching characters.

Table 6.3 Pattern-Matching Characters

Character	Description
underscore (_)	Matches any single character
percent sign (%)	Matches any sequence of zero or more characters **Note:** Be aware of the effect of trailing blanks. To match values, you might have to use the TRIM function to remove trailing blanks.
any other character	Matches that character

The LIKE expression is case sensitive. To search for mixed-case strings, use the UPCASE function to create an uppercase version of the term that you want to search. You can use a temporary term to store the results of the UPCASE function. (See Step 9 of "Create a Term" on page 31.) Use the LIKE operator to search the uppercase version of the term.

For example, you can search the term Part_Number for mixed-case strings that begin with HS and end with PP by using the two rules shown in the following display.



The following table shows examples of the matches that result if you search a term that could have these values: Smith, Smooth, Smothers, Smart, Smuggle.

Table 6.4 Examples of LIKE Expressions

LIKE Expression Example	Matching Results
`like 'Sm%'`	`Smith, Smooth, Smothers, Smart, Smuggle`
`like '%th'`	`Smith, Smooth`
`like 'S__gg%'`	`Smuggle`
`like 'S_o'`	(no matches)
`like 'S_o%'`	`Smooth, Smothers`

LIKE Expression Example	Matching Results
`like 'S%th'`	`Smith, Smooth`

Using Functions in Expressions

SAS Decision Manager supports the following functions in rule expressions:

- LOOKUP and LOOKUPVALUE functions. See "LOOKUP Function" and "LOOKUPVALUE Function" for more information.
- SAS DS2 functions. You can click on a function name in the Expression Editor to display information about the syntax for that function. For additional information about DS2 functions, see *SAS DS2 Language Reference*.

Working with Missing Values

You can use the MISSING function to check for missing values. This function returns a 0 (false) or 1 (true). Missing values have a value of **`false`** when you use them with logical operators such as AND or OR.

For more information, see "How DS2 Processes Nulls and SAS Missing Values" in *SAS DS2 Programmer's Guide*.

Terms and Operators Added by SAS Decision Manager

As you enter expressions into each cell, SAS Decision Manager displays the rule conditions and actions. To view the rule condition that was added click ✎ to display the Edit Rule window. The details of the rule that you added is under **Rule expression**. Remember these rules when you are entering expressions:

- If you do not specify an operator at the beginning of an expression, SAS Decision Manager adds an equal sign to the beginning of the expression. For example, if you enter `5+x` for an expression, the expression resolves to `=5+x`.
- Occasionally an AND or OR operator is followed immediately by another operator in a condition expression. In this caseSAS Decision Manager inserts the condition term between the AND or OR operator and the operator that follows it. For example, if you enter `>5 and <10` for `myterm`, the expression resolves to `myterm>5 and myterm<10`. SAS Decision Manager inserts the term for top-level AND or OR operators in condition expressions only. It does not insert the term with nested AND or OR operators or in action expressions.

Leading Plus and Minus Operators

If you specify the leading plus operator in an action expression, SAS Decision Manager adds the term name to the expression. Leading minus operators are not supported.

The condition expression `+1` is invalid. If you enter `+1` as an action expression, the expression resolves to `x=x + 1`. The expression `=+1` is invalid as both a condition and as an action expression.

If you enter `-1` as either a condition or an action expression, the expression is interpreted as a negative number and not as a leading minus operator. The expression resolves to `x=-1`.

Examples of Expressions

The following table shows examples of expressions that you can specify.

Table 6.5 *Examples of Expressions*

Expression as Entered into the Decision Table for Term X	Resulting Expression	Valid as a Condition Expression	Valid as an Action Expression
`5`	`x=5`	Yes	Yes
`=5`	`x=5`	Yes	Yes
+10	`x=x+10`	No See Note 7.	Yes
–10	`x=-10`	Yes	Yes See Note 7.
`"mystring"`	`x="mystring"`	Yes	Yes
`=term1`	`x=term1`	Yes	Yes
`5 or >100`	`x=5 or x>100`	Yes	No See Note 1.
`^=5 and x<10`	`x^=5 and x<10`	Yes	No

Expression as Entered into the Decision Table for Term X	Resulting Expression	Valid as a Condition Expression	Valid as an Action Expression
			See Note 1.
^=5 or >=(100/4)	x^=5 or x>=(100/4)	Yes	No See Note 1.
in (10,20,30)	x IN (10,20,30)	Yes	No See Note 1.
not in ('med','high')	x NOT IN ('MED','HIGH')	Yes	No See Note 1.
rate in ('med','high')	x = rate in ('med','high')	Yes	Yes See Note 8.
like ('M77__LL%','MA89_LL%')	x LIKE ('M77__LL%','MA89_LL%')	Yes	No See Note 1.
<'10JUN2012'd	x<'10JUN2015'd	Yes	No See Note 1.
>'10JUN2012:17:00:00'dt	x>'10JUN2015:17:00:00'dt	Yes	No See Note 1.
=ABS(-10)	x=ABS(-10)	Yes	Yes
=True	x=True	Yes	Yes
False	x=False	Yes	Yes
&myMacroVar	x=&myMacroVar	Yes See Note 2.	Yes See Note 2.
%EVAL(&myMacroVar)	x=%EVAL(&myMacroVar)	Yes See Note 2.	Yes See Note 2.

Expression as Entered into the Decision Table for Term X	Resulting Expression	Valid as a Condition Expression	Valid as an Action Expression
`term1=5`	`x=term1=5`	Yes See Note 3.	Yes See Note 4.
`term1=3 or term2=5`	`x=term1=3 or term2=5`	Yes See Note 5.	Yes See Note 6.
`5 or (x>10 and <20)`	This expression is invalid as both a condition expression and as an action expression. SAS Decision Manager does not add column names after nested AND or OR operators.		
`>"mystring"`	This expression is invalid as both a condition expression and as an action expression. SAS Decision Manager checks whether literal types are compatible with the specified operators. Character strings are not compatible with numeric operators.		
`=4.6927e-101`	`x=4.6927e-101`	Yes See Note 9.	Yes

Notes:

1. Action expressions must be assignment expressions only.
2. SAS Decision Manager validates macro functions and variables based only on whether the syntax is correct. It does not check to determine whether a macro function or variable is accessible when the rule set is executed. Macro support in expressions is controlled by a configuration property in SAS Management Console. See " Support macros in rule expressions " in *SAS Decision Manager: Administrator's Guide* for more information.
3. This expression is valid. However, it should be avoided. As a condition statement, this expression checks to determine whether both `x` and `term1` are equal to 5. The recommended way to enter this expression is `=5 and term1=5`.
4. As an action expression, this expression becomes a Boolean assignment statement. This expression determines whether `term1` is equal to 5, and if so, assigns a value of 1 (true) to `x`. If not, it assigns a value of 0 (false) to `x`.
5. This expression is valid. However, it should be avoided. As a condition statement, this expression checks to determine whether both `x` and `term1` are equal to 3 or whether `term2` is equal to 5. The recommended way to enter this expression is `(=5 or term1=3) or term2=5`.
6. As an action expression, this expression becomes a Boolean assignment statement. This expression determines whether either `term1` is equal to 3 or `term2` is equal to 5, and if so, assigns a value of 1 (true) to `x`. If not, it assigns a value of 0 (false) to `x`.

7 Leading plus (+) operators are valid in action expressions only. Leading minus (–) operators are not supported. See "Leading Plus and Minus Operators" on page 62 for more information.

8 As an action expression, this expression becomes a Boolean assignment statement. The expression determines whether `rate` is equal to `high` or `low`, and if so, assigns a value of 1 (true) to `x`. If not, it assigns a value of 0 (false) to `x`.

9 This expression is valid. However, you should use caution when testing for equality by using scientific notation. Two numbers that appear to be the same might evaluate to different numbers because of the precision involved in scientific notation.

Validate the Expressions in a Rule Set

When you save a rule set, SAS Decision Manager checks whether the syntax in the expressions is valid, and if so, saves the rule set.

SAS Decision Manager checks whether the results produced by the expressions are of the correct data type for the terms to which the expressions apply. Also, when domain values are defined for a term, SAS Decision Manager does not check whether the values that are assigned to the term are included in the list of domain values.

Managing Rules in a Rule Set

Edit a Rule

1 Select the rule, right-click on the rule, and select **Edit rule**. The Edit Rule window appears.

2 Edit the rule name and description as needed, and click **Edit**.

Duplicate a Rule

1 Select the rule, right-click the rule, and select **Duplicate rule**. The Duplicate Rule window appears.

2 Enter a new **Name** and click **Duplicate**. The duplicate rule is placed below the rule that was duplicated. If you do not specify a new name, SAS Decision Manager appends `_Copy` to the rule name.

Delete an Expression or a Rule

To delete a condition or action expression, right-click on the expression, and select **Delete the selected object**.

To delete an entire rule, select the rule, click ⋮, and select **Delete rule**.

Rename a Rule

1. Right-click the rule and select **Rename rule**. The Rename Rule window appears.
2. Enter a new **Name** and click **Rename**.

Change the Order of Rules

You can move a single rule to a new position, and SAS Decision Manager adjusts the position of the remaining rules in the rule set.

Note: If you move a rule that uses the ELSE or OR operator to position 1 in the rule set, the operator is changed to IF.

To move a rule, right-click on the rule that you want to move. Click **Move the selected item down** or **Move the selected item up**, depending on where you want to move the rule.

Edit the Properties of a Rule

1. Open the rule set that contains the rule, and click the **Rule Set** tab.
2. Select the rule, click the ⋮, and then select **Edit rule**.
3. Edit the name and description as needed, and click **Edit**.

Managing Rule Sets

Duplicate Rule Sets

To duplicate a single rule set:

1. In the Rule Sets category view, select the rule set, click ⋮, and then select **Duplicate**. The Duplicate window appears.
2. Enter the name for the duplicate rule set. If the folder in which you save the duplicate rule set contains a rule set with the same name that you enter, SAS Decision Manager appends `_Copy` to the rule set name.
3. (Optional) Enter a description for the rule set.
4. Select the version of the rule set that you want to duplicate.
5. Click **Duplicate**.

To duplicate multiple rule sets, select the rule sets that you want to duplicate, click ⋮, and then select **Duplicate**. SAS Decision Manager duplicates the current version of the selected rule sets and appends `_Copy` to the rule set names.

Delete Rule Sets

Note: You cannot delete a rule set if it is used in a rule flow or if it is open.

To delete rule sets, select the rule sets that you want to delete. Click the ⋮ and select **Delete**.

A window is displayed asking if you want to delete the rule set. Click **Delete**.

Move Rule Sets

You cannot move a rule set if it is open.

1. In the Rule Sets category view, select the rule sets that you want to move, click ⋮, and select **Move**. The Choose a Location window appears.
2. Select a new location for the rule sets, and click **OK**.

Edit the Properties of a Rule Set

To edit the properties of a rule set, open the rule set and click the **Properties** tab. You can edit only the description. If the rule set is empty, you can change the vocabulary that is associated with the rule set. If any rules have been defined for the rule set, you cannot change the vocabulary.

Editing and Refreshing a Rule Set's Vocabulary

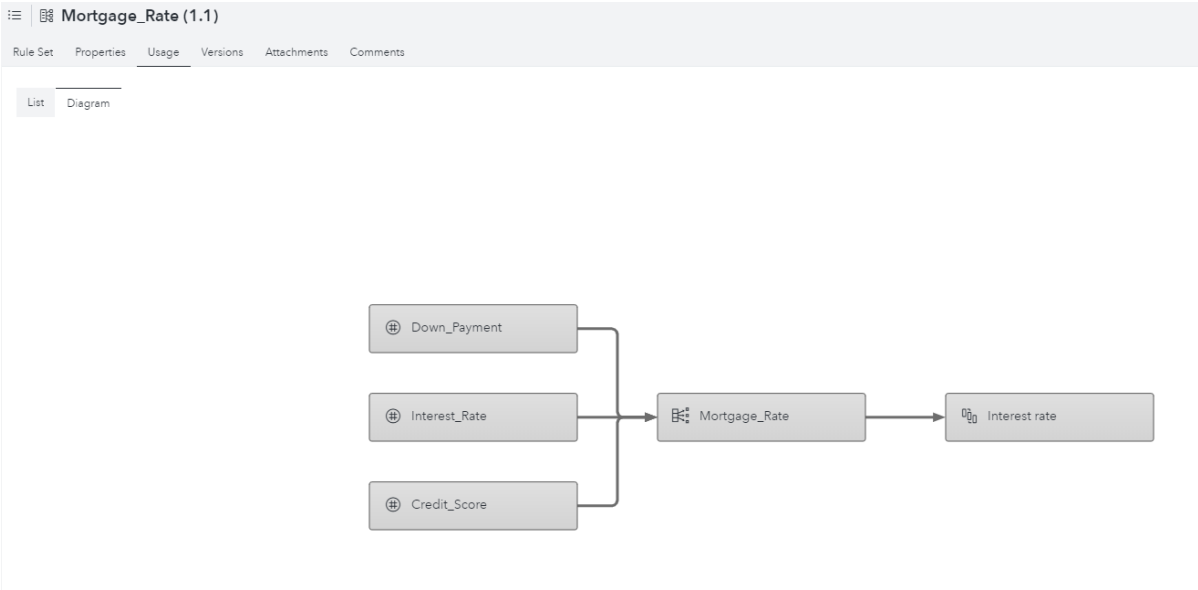
To open the vocabulary that is used by a rule set from within the rule set, click ⋮ in the top right of the window, and select **Manage Vocabulary**. This action switches you to the Vocabulary view and opens the vocabulary that is used by the rule set. For information about editing vocabularies, see Chapter 4, "Managing Vocabularies," on page 29.

If you change a vocabulary while you are editing a rule set that uses the vocabulary, those changes are not automatically available in the rule set. To make changes in the vocabulary available in the rule set, click ⋮, and select **Refresh Vocabulary**.

Display Usage Information for a Rule Set

To display usage information for a rule set, select the **Usage** page. Click **List** to display the terms and lookup tables that are referenced in the rule set and rule flows that use the rule set. Click **Diagram** to display a diagram showing the rules, rule set, and any rule flows that use the rule set.

Note: The diagram displays information from only the current version of a rule flow. Occasionally a published version of a rule flow uses a rule set but the current version of the same rule flow does not. In this case the rule flow does not appear in the diagram.



Managing Rule Set Versions

About Rule Set Versions

The *latest* version of a rule set is the rule set that has the highest version number. It is also the last version that you saved. You can edit only the latest version of a rule set.

Only one version of a rule set can be unlocked at a time. If you create a new version of a rule set, SAS Decision Manager locks the existing latest version before it creates a new latest version.

To edit a rule set, it must be unlocked. You cannot unlock a rule set. To make changes to a rule set that has been locked, you must create a new version of the rule set and make changes to the new version.

To publish a rule flow, all of the rule set versions that are referenced in the rule flow must be locked. When you publish a rule flow, SAS Decision Manager automatically locks any unlocked rule set versions that are used in the rule flow.

Set the Displayed Version

On the **Versions** page, ✓ indicates the displayed version. The displayed version is the rule set whose information is displayed on all other pages, except for the **Properties** page. The **Properties** page displays information for the entire rule set and not for a specific version of the rule set.

To change the displayed version, select the version that you want to view, and click **Set Version**.

Create a New Version of a Rule Set

Note: When you create a new version of a rule set, SAS Decision Manager locks the latest version of the rule set if it is not already locked.

Note: You cannot save changes to a rule set that is locked. You can attempt to modify a rule set that is locked and click . When you do,SAS Decision Manager asks you if you want to overwrite and replace the contents of latest unlocked version, or create a new version and save changes in new version.

To create a new version of a rule set:

1. Select the **Versions** page.
2. Click **New Version**. The New Version window appears.
3. Select the version type: **Minor** or **Major**. Version numbers follow the format *Major.Minor*. If you select **Major**, the number to the left of the period is incremented. If you select **Minor**, the number to the right of the period is incremented.
4. (Optional) Enter a note.
5. Click **Save**.

Lock a Rule Set Version

Note: You cannot make changes to a rule set after it has been locked. You cannot unlock a rule set version.

To publish a rule flow, all of the rule set versions that are referenced in the rule flow must be locked. When you publish a rule flow, SAS Decision Manager automatically locks any unlocked rule set versions that are used in the rule flow.

To manually lock a version of a rule set:

1. Select the **Versions** page.
2. Select the version of the rule set that you want to lock.
3. Click **Lock Version**..

Edit Version Notes

1. Open the rule set, and click the **Versions** tab.
2. Select the version of the rule set that you want to edit.
3. Enter text in the **Notes** column, and press Enter.

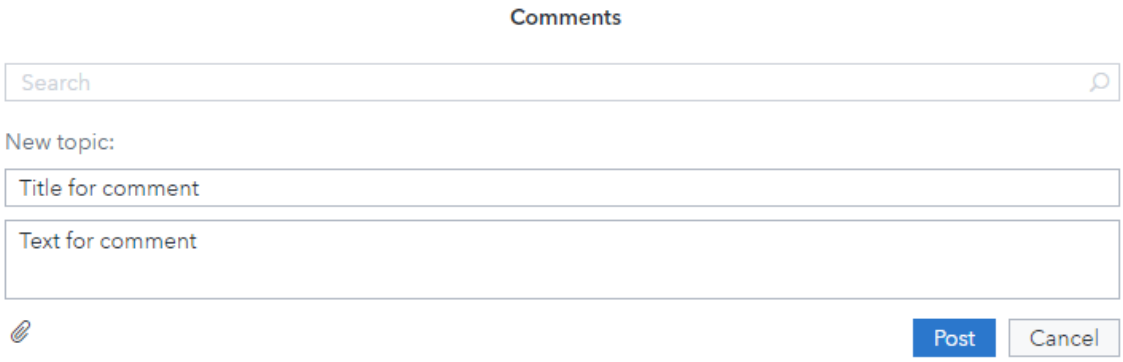
Export Version History

To view all of the changes for a specific version of a rule set, open the rule set, click the **Versions** tab, and click **Export History**. The history is exported into a CSV file, and a notification appears in the download bar at the bottom of the browser window.

Add Comments

You can add new comments or reply to existing comments. To add a new comment:

1. Click the **Comments** tab.
2. Enter a topic title and enter the comment. The topic title is required, and the **Post** button is not enabled until you enter the topic title.



Note: The green circle with a circular arrow inside it indicates that your comments are being checked for grammatical errors.

3. (Optional) Click 📎 to add an attachment such as an image or a document.

Note: You cannot attach executable files to a comment.

4 Click **Post**.

To reply to an existing comment, enter your reply in the field immediately below the topic title for the existing comment, and click **Post**.

Click ⟲ to see comments that have been posted by others.

To search for text in the comments, enter text in the search field at the top of the **Comments** page.

Note: The Comments: Administrator role enables users to edit and delete comments. For more information, see "Roles and Capabilities" in *SAS Decision Manager: Administrator's Guide*.

To edit a comment that you made, click ✎.

To delete a comment that you made, click 🗑.

Add Attachments

To add an attachment such as a document file or an image file:

1 Click the **Attachments** tab.

2 Click **+**, and select the file to attach.

3 Click **Open**.

Note: You can delete an attachment by selecting the attachment and clicking 🗑.

Validate and Save a Rule Set

To save changes to a rule set, click 💾. SAS Decision Manager validates the syntax of the expressions and displays an error message if it finds any problems. If SAS Decision Manager does not detect any problems with any of the expressions, it saves the rule set. See "Validate the Expressions in a Rule Set" on page 65 for more information.

7

Creating and Publishing Rule Flows

Introduction to Rule Flows

A business rule flow is a logical collection of multiple rule sets that define multiple conditions and actions. In general, the rule sets in a rule flow are executed in the order in which they are defined in the rule flow. However, with complex rule flows, certain sections of rule sets are usually executed more times than others. See “Simple Rule Flows, Complex Rule Flows, and BY Groups” on page 74 for more information.

After you publish a rule flow, other applications can deploy the published rule flows. The applications map terms used in the rule flow to table column in input data, evaluate the conditions in the rule flow, and execute the appropriate actions.

Simple Rule Flows, Complex Rule Flows, and BY Groups

There are two general types of rule flows: simple and complex. A simple rule flow has a single group of rule sets. All of the rule sets are run and output is generated for each input record.

A complex rule flow has at least three sections: Initial, Main, and Final. Rule sets in the Initial section are run only when the first input record is processed. Rule sets in

the Main section are run for each input record. Rule sets in the Final section are run after the last input record has been processed by the rule sets in the Main section.

For complex rule flows, you can specify *BY-group terms*. If you specify BY-group terms, then SAS Decision Manager sorts the input data by those terms.

If you specify BY-group terms, SAS Decision Manager adds two new sections to the rule flow, Group Start and Group End. The rules sets in these sections are run with the first and last input record in each BY group.

Note: Adding rules to any of the sections in a complex rule flow is optional. You can leave unneeded sections empty.

See "When Are Output Records Generated?" on page 92 for more information.

Create a Rule Flow Using the Rule Flow Editor

1. Click and then click the **New Rule Flow** button. The New Rule Flow window appears.
2. Enter a name for the new rule flow. Rule flow names are limited to 32 characters and can contain any character except forward slash (/), backslash (\), left brace ({), right brace (}), colon (:), and question mark (?).
3. (Optional) Enter a description for the new rule flow. Descriptions are limited to 256 characters.
4. Enter a location for the new rule flow. Do one of the following:
   - To create a new top-level folder, see see "Create New Top-Level Folders" on page 26.
   - To create a new folder inside an existing folder, select the folder and click . Then, enter a name for the new folder.
5. (Optional) Select **Create output only for records that fire rules** to limit the output of the rule flow. By default, all output records are written to the output data set. However, for some types of applications, only the output records for which at least one rule has fired are of interest. Limiting output is useful for applications that detect outliers, such as applications that detect fraud.
6. Click **Save**. SAS Decision Manager creates a new rule flow and opens the Rule Flow window where you can add rule sets. By default, the **Rule Sets** page is displayed with **Simple** selected for the rule set.

Add Rule Sets to a Rule Flow

1. (Optional) Select **Complex** from the drop-down menu on the toolbar. SAS Decision Manager adds Initial, Main, and Final sections to the rule flow table. The rules in the Initial and Final sections are run at the start and end of the rule flow. For more information, see "Simple Rule Flows, Complex Rule Flows, and BY Groups" on page 74.

2. Click **+Add Rule Set**, select the rule set that you want to add, and then click **Open**.

   Note: A rule flow can use only rule sets that are defined for the same vocabulary. After you add the first rule set to the rule flow, the vocabulary for the rule flow is established.

   Note: A rule set can be added to the same rule flow only once.

3. (Optional) If you selected **Complex** in Step 1, then you can specify BY-group terms. With BY-group processing, all of the input records that have the same values for the BY-group terms are processed before output is generated. One output record is written for each group. To select BY-group terms, complete these steps:

   a. Click 🗀 on the **BY-group terms** field to open the BY-Group Terms window.

   b. Select the terms that you want to use as BY-group terms, click +›, and then click **OK**. SAS Decision Manager adds Group Start and Group End sections to the rule flow. The rules in these groups are run at the start and end of each BY group.

4. For each additional rule set that you want to add to the rule flow, click **+Add Rule Set** (in the appropriate section if you are creating a complex rule flow), select the rule set, and click **Open**.

   By default, SAS Decision Manager sets the version of each rule set to **Use latest**. When the version is set to **Use latest**, then the most recently saved version of the rule set is always used when the rule flow is run. Specifying **Use latest** for the version is useful during rule flow development and testing. However, if the version of a rule set that is specified in the rule flow is unlocked when the rule flow is published,SAS Decision Manager automatically locks the rule set version. For more information, see "Managing Versions of a Rule Flow" on page 83.

5. (Optional) For each rule set, verify or change the version of the rule set that you want to be used when the rule flow is run. To specify a rule set version other than the latest version, click ✎ for the rule set, select a version, and click **Close**.

6. (Optional) Reorder the rule sets. To move a rule set, select the rule set, and click ↑ or ↓ to move it to a different row in the table. To move a rule set to a different

section (Initial, Main, and so on), you must remove the rule set, and then add it to the other section. To remove a rule set, select the rule set and click 🗑.

7 Click 💾 to save the rule flow.

Create a Rule Flow by Using Discovery Techniques

About the Discovery Techniques

With the New Discovery wizard, you can use discovery techniques to define vocabularies, terms, rule sets, and rule flows. The discovery techniques that you can select from are:

Decision Tree

Decision Tree analysis produces a tree-like structure in which each branch of the tree represents a possible decision or event. The tree structure shows how one choice leads to the next. Each branch represents a mutually exclusive option. Decision trees are often used for data segmentation or prediction modeling. You can create decision trees to classify observations based on the values of nominal, binary, or ordinal targets or to predict outcomes for interval targets.

Note: With the Decision Tree technique, input columns with a SAS datetime format or a date format other than MONTH*w*. and WEEKDAY*w*. are excluded from the rule discovery process.

Scorecard

Scorecards provide a quantitative score of the odds that a customer will display a defined behavior such as respond positively to a campaign, make a purchase, default on a loan, and so on. The higher the score, the more likely the defined behavior will occur. The SAS Decision Manager Scorecard uses the Weight of Evidence technique to generate scores.

Note: With the Scorecard technique, input columns with a SAS datetime format or a date format other than MONTH*w*. and WEEKDAY*w*. are excluded from the rule discovery process.

Note: The Scorecard technique requires a SAS Enterprise Miner license.

Recency Frequency Monetary (RFM)

RFM is a technique that is used to identify existing customers who are most likely to respond to a new campaign or product offer. RFM analysis looks at when a customer last placed an order or bought something, how often the

customer makes a purchase, and how much money they spend. Customers are assigned scores based on these factors.

Market Baskets
Market Basket analysis is used to predict items that are most likely to be purchased together. Market Basket analysis can be used to predict what items a customer is likely to buy.

Create a Rule Flow by Using the Discover New Rule Flow Wizard

When you run the Discover New Rule Flow wizard, it uses the discovery technique that you select to generate a rule flow and as many rule sets as are needed. If you do not select an existing vocabulary, the wizard also generates a vocabulary.

Note: The Discover New Rule Flow wizard produces temporary data sets during the rule discovery process. Do not delete these temporary data sets before you attempt to import the results of the rule discovery process. If you delete these temporary data sets, you cannot import the generated rule sets.

Note: The datetime that is set for the objects that are created by the Discover New Rule Flow wizard is the datetime of the database. When you create an object in the user interface, the datetime set for the object is the system time. If you open an object that created by the wizard, and if the datetime of the object is later than the system datetime, the application displays an error. To avoid this issue, ensure that the database and the system are set to the same time zone.

Note: If folder configuration is enabled, you might not be able to import the results of the rule discovery process. See "Enable Business Rules Folder Administration" in *SAS Decision Manager: Administrator's Guide* for more information.

To create a rule flow by using the Discover New Rule Flow wizard, complete these steps:

1. Click to navigate to the Rule Flows category view, click ⋮, and then select **Discover new rule flow**. The Discover New Rule Flow window appears, and the **Set up** page is displayed.

2. Enter a name for the new rule flow. Rule flow names are limited to 32 characters and can contain any character except forward slash (/), backslash (\), left brace ({), right brace (}), colon (:), and question mark (?).

   Note: The name that you enter is also used for the vocabulary name if you do not select an existing vocabulary in Step 5. Vocabulary names must be unique within the SAS Decision Manager database. Rule flow names can contain spaces but vocabulary names cannot. If the name that you enter contains a space, it is converted to an underscore in the vocabulary name.

3 (Optional) Enter a description for the new rule flow. Descriptions are limited to 256 characters.

4 Select a location for the new rule flow.

5 Select an existing vocabulary or select **Create a vocabulary**. For information about creating a vocabulary, see "Create a Vocabulary".

> **IMPORTANT** If you select an existing vocabulary, and the discovery process generates a vocabulary that has a term with the same name but a different data type, you cannot import the rules that are generated.

6 Select the discovery technique. The techniques that are available depend on the products that are licensed at your site. The Recency Frequency Monetary (RFM) technique is available with Base SAS. The Decision Tree and Scorecard techniques require a SAS/STAT software license. The Market Baskets technique requires a SAS Enterprise Miner license.

SAS Decision Manager adds fields below the Data Source field for the setup variables that are needed for the discovery technique that you select.

7 Select the **Data source** that you want to use for the discovery analysis.

Note: You cannot use the Market Baskets discovery technique with data sources that contain values for the **Item** term that do not conform to the SAS name rules for the VALIDVARNAME=V7 system option. See "VALIDVARNAME=" in *SAS System Options: Reference* for more information.

8 Enter the information necessary for the setup variables that are specific to the discovery technique that you selected. The fields for the setup variables appear below the **Data source** field.These fields are described in Table 7.1.

Table 7.1 *Setup Options and Terms for Discovery Techniques*

Discovery Technique	Setup Variables	Action Terms
Decision Tree	**Maximum number of rules**: Select the maximum number of rules that you want to be generated by the discovery analysis.	Select the terms whose values you want to predict, and click ➕ to move them to the **Actions** list.
Scorecard	**Minimum points**: The scorecard points are scaled with this option as the minimum value. You can specify any nonnegative integer. **Maximum points**: The scorecard points are scaled with this option as the maximum value. You can specify any positive integer that is greater than the **Minimum points** value.	**Target variable**: specifies the variable that you are modeling. The variable must have exactly two discrete values such as `0` and `1` or `True` and `False`. **Target category**: specifies how the values of the target variable are mapped. The scorecard points are scaled to the likelihood of the two target variable values based on the sort order. Select **High** to indicate that the highest lexical value of the target variable is mapped to the **Maximum points** value. Select **Low**

Discovery Technique	Setup Variables	Action Terms
		to indicate that the lowest lexical value of the target variable is mapped to the **Maximum points** value.
Recency Frequency Monetary	Select the binning method. **Independent**: Simple ranks are assigned to recency, frequency, and monetary values. The three ranks are assigned independently. **Nested**: A simple rank is assigned to recency values. Within each recency rank, customers are then assigned a frequency rank. Within each frequency rank, customer are assigned a monetary rank.	**Customer ID**: specifies a numeric or character term that uniquely identifies a customer. **Transaction date**: specifies the transaction date. **Transaction amount**: specifies the transaction amount.
Market Baskets	**Maximum number of rules**: Select the maximum number of rules that you want to be generated from the discovery analysis.	**ID**: specifies the customer ID. **Item**: specifies the item that was purchased. Each value for the item must comply with the rules for valid names according to the VALIDVARNAME=V7 system option.

9 Click **Action terms** and select the action terms that are required for the discovery technique that you selected. For information about the action terms, see Table 7.1.

Note: If you specified an existing vocabulary in Step 5, and the action terms that you select are are excluded from input, the rule flow will not run. See "Create a Term" for more information.

10 (Optional) If you selected the Decision Tree or Scorecard discovery technique, click **Condition terms**, select the input variables that you want to be used as condition terms in the rule flow, and click **+**.

11 Click **Results** to display the Results page.

12 Click **Run** to run the analysis.SAS Decision Manager displays the rule sets that were generated by the analysis. You should check the SAS log before you import the data.

13 Click **Import** to import the data. If the data was imported successfully, SAS Decision Manager displays a confirmation message telling you what data was imported and which folder it was added to.

14 (Optional) Click **Download Rule Generation Log** and **Download Rule Import Log** to download the log files to your local machine. The log file name is `RuleFlowName_generation.log`, and the import log file name is `RuleFlowName_import.log`. If rules cannot be generated or the import process fails, the log files contain detailed error messages.

15 Click **Close** to close the New Discovery wizard. SAS Decision Manager opens the new rule flow in the rule flow editor and displays the **Rule Sets** page.

After you use the New Discovery wizard to generate and import a new rule flow, all of the rule set versions in the rule flow are the latest versions and they are unlocked. When you publish the rule flow, SAS Decision Manager automatically locks any unlocked rule sets. See "Create a Rule Flow Using the Rule Flow Editor" on page 75for more information.

Open Rule Sets from the Rule Flow Page

You can open a rule flow and some or all of its rule sets. On the Rule Flows page, select the rule flow and click 🗀.

Add Attachments

To add an attachment such as a document file or an image file:

1 Click the **Attachments** tab.

2 Click +, and select the file to attach.

3 Click **Open**.

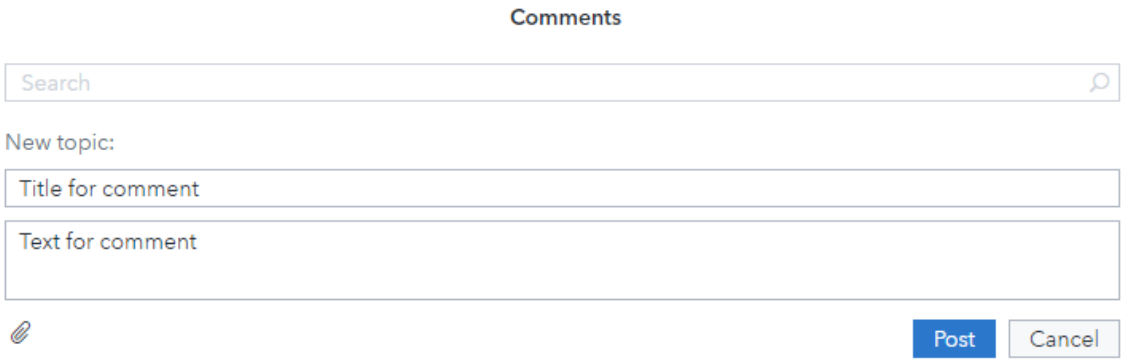
Note: You can delete an attachment by selecting the attachment and clicking 🗑.

Add Comments

You can add new comments or reply to existing comments. To add a new comment:

1 Click the **Comments** tab.

2 Enter a topic title and enter the comment. The topic title is required, and the **Post** button is not enabled until you enter the topic title.



Note: The green circle with a circular arrow inside it indicates that your comments are being checked for grammatical errors.

3 (Optional) Click 📎 to add an attachment such as an image or a document.

Note: You cannot attach executable files to a comment.

4 Click **Post**.

To reply to an existing comment, enter your reply in the field immediately below the topic title for the existing comment, and click **Post**.

Click ⟲ to see comments that have been posted by others.

To search for text in the comments, enter text in the search field at the top of the **Comments** page.

Note: The Comments: Administrator role enables users to edit and delete comments. For more information, see "Roles and Capabilities" in *SAS Decision Manager: Administrator's Guide*.

To edit a comment that you made, click ✎.

To delete a comment that you made, click 🗑.

Change the Order of the Rule Sets

You can change the order of rule sets within the same section only (Initial, Main, Final, and so on). To reorder the rule sets in a rule flow, select the rule set that you want to move, and click ↑ or ↓.

View the Rule Set Logic Expression

If you want to view the logic expression for a rule set, select the rule set and click . The Rule Set Logic Expression window appears. The window displays the rule number, rule name, condition, and action. Click **Close** to close the window.

View the Associated Terms for the Rule Set

To view the input or output terms that are used in a rule set in a rule flow, open the rule flow, and click at the far right of the rule set. The Vocabulary Terms windows appears with a list of the terms that are used in the rule set.

Note: This icon is unavailable if you have made editing changes to the rule flow. You must save the changes to the rule flow before you click this icon.

Managing Versions of a Rule Flow

About Rule Flow Versions

The *Current Version* of a rule flow is the first version of the rule flow. It is also the last version that you saved. You can edit only the latest version of a rule flow.

Only one version of a rule flow can be unlocked at a time.

When you publish the current version of a rule flow, that version is locked and assigned a version number. A new current version is created. You cannot unlock a rule flow.

Set the Displayed Version

On the **Versions** page, ✓ indicates the displayed version. The displayed version is the rule flow whose information is displayed on all pages except the **Properties** page. The **Properties** page displays information for the entire rule flow, not for a specific version of the rule flow.

To change the displayed version, select the version that you want to view, and click **Set Version**.

Edit a Version Description

1. Select the **Versions** page.
2. Select the version of the rule flow that you want to edit.
3. Enter text in the **Notes** column, and press Enter.

Rename a Rule Flow

1. Close the rule flow if it is open. You cannot rename a rule flow if it is open.
2. In the Rule Flows category view, right-click on the rule flow, click ⋮, and select **Rename**.
3. Enter the new name and click **Rename**.

Duplicate Rule Flows

To duplicate a single rule flow:

1. In the Rule Flows category view, select a rule flow, click ⋮, and select **Duplicate**. The Duplicate Rule Flow window appears.
2. Enter the name for the duplicate rule flow.
3. (Optional) Enter a description for the rule flow.

4 Click **Duplicate**. If you do not enter a new name and the folder in which you save the duplicate rule flow already has a rule flow with the same name, SAS Decision Manager appends `_Copy` to the name.

   The rule flow is copied to the same folder as the rule flow that you selected for copying.

To duplicate multiple rule flows:

1 In the Rule Flows category view, select the rule flows that you want to duplicate.

2 Click ⋮, and then select **Duplicate**.

The rule flows are copied to the same folder as the rule flows that were selected for copying. SAS Decision Manager appends `_Copy` to the name.

Move Rule Flows

You cannot move a rule flow if it is open.

1 In the Rule Flows category view, select one or more rule flows, click ⋮ and select **Move**. The Choose a Location window appears.

2 Select a new location for the rule flows, and click **OK**.

Delete Rule Sets from a Rule Flow

To delete rule sets from a rule flow, open the rule flow and click 🗑 to the right of the rule set that you want to delete.

Delete Rule Flows

Note: You cannot delete a rule flow if it is open or used in a decision.

In the Rule Flows category view, select the check boxes for the rule flows that you want to delete, click ⋮, and select **Delete**.

Testing a Rule Flow

You can test a rule flow before you publish it. If necessary, you can specify initialization or setup code that you want to run before the rule flow is run. SAS Decision Manager reports rule flow results and test data such as rule-fired data. SAS Decision Manager saves the test results from the last time a test was run.

Input Data for Rule Flow Tests

SAS Decision Manager expects the input data for the rule flow test to already exist and to be added as a data table. See "About Managing Data Tables" on page 15 for more information about adding data tables. Your user ID must have permission to access the data.

Create and Run a New Rule Flow Test

To test a rule flow:

1. Open the rule flow that you want to test.
2. Select the **Tests** page.
3. Click **New Test**. The **New Test** window appears.
4. Enter a name for the new test. Test names are limited to 30 characters.
5. (Optional) Enter a description for the test.
6. Select the data source that contains the input data for the test, and click **Save**.
7. Verify or change the variable mappings. The input terms in the rule flow must be mapped to columns in the input table that you selected for the test. SAS Decision Manager automatically maps the terms in the rule flow to columns in the input table when the names and data types of the terms match those of the table columns. If any input terms cannot be mapped automatically, an error message is displayed. You can change the automatic variable mappings in the Variable Mappings window.

   To change variable mappings:

   a. Click **Variables**. The Variable Mappings window appears.
   b. For each input term, select the table column to which the term should be mapped.
   c. Click **OK** to close the Variable Mappings window.

8 (Optional) Click **Preprocessing Code** and enter any SAS code, such as initialization code or setup code, that you want to run before the rule flow is run. See "Specify Preprocessing Code" on page 88 for more information.

9 Click **Run** to run the test. Alternatively, click **Save** to save the test definition without running it.

The status of the test is indicated by the icon in the **Status** column.

Icon	Status
	The test is not ready to run. The test definition is not complete, or it might contain errors.
	The test is defined correctly and is ready to run.
	The test is running.
	The test completed successfully.
	The test completed, but warnings were issued in the SAS log.
	The test did not run successfully. View the SAS log for information.

10 Click in the **Results** column to view the results of the test. You can view the output of the rule flow, the results of the rule-fired analysis, the SAS code that was generated and run by SAS Decision Manager, and the SAS log that was generated by the test in addition to other information. See "View Rule Flow Test Results" on page 89 for more information.

Rule flow tests are associated with the version you set in the **Versions** tab. The version that is being used has a ✓ in the versions column. After a test completes, the test version is displayed on the **Tests** page.

Run a Rule Flow Test

1 Open the rule flow that you want to test.

2 Select the **Tests** page.

3 Select the test that you want to run, and click **Run**.

Duplicate a Rule Flow Test

1 Open the rule flow.

2 Select the **Tests** page.

3 Select the test that you want to copy, click ⋮, and select **Duplicate**.

Edit a Rule Flow Test

1 Open the rule flow, and click the **Tests** tab.

2 Click the name of the test that you want to edit. The Edit Test window appears.

3 Select a new data source, map new variables, or update preprocessing code.

4 Click **Run** to run the test, or click **Save** to save it without running it.

Delete a Rule Flow Test

1 Open the rule flow, and click the **Tests** tab.

2 Select the check box for the test that you want to delete, click ⋮, and select **Delete**.

Specify Preprocessing Code

To specify code that you want to run before the rule flow is executed, expand the **Preprocessing Code** section enter the code in the **New Test** window.

You can use the &BRM_CODE_TYPE macro variable to specify whether SAS Decision Manager generates DS1 code for the rule flow test. See "Generating DATA Step Code for a Rule Flow" on page 90 for more information.

You can use the &DCM_USE_LATEST_VERSION macro variable to ensure that when a rule flow is run, the latest compatible version that is always used. See "Dynamically Running the Latest Rule Flow Version" on page 90 for more information.

If you are using an Open Database Connectivity (ODBC) library and you are using a schema that is different than the default user schema, specify the schema with the &BRM_DS2_SCHEMA_NAME_OVERRIDE macro variable. For more information, see "Using an ODBC Library" on page 91.

You can use the &DCM_DS2_OPTIONS macro variable to specify DS2 options to be included in the code that is generated for a rule flow. For example, you can specify that missing values generate notes instead of error messages by defining the macro variable as follows:

```
%LET DCM_DS2_OPTIONS=STR%(MISSING_NOTE)
```

For more information, see "DS2_OPTIONS" in *SAS DS2 Language Reference*.

View Rule Flow Test Results

To view the test results of a rule flow, click in the **Results** column. SAS Decision Manager displays the output of the rule flow together with other information under the **Test Results** folder.

The following results are available after a test has run successfully:

Output Table
displays the output table created by the rule flow.

Input Table
displays the input table that you selected for the test.

Rule-Fired Analysis
displays the data for each output record for which at least one rule fired. Click the number in the Rules Fired Count column to display which rules fired for a specific record. See also "When Are Output Records Generated?" on page 92.

Code
displays the code that was generated and run by SAS Decision Manager.

Log
displays the SAS log that was generated when the rule flow was run.

Plot
displays a bar chart that shows how many times each rule fired.

Terms
displays the terms that were used in the rule flow.

Preprocessing Code
displays the preprocessing code that you specified in the test definition.

You can sort the rows that are displayed in any of the tables by clicking a column heading in the table. If the rows are sorted in ascending order, ↑ appears in the column heading. If the rows are sorted in descending order, ↓ appears in the column heading.

Note: The _recordCorrelationKey column in the output table is a unique key that is added to each output record. This key enables the output records to be correlated with the records in the rule-fired details table. This key is hidden by default. See "Rule-Fired and Test Information Tables" in *SAS Decision Manager: Macro Guide*.

Generating DATA Step Code for a Rule Flow

You can generate DATA step (DS1) code or DS2 code for a rule flow. In many cases, you will get better performance by specifying DS1. However, consider specifying DS2 if your input data is in Teradata, Greenplum, or Hadoop, and you have installed the SAS Code Accelerator. In addition, the LIKE operator is not supported for DS1.

The **brm.runtime.codetype** configuration property in SAS Management Console determines whether SAS Decision Manager generates DS1 code or DS2 code during rule flow testing and when a published rule flow is run. By default, this property is set to DS2. You can change this property to specify DS1.See "Business Rules Manager Web Advanced Properties" in *SAS Decision Manager: Administrator's Guide* for more information.

To generate DS1 code for a specific rule flow regardless of the setting of the **brm.runtime.codetype** property, you can specify the &BRM_CODE_TYPE macro variable in preprocessing code. Define this variable in preprocessing code such as in the **Preprocessing Code** section of a rule flow test or in the **Precode** section of the **Precode and Postcode** tab in SAS Data Integration Studio. Define this variable before calling the %BRM_RULE_FLOW macro:

```
%let BRM_CODE_TYPE=DS1;
```

Using this macro variable helps you determine whether you want to change the **brm.runtime.codetype** setting.

Dynamically Running the Latest Rule Flow Version

You can use the &DCM_USE_LATEST_VERSION macro variable and either the &DCM_RULEFLOW_NAME or &DCM_DEPLOYED_RULEFLOW_NAME macro variable to ensure that when a rule flow is run, the latest version of the rule flow is always used. If you specify both &DCM_RULEFLOW_NAME and &DCM_DEPLOYED_RULEFLOW_NAME, then the name specified by &DCM_DEPLOYED_RULEFLOW_NAME is used.

For &DCM_DEPLOYED_RULEFLOW_NAME, specify the name of the published rule flow and the identification number of the rule flow. You can find the published name and identification number in the **Name** column of the rule flow **History** page. For example:

```
%let DCM_DEPLOYED_RULEFLOW_NAME=published_flow_name(ID_number);
```

Note: If you specify &DCM_RULEFLOW_NAME and SAS Decision Manager finds multiple rule flows that match the specified name, it writes an error message in the SAS log, and the rule flow is not executed. If you encounter this issue, specify the specific rule flow by using &DCM_DEPLOYED_RULEFLOW_NAME.

Define these macro variables in preprocessing code such as in **Precode** section on the **Precode and Postcode** tab in SAS Data Integration Studio. Define these variables before you call the %BRM_RULE_FLOW macro. For example:

```
%let DCM_USE_LATEST_VERSION=Y;
%let DCM_RULEFLOW_NAME=rule_flow_name;
```

Note: SAS Data Integration Studio uses the latest version of the rule flow that matches the variable mappings in the Business Rules transformation. SAS Decision Manager writes a note in the SAS log that states which version was selected.

Using an ODBC Library

If you are using an Open Database Connectivity (ODBC) library and you are using a schema that is different than the default user schema, specify the schema with the &BRM_DS2_SCHEMA_NAME_OVERRIDE macro variable. Define this macro variable in preprocessing code such as in the **Preprocessing Code** section of a rule flow test or in the **Precode** section on the **Precode and Postcode** tab in SAS Data Integration Studio. Define this variable before you call the %BRM_RULE_FLOW macro. For example:

```
%let BRM_DS2_SCHEMA_NAME_OVERRIDE=CUSTOMER_SCHEMA;
```

Running Rule Flows in SAS Data Integration Studio

Reducing Overhead

If you have previously run a rule flow using the **Location of generated debug code file** option in SAS Data Integration Studio, you can use the &BRM_USE_EXISTING_CODE macro variable to reduce overhead when you run the same version of the same rule flow again. On the **Precode and Postcode** tab in SAS Data Integration Studio, set this macro variable to `Y`:

```
%LET BRM_USE_EXISTING_CODE=Y;
```

Setting this variable eliminates variable remapping and other checks, such as determining whether the rule flow can be run in-database.

Customizing the Database Connection

Your site might have multiple environments, such as testing and production, that are using the same metadata server. In these cases, if a rule flow uses a lookup table or specifies **Use latest** for a rule set version, you might need to customize the database connection to ensure that running jobs access the database in the correct environment. To customize the connection, you can specify the following macro variables on the **Precode and Postcode** tab in SAS Data Integration Studio:

&DCM_DBMS_OVERRIDE
: specifies PostgreSQL as the database. Specify `POSTGRES`.

&DCM_DATABASE_OVERRIDE
: specifies the database name.

&DCM_SERVER_OVERRIDE
: specifies the fully qualified host name of the server on which the database is installed.

&DCM_PORT_OVERRIDE
: specifies the port that is used by the database.

&DCM_AUTH_DOMAIN_OVERRIDE
: specifies the authorization domain for the database.

For example:

```
%let dcm_dbms_override=%str(POSTGRES);
%let dcm_database_override=%str(database_name);
%let dcm_server_override=%str(server);
%let dcm_port_override=%str(port);
%let dcm_auth_domain_override=%str(dcm_auth_domain);
```

When Are Output Records Generated?

If an input record does not fire any rules, then an output record might not be created, depending on the rule flow. If an input record fires a rule, then an output record is created. In this case, the point at which output records are generated depends on the structure of the rule flow.

simple rule flow
: One output record is generated for each input record.

complex rule flow without BY-group terms
: One output record is generated for each input record. If there are rules in the Final section, an output record is also generated after the rules in the Final section run.

complex rule flow with BY-group terms
One output record is generated for each BY-group. This output record is generated after the rules in the Group End section run. An additional output record is generated after the rules in the Final section run.

Publish a Rule Flow

Publishing is the process of writing a business rule flow to the content server. After you publish a rule flow to the content server, other applications can use it.

When you publish the current version of a rule flow, that version of the rule flow is locked and cannot be unlocked. For more information, see "Managing Versions of a Rule Flow" on page 83.

Note: To publish a rule flow, all of the rule set versions that are referenced in the rule flow must be locked. If any of the rule sets are not locked when you publish a rule flow, SAS Decision Manager asks you if you want to lock the rule set versions that are used in the rule flow.

To publish a rule flow:

1. Open the rule flow.
2. If the rule flow contains changes that have not been saved, click . You cannot publish a rule flow if it contains changes that have not been saved.
3. Click ⋮ and select **Publish**. If all of the rule sets that are used in the rule flow are locked, the Choose a Location window appears.

   Note: If a rule flow has already been published, SAS Decision Manager always publishes the rule flow to the same location. You are not prompted for a location the next time the rule flow is published.

   Note: If the rule flow contains unlocked rule sets, SAS Decision Manager asks you if you want to lock the rule set versions that are referenced in the rule flow. You must click **Yes** to publish the rule flow.

4. Select the location where you want to publish the rule flow, and click **OK**. SAS Decision Manager confirms that the rule flow has been published and displays the published name and identification number of the published rule flow.

   TIP To create a new subfolder in the Choose a Location window, click .

5. Click **Close**.

Deploy a Rule Flow as a Stored Process

A stored process is a SAS program that is stored on a server and defined in metadata, and which can be executed as requested by client applications. When you deploy a rule flow as a stored process, the rule flow is made available as a stored process on the SAS Stored Process Server.

Note: To deploy a rule flow, all of the rule set versions that are referenced in the rule flow must be locked. If any of the rule sets are not locked when you deploy a rule flow, SAS Decision Manager asks you if you want to lock the rule set versions that are used in the rule flow.

Note: Only simple rule flows can be deployed as stored processes.

To deploy a rule flow as a stored process:

1. Open the rule flow.
2. If the rule flow contains changes that have not been saved, click . You cannot deploy a rule flow if it contains changes that have not been saved.
3. Click ⋮ on the top right of the page and select **Create stored process**. The Choose a Location window appears.

   Note: If the rule flow contains unlocked rule sets, SAS Decision Manager asks you if you want to lock the rule set versions that are referenced in the rule flow. You must click **Yes** to publish the rule flow.

4. Select the location where you want to deploy the rule flow.

   TIP This window lists all of the objects that are defined in the SAS metadata folders.

   Note: To create a new subfolder in the Choose a Location window, highlight the folder where you want to create a new folder and click .

5. Click **OK**.

For more information about stored processes, see *SAS Stored Processes: Developer's Guide*.

Display Publish Information for Rule Flows

Publish information for a specific version of a rule flow is available on the **Versions** page. The information available includes the published rule flow name, the folder path to which the rule flow was published, the date on which the version was published, and the display name or user ID of the user that published the rule flow. To display publish information for a rule flow:

1. Open the rule flow.
2. Select the **Versions** page.
3. Click **Details** for the version that you are interested in.

Viewing Lineage Information for a Rule Flow

About Lineage Information

The lineage viewer is provided by SAS Lineage. The relationship information that is displayed by SAS Lineage is taken from the Relationship database that is a part of the SAS Web Infrastructure Platform Data Server. SAS Lineage can display most types of SAS metadata. This data includes models, rule flows, and data objects, including columns, tables, external files, stored processes, and more.

SAS Lineage displays three types of diagrams:

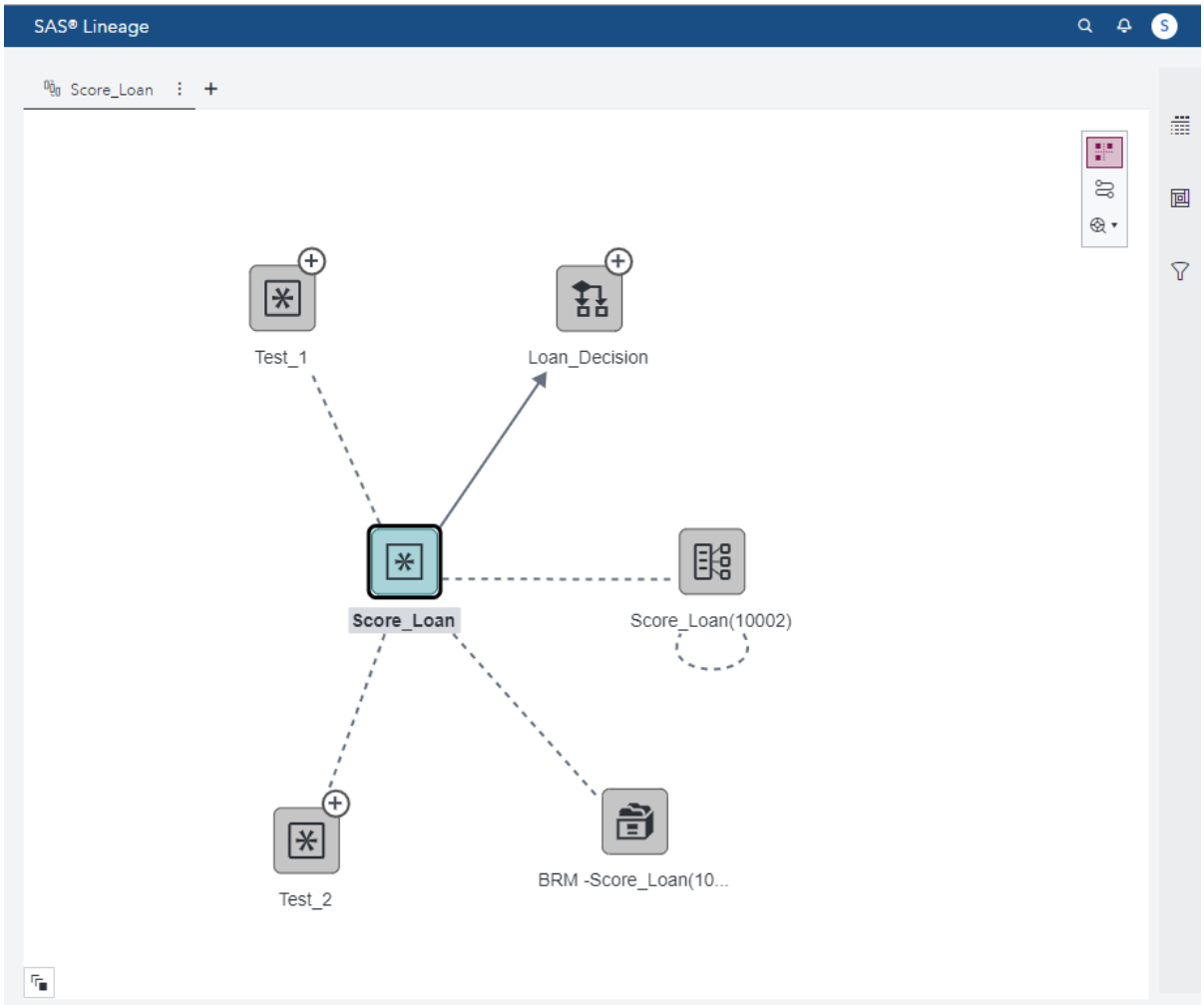
- a network diagram that displays all relationships
- a dependency diagram that displays governance information
- a dependency diagram that displays parent and child relationships

View Lineage Information for a Rule Flow

To view lineage information, click ⋮ in the top right of the page, and select **View Lineage**. SAS Lineage displays in a new tab

For additional information about SAS Lineage, click **Help** or see *SAS Lineage Viewer: User's Guide*.

The following image shows a diagram for a simple rule flow with one rule set.



PART 3

Working with Models, Projects, and Portfolios

8

Managing Folders for Models, Projects, and Portfolios

About Managing Folders

In the Models, Projects, and Portfolios category views, you can manage folders, as well as archive or restore folder contents. You must create a folder before you can create a project or portfolio. You can create subfolders within another folder to organize your projects and portfolios. Designing a folder structure enables you to get summary information about the contents of the folder. This information includes the number of models, versions, and scoring tests, as well as reports for the models that contain model variables and target variables. Your folder structure could be similar to your business departmental hierarchy, or it could list individual project, portfolio, or model names.

Note: If you see a folder named **FactoryMiner**, it is being used in the Portfolios category to store portfolios that contain project segments and models from SAS Factory Miner. Do not remove this folder.

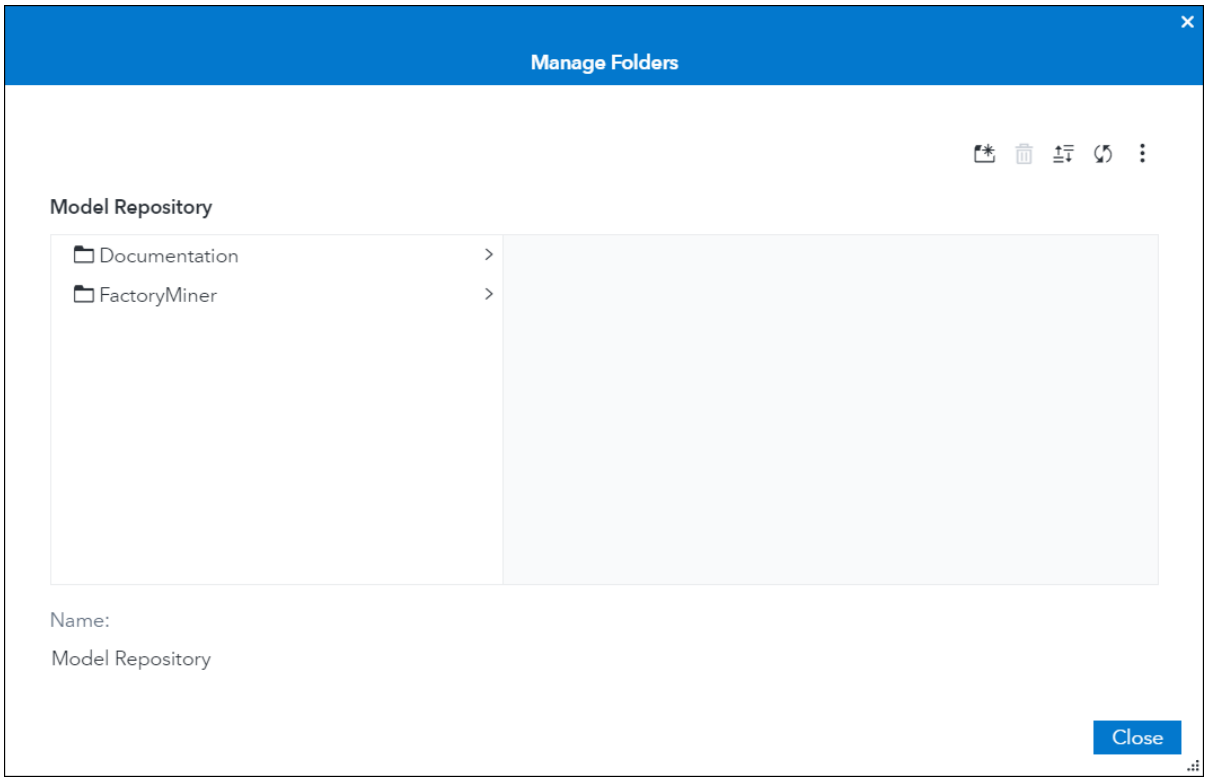
To view the summary information, click ⋮ and then select **View summary** ⇨ **for a folder**.

Create a New Folder

Before you create new projects or portfolios to manage models, you must create new folders to store them in. You can create new folders in the Manage Folders window that is available in the Models, Projects, and Portfolios category views. You can also create a new folder from the New Project or New Portfolio windows when creating a new project or portfolio. In addition, you can create a new folder when importing models into a folder.

Note: You can create new folders only from the Manage Folders window after a new project, portfolio, or model has been created.

1 Click ⋮ and select **Manage folders**. The Manage Folders window appears.



2 Click ✱ and enter a name for the folder.

3 Click **Close**.

Rename a Folder

1. Click ⋮ and select **Manage folders**. The Manage Folders window appears.
2. Right-click the folder, and select **Rename**.
3. Enter a new name and press Enter.

   Note: Folder names are case sensitive. SAS Decision Manager considers `myfolder` and `MYFOLDER` to be two unique folders.

Alternatively, click on the folder, select ⋮, and select **Rename**.

Delete a Folder

1. Click ⋮ and select **Manage folders**. The Manage Folders window appears.
2. Right-click the folder and select **Delete**.
3. Click **Delete** in the warning message.

Alternatively, select the folder and click 🗑.

Archive and Restore Folders

In the Models, Projects, and Portfolios category views a folder and its contents can be archived and restored to a different system.

Using the archive and restore facilities, a SAS Decision Manager administrator can back up a folder in one repository and restore it to another repository. The folder is archived as a compressed ZIP file.

Note: The attachments and comments at the portfolio level, project level, and model level are managed by separate services and are not stored within the portfolio, project, and model objects. Therefore, the attachments and comments are not included in the archived ZIP file.

Before you restore a folder, you should first create a folder to restore it to, since the restored projects reside at the same level that you specified. A best practice is to

give the restored folder the same name as the archived ZIP file. The contents of the archived folder are restored to the new folder.

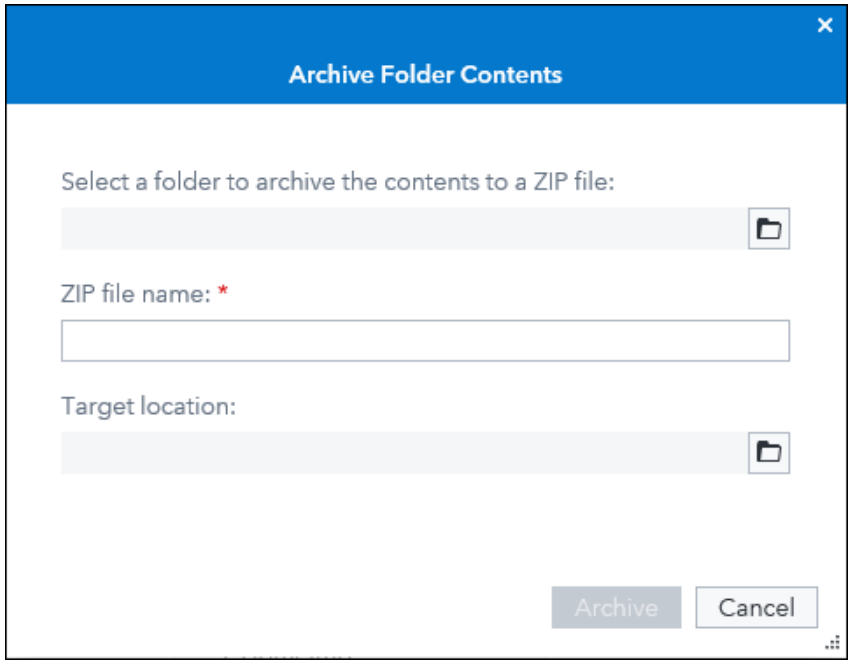
Note: All tables that are referenced within the projects and portfolios that are restored must be registered in the SAS Metadata Repository and made available to the **Data** category view. For more information, see "About Managing Data Tables" on page 15.

Folders cannot be restored in these situations:

- The name of the organizational folder to be restored is the same as a project name in the archived folder.
- The same archived ZIP file has already been restored in a folder on the same WebDAV server.

To archive a folder:

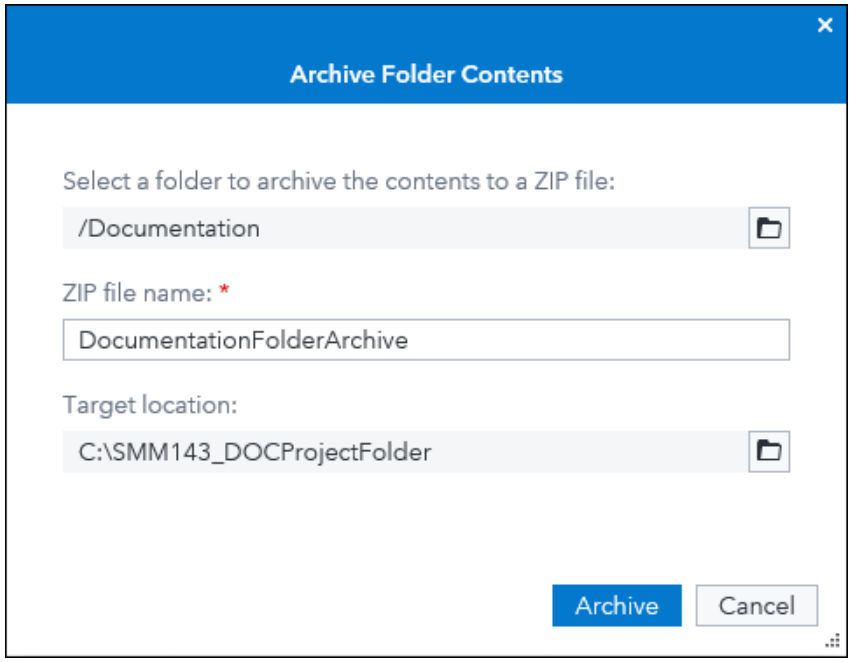
1 Click ⋮ and select **Archive**. The Archive Folder Contents window appears.



2 Click 🗀, select a folder to archive the contents to a ZIP file, and click **OK**.

3 Enter a ZIP file name.

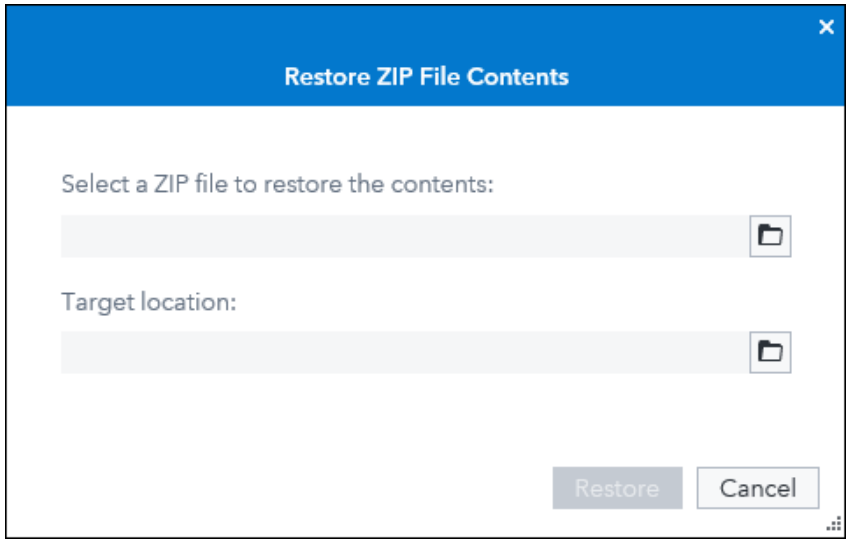
4 Click 🗀 and select a target location where the contents are to be saved.



5 Click **Archive**.

To restore a folder:

1 Click ⋮ and select **Restore**. The Restore ZIP File Contents window appears.



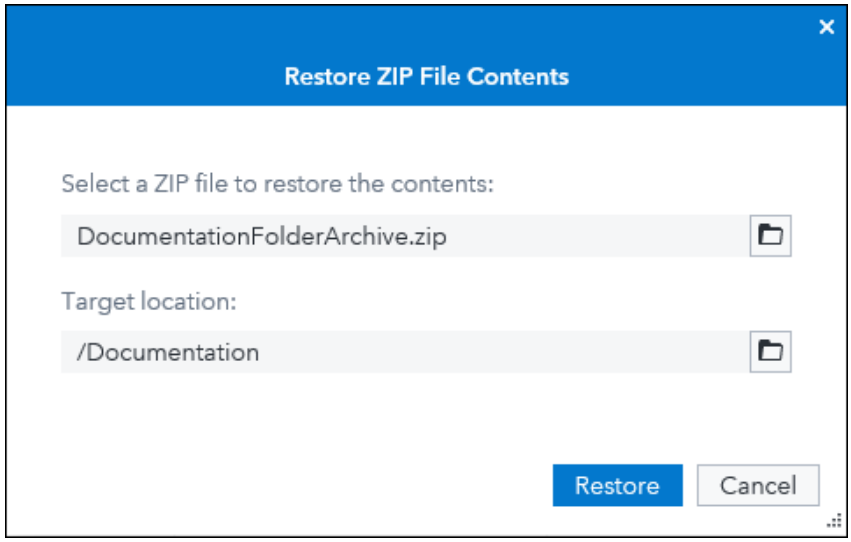
2 Click 🗀 to navigate to the location of the saved ZIP file that contains the contents that you want to restore.

3 Select the ZIP file and click **OK**.

4 Click 🗀 and select a target location in the model repository in which to restore the file contents.

Note: If no folders already exist, click 🗀* to create a new folder. Enter a name for the folder.

Click **OK**.



5 Click **Restore**.

Note: After restoring a folder, verify that the following requirements have been met:

- All scheduled jobs for scoring tests, performance, and retraining for the projects within a folder must be deleted and re-created on the system where the folder was restored.
- All user-defined templates for a model, report, and properties must exist on the system where the folders were restored. If they do not exist you must re-create the templates.

For more information, see the following topics:

- "Schedule a Scoring Test" on page 189
- "Schedule a Retrain Definition" on page 293
- "Schedule Performance Definitions" on page 269
- "Creating and Managing Templates" on page 121

9

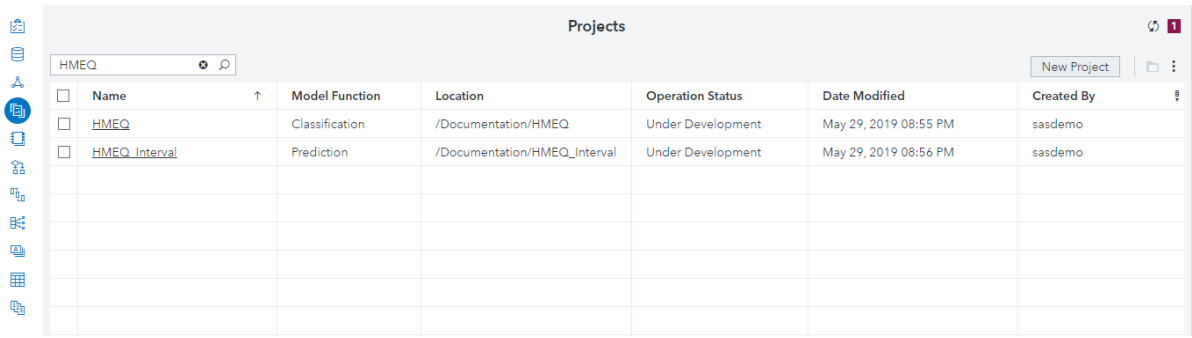
Working with Projects

Overview of Projects

A project consists of the models, variables, reports, performance results, and other resources that you use to determine a champion model. For example, a banking project might include models, data, and reports that are used to determine the champion model for a home equity scoring application. The home equity scoring application predicts whether a bank customer is an acceptable risk for granting a home equity loan.

You create projects within folders. The models within a project are associated with a project version. A *version* is used to organize project content and model information for a specific time period.

Figure 9.1 *Projects Category*



Planning a Project

Before you begin a project, you must plan your project resources. Here is a list of questions to consider and conditions to meet for a modeling project:

- After you know which users are assigned to a project, an administrator must ensure that the user is assigned to the appropriate user group and role. For more information, see "Configuring Users, Groups, and Roles" in *SAS Model Manager: Administrator's Guide*.
- How do you want to structure your project? A project is stored in a folder that can contain multiple levels so that you can customize the structure. For example, your project folder could be similar to your business departmental hierarchy or it could list individual project names. For more information, see "About Managing Folders" on page 99.
- What models do you want to use in the project? If the models were created using SAS Enterprise Miner, SAS/STAT, or the SAS/ETS procedures COUNTREG and SEVERITY, all model components are available when you import the model. If your model is a SAS code model that is not contained in a miningresult.spk file

or a model that was created by third-party software such as R, you must ensure that you have imported all of the model component files. For more information, see "Overview of Importing Models" on page 128.

- How do you want to define your project input and output variables? When you create a project, you can import the variables using input and output tables, copy the variables from an existing champion model, or define individual variables. If you use tables to define the project input and output variables, the tables must be registered in the SAS Metadata Repository. For more information, see "Defining Project Input and Output Variables" on page 114.
- How do you want to track the progress of a version? The Workflows view enables you to track the progress of tasks from the version level. An authorized user can create a workflow and associate it with a version. For more information, see "Overview of Using Workflows" on page 327.
- You might have project documents that you would like to access. You can attach documents at the project or model level on the **Attachments** tab. For more information, see "Add Attachments to a Project" on page 120.
- You might have comments that you would like others to see or respond to. You can add comments at the project or model level on the **Comments** tab. For more information, see "Add Comments to a Project" on page 120.
- Several reports are available to help you assess candidate models. You can review the types of reports that are available and plan for which reports you want to use. Your plans might also include a custom report that you can run. For more information, see "Overview of Model Comparison, Validation, and Summary Reports" on page 194.
- After your champion model is in a production environment, you can monitor the performance of the model using your organization's performance data. For more information, see "Overview of Performance Monitoring" on page 244.
- When you define performance monitoring reports, you can set up performance index alert and warning conditions to notify users when conditions exceed the indexes. For more information, see "Performance Index Warnings and Alerts" on page 253.

Prerequisites for Creating Projects

Projects can be created only by administrators and advanced users. Ensure that users who create projects are assigned to the group **Model Manager Administrator Users** or **Model Manager Advanced Users** in SAS Management Console.

All modeling projects require that you know the model function type before you create a project. The following model function types are available:

- Classification
- Prediction
- Segmentation
- Analytical

To determine the model function type for your project, see Table 9.1 on page 111.

If you use prototype tables to define the project input and output variables, you must create the project input and output tables and register them in the SAS Metadata Repository using the Data category view or SAS Management Console. If you use SAS Management Console, you must then add the registered tables in a library by using the Data category view to make the tables available to the application.

For more information, see the following documentation:

- Defining Project Input and Output Variables
- Managing Data Tables

Create a Project

1. Click to navigate to the Projects category view.
2. Click **New Project**. The **New Project** window appears.
3. Enter a name for the project.

   Note: Short names are recommended for folders, projects, and models. Short names are essential when you perform specific actions for the model such as scoring, running reports, or monitoring performance. If the value of the **URL** model property exceeds 262 bytes, you receive an error message that the action could not be completed.

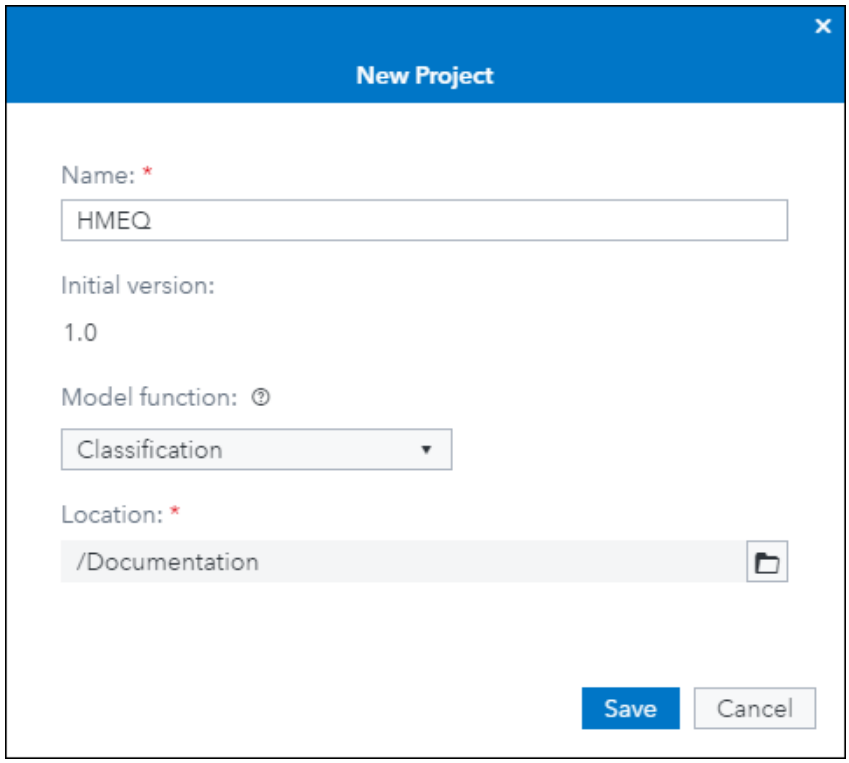
   The initial version 1.0 is displayed and reflects the level for sequential versions.

4. (Optional) Select a model function (Classification, Prediction, Segmentation, or Analytical) to indicate the type of models that can be imported into the project. The model function indicates the type of output that your predictive model project generates.

   Note: The value for **Model function** cannot be modified after you click **Save**. If you want to monitor performance of a model, it is recommended to select **Classification** or **Prediction** when creating a project. Only projects with a model function of **Classification** or **Prediction** can be monitored for performance.

5. Click to select a location. Select a folder and click **OK**.

   Note: If no folders already exist, click to create a new folder. Enter a name for the folder.



6 Click **Save**.

To delete a project:

1 Select a project, click ⋮, and then select **Delete**.

2 Click **Delete** in the warning message.

Project Properties

About Project Properties

Project properties contain the project metadata. Project metadata includes information such as the name of the project, the type of project, the project owner, the project identifier, the name and path of the repository, and of the tables and variables that are used by project processes.

Project properties are organized into the following types:

- General Properties
- Specific Properties
- System Properties
- User-Defined Properties

General Properties

General Properties are system-defined properties that you cannot modify, with the following exceptions: folder description, operation status, and lock status.

Property Name	Description
Description	A place to provide a description of the project.
Model function	Specifies the type of output that your predictive model project generates. The **Model function** property that you specify affects the model templates that are provided when you are ready to import models into a project. After it has been declared, the **Model function** property for a project cannot be changed. Ensure that the types of models that you are going to use in the project fit within the selected model function type. For more information about the types of model functions, see Table 9.1 on page 111.
Operation status	Specifies the current state of the project: Under Development indicates that the project has started but a champion model is not yet in production. Active indicates that a champion model for this project is in production. Inactive indicates that the champion model is temporarily suspended from production. Retired indicates that the champion model for this project is no longer in production. To set the status, select an option from the **Operation status** drop-down list.
Lock project variables	Specifies that the project metadata is locked and the project definition cannot be modified. For more information, see “Lock or Unlock Project Variables” on page 121..

Table 9.1 Types of Model Functions

Model Function	Description	Example
Analytical	Function for any model that is not Prediction, Classification, or Segmentation.	Analytic store model
Classification	Function for models that have target variables that contain binary, categorical, or ordinal values.	**DEFAULT_RISK** = {Low, Med, High}
Prediction	Function for models that have interval targets with continuous values.	The score output of a prediction model could estimate the weight of a person. The output of a model would be P_Weight.
Segmentation	Function for segmentation or clustering models.	Clustering models

Specific Properties

Specific Properties contain information about tables that are used by the project as well as various input and output variables and values that are used in scoring the models in test and production environments. This data can be added or modified after you add variables. For more information, see "Defining Project Input and Output Variables" on page 114.

Property Name	Description
Default test table	Specifies a default SAS data set that can be used to create the New Dynamic Lift and Interval Target Variable reports.
Default scoring input table	Specifies a default SAS data set that is used as the input data table for all scoring tests within the project. If you specify a value for the **Default scoring input table** property, the value is used as the default input table in the Add a New Scoring Test window.
Default scoring output table	Specifies a default SAS data set that defines the variables to keep in the scoring results table and the scoring test output table. If you specify a value of the **Default scoring output table** property, the value is used as the default output table in the Add a New Scoring Test window.

Property Name	Description
Default performance table	Specifies the default performance table for all model performance monitoring tests within a project.
Default train table	Specifies the default train table that is used for retraining models and for the Training Summary Data Set report. The **Default train table** is also used to validate scoring functions or scoring model files when a user publishes the associated project champion model or challenger models to a database. This property is optional.
Champion version	Specifies the version that contains the champion model in a production environment.
Model function	Specifies the type of output that your predictive model project generates. The **Model function** property that you specify affects the model templates that are provided when you are ready to import models into a project. After it has been declared, the **Model function** property for a project cannot be changed. Ensure that the types of models that you use in the project fit within the selected model function type.
Training target variable	Specifies the name of the target variable that was used to train the model.
Target event value	Specifies the target variable value that defines the desired target variable event.
Class target values	For class, nominal, ordinal, or interval targets, the set of possible outcome classes, separated by commas. For example, binary class target values might be `1, 0` or `Yes`, `No`. Nominal class target values might be `Low, Medium, High`. These values are for information only.
Class target level	Specifies the class target level of binary, nominal, ordinal, or interval.
Output event probability variable	The output event probability variable name, when the **Model function** property is set to **Classification** or **Analytical**.

Property Name	Description
Output prediction variable	The output prediction variable name, when the **Model function** property is set to **Prediction** or **Analytical**.
Output segmentation variable	The output segmentation variable name, when the **Model function** property is set to **Segmentation** or **Analytical**.

System Properties

System Properties are system-defined properties (UUID, Location, and URL) that you cannot modify.

Note: Short names are recommended for folders, projects, and models. Short names are essential when you perform specific actions for the model such as scoring, running reports, or monitoring performance. If the value of the **URL** model property exceeds 262 bytes, you receive an error message that the action could not be completed.

User-Defined Properties

You can add you own project properties under **User-Defined Properties**. The property-value pair is metadata for the project.

To add a user-defined property:

1. On the **Properties** tab, select **User-Defined**.
2. Click . The New User-Defined Property window appears.
3. Enter a name and value for the property. Do not include spaces or double-byte character sets in the property name.
4. Click **OK**.

To remove a user-defined property:

1. On the **Properties** tab, select **User-Defined**.
2. Select a property.
3. Click .
4. Click **Remove** in the warning message.

Defining Project Input and Output Variables

About Defining Project Input and Output Variables

Project input and output variables are the variables that are used by the champion model and challenger models. Project input and output variables must be defined before a champion model can be published to a production environment. You can define the project input and output variables when you create a project or during the champion model selection process.

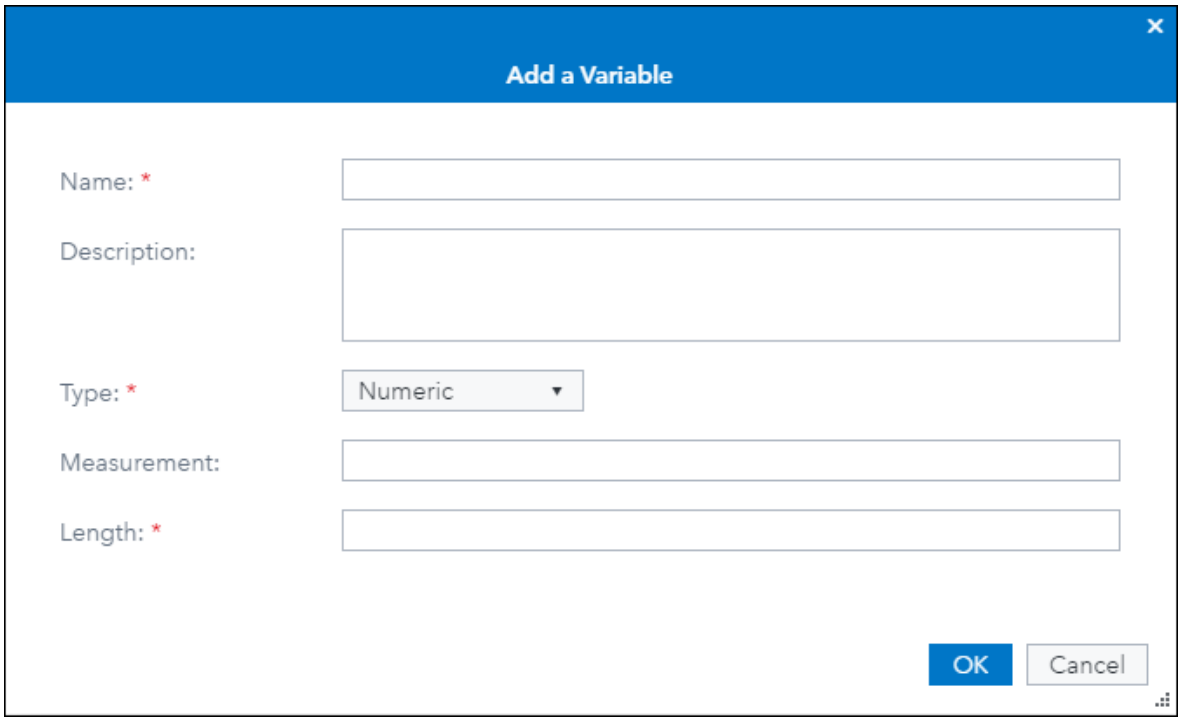
You define the project input and output variables by creating input and output prototype tables and then importing the variables using these tables, or by copying the input and output variables from another project. If you declare a champion model and the project variables have not been defined, you are prompted to add model input variables to the project and to map model output variables to project output variables.

On the **Variables** tab of a project, you can add, delete, edit, copy, and import project variables.

Add a Custom Variable

To add a new custom variable:

1. Click **Add variables** and select **Custom variable**. The Add a New Variable window appears.



2 Enter a name.

3 (Optional) Enter a description.

4 Select a type:

- **Numeric**
- **Character**

5 (Optional) Enter a measurement.

6 Enter a length.

7 Click **OK**.

8 Click ⊟ to make the changes effective for other tabs.

Delete Variables

To delete variables:

1 Select one or more variables.

2 Click ⋮ and select **Delete variables**.

3 Click **Delete** in the warning message.

4 Click ⊟ to make the changes effective for other tabs.

Edit a Variable

To edit a variable:

1 Click the variable name.

2 Edit the necessary fields and click **OK**.

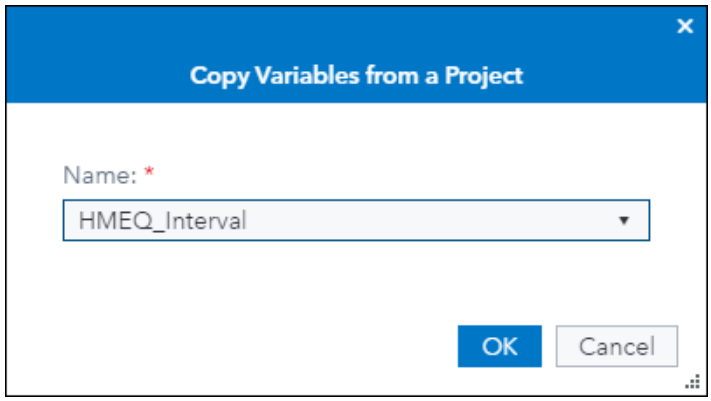
3 Click ⊟ to make the changes effective for other tabs.

Copy Variables

To copy variables from a project:

1 Click **Add variables** and select **Copy from a project**. The Copy Variables from a Project window appears.

2 Select a project.



3 Click **OK**.

4 Click ⊟ to make the changes effective for other tabs.

Import Variables

To import variables from a table:

1 Click **Add variables** and select **Import from a data source**. The Choose an Itemwindow appears.

2 Select a table from a library.

3 Click **OK**.

4 Click to make the changes effective for other tabs.

Managing Project Versions

About Project Versions

After a project is created, you can view information about the project on the **Versions** tab. An initial version is created automatically, and it functions as a time-phased container for your projects. The version is a sequential number that increments by plus one each time you add a new version. You can also specify a description for the version when adding a new one, such as a time interval for a project cycle. Your version might represent a calendar year, a retail season, or a fiscal quarter. A project can contain multiple versions. A version contains all of the candidate model resources that you need to determine a champion model as well as all champion model resources. For example, you might develop models for a scoring program that determines whether a customer is eligible for a home equity loan. The version contains all of the models, scoring tests, and reports that are used to determine the champion model.

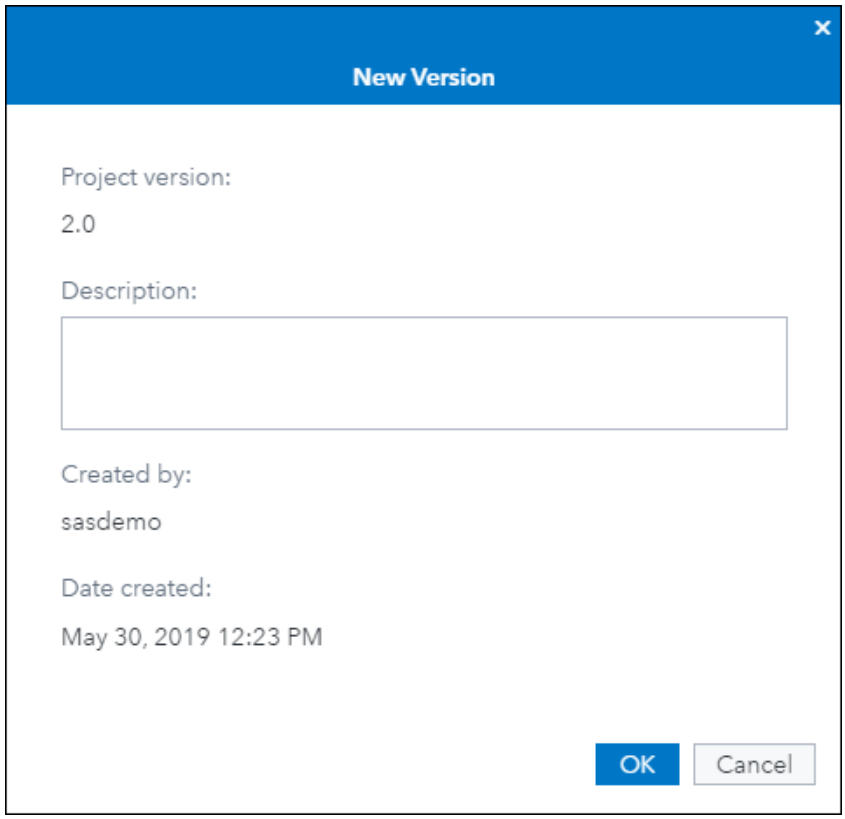
Click to add or remove columns that display information this is associated with a version.

Create a New Version of a Project

To create a new version:

1 Click the **Versions** tab.

2 Click **New Version**. The New Version window appears.



3 The next sequential number appears as the new version number for the project.

4 (Optional) Enter a description for the version.

5 Click **OK**.

You can also delete a version if it is not the current version, or if it is locked. Select a version, click ⋮, and select **Delete version**.

Set the Displayed Version

To set the displayed version:

1 Click the **Versions** tab.

2 Select a version and click **Set Version**, or double-click a version.

3 The ✓ icon indicates the version that is being displayed.

Lock and Unlock a Project Version

You can enable or disable modifications of some version models properties and files. Locking a version restricts the activities that you can do with the project. You normally lock a version after you declare a champion model in preparation for deploying the champion model to a production environment.

To lock or unlock a version:

1 Select the **Versions** tab.

2 Select a version and click 🔒 to lock the version, or click 🔓 to unlock the version.

The 🔒 icon appears to the left of the version name to indicate that the version has been locked.

Attach a Portable Formats File

The portable formats file contains the user-defined formats that are associated with the train table that was used to create a model. In order for the validation to be successful, the table that is selected at publish time to validate the model must be associated with the same user-defined formats. You must transform the user-defined formats SAS catalog into a portable formats file and attach it to the version. This action enables the user-defined formats to be published to the database with the model.

To attach a portable formats file:

1 Click the **Versions** tab.

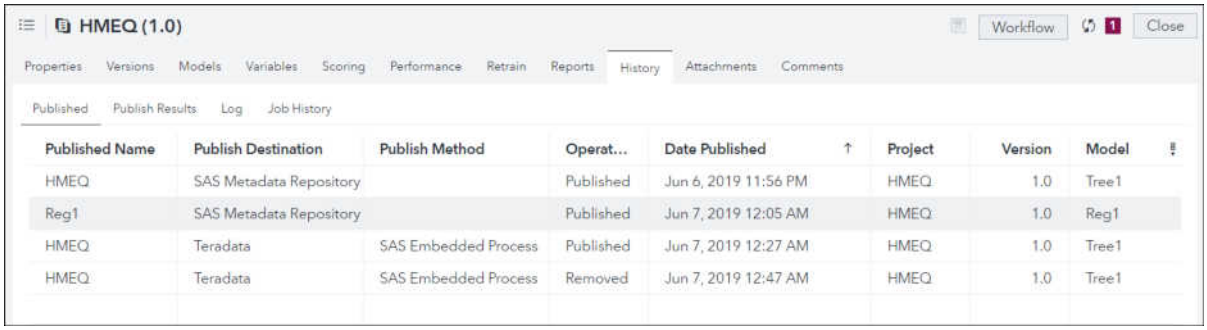
2 Select a version, click ⋮, and then select **Attach a portable formats file**.

3 Navigate to the appropriate folder and select the portable formats file to attach to the selected version.

4 Click **OK**.

View Project History

On the **History** tab, you can view the history log for changes to the project, the history of models that were published at the project and model level, and the history of scoring, performance, and retrain jobs that were executed.



Published Name	Publish Destination	Publish Method	Operat...	Date Published	Project	Version	Model
HMEQ	SAS Metadata Repository		Published	Jun 6, 2019 11:56 PM	HMEQ	1.0	Tree1
Reg1	SAS Metadata Repository		Published	Jun 7, 2019 12:05 AM	HMEQ	1.0	Reg1
HMEQ	Teradata	SAS Embedded Process	Published	Jun 7, 2019 12:27 AM	HMEQ	1.0	Tree1
HMEQ	Teradata	SAS Embedded Process	Removed	Jun 7, 2019 12:47 AM	HMEQ	1.0	Tree1

Add Attachments to a Project

On the **Attachments** tab of a project, you can view and add attachments such as images or documents. All new attachments are associated with the project. Values in the version and location columns appear only for attachments that were migrated from a previous release of SAS Decision Manager. The version and location columns also appear for performance and training summary data sets that are associated with the selected version. The value for location is the directory path where the attachment is stored in the model repository. Attachments for versions within a project that were migrated now appear at the project level.

To add an attachment:

1 Click +.

2 Select a file to attach and click **Open**.

To delete attachments:

1 Select one or more attachments and click 🗑.

2 Click **Delete** in the warning message.

Add Comments to a Project

On the **Comments** tab, you can add new topics or respond to an existing topic. You can also search the comments.

To add a comment:

1 Enter a topic name and a comment.

2 (Optional) Click 📎 to attach a file to the new topic. Repeat this step to attach multiple files.

Note: You cannot attach executable files to a topic.

Note: The Comments: Administrator role enables users to edit and delete comments. For more information, see "Roles and Capabilities" in *SAS Decision Manager: Administrator's Guide*.

To edit a comment that you made, click ✎.

To delete a comment that you made, click 🗑.

You can also click 🗑 to delete an attachment.

3 Click **Post**.

Lock or Unlock Project Variables

You cannot modify project variables that are locked for a project. Also, you cannot set a new champion or challenger model for the project.

To lock or unlock a project:

1 In the Projects category view, select a project.

2 Click ⋮ and select **Lock project variables**. Note that the **Lock project variables** check box is selected on the **Properties** tab of the project.

3 To unlock the project, click ⋮ and select **Lock project variables**. Note that the **Lock project variables** check box is deselected on the **Properties** tab of the project.

Note: You can also select or deselect the **Lock project variables** check box on the **Properties** tab of a project.

Creating and Managing Templates

About Creating and Managing Templates

There are three different types of templates that you can create or edit. The template types are Model, Report, and Properties. Models are associated with a specific model template. A model template contains properties and component files that define a type of model. Report templates can be used to create user-defined reports. A report template contains report requirements such as report name and the number of required models to run the report. The properties template contains user-defined properties and values for the model and project object types. In the Projects category view, you can create a new template or manage existing templates.

Note: Only users who are in the Model Manager Administrator Users or Model Manager Advanced Users groups and who have Write permission to the WebDAV folder where the user-defined model and report templates are stored can save a new template or save changes to an existing template. For more information, see "Verify WebDAV Folder Permissions for User-Defined Templates " in *SAS Decision Manager: Administrator's Guide*.

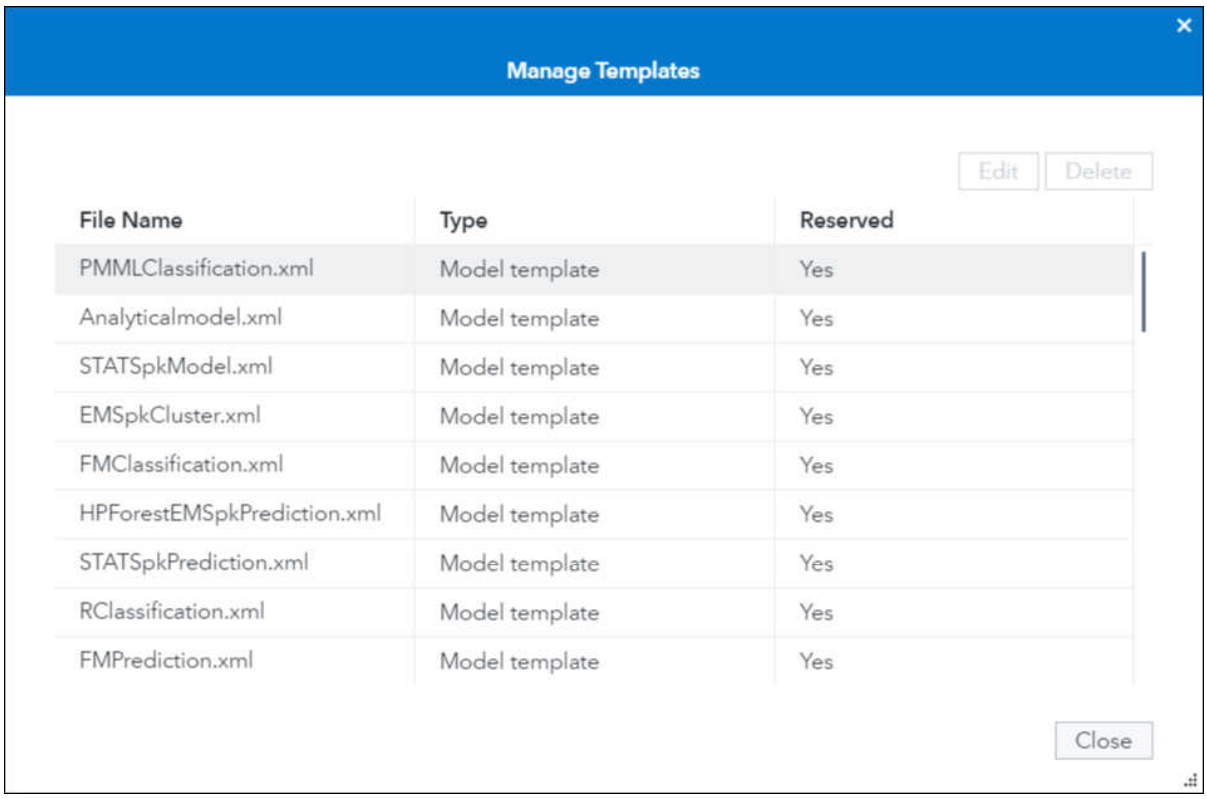
For more information about the different types of templates, see the following topics:

- Appendix 1, “Model Templates,” on page 361
- “Report Templates”
- “User-Defined Properties Template”

Manage Templates

To manage templates:

1 From the Projects, Portfolios, or Models category views, click ⋮ and select **Templates** ⇨ **Manage templates**. The Manage Templates window appears.



2 Select an XML template or SAS code file to edit or delete. In order for the template to be editable, the Reserved column must have a value of **No**. Life cycle templates cannot be edited but can be viewed as Read-only.

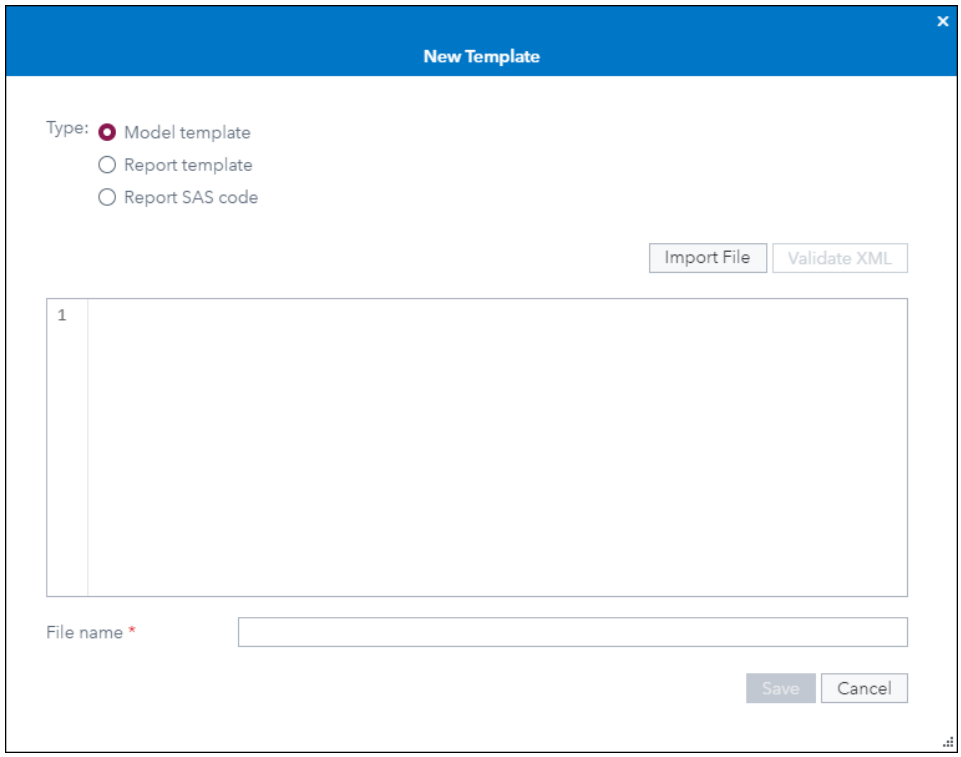
- To edit a file, select a file and click **Edit**. Make the appropriate changes and click **Save**.
- To delete a file, select a file and click **Delete**. Click **Yes**.

3 Click **Close**.

Create a New Template

To add a new template:

1 From the Projects, Portfolios, or Models category views, click ⋮ and select **Templates** ⇨ **New template**.



2 Select a type:

- **Model template**
- **Report template**
- **Report SAS code**

3 Enter a file name.

4 Click **Import File** to select an XML or SAS code file. You can also copy and paste the XML or SAS code in the text box.

Note: Ensure that the selected template type matches the XML content type before importing the file.

5 Click **Validate XML**.

6 Click **Save**.

User-Defined Properties Template

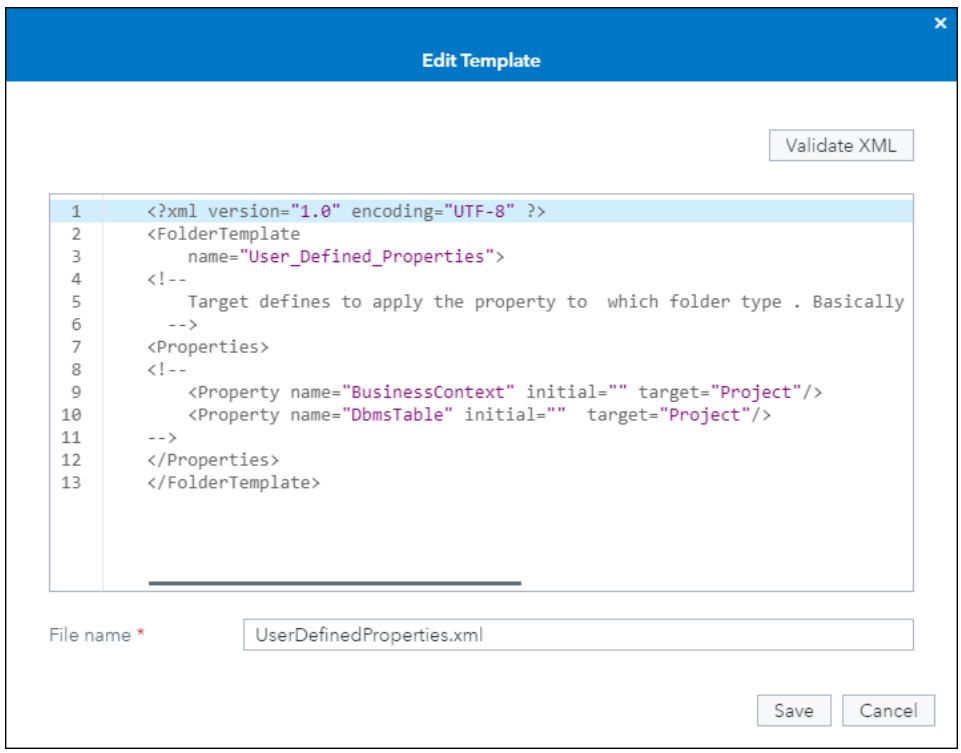
When you add a user-defined property using the UserDefinedProperties.xml file, you specify the name of the property, the initial value of the property, and the type of object in the model repository to which it applies. The user-defined property is created for the specified object type when the object is added to the model repository. For example, if the XML file specifies a user-defined property *Due date* for an object type of project, the project object has a property of **Due date** each time a project is created in the Projects category. User-supplied properties are not added to existing objects in the model repository.

You can specify these object types in the UserDefinedProperties.xml file:

- AnalyticalModel
- ClassificationModel
- ClusteringModel
- PredictionModel
- Project

To add user-defined properties for an object type:

1. From the Projects, Portfolios, or Models category views, click ⋮ and select **Templates** ⇨ **Manage templates**.
2. Select the `UserDefinedProperties.xml` template and click **Edit**.



3. Add properties using an XML property element for each property. These arguments are required:

name="*property-name*"
: specifies the name of the property.

initial="*initial-value*"
: specifies a value for the property when it is added as a property for the specified object type in the model repository. If you do not want to specify an initial value, use two double quotation marks, `initial=""`

target="*object-type*"
: specifies the object type in the model repository for which the user-supplied value applies.

Example: `<Property name="Due date" initial=" " target="Project"/>`

4 Click **Save**.

5 Click **Close**.

10

Working with Models

About Working with Models

Models can be stored within a folder or project version in the model repository. The Models category enables you to access all of the models in the model repository in one place, whether they are located in a folder, portfolio, or project. You can also import models into a folder, update models, and export models from a folder or project version.

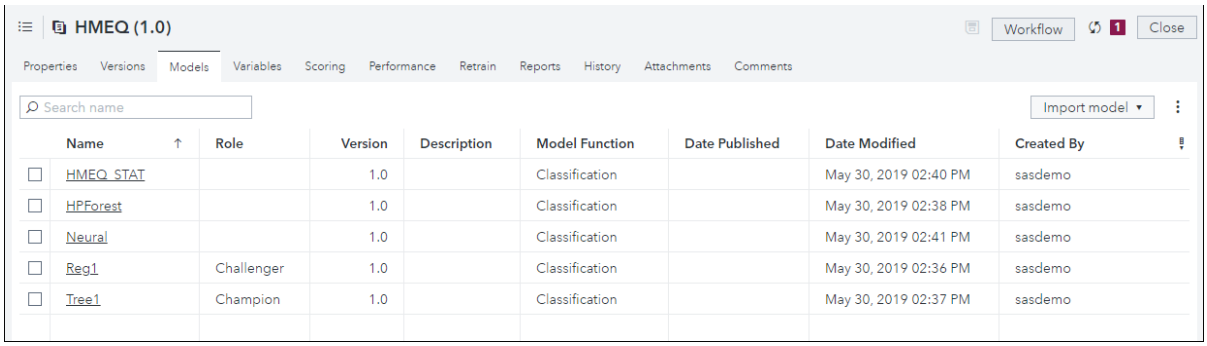
Importing Models

Overview of Importing Models

After you create a project, you import models into a project version on the **Models** tab. A project can contain multiple versions. You can see only the models for the selected version on the **Models** tab. After model evaluation, you set one of the candidate models as the champion model.

You can also import generic models into a folder from the SAS Workspace Server. For more information, see "Importing Models into a Folder" on page 136.

Figure 10.1 *Models Tab*



There are many methods of importing your SAS models into your project version:

- Import a model from the SAS Metadata Repository
- Import a model from a SAS Model Package File
- Import a model from a SAS analytic store file
- Import a model from local files
- Import a model from a PMML file
- Add model files to an existing model

SAS macros are also provided so that you can use SAS code to import or register SAS models into your project. For more information, see "Overview of Access Macros" in *SAS Decision Manager: Macro Guide* and "Using Macros to Register Models Not Created by SAS Enterprise Miner" in *SAS Decision Manager: Macro Guide*.

Keep the following details in mind:

- Scorecard models can be imported using the SAS Code Models local files method and the SAS Model Package File import method.
- HPFOREST procedure models can be imported using the SAS Metadata Repository import and the SAS Model Package File import. You cannot import PROC HPFOREST models using local files.
- High-Performance analytics models that are not created with SAS Enterprise Miner can be registered to the SAS Metadata Repository using the %AA_Model_Register. These models can then be imported to SAS Decision Manager by importing the models from the SAS Metadata Repository from a SAS model package file.
- Before you can import COUNTREG procedure and SEVERITY procedure models, you must create the model score code using the %MM_Countreg_Create_Scorecode macro and the %MM_Severity_Create_Scorecode macro. After the score code is generated, you can use the %MM_Model_Register macro or the local files method to import these models. For more information about the types of model component tables, see "Generating Score Code for COUNTREG Procedure Models" in *SAS Decision Manager: Macro Guide*.
- SAS Decision Manager can publish to a database or Hadoop the models that are associated with the **DATA step** score code type. Models that have a score code type of **Analytic store** can be published only to Hadoop and Teradata. Models that have a score code type of **SAS Program**, **PMML**, or **DS2** cannot be published to a database.
- Model component table variable names must start with a letter or underscore and can contain letters, an underscore (_), a hyphen (-), and a period (.). Variable names that have special characters can be used only when the SAS administrator has set the VALIDVARNAME system option to ANY. For more information, see "Valid Variable Name Options" in *SAS Decision Manager: Administrator's Guide*.

Note: Short names are recommended for folders, projects, and models. Short names are essential when you perform specific actions for the model such as scoring, running reports, or monitoring performance. If the value of the **URL** model property exceeds 262 bytes, you receive an error message that the action could not be completed.

CAUTION

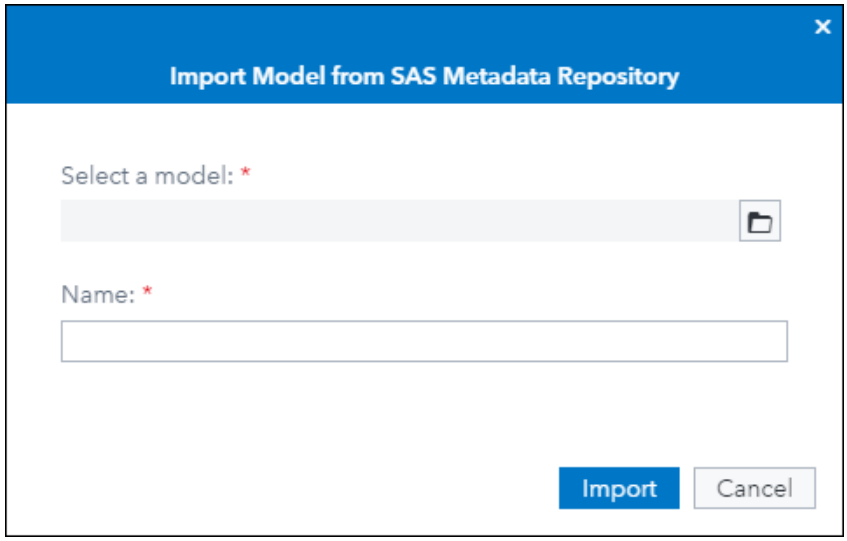
Unexpected results might occur if you import a model that was previously exported using SAS Decision Manager. A best practice is to import models that were not previously exported by SAS Decision Manager.

Import a Model from the SAS Metadata Repository

If your SAS Enterprise Miner 5.1 (or later) model files or your models that were created by the %AA_Model_Register macro are registered in your SAS Metadata Repository, you can import them into SAS Decision Manager from the repository.

To import a model from the SAS Metadata Repository:

1 Click **Import model** and select **from the SAS Metadata Repository**.



2 Click 🗀 and navigate to the location of the model file. Select the model file to import and click **OK**.

3 Enter a name for the model.

4 Click **Import**.

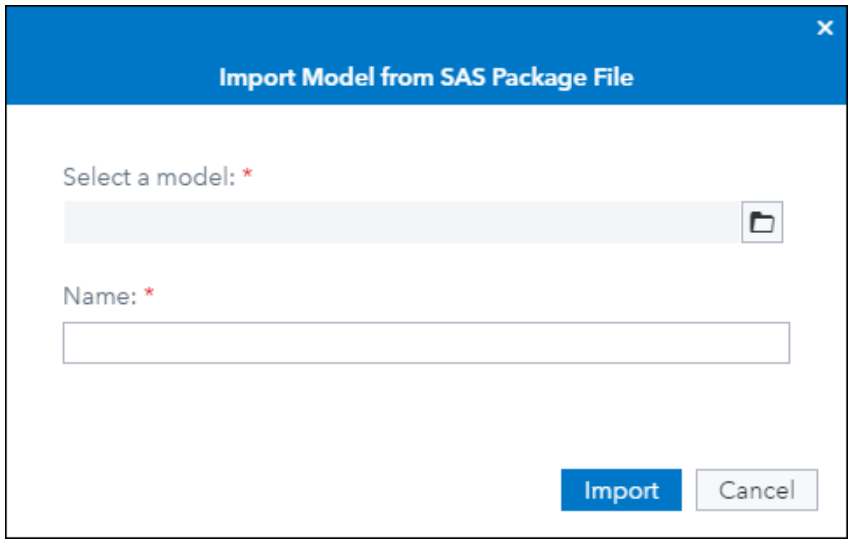
Import a Model from a SAS Package File

Import a SAS Package File

A SAS model package (SPK) file is a SAS Enterprise Miner SPK file or an SPK file that was created by using the %AA_Model_Register macro. SPK files contain complete model information. They enable you to import a complete model that is not registered in a SAS Metadata Repository.

To import a model from a SAS model package file:

1 Click **Import model** and select **from a SAS package file**.



2 Click 🗀 and navigate to the location of the model file. Select the model file to import and click **Open**.

3 Enter a name for the model.

4 Click **Import**.

Create SAS Package Files in SAS Enterprise Miner

To create SAS Package Files in SAS Enterprise Miner:

1 Open the SAS Enterprise Miner diagram that contains the model, and then run the model.

2 After the model run is complete, right-click the node in the SAS Enterprise Miner Diagram Workspace, and select **Create Model Package**. The new SPK filename appears under the Model Packages folder in your SAS Enterprise Miner Project Navigator.

3 Right-click the filename and select **Save As** to copy the SPK file from the SAS Enterprise Miner server to your computer.

4 Specify a destination folder on your computer, such as, `C:\MMData`, and save the file to your workstation folder.

Create SAS Package Files Using the %AA_Model_Register Macro

These models can be created by SAS procedures and are supported by SAS Decision Manager:

- SAS/STAT item store models
- High-performance models
- SAS/ETS COUNTREG procedure models
- SAS/ETS SEVERITY procedure models

You can use the %AA_Model_Register macro to create an SPK file to contain these models. For more information, see "Overview of Access Macros" in *SAS Decision Manager: Macro Guide*.

Import a Model from a SAS Analytic Store File

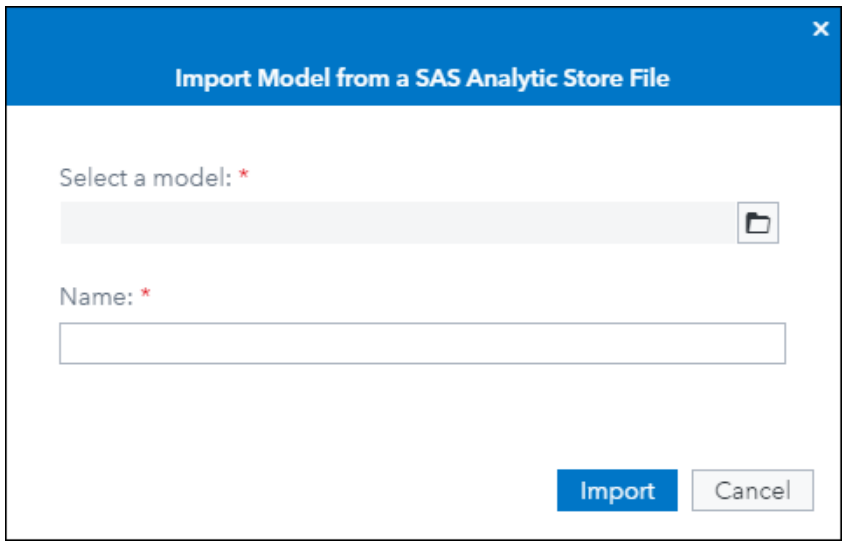
The HPFOREST and HPSVM procedures are used by SAS Factory Miner to create the SAS analytic store (SASAST) file that contains the model scoring files and model input and output variables. You can register SAS analytic store models from SAS Factory Miner, or you can register them by importing a model from a SAS analytical store file into SAS Decision Manager. SAS analytic store models that are created using SAS Enterprise Miner and that are in SAS package file (SPK) format are not supported in this release.

SAS Decision Manager supports publishing SAS analytic store models only to Hadoop and Teradata. The scoring files that are required for analytic store scoring by the SAS Scoring Accelerator are generated by the HPFOREST or HPSVM procedures. The HPFOREST and HPSVM procedures can also be used in Base SAS to create a SAS analytic store model. For more information, see "Introduction to Analytic Store Scoring" in *SAS In-Database Products: User's Guide* and *SAS Factory Miner: User's Guide*.

Note: When you are importing a model from a SAS analytic store file, the model function defaults to the value of `Analytical` and the file does not contain a target variable. When you are registering models from SAS Factory Miner to the model repository, the model function value of classification or prediction is accepted.

To import a model from a SAS analytic store file:

1 Click **Import model** and select **from a SAS analytic store file**.



2 Click 🗀 and navigate to the location of the model file. Select a SASAST model file to import and click **Open**.

3 Enter a name for the model.

4 Click **Import**.

Import a PMML Model

Predictive Modeling Markup Language (PMML) is an XML-based standard for representing data mining results. PMML is designed to enable the sharing and deployment of data mining results between vendor applications and across data management systems. You can import PMML models that are produced by using other applications. PMML 4.2 is supported. Models that are created using PMML 4.2 support DATA step score code.

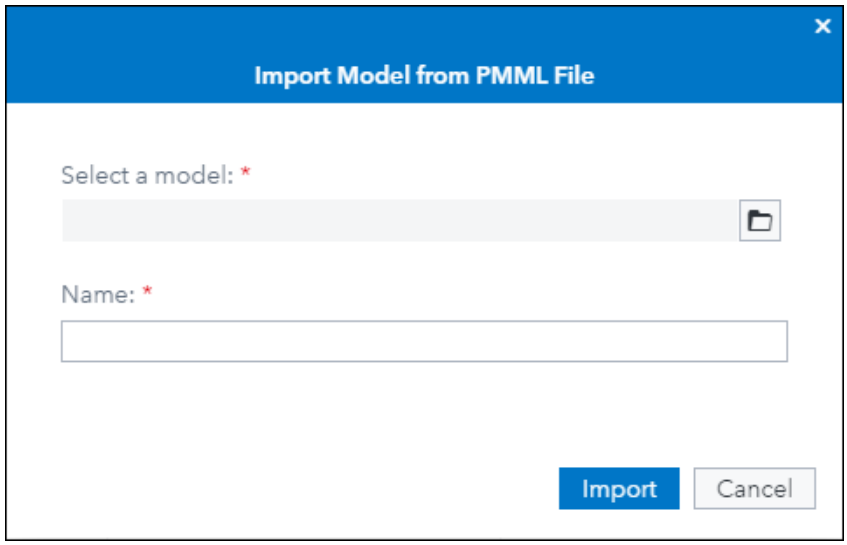
Note: If your PMML model contains variable names with blanks or special characters other than underscores, you must set the system option VALIDVARNAME=ANY to perform tasks such as scoring tests, performance monitoring, and reporting that use the score.sas file. For information about setting the VALIDVARNAME=“ANY”, see “Valid Variable Name Options” in *SAS Decision Manager: Administrator’s Guide*.

For more information, see Appendix 3, “PROC PSCORE and PMML Support,” on page 389. If you have a license for SAS Enterprise Miner, see the topic “SAS Enterprise Miner PMML Support” in the product Help or in *SAS Enterprise Miner: Reference Help* available at http://support.sas.com/documentation/onlinedoc/miner/.

Note: PMML variables must be valid SAS variable names and cannot contain more than 20 characters. In addition, SAS Decision Manager does not support the importing of a PMML file that contains multiple models.

To import a PMML model:

1 Click **Import model** and select **from a PMML file**.



2 Click 🗀 and navigate to the location of the model file. Select the model file to import and click **Open**.

3 Enter a name for the model.

4 Click **Import**.

Import Models from Local Files

You can import R models, and you can also import models that you created using SAS code, but that were not created in or exported from SAS Enterprise Miner. An example of a model might be a SAS LOGISTIC procedure model, a SEVERITY model, or an R logistic model. You can also add files later that were not available when the model was originally imported.

When you import models using the local file method, keep the following in mind:

- The table names that you specify as model components must start with a letter or underscore.
- Table names can contain a period.
- Table names cannot be more than 32 characters long.
- Spaces or special characters (for example, ~`!@#$%^&*()+={}[]|\\:;'<>?/") are not valid in a table name.

For more information, see Model Template Component Files on page 361.

Note: HPFOREST models cannot be imported using local files.

To use the Local Files method, you must prepare model component files. Model component files provide the metadata that is used to process a model in SAS Decision Manager. The model component files that you prepare are dependent upon the project's model function. You can find the model function in the project property **Model function**. The model functions for SAS code models are analytical, classification, prediction, or segmentation. The model functions for R models are analytical, classification, or prediction. For a list of component files by model

function, see Appendix 1, “Model Templates,” on page 361. If you do not have all of the component files when you import the model, you can create them and add them later. For more information, see “Add Model Files to an Existing Model” on page 148.

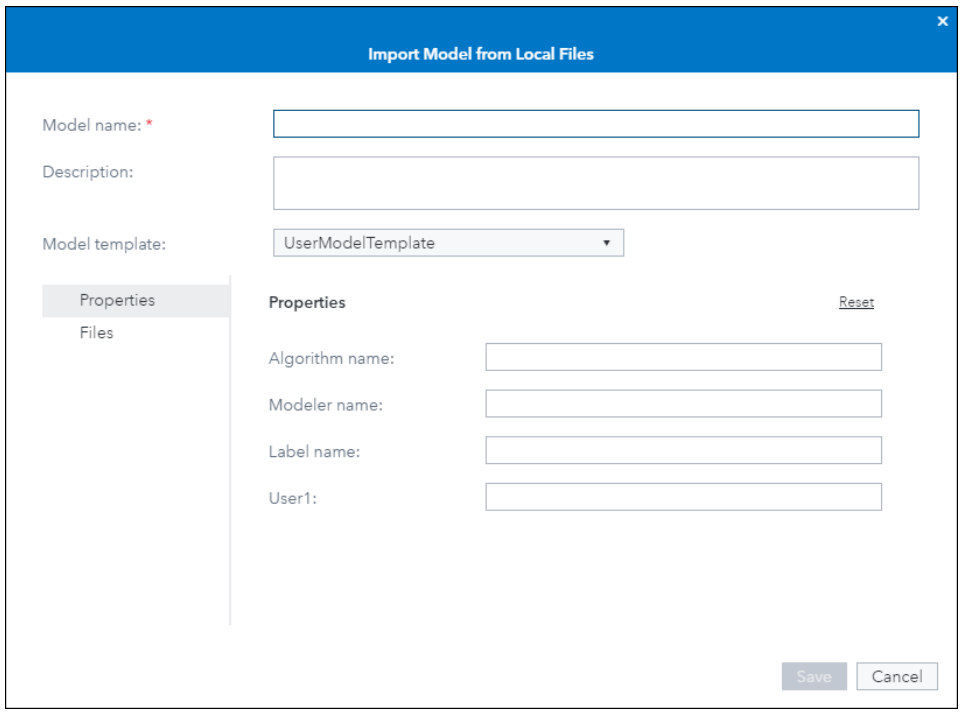
SAS code models, at a minimum, require a score code component file (score.sas) and other component files to define the model input and output variables in SAS tables. Prediction and classification models also require a component file to define target variables.

R models, at a minimum, require SAS and R score code component files, a file for the output parameter estimate, and the other component files to define the model input and output variables using either SAS data sets or XML files. Prediction and classification models also require a component file to define target variables. For more information, see “Overview of Using R Models with SAS Decision Manager” on page 393.

The score code component file (score.sas) is DATA step score code and is used as input by the SAS Scoring Accelerator when publishing a model to a database. In the scoring function publish method, some SAS language elements and syntax are not supported when you create or modify your score code. Only the SAS language elements and syntax that are required to run critical data transformations and model scoring functions are available. If you use a statement or function that is not supported, your model is not published to the database. For more information, see “Considerations When Creating or Modifying DATA Step Score Code” in *SAS In-Database Products: User’s Guide*.

To import models from local files:

1 Click **Import model** and select **from local files**.



2 Enter a name for the model.

3 (Optional) Enter a description for the model.

4 Select a model template from the drop-down list.

Note: If you specify values for the properties and then select a different template, the values are cleared.

5 Specify the model properties on the **Properties** tab.

6 Click **Files** and select the local files that match the template files. You cannot delete a file once you have added it. To replace the file, select another file or cancel the import and start over.

7 Click **Save**.

Importing Models into a Folder

About Importing Models into a Folder

You can import an individual model or multiple models at one time from the SAS Workspace Server into a folder in the model repository. The model repository folders are located on the SAS Content Server. To access the SAS Workspace Server, map a network drive to a drive on the machine where the SAS Decision Manager Middle-Tier Server is running. All of the model files in the selected location are imported. The folder name is used as the model name. If you have subfolders, each subfolder is considered to be a separate model. Each folder's contents are considered to be model files. A folder should not contain both model files and subfolders at the same level. If the top-level folder contains both, the subfolders are ignored and only one model is added with the files that are within the selected folder.

Note: The name of the model folders that are imported from the SAS Workspace Server can contain only alphanumeric characters, spaces, an underscore (_), a hyphen (-), and a period (.).

After you import models into a folder, you can also perform the following tasks:

- export a model
- export one or more models from a folder
- update one or more models from a folder

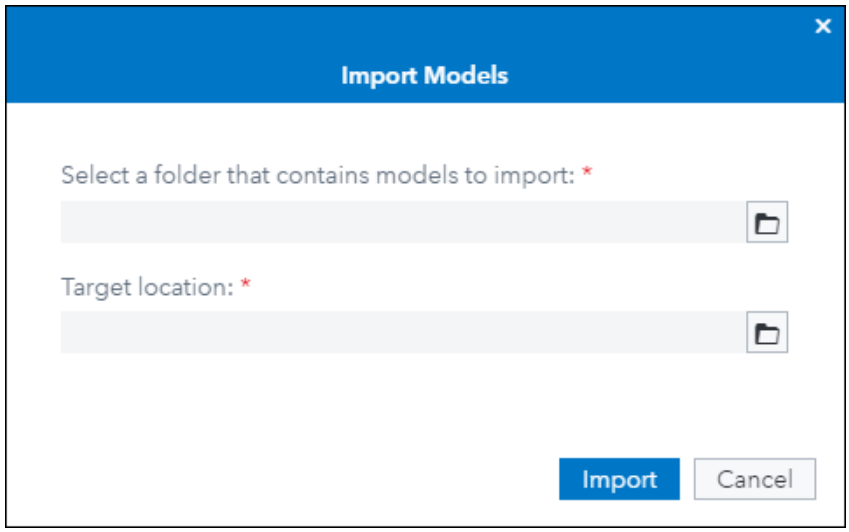
Note: These models cannot be moved or copied from a folder to a project within the user interface. When you export models from the folder level, models within a project are not included. Only models that reside directly within the selected folder are exported.

Import Models into a Folder

To import models:

1 Click ⅄ to navigate to the Models category view.

2 Click ⋮ and select **Import models**. The Import Models window appears.

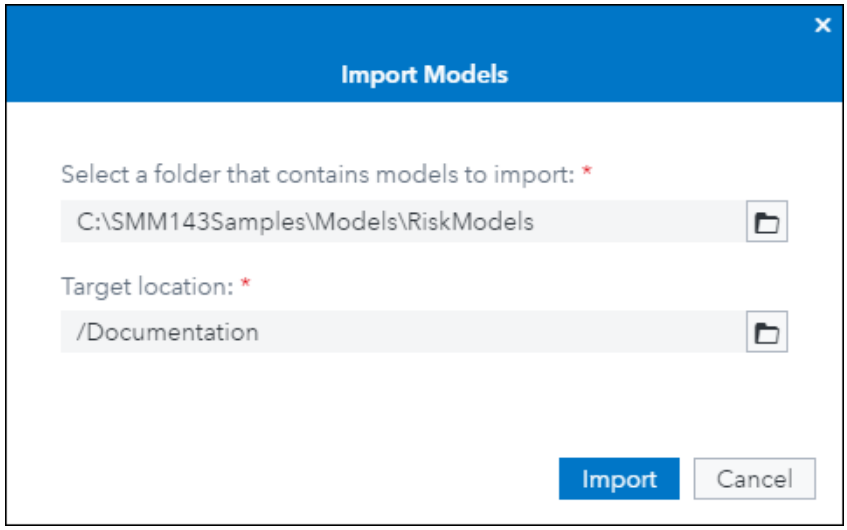


3 Click 🗀 and select a folder on the SAS Workspace Server that contains models to import. Click **OK**.

4 Click 🗀 and select a target location in the model repository to store the imported models.

Note: If no folders already exist, click 🗀* to create a new folder. Enter a name for the folder.

Select a folder and click **OK**.



5 Click **Import**.

Update Models in Folders

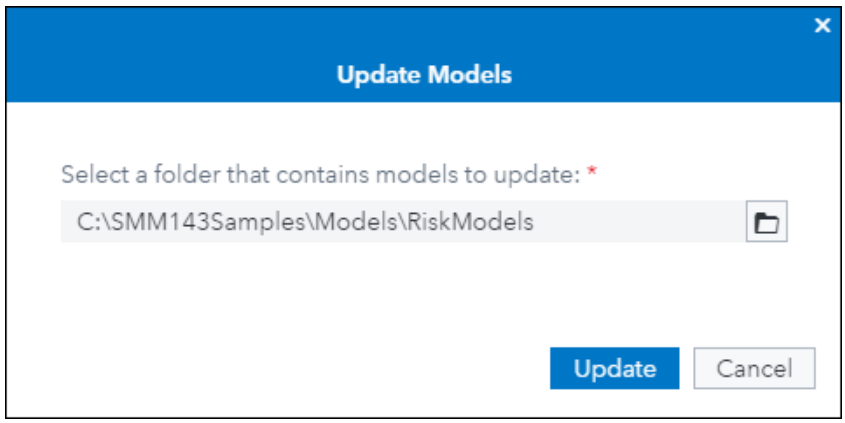
You can update one or more models at one time in the model repository. Only models that have previously been exported to the SAS Workspace Server can be updated. The reason for this is that a properties file is exported with the model files. The properties file contains the UUIDs of the models. Both new and modified model files are included in the updates to the model. A new model version is created each time you update the model.

To update models in a model repository:

1 Click to navigate to the Models category view.

2 Click ⋮ and select **Update models**. The Update Models window appears.

3 Click and select a folder on the SAS Workspace Server that contains models to update. Click **OK**.



4 Click **Update**.

Copying a Model from Another Project

To copy a model from another project:

1 Click to navigate to the Projects category view.

2 Open a project.

3 Click the **Models** tab.

4 Select a model, click ⋮, and select **Copy**.

5 Click .

6 Click the name of the destination project to open it and click the **Models** tab.

7 Click ⋮, and select **Paste**.

Exporting Models

Export Models from a Project

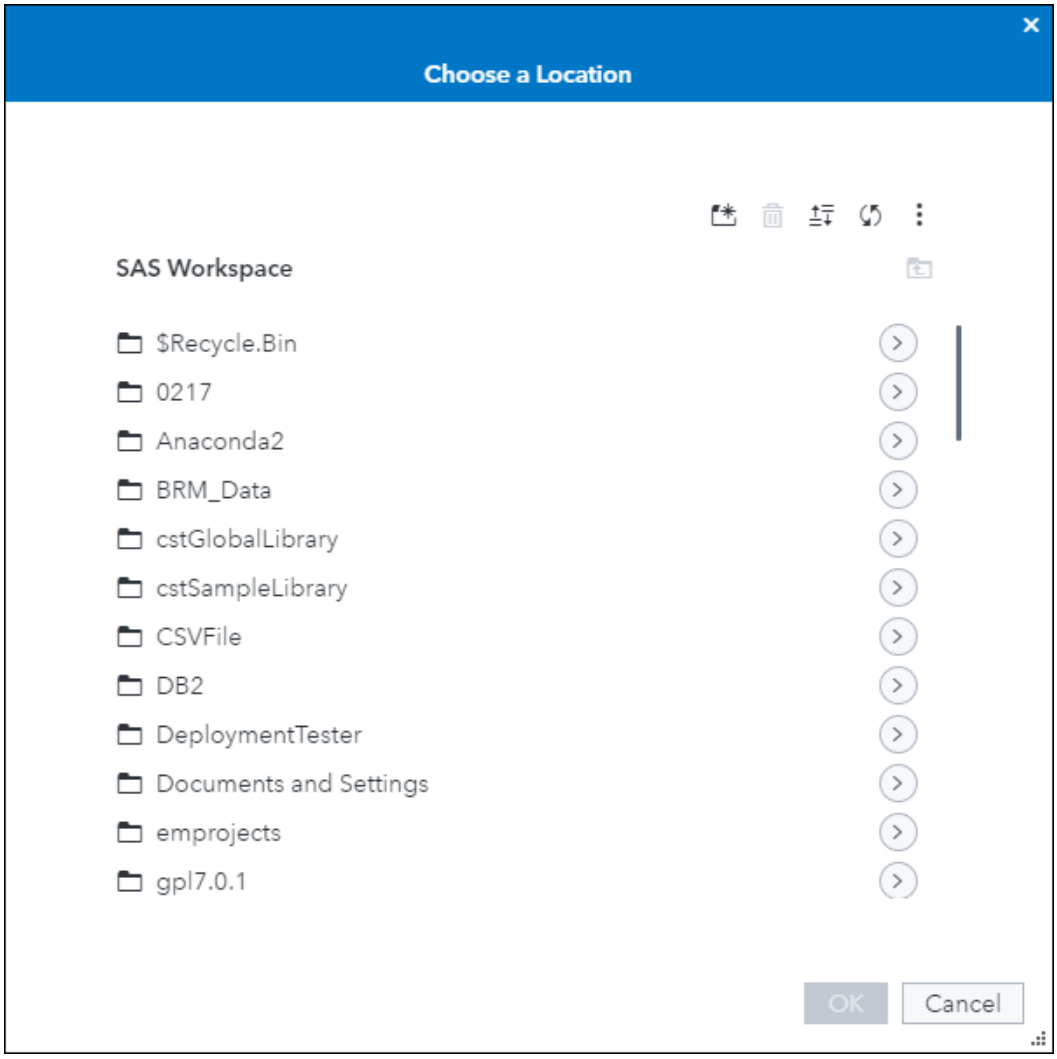
To export an individual model from a project version to the SAS Workspace Server:

1 Click to navigate to the Projects category view.

2 Open a project and select the **Models** tab.

Note: If your model is not in the current project version, you must set the displayed project version on the **Versions** tab. The current project version is displayed next to the project name in the title bar (for example, HMEQ (1.0)).

3 Select a model, click ⋮, and select **Export**.



4 Select a location on the SAS Workspace Server.

Note: If a model with the same name already exists in the selected location, the existing model is replaced.

5 Click **OK**.

See Also

Export Models from a Folder

Export Models from the Models Category View

You can export an individual model or multiple models at one time from a folder in the model repository to the SAS Workspace Server. The model repository folders are located on the SAS Content Server.

Note: When you export models from the folder level, models within a project are not included. Only models that reside directly within the selected folder are exported.

Export a Model

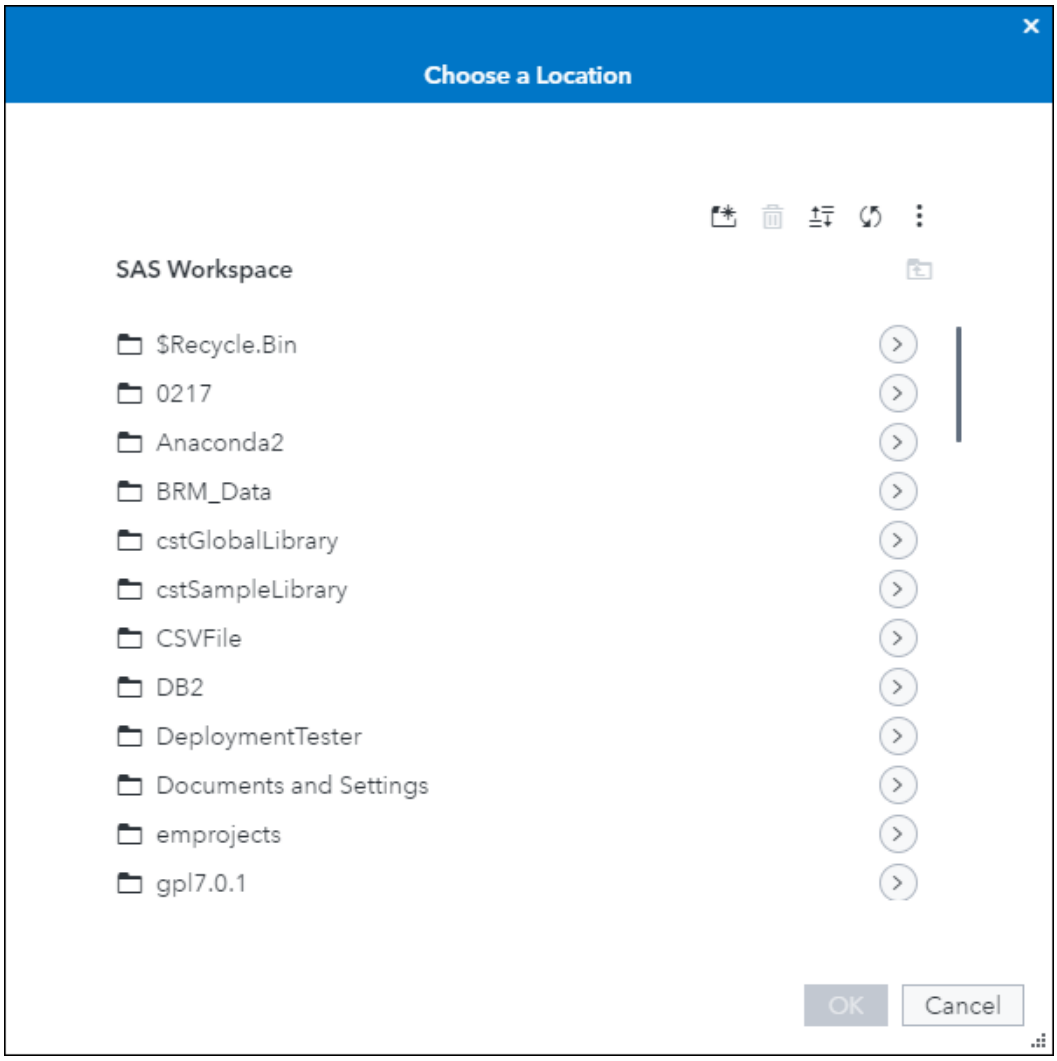
To export an individual model from a folder or project version:

1 Click to navigate to the Models category view.

2 Select a model, click ⋮, and select **Export**.

3 Select a location on the SAS Workspace Server.

Note: If a model with the same name already exists in the selected location, the existing model is replaced.



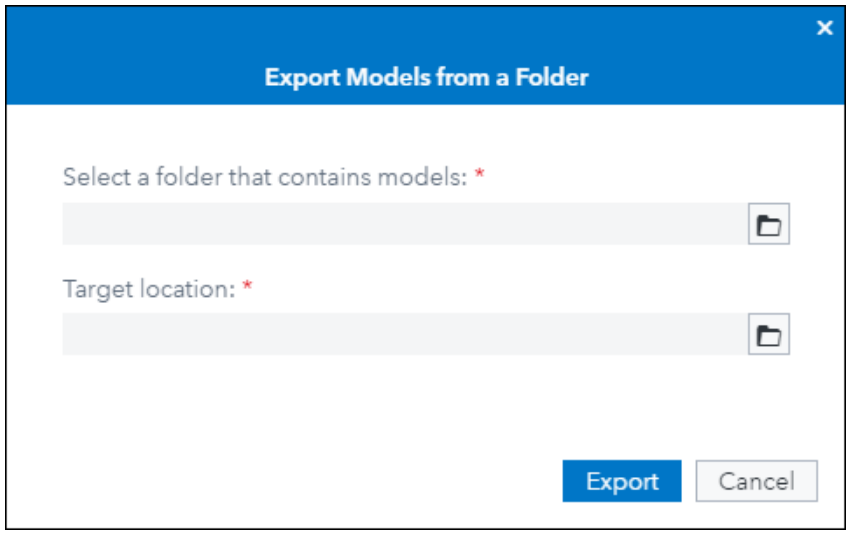
4 Click **OK**.

Export Models from a Folder

To export one or more models from a folder:

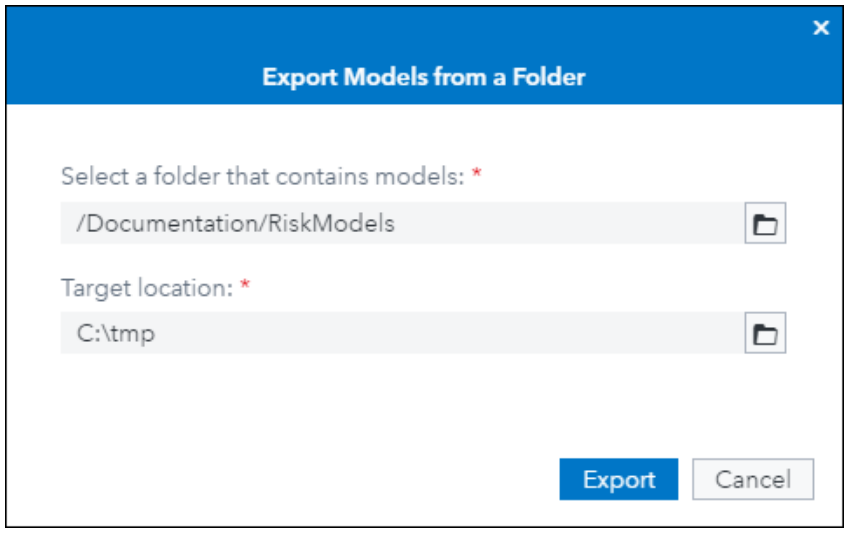
1 Click ⅄ to navigate to the Models category view.

2 Select a model, click ⋮, and select **Export Models from a Folder**.



3 Click 🗀 and select a folder in the model repository that contains the models to export. Click **OK**.

4 Click 🗀 and select a target location on the SAS Workspace Server to export the models to. Click **OK**.



5 Click **Export**.

Note: If the folder already exists in the target location, a warning message appears. Click **Yes** to replace the folder.

See Also

Export Models from a Project

Managing Model Content and Versions

Overview of Managing Model Content and Versions

When you open a model, you can modify the model properties, add or view model versions, add attachments, and add comments. You can open a model from the Models category view and from the **Models** tab of a project.

Set Model Properties

After you import a model, you can specify additional property values for your imported model. On the **Model Properties** page, you can perform the following tasks:

- View the input and output variables, and create a scoring output table
- Map model output variables to project output variables
- Specify model-specific properties and user-defined properties
- View and edit score code
- View and add model files
- Create input and output variables from the score.sas file
- View the history to see a log that shows changes to the model, and to the published models

To set the model properties:

1 Select and open a model and view the **Model Properties** page. See the below table for what types of properties can be specified.

Model Properties	Description
General	On this page you can view the model name, who created it, and the dates it was created and modified. The only property that you can edit is the description. For more information, see "General Properties" on page 110.

Model Properties	Description
Specific	On this page you can enter information for various items. Some values are automatically populated and cannot be modified. For editable properties, enter a value, click and select an item, or select a value from a drop-down list. For more information, see "Specific Properties" on page 372.
System	This page is Read-only and is created after a model has been imported. The system properties for models do not require any configuration after the model is imported. For more information, see "System Properties" on page 113.
User-Defined	On this page you can view the user-defined properties for a model. You can also create user-defined properties. For more information, see "User-Defined Properties" on page 113.
Factory Miner	On this page you can view the SAS Factory Miner model properties. **Note:** This tab appears only for SAS Factory Miner models.

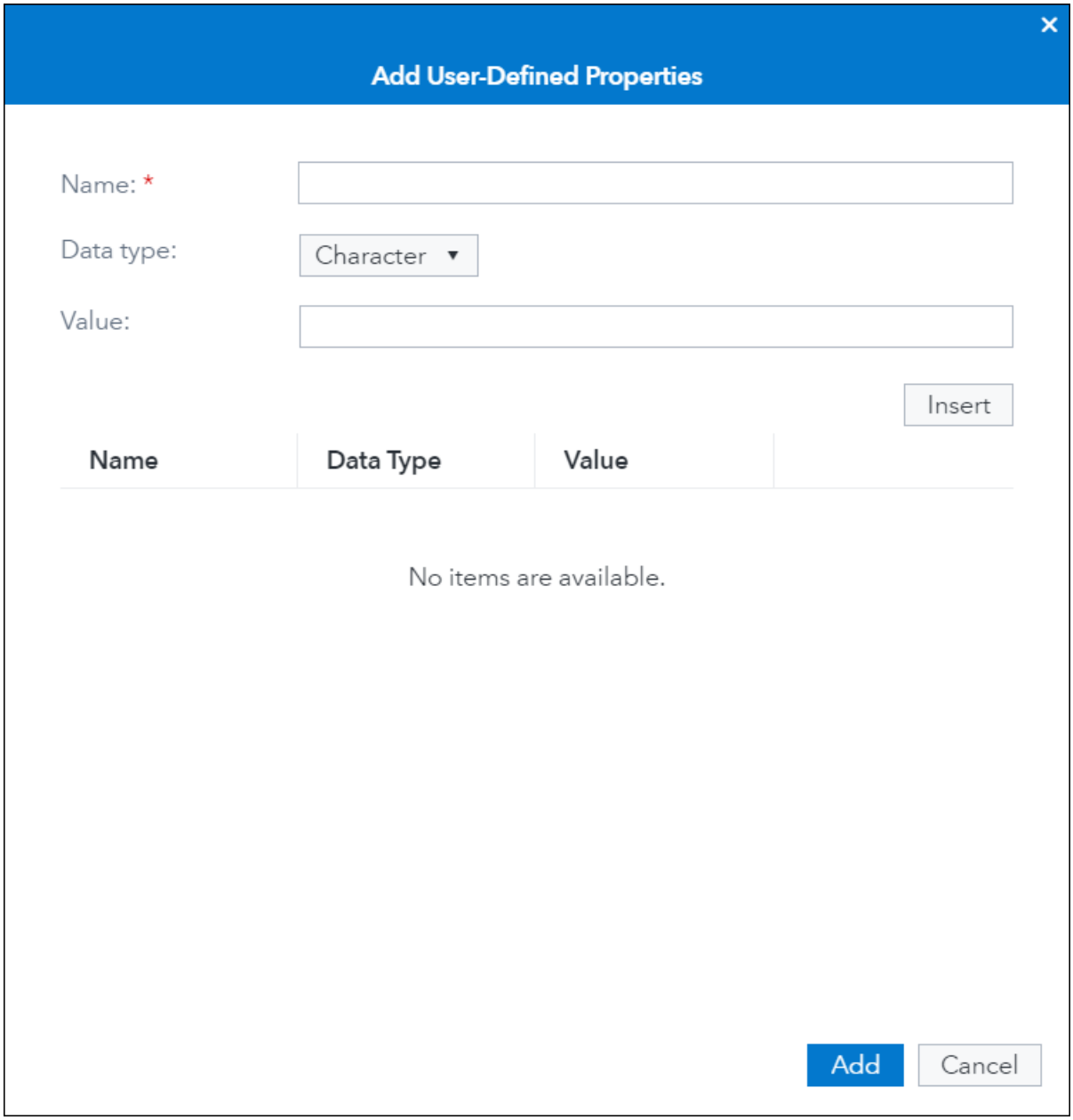
2 Click .

To create a scoring output table, see "Create Scoring Output Tables" on page 184.

Add Model User-Defined Properties

1 On the **Model Properties** tab, select **Properties** ⇨ **User-Defined**.

2 Click **Add Property**, if no properties are available. If properties already exist, click . The Add User-Defined Properties window appears.



3 Specify a name and data type for the property. A value for the property is optional.

Note: The property name can contain only alphanumeric characters, double-byte characters, underscores (_), and periods (.). The name must not begin with a period. Spaces and other special characters are not allowed.

4 Click **Insert** to the property to the table.

5 Repeat steps 3 and 4 for each variable that you want to add.

6 Click **Add**.

7 Click ⊟.

To edit a property:

1 Click a property name.

2 Make your changes and click **OK**.

3 Click 🖫.

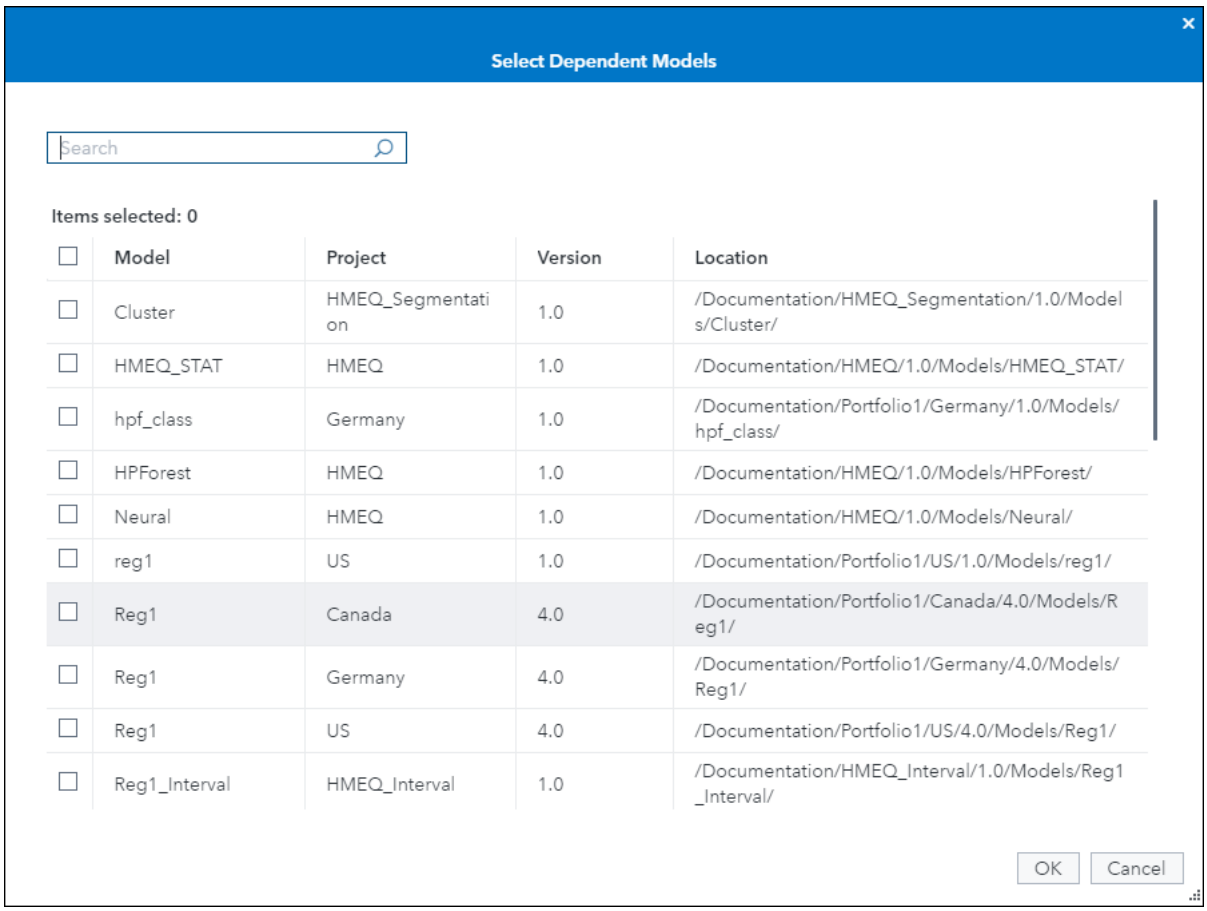
To view the history of changes for a property, select the property and click 🕓. Click **Close** in the History of Changes window.

Add Model Dependencies and View Lineage

Open a model and select **Model Properties** ⇨ **General** to view the model dependencies.

To add model dependencies:

1 Click **+**. The Select Dependent Models window appears.



Model	Project	Version	Location
Cluster	HMEQ_Segmentation	1.0	/Documentation/HMEQ_Segmentation/1.0/Models/Cluster/
HMEQ_STAT	HMEQ	1.0	/Documentation/HMEQ/1.0/Models/HMEQ_STAT/
hpf_class	Germany	1.0	/Documentation/Portfolio1/Germany/1.0/Models/hpf_class/
HPForest	HMEQ	1.0	/Documentation/HMEQ/1.0/Models/HPForest/
Neural	HMEQ	1.0	/Documentation/HMEQ/1.0/Models/Neural/
reg1	US	1.0	/Documentation/Portfolio1/US/1.0/Models/reg1/
Reg1	Canada	4.0	/Documentation/Portfolio1/Canada/4.0/Models/Reg1/
Reg1	Germany	4.0	/Documentation/Portfolio1/Germany/4.0/Models/Reg1/
Reg1	US	4.0	/Documentation/Portfolio1/US/4.0/Models/Reg1/
Reg1_Interval	HMEQ_Interval	1.0	/Documentation/HMEQ_Interval/1.0/Models/Reg1_Interval/

2 Select one or more models.

Note: Models from all projects are included in the list.

3 Click **OK**.

4 Click 🖫 to save the model properties.

To view the lineage of a model:

1 Open a new tab in your browser window and enter the following URL in the address bar:

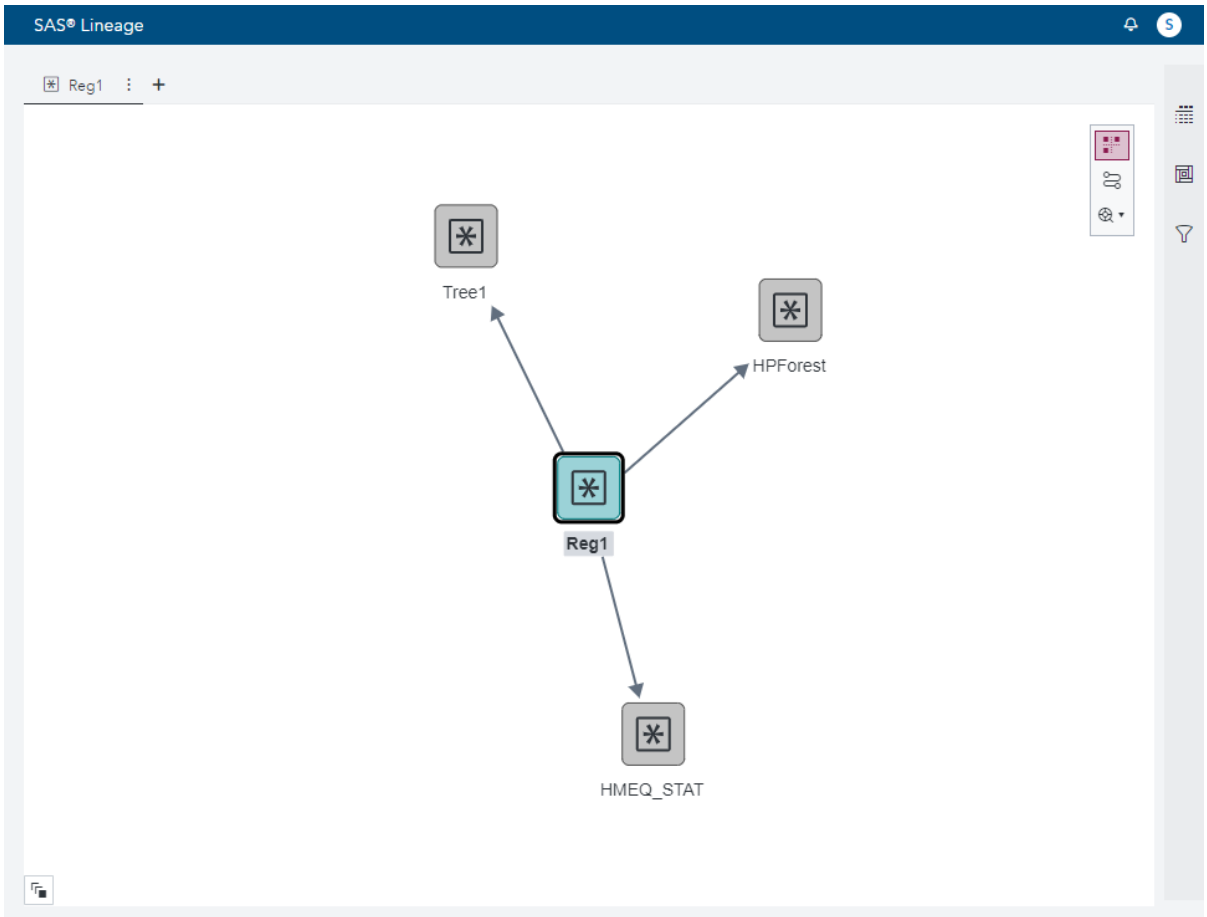
http://*host_name*:*port*/SASLineage/

The SAS Lineage web application appears.

2 Enter the model name in the **Keyword** box and enter `ModelManagerModel` in the **Types** box of the Search for Subjects window.

3 Click **Submit Search**.

4 Select the model from the **Subjects** list and click **Open**.



Note: For information about SAS Lineage and using the lineage viewer, click the user button in the application bar and select **Help Center** from the application options.

To remove model dependencies:

1 Select one or more models from the list.

2 Click 🗑.

3 Click 💾 to save the model properties.

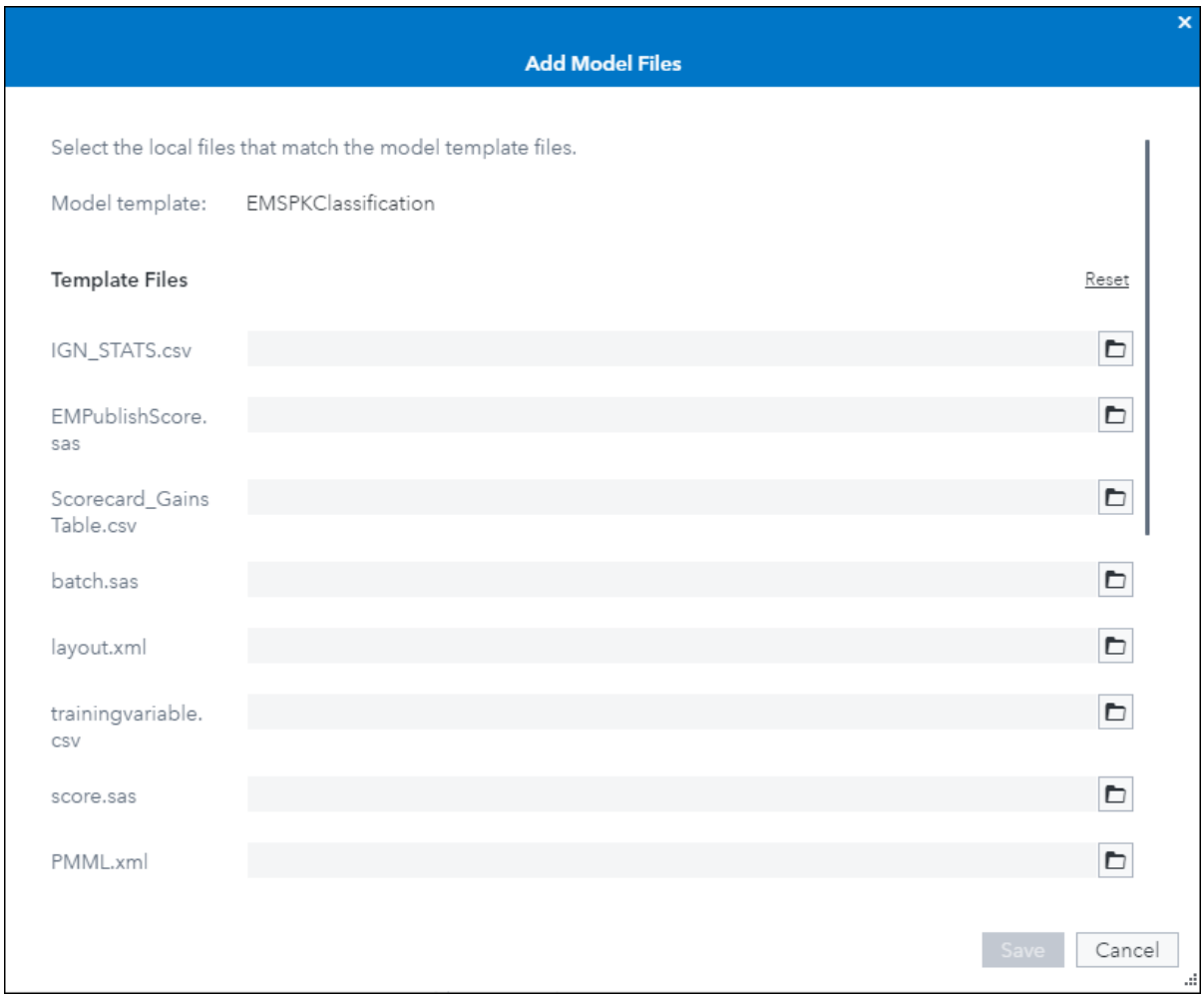
Add Model Files to an Existing Model

Suppose you want to import a model, but you lack some of the model component files that are needed to complete a model import. The model files utility enables you to add files later that were not available when the model was originally imported.

To add a local file to an existing model:

1. Select and open a model.
2. On the **Model Properties** tab, select **Advanced** ⇨ **Model Files**.
3. Click +.
4. Click 🗀 to select the local files that match the model template files.

Note: Not all files must be specified. You can specify one or more.



Note: If you are adding files to a model that is locating inside a folder, the Choose Files window appears for you to select a file from the **SAS Workspace**.

5 When the updates are complete, click **Save**.

6 Click . If you do not see your updates immediately, you might need to close the model and reopen it.

Create Input and Output Variables from a SAS Code File

You can create model input and output variables from the score.sas file. Creating the variables enables you to generate missing metadata for model variables.

1 On the **Model Properties** tab of a model, select **Advanced** ⇨ **Model Files**.

2 Select a SAS code file (for example, score.sas) and click .

3 Click **Yes** in the warning message to replace the existing input and output variables. The Create Input and Output Variables window appears.

Note: If a champion is already set, you might receive another message indicating that the champion and challenger models will be cleared. Also, if you add new variables that are not project variables, you are prompted to add the model variables to the project variables when setting the model as the champion.

4 Select input variables that you want to add as output variables for the model.

5 Click **OK**. The inputvar.xml and outputvar.xml model files are generated.

Map Model Variables to Project Variables

After a model has been imported and the remaining model properties are set on the **Model Properties** page, you must map the model output variables to the project output variables. For more information about project input and output tables, see Defining Project Input and Output Variables on page 114.

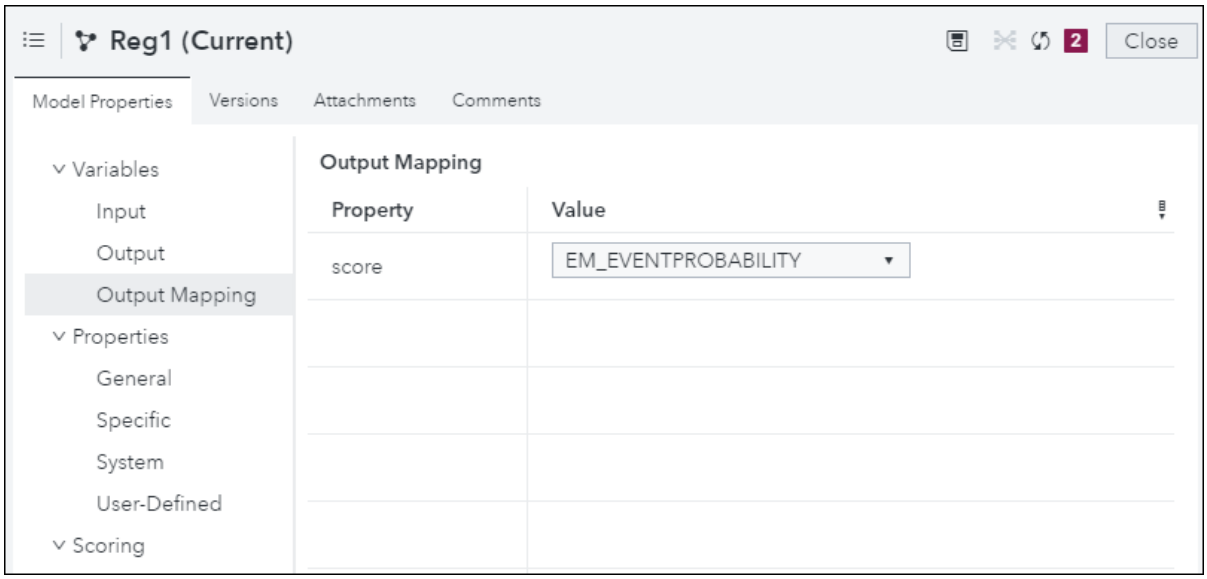
To map model variables to project variables:

1 Select and open a model.

2 Select **Model Properties** ⇨ **Variables** ⇨ **Output Mapping**.

3 Click the box in the **Value** column beside the variable in the **Property** column to display project variables.

4 Select a model output variable.



5 Repeat steps 3 and 4 for each model variable that requires mapping.

6 Click ▣.

User-Defined Model Templates

When you import a SAS code model or R model, you must define the component files to be used in the model and specify the properties for the model. SAS Decision Manager provides model templates that you can use as an example to create your own model template. You can define model component files and specify system and user properties for your model template. The model templates that are included cannot be modified. For a list of the component files that must be created for the different model types, see "Model Template Component Files" on page 362. For a list of properties, see "Specific Properties" on page 372.

Note: Only users who are in the Model Manager Administrator Users or Model Manager Advanced Users groups and who have Write permission to the WebDAV folder where the user-defined templates are stored can save a new template or save changes to an existing template. For more information, see "Verify WebDAV Folder Permissions for User-Defined Templates " in *SAS Decision Manager: Administrator's Guide*.

Several sample user template XML files are included with the installation package and are available to be used as a starting point for creating your own model template. For more information, see "Creating and Managing Templates" on page 121.

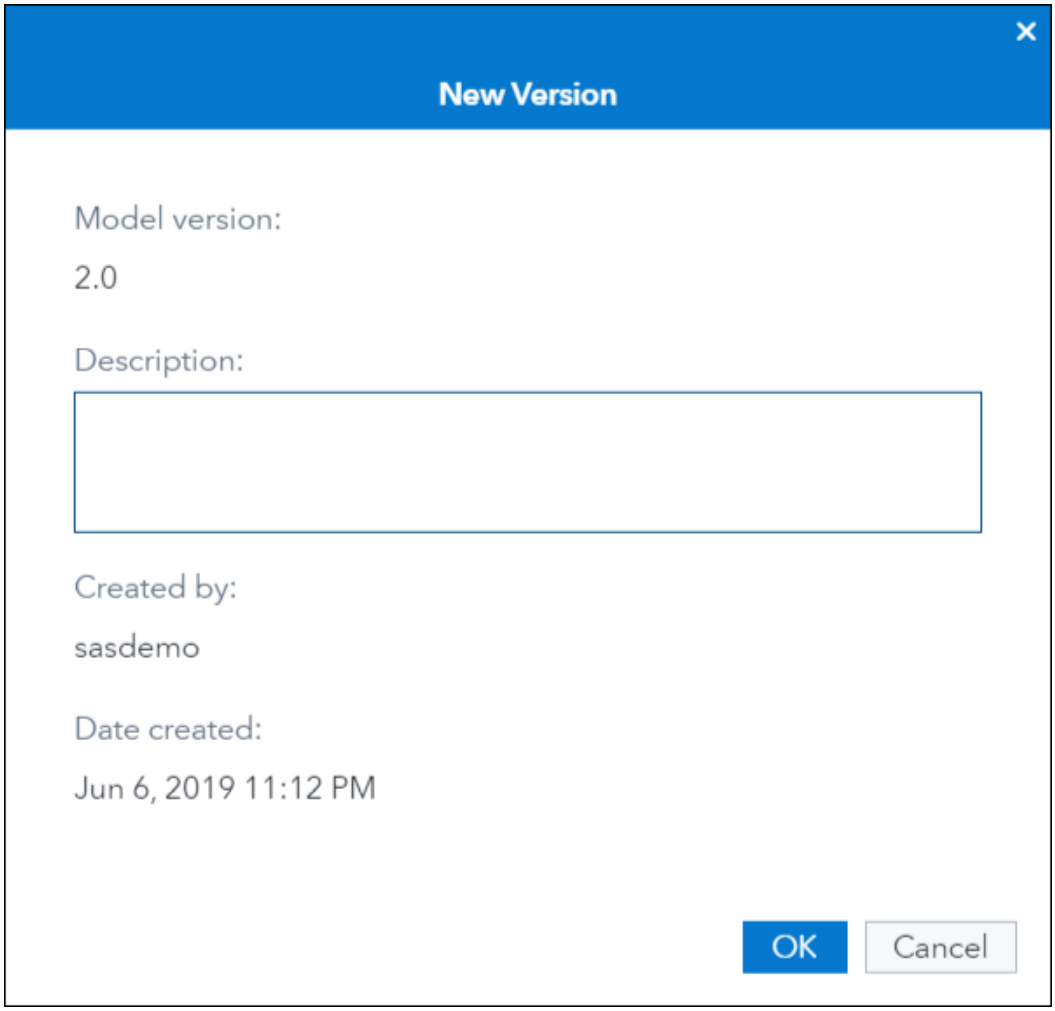
Managing Model Versions

About Model Versions

The current version of a model is the latest version in which the model properties and file contents are editable. If you add a new model version manually or perform an action that automatically creates a new model version (such as setting it as the champion model or publishing a champion model from the project level), a snapshot of the model's contents is taken and a version number is assigned. A new version is also created when you update a model that is located within a folder. However, the contents of the new model version that is created can no longer be edited. You can only view the contents of the new model version. Model versions cannot be deleted.

Add a New Model Version

1. Click the **Versions** tab.
2. Click **New Version**. The New Version window appears. The next sequential number appears as the new version number.



3 (Optional) Enter a description for the version.

4 Click **OK**.

Set the Model Version

1 Click the **Versions** tab.

2 Select a version and click **Set Version**. The ✓ icon indicates the version that is being displayed.

Add Attachments

You can view and add attachments such as images or documents. Attachments can be added at the object-level for portfolios, projects, and models.

To add an attachment:

1 Click the **Attachments** tab.

2 Click +.

3 Select a file to attach and click **Open**.

To delete attachments:

1 Select one or more attachments and click 🗑.

2 Click **Delete** in the warning message.

See Also

"Add Attachments to a Project" on page 120

Add Comments

You can add new topics or respond to an existing topic. You can also search the comments. Comments can be added at the object-level for portfolios, projects, and models.

To add a comment:

1 Select the **Comments** tab

2 Enter a topic name and a comment.

3 (Optional) Click 📎 to attach a file to the new topic. Repeat this step to attach multiple files.

Note: You cannot attach executable files to a topic.

Note: The Comments: Administrator role enables users to edit and delete comments. For more information, see "Roles and Capabilities" in *SAS Decision Manager: Administrator's Guide*.

To edit a comment that you made, click ✎.

To delete a comment that you made, click 🗑.

You can also click 🗑 to delete an attachment.

4 Click **Post**.

See Also

"Add Comments to a Project" on page 120

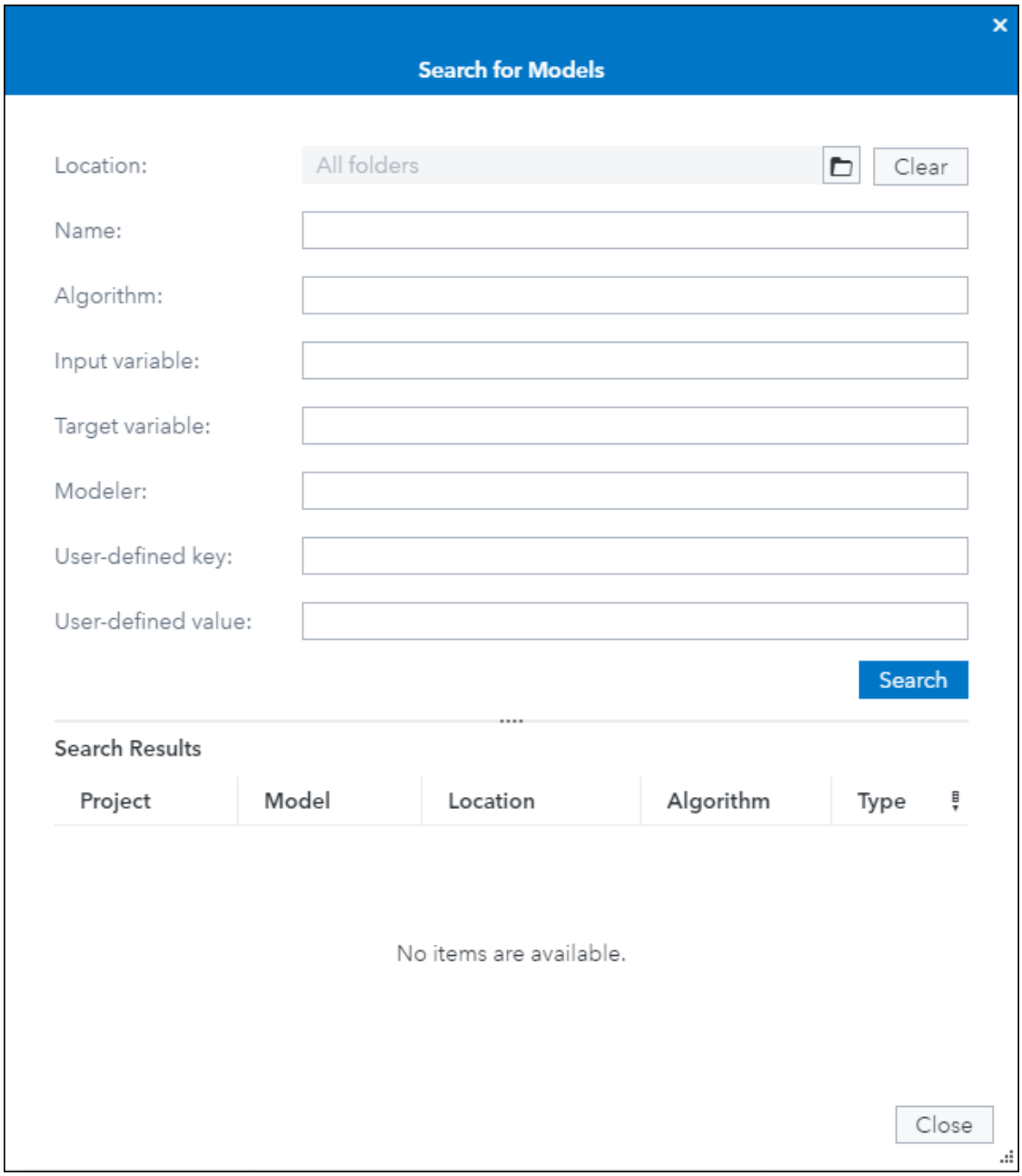
Searching for Models

You can search for models based on certain criteria in the Projects and Portfolios category views. The results appear below the search criteria. You can also search all models in the model repository from the Models category by using the category search options.

Note: The 🔍 button that is available in the application bar enables users to search for objects across SAS web applications. However, SAS Decision Manager object types are not returned in the search results. For more information, see "Search" in *SAS 9.4 Web Applications: General Usage Help*.

To search for models:

1 Click ⋮ and select **Search for models**. The default is to search **All folders**.



2 Click 🗀 and select a location.

Note: **All folders** is the default and searches all folders in the category view.

3 Enter a name for the model.

4 Enter an algorithm.

5 Enter an input variable. The field is case sensitive.

6 Enter a target variable. The field is case sensitive.

7 Enter a modeler.

8 Enter a user-defined key and value. The user-defined key field is case sensitive.

9 Click **Search**.

10 In the **Search Results** click the name of a model, or double-click a row to open the model. You can view or edit the model. Click to save your changes.

11 Click **Close**.

The search results display the following information:

Column	Description
Project	Specifies the name of the project.
Model	Specifies the name of the model.
Location	Specifies the location of the model.
Algorithm	Specifies the name of the algorithm, such as regression or logistic, that is used by the model.
Type	Specifies one of the model types: ■ Analytical ■ Classification ■ Prediction ■ Cluster

11

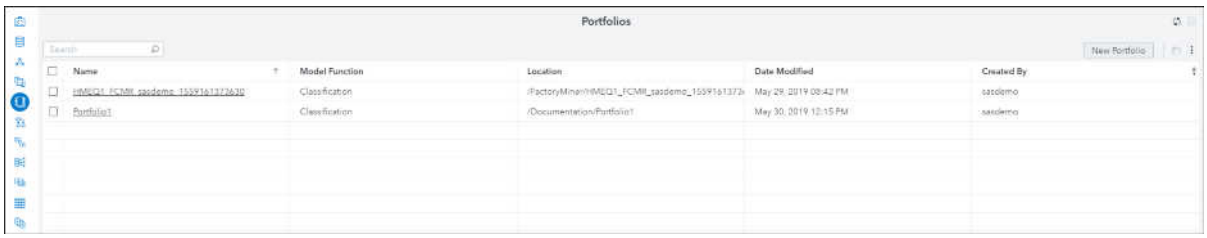
Working with Portfolios

Overview of Portfolios

SAS Decision Manager enables you to create a portfolio in the model repository. You use a portfolio to manage multiple projects and models in one place. From a portfolio level, you can create multiple projects from a control table and then add new versions or new input variables to all projects within the portfolio. After you set the champion model for each project, you can monitor the performance of the champion models for all projects and publish the champion models to the SAS Metadata Repository.

Portfolios are also created when you use SAS Factory Miner to register projects to the model repository. The portfolios contain the project segments and models from the SAS Factory Miner project. For more information about how to register SAS Factory Miner project segments and models, see *SAS Factory Miner: User's Guide*

Click to access the Portfolios category view.



Here are the tasks that can be performed for a portfolio:

- Create a portfolio
- Add a new version
- Add an input variable to all projects
- Publish project champion models
- Monitor performance of project champion models

Planning a Portfolio

Before you begin a portfolio, you must plan your portfolio resources. Here are questions to consider and conditions to meet for modeling projects within a portfolio:

- After you know which users are assigned to the projects within a portfolio, a SAS Decision Manager administrator must ensure that the user is assigned to the appropriate user group and role. For more information, see "Administering Group and Role Membership" in *SAS Decision Manager: Administrator's Guide*.
- How do you want to structure the projects within the portfolio? A portfolio is an object within a folder. The Portfolios category view enables multiple levels of folders so that you can customize how you structure the portfolios. For more information, see "About Managing Folders" on page 99.
- What models do you want to use in each project of the portfolio? If the models were created using SAS Enterprise Miner, SAS/STAT, or the SAS/ETS procedures COUNTREG and SEVERITY, all model components are available to SAS Decision Manager when you import the model. Only models that are contained in an SPK file can be imported. At least one SPK file must be prepared for each project and the SPK files should be placed in the same location. If your model is a SAS code model or a PMML model that is not contained in an SPK file, you must import it separately into the desired project within the portfolio, after the portfolio is created. You must also ensure that you have imported all of the model component files. For more information, see "Import Models from Local Files" on page 134 and "Import a PMML Model" on page 133.
- What model function do you want to use in each project of the portfolio?

SAS Decision Manager has several model function types:

- Classification
- Prediction
- Segmentation
- Analytical

After the model function is specified for the portfolio, the **Model function** property for a project cannot be changed. Ensure that the types of models that you are going to use in each project of the portfolio fit within the selected model function type. For more information, see Table 9.1 on page 111.

- How do you want to define your project input and output variables? When you create a portfolio, you can import the variables using input and output prototype tables. The project variables are set for each project within the portfolio. The prototype tables must be registered in the SAS Metadata Repository. Tables that were registered using the SAS Management Console must also be made available in the Data category view before you create the portfolio. For more information, see “Defining Project Input and Output Variables” on page 114.
- What method do you want to use to track the progress of a version? The Workflows and My Tasks category views enable you to track the progress of tasks from the version level for each individual project within a portfolio. An authorized user can create a workflow and associate it with a version. For more information, see “Overview of Using Workflows” on page 327.
- When you publish project champion models from a portfolio to the SAS Metadata Repository, you must specify a location in which to store the models. You might need to create a folder in the SAS Metadata Repository, if one does not already exist. For more information, see “Publishing Models from a Portfolio” on page 169.
- After your project champion models are in a production environment, you can monitor the performance of the project champion models within a portfolio in SAS Decision Manager using your organization's operational data. If you use SAS Decision Manager to monitor performance of projects within a portfolio, you must first prepare performance tables using the operational data and then register the tables in the SAS Metadata Repository using the Data category view. Tables that are registered to the SAS Metadata Repository using SAS Management Console must also be made available to the Data category view. For more information, see “Creating a Performance Table” on page 384.
- When you run performance monitoring reports, you can set up performance index alert and warning conditions to notify users if conditions exceed the indexes. For more information, see “Performance Index Warnings and Alerts” on page 253.

Prerequisites for Creating Portfolios

After you have planned the projects and models that you want to have in your portfolio, you must create a project control table that contains the segment identifiers, projects, and models. The project control table can then be used to create a hierarchy of your portfolio.

Portfolios can be created only by authorized users who have the capability to access the Portfolios category. Ensure that users who create portfolios are assigned to the group **Model Manager Administrator Users** or **Model Manager Advanced Users** in SAS Management Console.

The project control table must contain the project names (project_name variable) to create the projects within the portfolio. At least one segment identifier variable (for example, segid) is required, and that segment identifier variable must also be in the performance data set. When you want to monitor the performance of project champion models, you must also associate the model name (model variable) with each project (project_name) and segment identifier (segid, or another name for the segments) in the table.

You must know the model function type before you create a portfolio. SAS Decision Manager has several model function types:

- Classification
- Prediction
- Segmentation
- Analytical

To determine the model function type for your project, compare your model to the descriptions in Table 9.1 on page 111.

If you use prototype tables to define the project input and output variables, you must do one of the following two things before you can create a portfolio. Create the project input and output tables and register them in the SAS Metadata Repository using the **Data** category view. Tables that are registered to the SAS Metadata Repository using the SAS Management Console must then be made available to the **Data** category view of SAS Decision Manager. See the following documents for details:

- For instructions about creating project input and output tables, see “Creating Project Input and Output Tables” on page 381.
- For instructions about registering tables using the Data category view, see “About Managing Data Tables” on page 15.

Creating a Project Control Table

After you have planned the projects and models that you want to have in your portfolio, you must create a project control table that contains the segment identifiers, projects, and models. The project control table is then used to create the hierarchy of your portfolio when you create a new portfolio. The variable names that are required in the project control table are at least one segment identifier (for example, segid), project_name, and model. All variables other than project_name and model are treated as segment identifier variables. The segment identifier variables do not have a required naming convention.

Here is an example of the code to create a project control table.

```
data control_Table;
 length segid project_name model $20;
 infile datalines dsd dlm=',' missover;
```

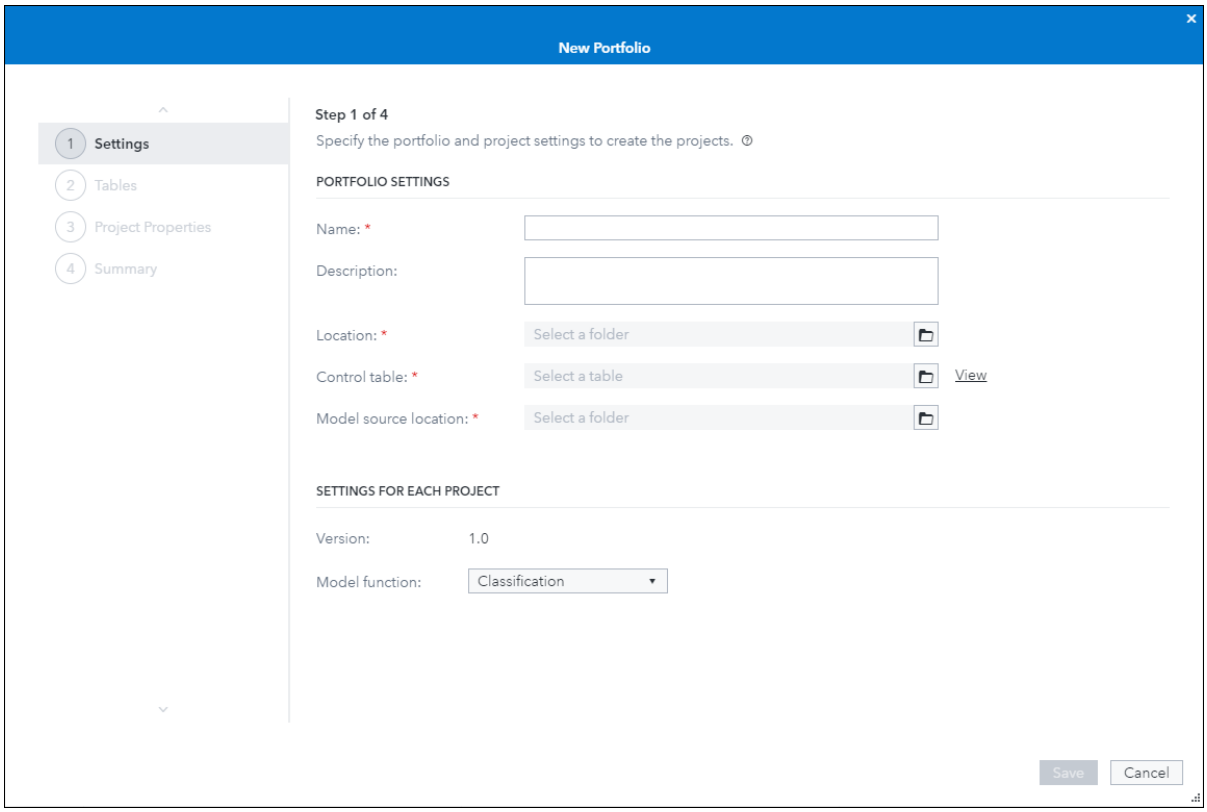
```
input segid project_name model;
datalines;
seg01,US,reg1.spk
seg02,Canada,tree1.spk
seg03,Germany,hpf_class.spk
;
run;
```

Create a New Portfolio

1 Verify that the project control table contains the required variables. For more information, see "Prerequisites for Creating Portfolios" on page 161.

2 Click to navigate to the Portfolios category view.

3 Select **New Portfolio**. The New Portfolio window appears.



Note: The value for the initial version is auto-populated and is the version name that is created within each project for the new portfolio.

4 On the **Settings** page, enter a name for the portfolio.

5 (Optional) Enter a description for the portfolio.

6 Click to select a location. Select a folder and click **OK**.

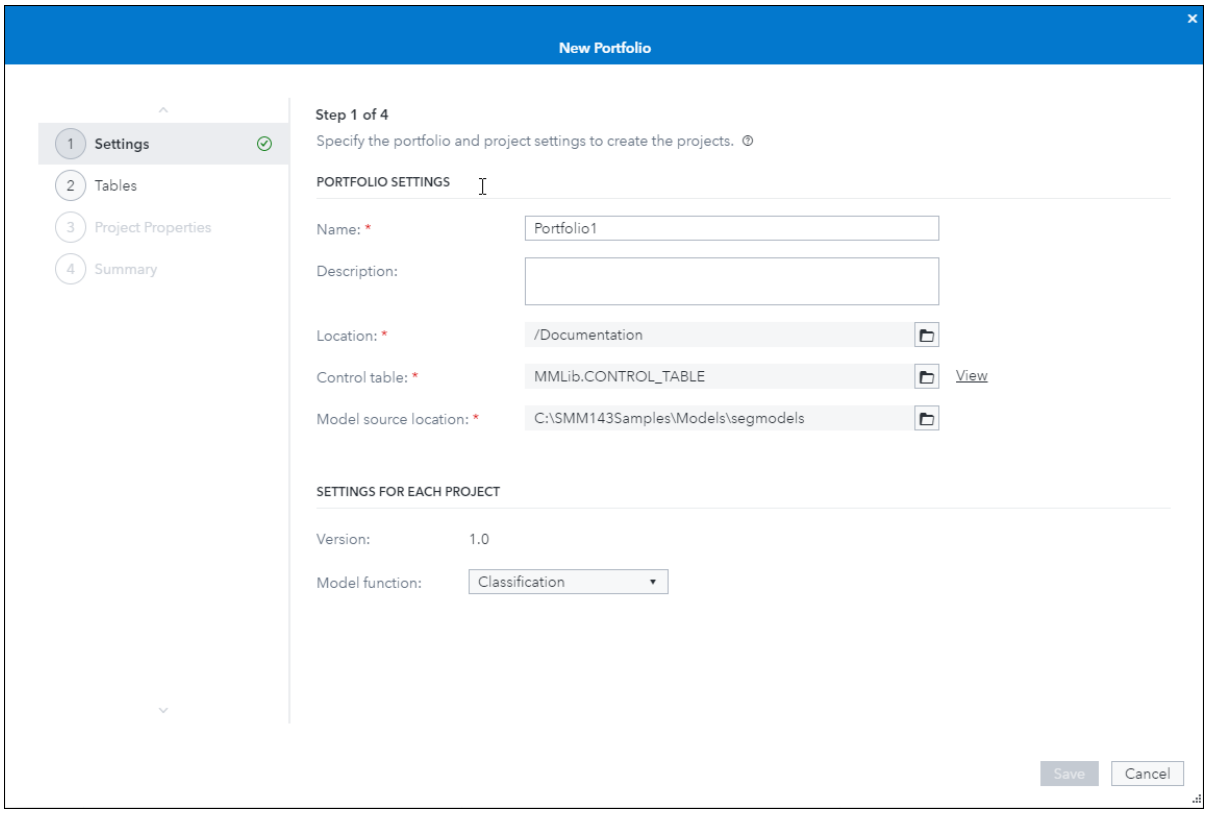
Note: If no folders already exist, click to create a new folder. Enter a name for the folder.

7 Click to select the control table. Click **Open**.

Note: After you select a control table, click **view** to see the contents of the control table.

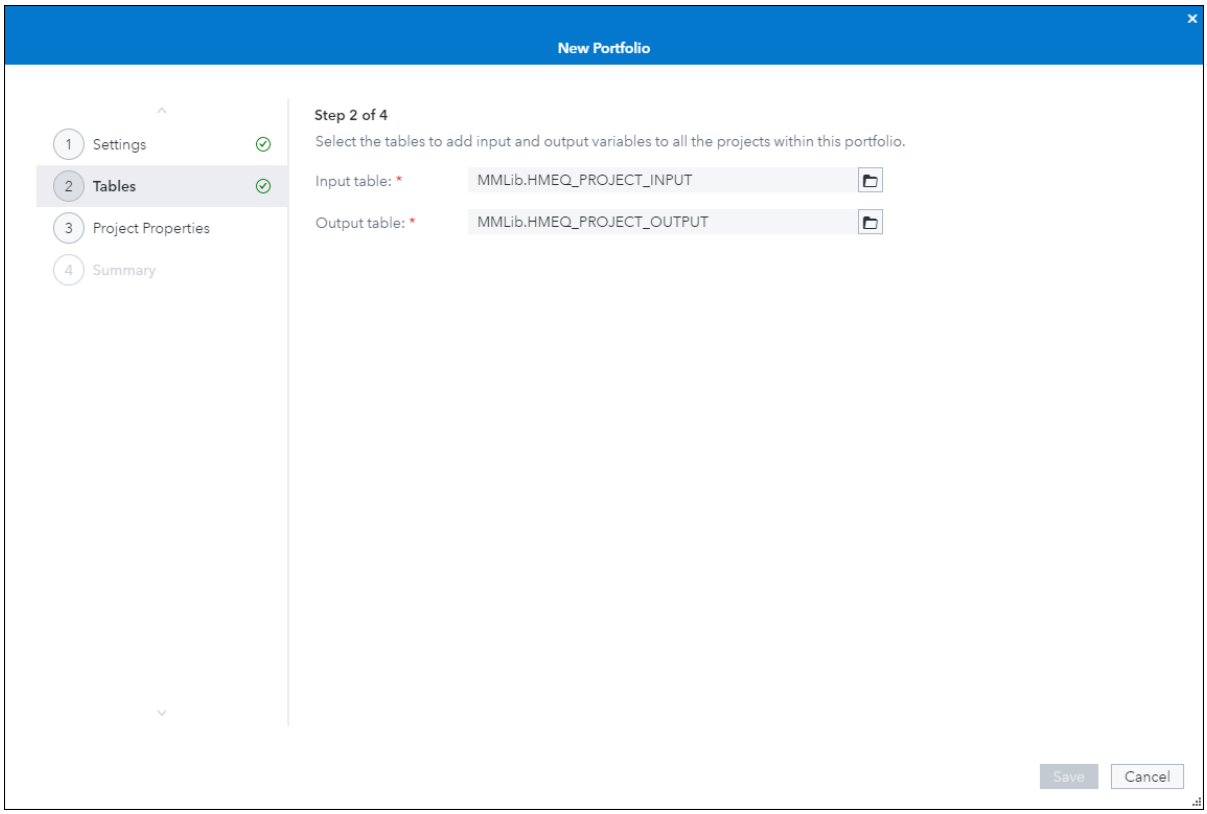
8 Click to select the location of the model SPK files that are specified in the control table. Click **OK**.

9 Select a model function to indicate the type of models that should be imported into each project within the portfolio.

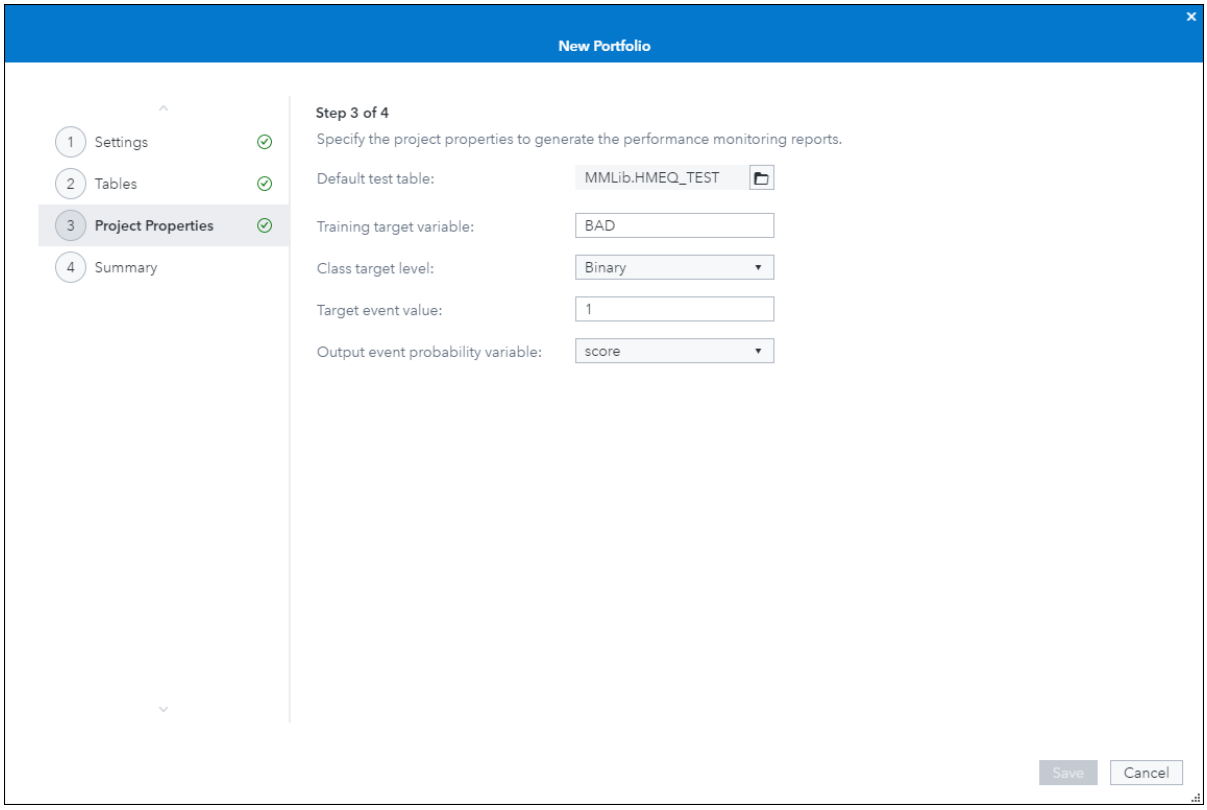


Note: You cannot proceed to the next page until the completed icon is present next to the page header.

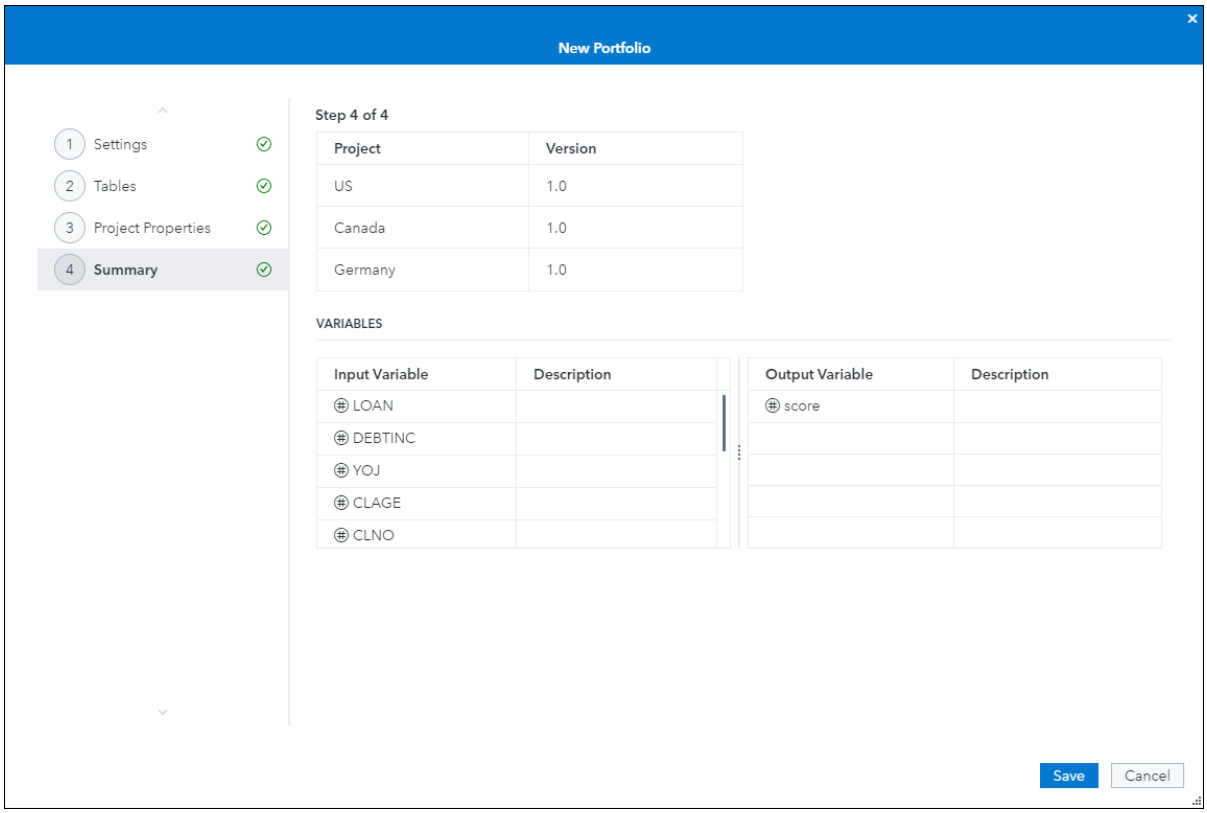
10 On the **Tables** page, click to select the input and output tables. The input and output variables in the tables are applied to all of the projects.



11 On the **Project Properties** page, specify the project properties to apply to all projects within the portfolio. The properties are used to perform tasks and generate reports.



12 The summary of the information that has been specified is on the **Summary** page.



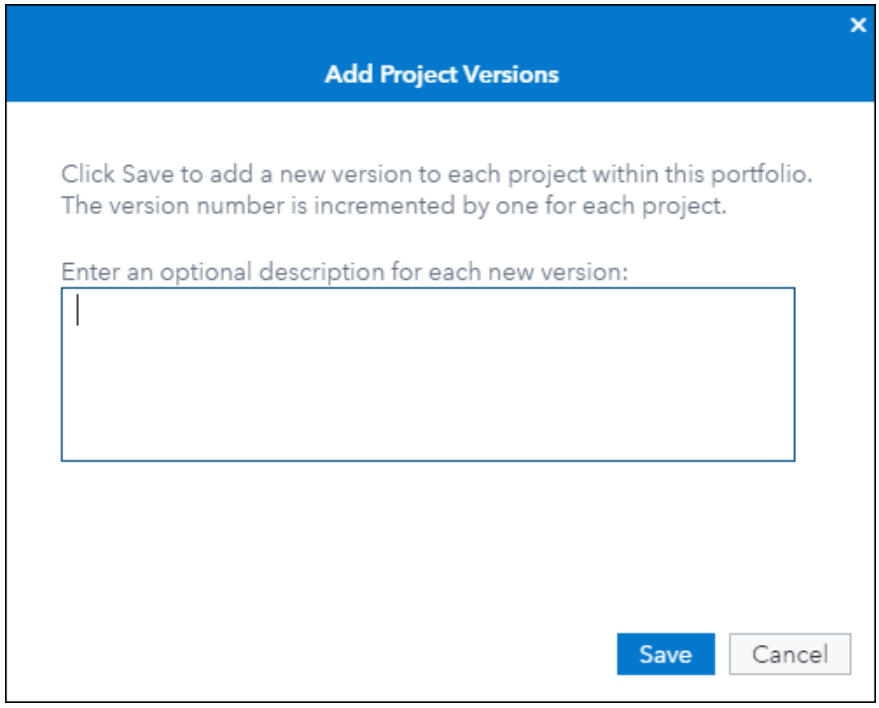
13 Click **Save**. The new portfolio appears in the list.

Add a New Version

You can add a new version to all projects within a portfolio.

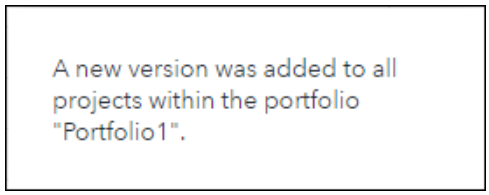
1 Open a portfolio, click the **Projects** tab, and click ⋮ .

2 Select **Add project versions**. The Add Project Versions window appears.



3 (Optional) Enter a description for each new version.

4 Click **Save**. The version number is incremented by one for each project within the portfolio. A confirmation message appears.

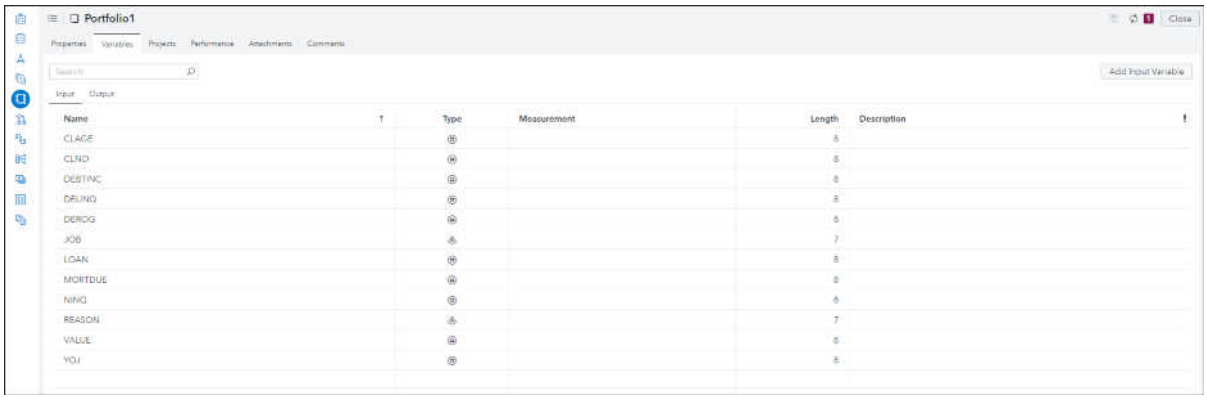


Add an Input Variable

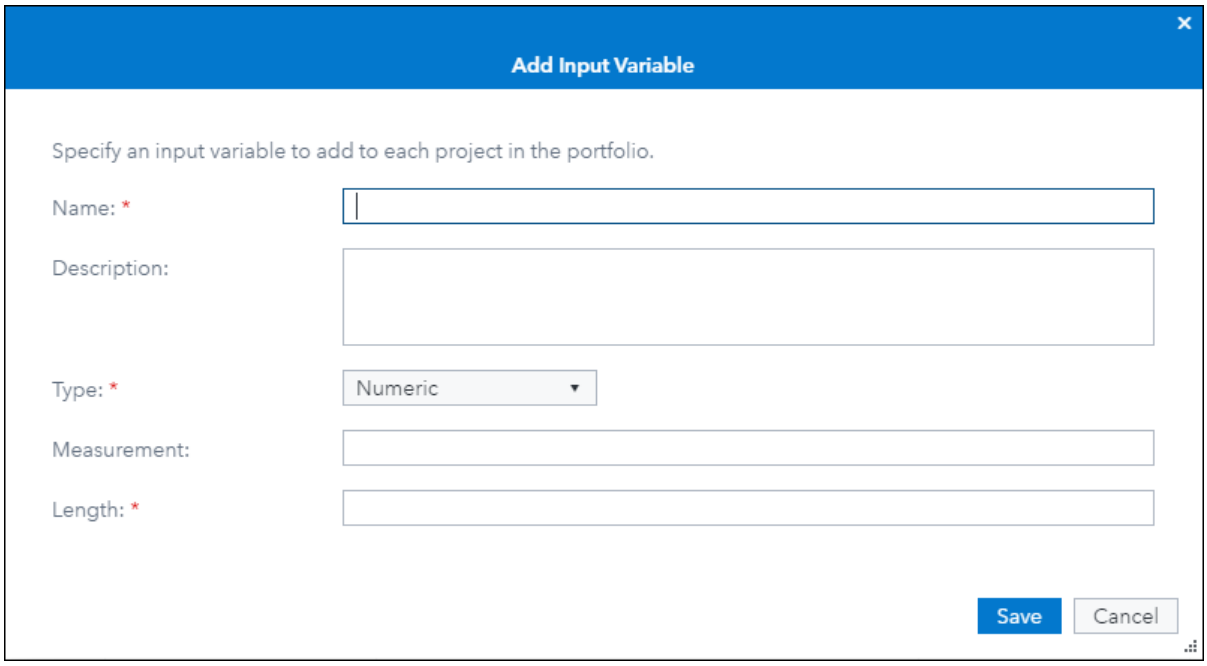
You can add input variables to each project within a portfolio.

1 Open a portfolio.

2 Click the **Variables** tab and click the **Input** tab.



3 Click **Add Input Variable**.



4 Enter a name.

5 (Optional) Enter a description.

6 Select a type.

7 (Optional) Enter a measurement.

8 Enter a length.

9 Click **Save**. The input variable is added to the portfolio and to all projects within the portfolio.

Publishing Models from a Portfolio

About Publishing Models

To publish the champion models and challenger models for projects within a portfolio, you must have already set the models that you want to publish as project champion models or challengers. SAS Decision Manager examines the projects and always publishes the champion models. When the champion model for a project changes and you publish the model again to the same location, the scoring application automatically uses the latest score code. In the Portfolios category view, when you select a portfolio, you only can publish the project champion models to the SAS Metadata Repository. When you open a portfolio, the **Projects** tab offers you the option of publishing a project champion model and its challengers to the SAS Metadata Repository, a SAS Channel, and to a configured database or Hadoop.

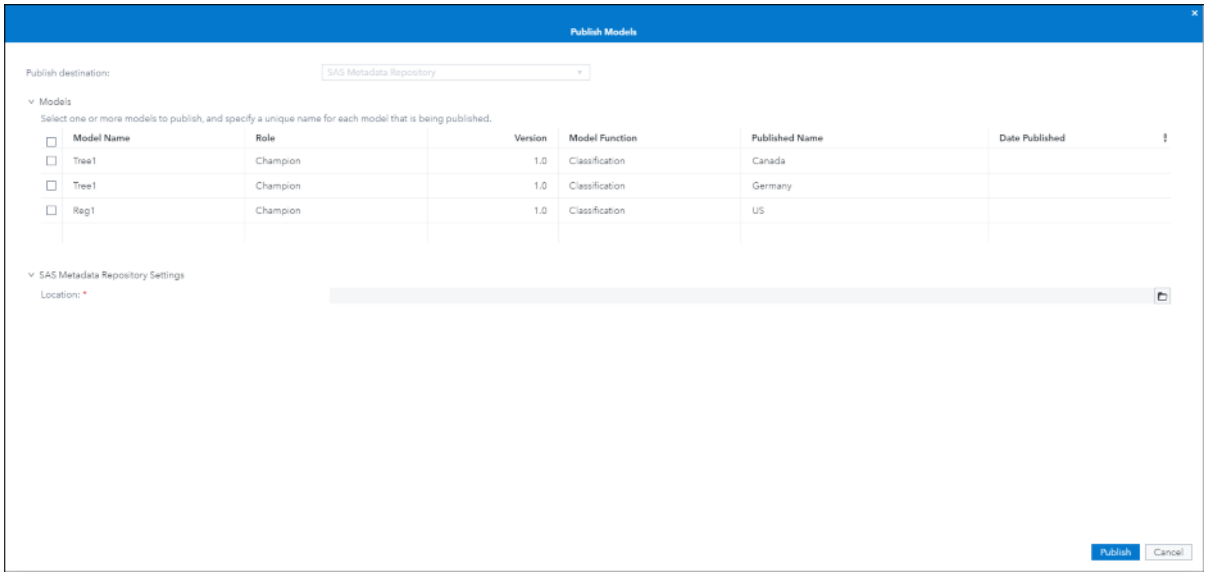
Note: SAS Decision Manager cannot publish R models. SAS analytic store models within a project segment can be published only to Hadoop and Teradata. Publishing SAS analytic store models to the SAS Metadata Repository is not supported.

To verify that a champion model has been assigned to all of the projects within a portfolio that you want to publish. Open a project and click the **Models** tab . The **Role** column identifies which model is the champion. For more information, see "Champion Models" on page 300.

Publishing Project Champion Models

In the Portfolios category view, you can publish the champion models for projects within a portfolio to the SAS Metadata Repository.

1. Select a portfolio.
2. Click ⋮ and select **Publish**.



3 Select one or more champion models that you want to publish from the models list.

4 Click 🗀 and select the location to publish the model to.

5 Click **Publish**.

6 Click **Close** in the confirmation message.

See Also

"Publishing Models to the SAS Metadata Repository" on page 307

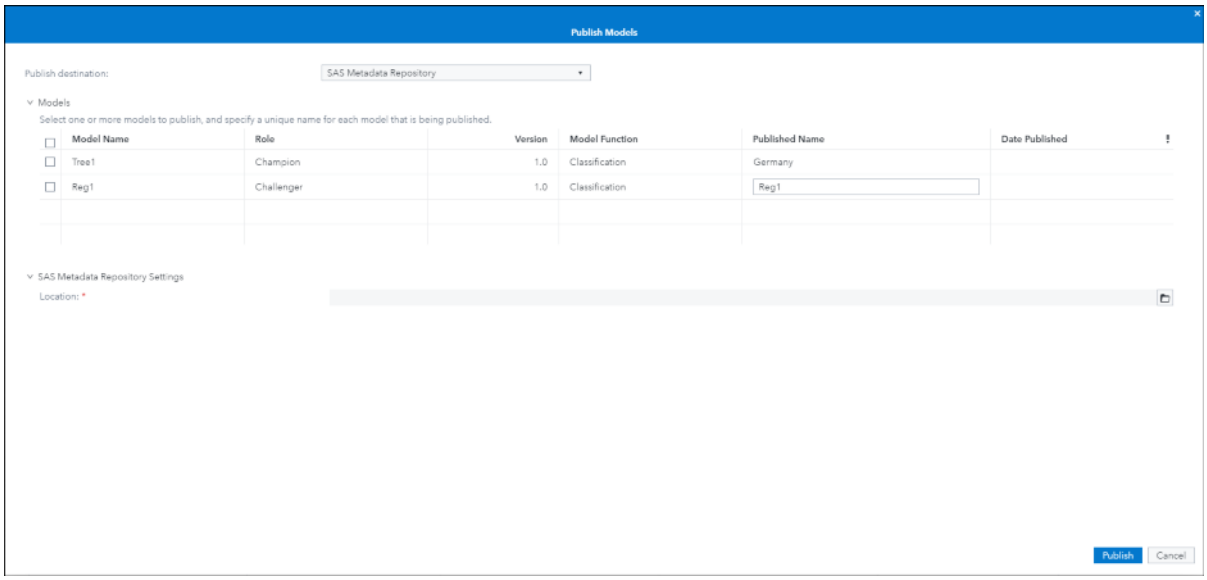
Publish Champion and Challenger Models

Publish to the SAS Metadata Repository

1 Open a portfolio and click the **Projects** tab.

2 Select a project and click ⋮. Select **Publish**.

3 Select **SAS Metadata Repository** from the publish destination list.



4 Specify a **Published Name** for the challenger models. The published name for a champion model cannot be modified.

5 Click 🗀 and select the location to publish the model to.

6 Select the models that you would like to publish.

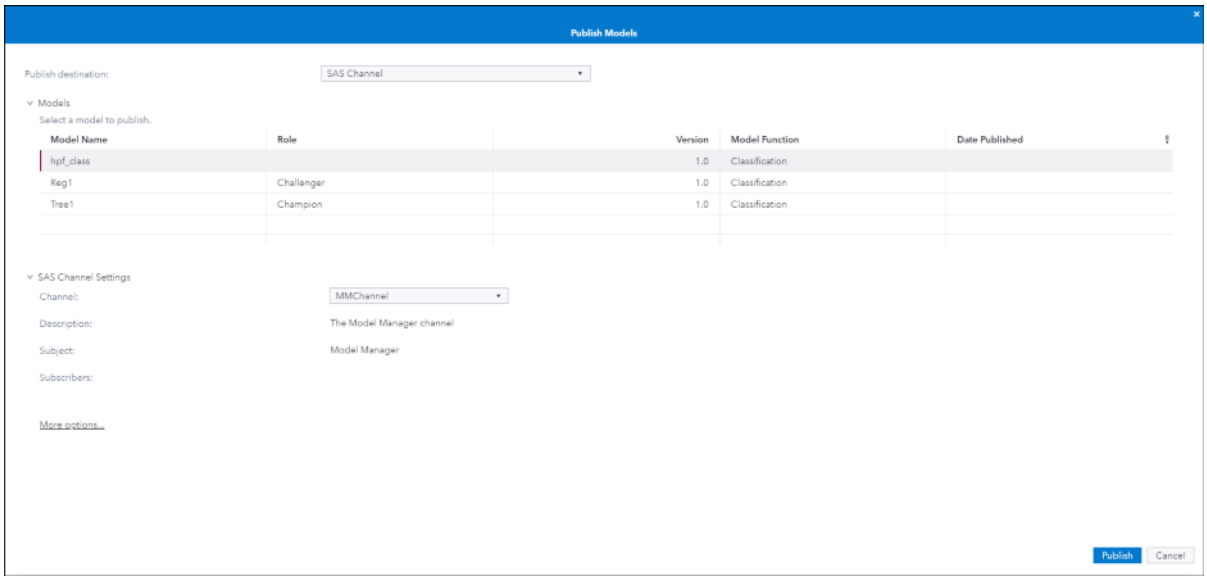
7 Click **Publish**.

Publish to a SAS Channel

1 Open a portfolio and click the **Projects** tab.

2 Select a project and click ⋮. Select **Publish**.

3 Select **SAS Channel** from the publish destination list.



4 Select the model that you want to publish from the models list.

Note: Only one model can be published to the SAS Channel at a time.

5 Select a publication channel from the channel drop-down list.

6 (Optional) Click **More Options** to specify a message subject, notes, and user-defined properties. Click **Save**.

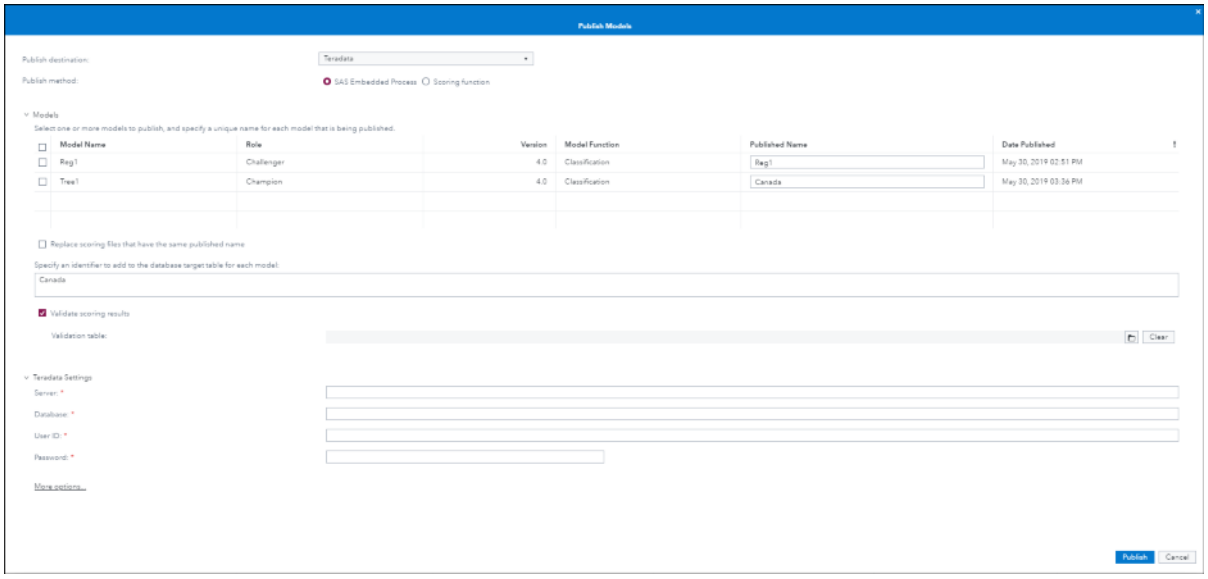
7 Click **Publish**.

Publish to a Database

1 Open a portfolio and click the **Projects** tab.

2 Select a project and click ⋮. Select **Publish**.

3 Select a database from the publish destination list.



4 Select a publish method.

5 Select one or more models that you want to publish from the models list.

Note: SAS analytic store models can be published only to Hadoop and Teradata.

6 Specify a **Published Name** for each model.

7 (Optional) Select whether to **Replace scoring files that have the same published name**.

8 Specify an identifier to add to the database target table for each model.

9 (Optional) Select whether to **Validate scoring results**. If selected, click 🗀 to navigate to the appropriate train table.

10 Specify the database settings.

11 Click **More options** to specify other options for the database. Click **Save**.

12 Click **Publish**.

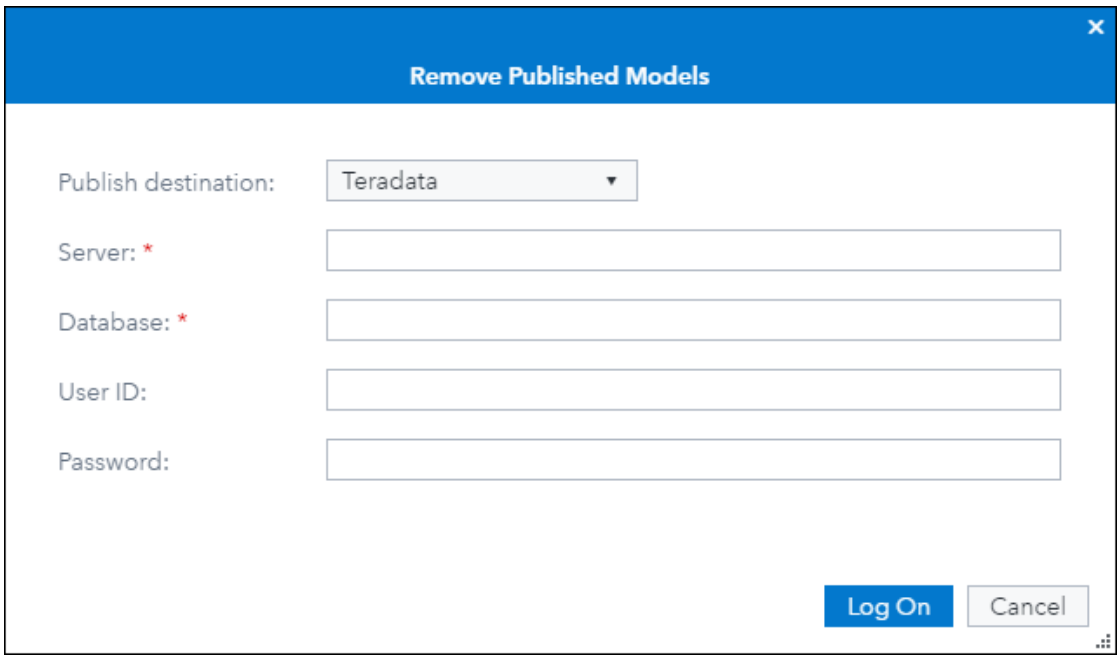
Remove Published Models from a Database

The SAS Embedded Process publish method enables you to replace the model scoring files, but the scoring function publish method publishes the model as a separate entry in the database each time. If you modify the previously published models or change the champion model or challenger models, the Remove Models from a Database feature enables you to remove the previously published models, so that you can clean up the test or production database.

1 Open a portfolio and click the **Projects** tab.

2 Select a project and click ⋮ .

3 Select **Remove published models**. The Remove Published Models window appears.



4 Select the publish destination and then specify the database or Hadoop settings. Click **Log On**.

5 Select the models that you want to remove from the database.

6 Click **Remove Models**.

7 Click **Close** in the confirmation message.

Monitor Performance of Project Champion Models

To create performance monitoring reports for all projects within a portfolio, you create and execute a performance definition for all projects within a portfolio. Execution of the generated code creates the SAS data sets that are used to display the performance monitoring reports on the **Performance** tab of each project.

1 On the **Performance** tab of a portfolio, click **New Definition**.

Note: Once a performance definition has been created, click **Edit Definition** to make additional changes.

2 Specify the performance data options on the **Data Options** page.

- Click to select the performance data source.

  Note: The performance data source must contain the same segment identifier variables as the control table.

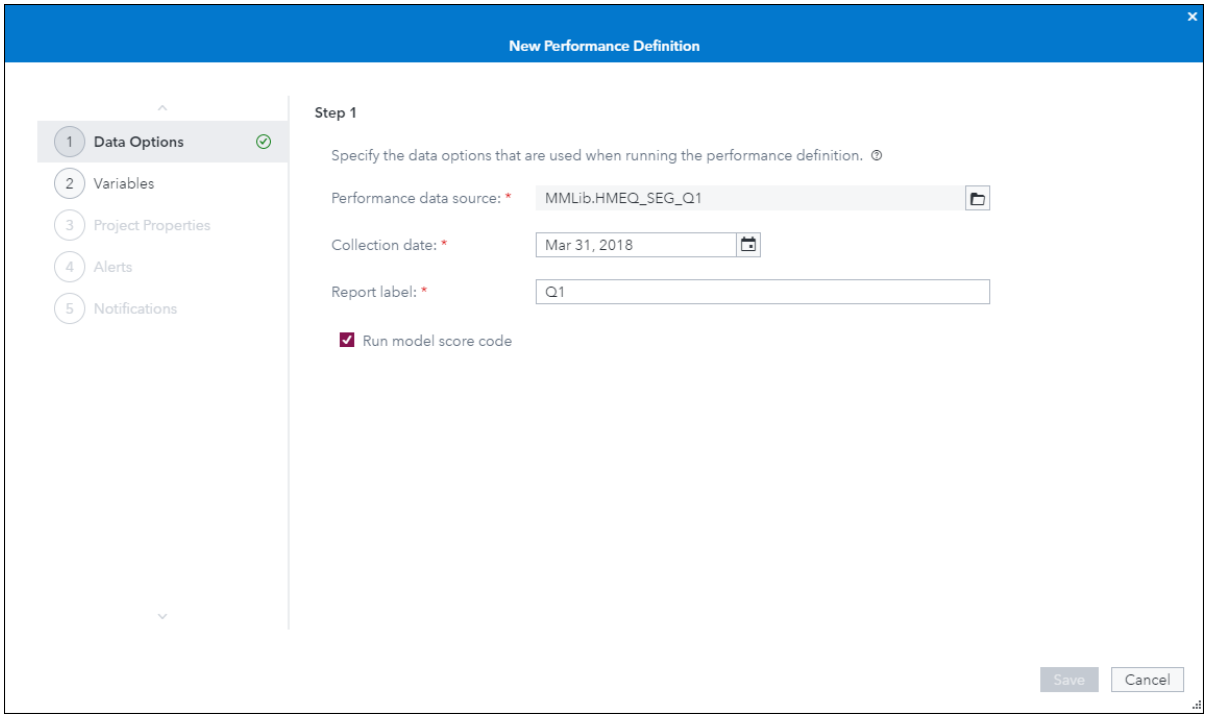
- Click and select a date. The date can be any date in the time period when the performance data was collected.

  Note: A baseline collection date is generated when a performance definition is run. When you edit a performance definition, the collection date must be later than the baseline collection date.

- Enter a report label to associate with the performance data. The report label represents the time point of the performance data source. Because the report label appears in the performance charts, use a label that has not been used for another time period, is short, and is understandable (for example, Q1).

  Note: If you duplicate report labels, previous performance results are overwritten.

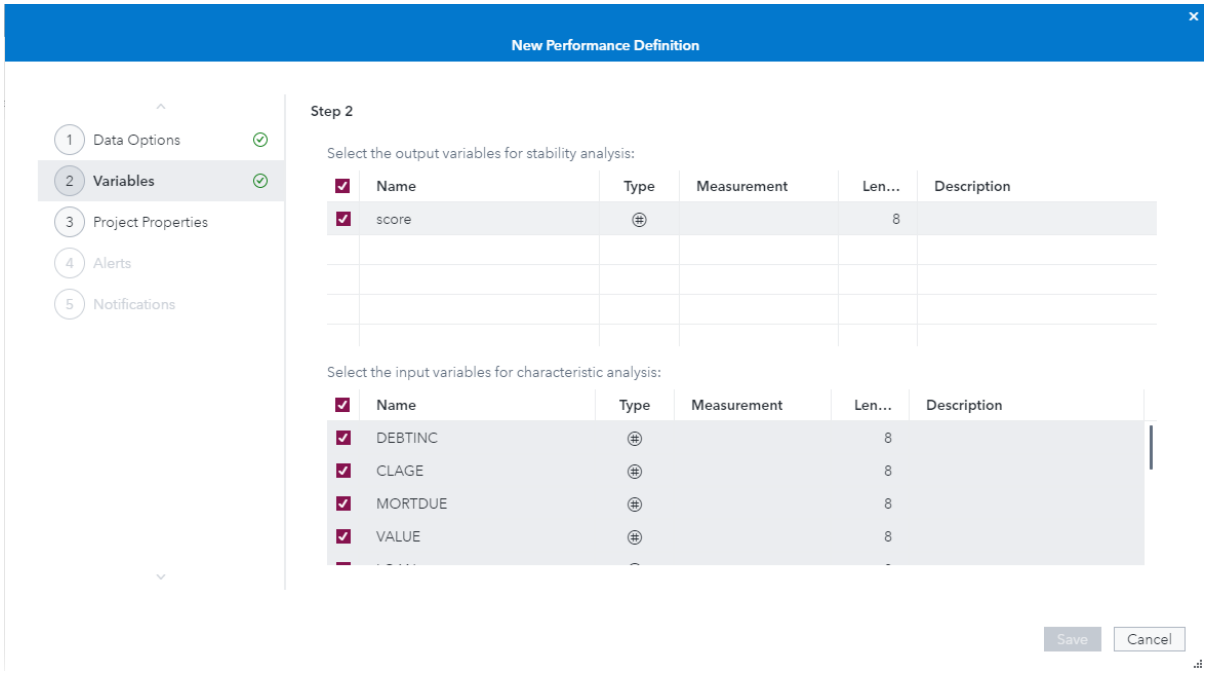
- To run the score code in the performance monitor job, select the **Run model score code** check box. If the check box is not selected, all of the output variables for stability analysis must be in the performance data source.



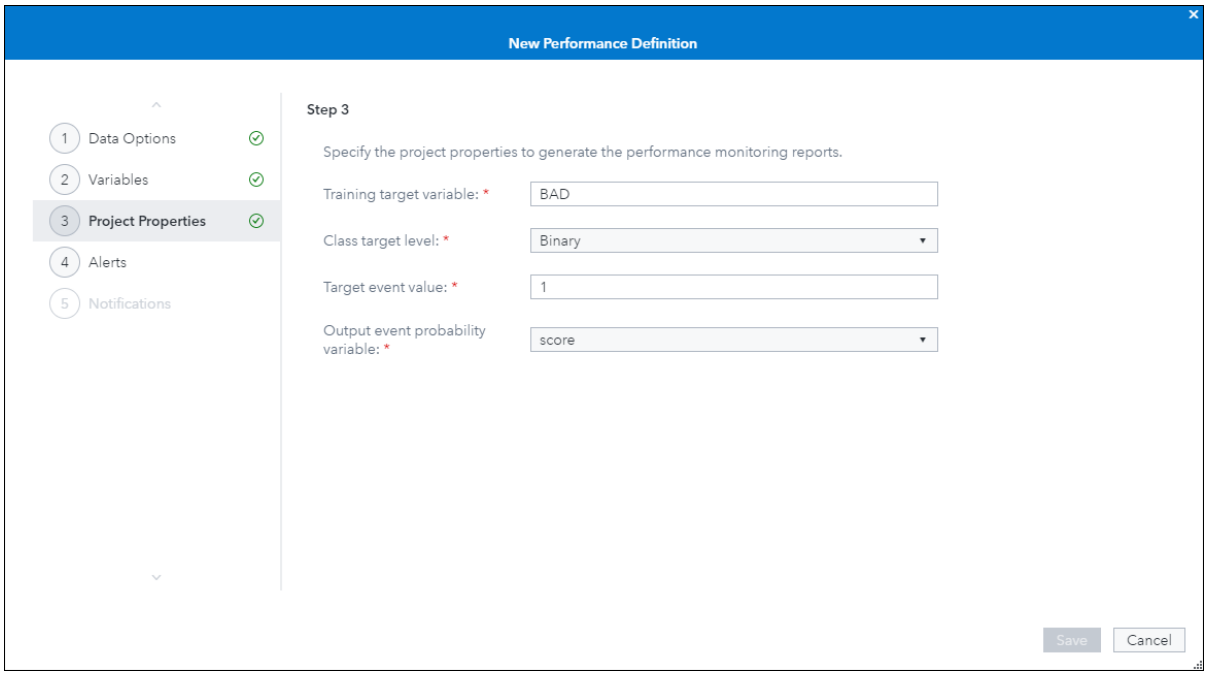
Note: You cannot proceed to the next page until the completed ✓ icon is present next to the page header.

3 On the **Variables** page, specify the variables for stability analysis.

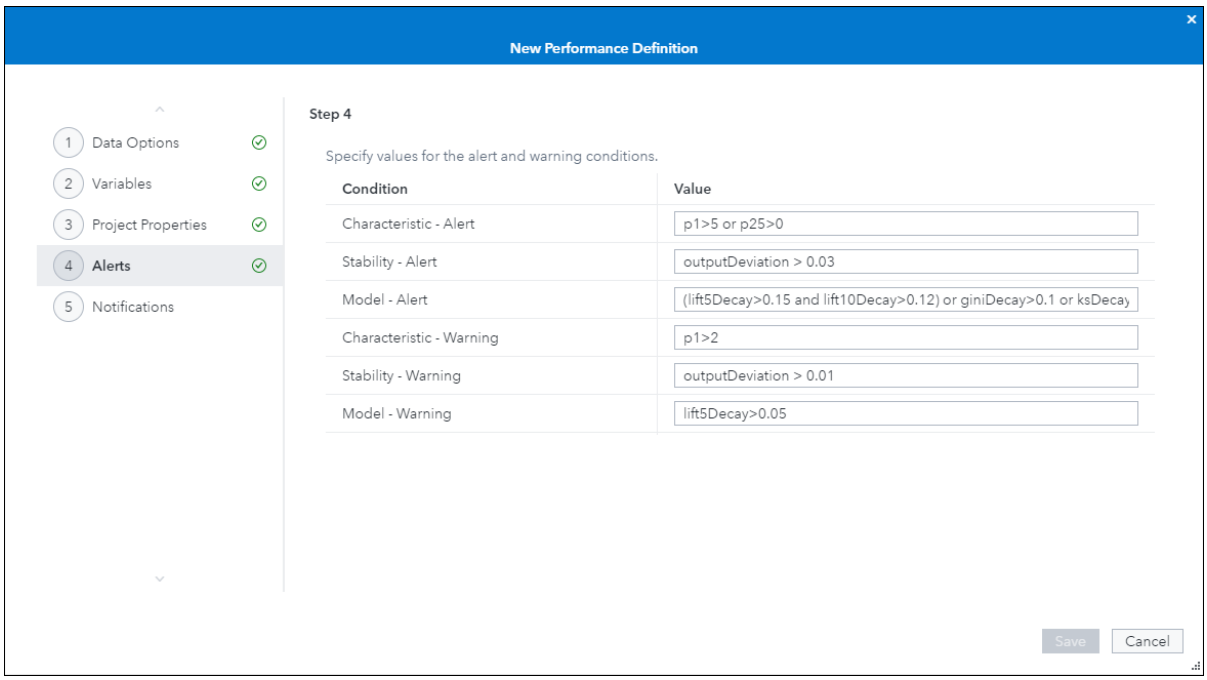
- Select one or more output variables for stability analysis.
- Select one or more input variables for characteristic analysis.



4 Specify the properties that are used to generate the performance monitoring reports on the **Project Properties** page. The properties default to the common values that were set when you created each project.

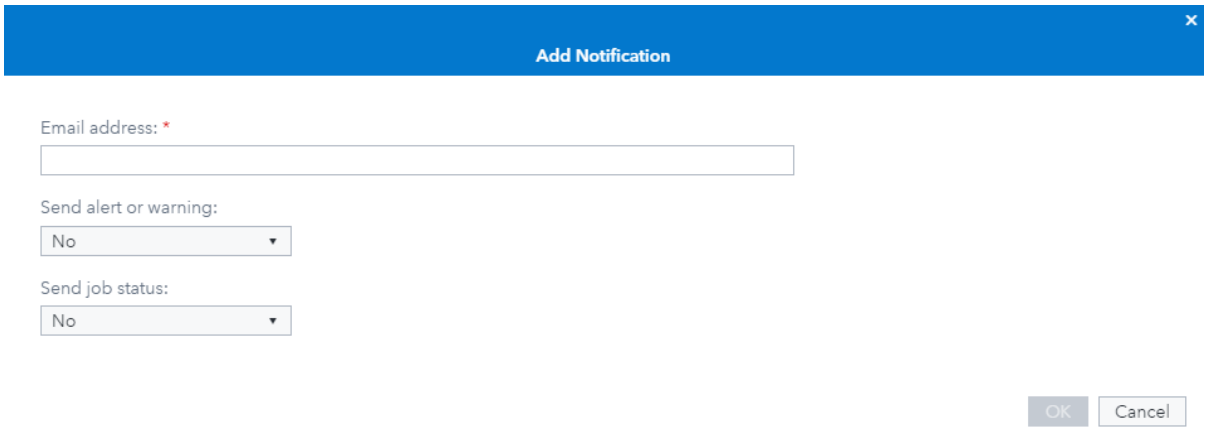


5 (Optional) Specify values for the alert and warning conditions or accept the defaults on the **Alerts** page.



6 (Optional) On the **Notifications** page, you can send the results by email.

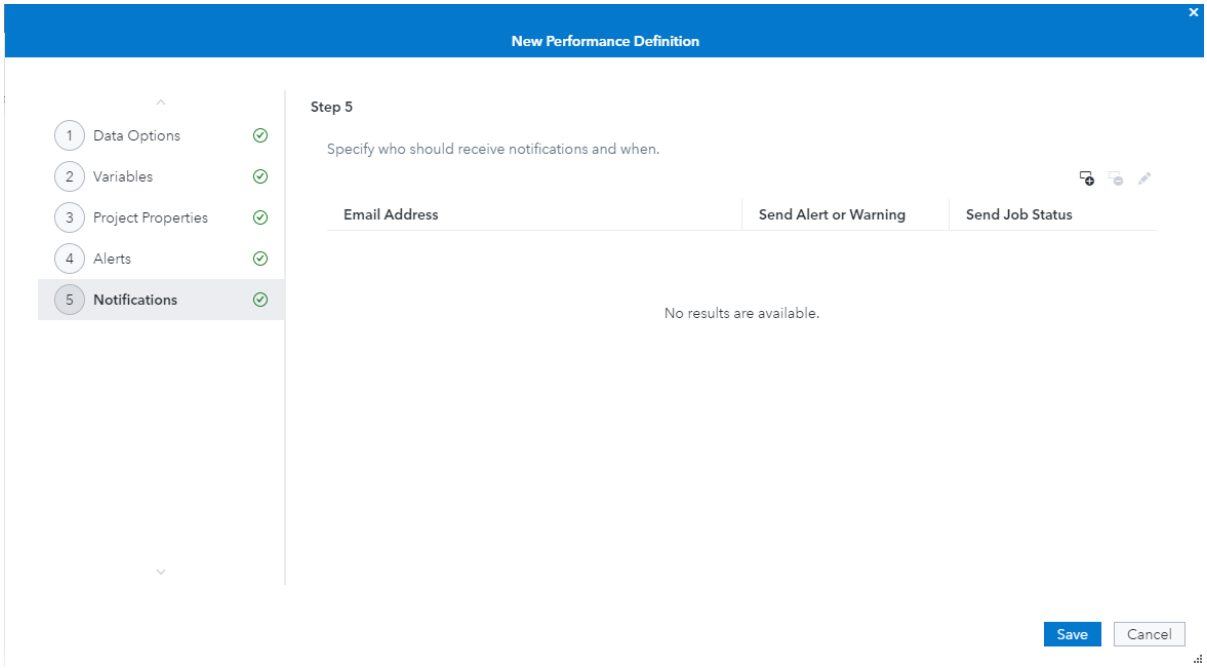
a Click the Add Notification window appears.



b Enter an email address.

c Select **Yes** if you want an alert or warning to be sent by email when alert or warning thresholds have been exceeded. **No** is selected by default.

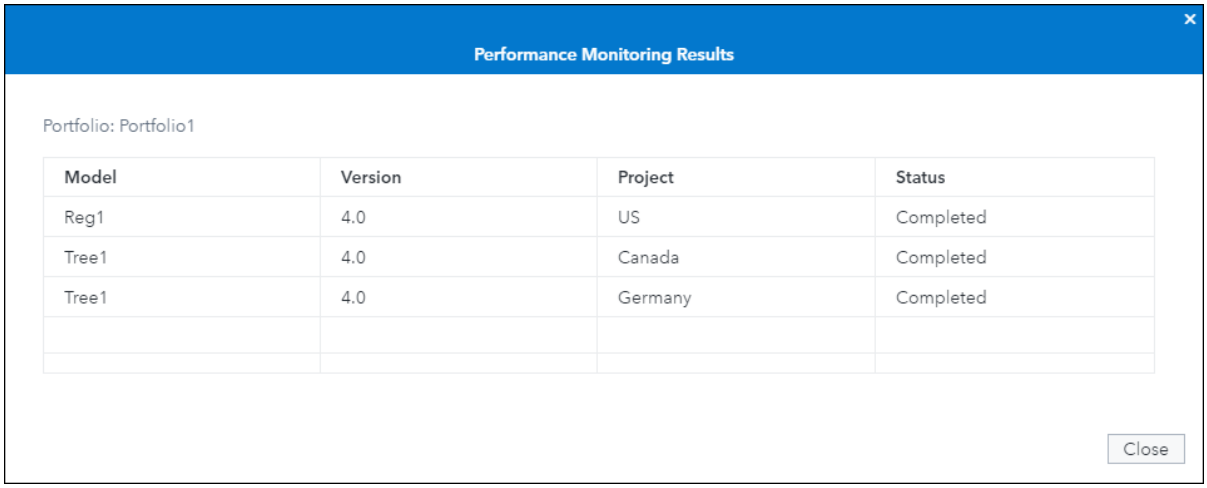
d Select **Yes** if you want a completion notice with the job status to be sent by email every time the report runs. **No** is selected by default.



7 Click **Save**.

8 Click **Run Definition**.

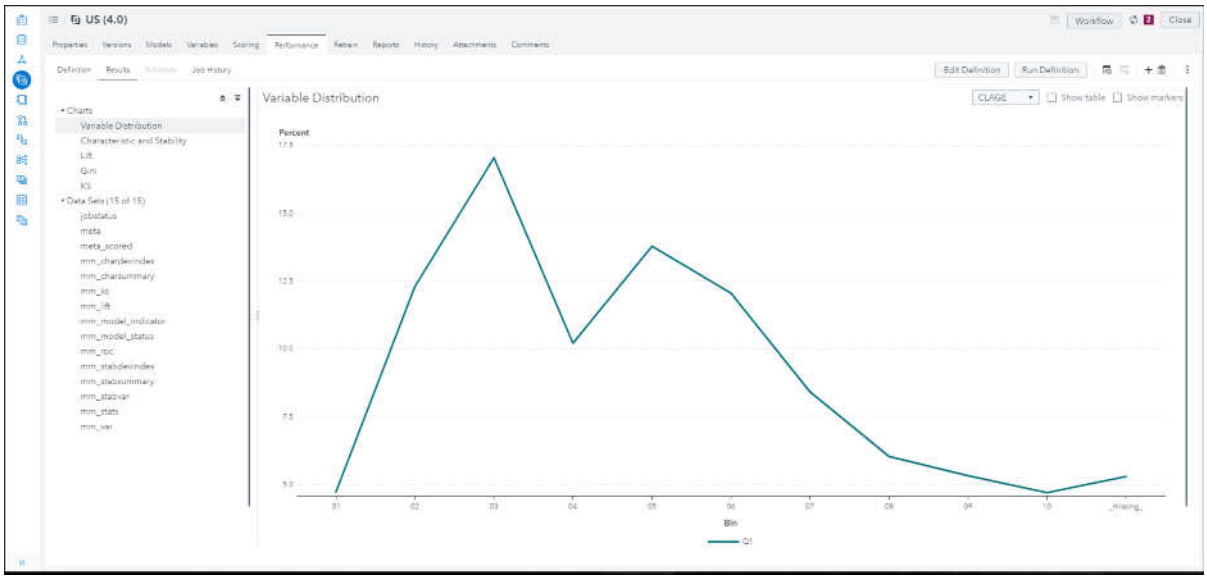
9 After the performance monitoring is complete, a confirmation message appears. Click **Close**.



Model	Version	Project	Status
Reg1	4.0	US	Completed
Tree1	4.0	Canada	Completed
Tree1	4.0	Germany	Completed

10 To view the performance results, click the **Projects** tab in the portfolio, and open a project. Click the **Performance** tab, and view the results on the **Results** tab.

Note: You must select the champion version of a project to display the champion model.



See Also

"Prerequisites for Creating a Performance Definition" on page 258

Add Attachments

You can view and add attachments such as images or documents. Attachments can be added at the object-level for portfolios, projects, and models.

To add an attachment:

1 Click the **Attachments** tab.

2 Click +.

3 Select a file to attach and click **Open**.

To delete attachments:

1 Select one or more attachments and click 🗑.

2 Click **Delete** in the warning message.

See Also

"Add Attachments to a Project" on page 120

Add Comments

You can add new topics or respond to an existing topic. You can also search the comments. Comments can be added at the object-level for portfolios, projects, and models.

To add a comment:

1 Select the **Comments** tab

2 Enter a topic name and a comment.

3 (Optional) Click 📎 to attach a file to the new topic. Repeat this step to attach multiple files.

Note: You cannot attach executable files to a topic.

Note: The Comments: Administrator role enables users to edit and delete comments. For more information, see "Roles and Capabilities" in *SAS Decision Manager: Administrator's Guide*.

To edit a comment that you made, click ✎.

To delete a comment that you made, click 🗑.

You can also click 🗑 to delete an attachment.

4 Click **Post**.

See Also

"Add Comments to a Project" on page 120

PART 4

Evaluating Models and Monitoring Performance

12

Scoring Models

Overview of Scoring Tests

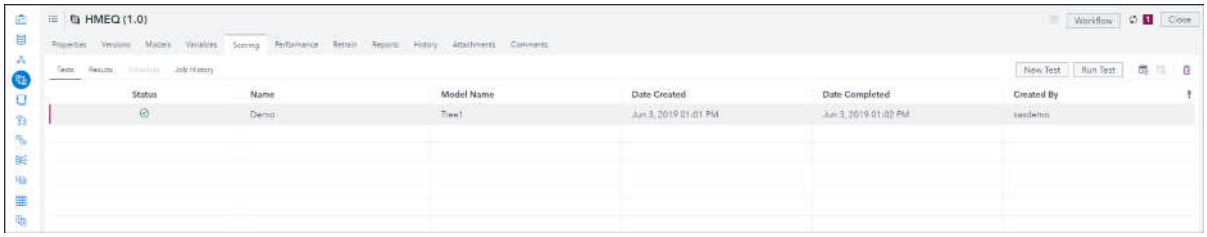
The purpose of a scoring test is to run the score code of a model and produce scoring results that you can use for scoring accuracy and performance analysis. The scoring test uses data from a scoring test input table to generate the scoring test output table. The following types of score code for a model can be imported: analytic store, DATA step fragment, and ready-to-run SAS code.

If your environment has its own means of running the score code, then your use of the SAS Decision Manager scoring tests is mostly limited to testing the score code. Otherwise, you can use the scoring tests both to test your score code and run it in a production environment. Scoring results for a model in a test environment are stored on the SAS Content Server. Scoring results for a model in a production environment are written to the location that the output table metadata specifies. In Windows, the scoring test output table in a SAS library must have Modify, Read and run, Read, and Write security permissions. For more information, see "Administering Group and Role Membership" in *SAS Decision Manager: Administrator's Guide*.

CAUTION

Running a scoring test in production mode overwrites the scoring test output table, which might result in a loss of data.

You create a new scoring test in the **Scoring** tab of your project.



These are the tests that you perform as part of the scoring test workflow:

- Before creating a scoring test, you must create and register scoring test input and output tables. For more information, see “Create Scoring Output Tables” on page 184.
- When a new scoring test is successfully created, the scoring test is selected on the **Scoring** tab. The scoring test displays the various scoring test information. For more information, see “Create a Scoring Test” on page 187.
- Before you run the scoring test, it is recommended that you verify the scoring test output variable mappings on the Scoring Output Table view. For more information, see “Create Scoring Output Tables” on page 184.
- To run a scoring test, you can select and run a test. For more information, see “Run a Scoring Test” on page 188.
- To run a scoring test at a scheduled time, you can specify the date, time and frequency that you want the scoring test to run. For more information, see “Schedule a Scoring Test” on page 189.
- After the scoring test runs successfully, you can view the results on the Results tab. For more information, see “Run a Scoring Test” on page 188.

Create Scoring Output Tables

What Is a Scoring Output Table?

A scoring output table is a SAS data set that contains the data from running a scoring test. The scoring output table cannot be a database table. You can provide a scoring output table or you can create a scoring output table definition using SAS Decision Manager. When you create a scoring test, you specify either the scoring output table that you provide or the scoring test output definition as the scoring test output table. A SAS data set that you provide as a scoring output table must be registered in the SAS Metadata Repository and made available to SAS Decision Manager in the Data category view.

You can create a scoring output table definition by using the Create Scoring Output Table function directly from the model. You select variables from a scoring test input table as well as variables from the model's output. The variables in the input variables table are variables from the scoring test input table when one is specified for the **Default scoring input table** property on the **Model Properties** tab for the selected model, or on the **Project Properties** tab for the project that contains the selected model. Otherwise, the input variables table is empty. The output variables that appear are model output variables. You use the variables from both tables to create the scoring output table. For more information, see "Set Model Properties" on page 143.

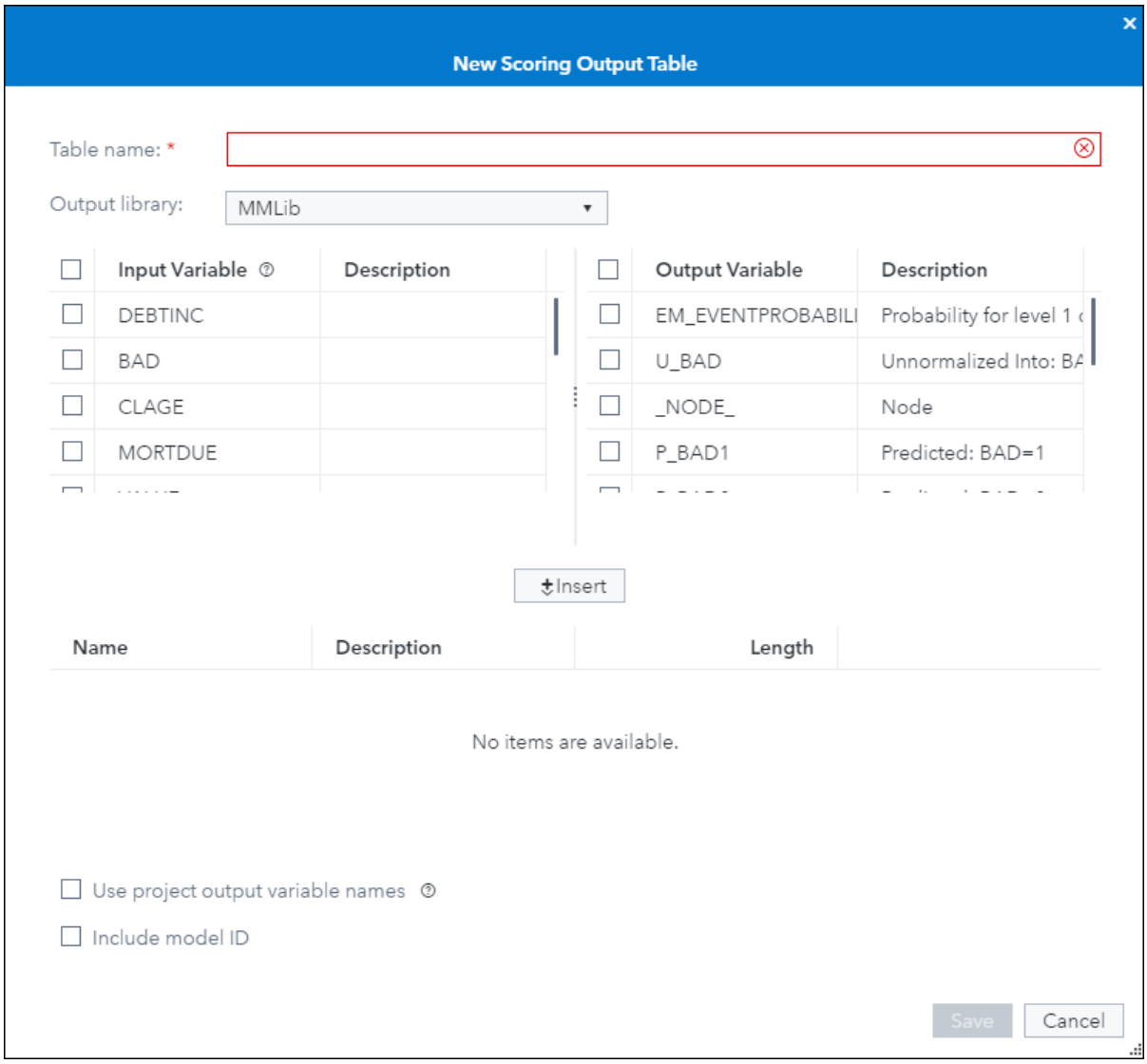
If you create a scoring output table on the **Model Properties** tab, it is automatically saved in the SAS Metadata Repository. You then have to add it to the desired library in the Data category view. If you add an existing scoring output table to a library in the Data category view, it must be available in the SAS Metadata Repository.

SAS Decision Manager saves the table definition as metadata in the SAS Metadata Repository. The location of the metadata is defined by the SAS library that you specify when you create the output table definition. After the table definition is created, the table can be selected as the output table for subsequent scoring tests.

You can view a scoring output table definition in the Data category view. Scoring test results are stored in the **Results** tab on the **Scoring** tab.

Create a Scoring Output Table

1. Select a model on the **Models** tab and click ⋮.
2. Select **New scoring output table**. The New Scoring Output Table window appears.



Note: You can also open a model and then select **Model Properties** ⇨ **Variables** ⇨ **Output** . Click ⋮ and select **New scoring output table**.

3 Enter a name for the scoring output table.

4 Select an output library.

5 Select the input variables.

6 Select the output variables.

7 Click **Insert**. The new variables appear below.

8 Select whether to use project's output variable names in the output table for model variables that are mapped to project variables.

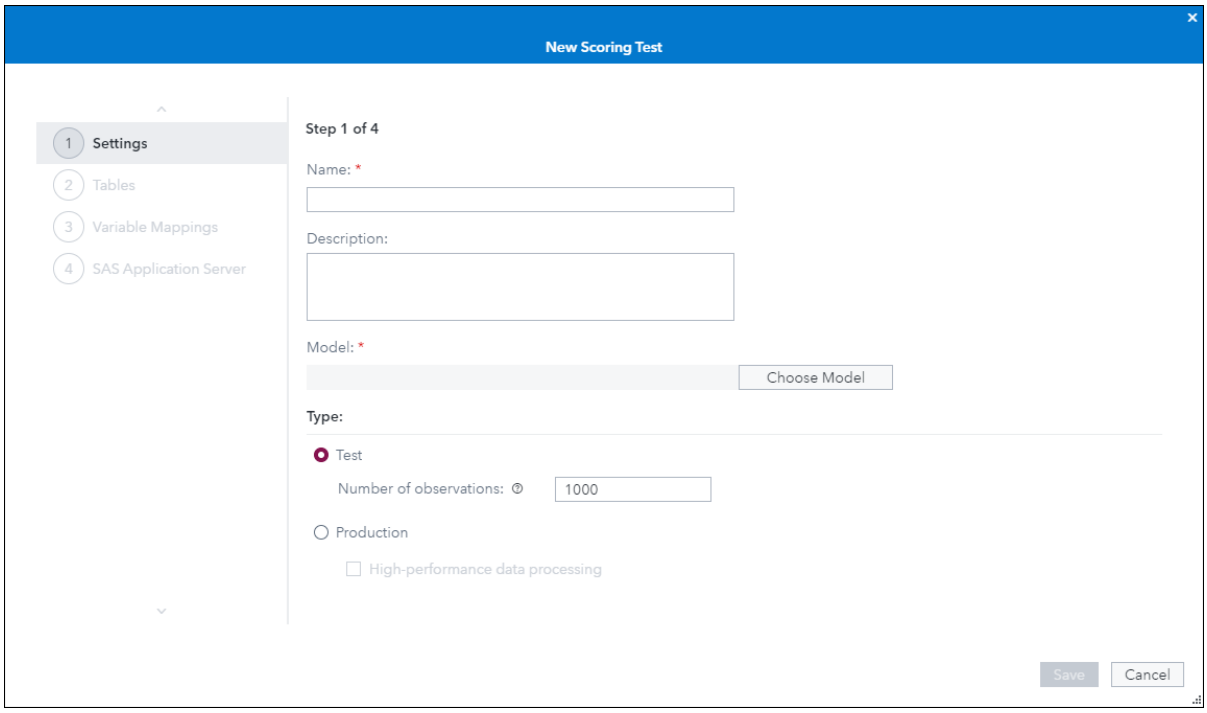
9 Select whether to include the model ID variable to the output table. The model UUID appears in all rows of the output table.

10 Click **Save**.

11 You must then make the new scoring output table available to SAS Decision Manager. For more information, see "Add Registered Tables from Metadata" on page 16.

Create a Scoring Test

1 On the **Scoring** tab of a project, click **New Test**. The New Scoring Test window appears.



2 On the **Settings** page, specify the settings for the new scoring test.

a Enter a name for the scoring test.

b (Optional) Enter a description of the scoring test.

c Click **Choose Model** and select a model from the list.

d Select a type of scoring test:

- **Test**

  Specify the number of observations to be read from the scoring input table (default is 1000 rows).

- **Production**

  To run the scoring test in a High-Performance Analytics production environment, select **High-performance data processing**.

Note: A best practice is to select **Test** before beginning all scoring tests. Later, when you are satisfied with the results of running the scoring test and you are ready to put the test into production, you can change the type to **Production**.

Note: You cannot proceed to the next page until the completed icon is present next to the page header.

3 On the **Tables** page, specify the input and output tables.

   a Specify an **Input table**. Use the default scoring input table that is set on the **Properties** tab of a project, or select a new input table. To select a table, click and select a table. Click **Open**.

   b Specify an **Output table**. To select a table, click and select a table. Click **Open**.

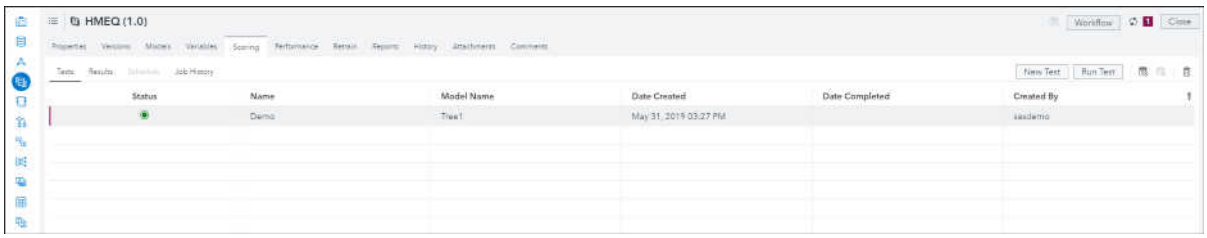
4 On the **Variable Mappings** page, select an available variable for each scoring output variable. The scoring output variables are mapped automatically if the names match those in the **Maps To** column.

5 On the **SAS Application Server** page, select a SAS Application Server from the list. SASApp is selected by default.

6 Click **Save**.

Run a Scoring Test

1 On the **Tests** tab of the **Scoring** tab, select a scoring test from the list and click **Run Test**.



Note: The status icon updates in the **Status** column when the scoring test has completed.

2 Click the **Results** tab or double-click the scoring test to view the scoring test results.

Note: You can check the status of a job by clicking and then selecting the **Tests** tab, the **Results** tab, or the **Job History** tab.

Schedule a Scoring Test

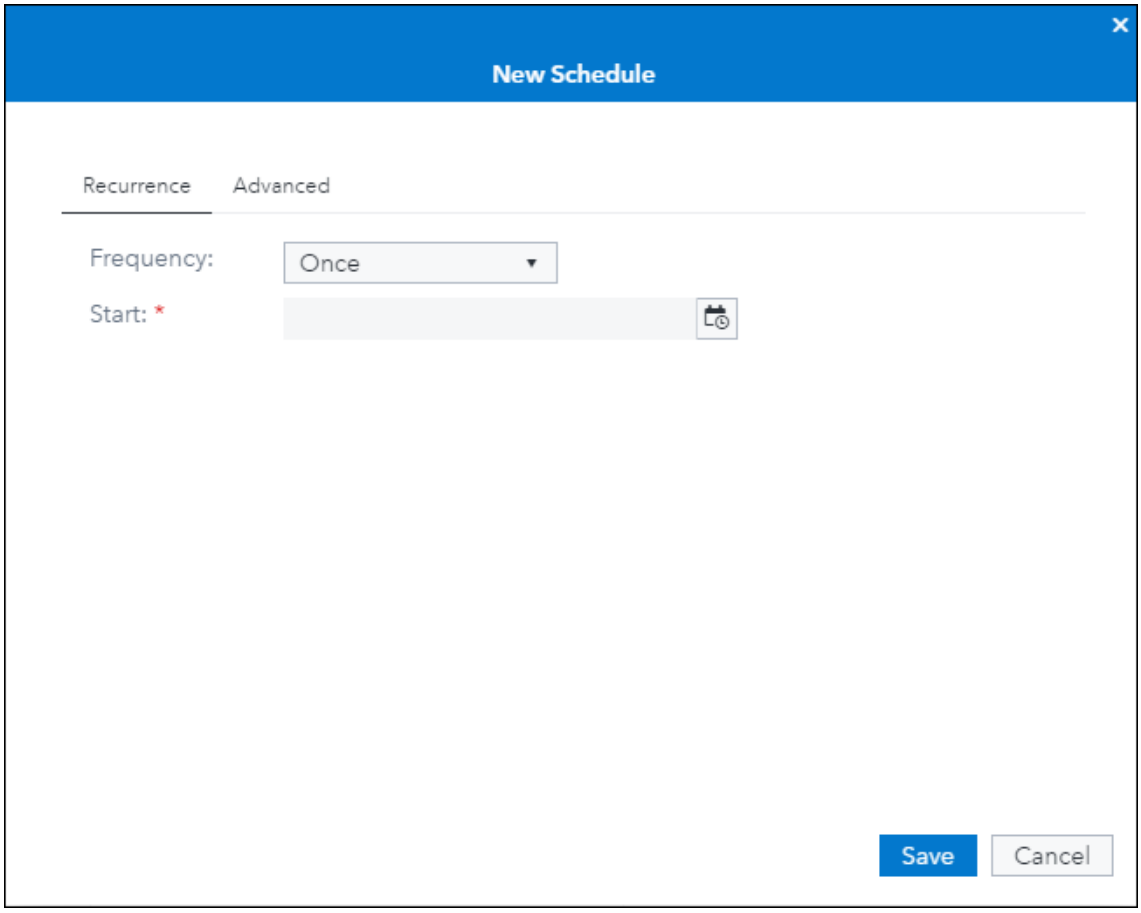
Instead of running a scoring test, you can schedule a scoring test to run on a particular date and time. You can also schedule how often you want the scoring test to run. Advanced settings enable you to set the scheduling server, the batch server to run the scoring test, and the location of the scoring results.

Before you can schedule a scoring test, your user ID and password must be made available to the SAS Metadata Repository. You must also sign in to SAS Decision Manager using your full user credentials that were specified for your user account in SAS Management Console. For user accounts where a Microsoft Windows user ID is specified, you must enter your user ID in the format of *domain\userID*. Contact your system administrator to add or update your password, and to determine the correct user credentials for your account.

Note: You must have already created a scoring test before you can schedule a job to run the scoring test.

CAUTION
Check your configuration settings before scheduling jobs. Users who are configured for single sign-on authentication by Kerberos cannot schedule jobs.

1 On the **Scoring** tab of the project, select the scoring test that you want to schedule from the list and click .



2 On the **Recurrence** tab, select the recurrence pattern.

3 Specify the criteria for when and how often the job should be run.

4 (Optional) Click the **Advanced** tab.

   a Select the server that schedules the job from the **Scheduling server** list box.

   Note: The Operating System Services Scheduling Server is not supported.

   b Select the batch server that runs the job from the **Batch server** list box.

   c Click to select a location for the output and click **OK**.

5 Click **Save**.

6 After the job has been scheduled, a confirmation message appears. Click **Close**.

7 Click the **Schedule** tab to view the scheduled job specifics.

8 Click the **Job History** tab to view the job status.

9 Click the **Results** tab to view the scoring test results.

Note: Scoring test job schedules cannot be edited. To change the schedule, delete the schedule and create a new schedule.

To delete a schedule, select the schedule and then click . After the job has been deleted, a confirmation message appears. Click **Close**.

Scoring Model Properties

Scoring Test Properties

Here is a list of the **Scoring test** properties that provide information that is specific to the scoring test.

Property Name	Description
Scoring test type	Specifies a value of **Test** or **Production** for the type of scoring test.
SAS Application Server	Specifies the name of the SAS Application Server to which SAS Decision Manager is connected. This value is taken from the SAS Metadata Repository.
Model	Specifies the name of the model whose score code is to be run on the SAS Application Server. This value is set when the scoring test is created and cannot be modified.
Input table	Specifies the name of the input table (data source) to be used in scoring. This value is set when the scoring test is created and cannot be modified.
Output table	Specifies the name of the output table to be used in scoring. This value is set when the scoring test is created. If the scoring test type is **Test**, the output file is stored on the SAS Content Server. If the scoring test type is **Production**, then this setting identifies the output table where the results of the scoring are written.

Result Set Properties

The following property provides information that is specific to the scoring test.

Property Name	Description
Number of observations	When **Scoring test type** is set to **Test**, this property specifies how many observations are to be read from the scoring test input table. This setting enables you to limit the number of records that are written to the scoring test output table on the SAS Content Server in order to reduce operation costs. If a value is not specified, the default value of 1000 rows is used for the number of observations. When **Scoring test type** is set to **Production**, this property specifies how many observations are to be read from the scoring test input table and displayed when you select **Result Set** from the **Results** tab. The default value is 0, indicating that there is no limit. This value cannot be changed in SAS Decision Manager. The administrator can modify the value by using SAS Management Console. For more information, see *SAS Decision Manager: Administrator's Guide*.

13

Using Reports to Evaluate and Validate Models

Overview of Model Comparison, Validation, and Summary Reports

What Are Model Comparison, Validation, and Summary Reports?

The SAS Decision Manager model comparison, validation, and summary reports are tools that you can use to evaluate and compare the candidate models in a version or across versions to help you select and approve the champion model that moves to production status. The model comparison reports are analytical tools that project managers, statisticians, and analysts can use to assess the structure, performance, and resilience of candidate models. The model validation reports use statistical measures to validate the stability, performance, and calibration of risk models and parameters. The training summary data set report creates frequency and distribution charts that summarize the train table variables.

The reports present information about a number of attributes that can affect model performance. Together, the reports provide qualified information that can serve as the analytical basis for choosing and monitoring a champion model.

Here is a description of the comparison reports:

Delta Report
This report compares the profile data for two models and notes the differences.

Dynamic Lift Report
The Dynamic Lift report provides visual summaries of the performance of one or more models for predicting a binary outcome variable.

Interval Target Variable Report
The Interval Target Variable report creates two plots for you to view the actual versus predicted values for a model and the actual versus residual values for a model. Interval Target Variable report can be created only for prediction models.

Model Profile Report

For a single model, this report displays the profile data that is associated with input, output, and target variables. Profile data includes the variable name, type, length, label, SAS format, measurement level, and role.

Here are the Basel III model validation reports:

Loss Given Default Report

The Loss Given Default (LGD) report calculates the amount that might be lost in an investment and calculates the economic or regulatory capital for Basel III compliance.

Probability of Default Model Validation Report

The Probability of Default (PD) Validation report estimates the probability of defaulting on a debt that is owed. Probability of default is used to calculate economic or regulatory capital for Basel III compliance.

The model validation reports use statistical measures that report on these model validation measures:

- The model stability measures track the change in distribution for the modeling data and scoring data.
- The model performance measures check the model's ability to distinguish between accounts that have not defaulted and accounts that have defaulted, as well as report on the relationship between actual default probability and predicted default probability.
- The model calibration measures check the accuracy of the selected models for the LGD and PD reports by comparing the correct quantification of the risk components with the available standards.

This is the train table data set summary reports:

Training Summary Data Set Report

The Training Summary Data Set report creates frequency and distribution charts for a training data set.

After you execute a performance definition, you can generate performance monitoring results and compare the champion and challenger models:

Champion and Challenger Report

After you execute a performance definition for the champion model, you can execute a performance definition for the challenger model using the same performance data sets. You can then create a Champion and Challenger Performance report that compares the performance of the two models.

Monitoring Report

After you execute a performance definition, SAS Decision Manager stores the output data sets in the project folder. You can format the performance monitoring results and then view the performance monitoring results report.

You create the reports using the New Report window that you start from a project's **Reports** tab.

Model Comparison, Validation, and Summary Report Input Files

SAS Decision Manager uses a test table as the input table for the Dynamic Lift report and the Interval Target Variable report.

Before you can create a Dynamic Lift report or the Interval Target Variable report, make sure that a test table has been added to the SAS Metadata Repository and registered in the Data Tables category or SAS Management Console. The test table can be viewed in the Data Tables category view. Then, specify the test table in the project property **Default test table**.

You specify the input table for validation reports in the New Report window. The input table for the validation reports can contain only input variables or it can contain input and output variables. If the input table contains input and output variables, the report generation does not need to run a scoring test to obtain the output variables.

When you create a train table summary report, the train table or specified input table is used to create the training summary data sets. The train table must be available in the SAS Metadata Repository. The train table must then be specified in the project property for the **Default train table**.

The Model Comparison, Validation, and Summary Report Output Files

The Reports tab stores the model comparison, validation, and summary report output files in the **Model Evaluation** tab. The name of the report is the value of the **Name** box that you specified in the New Report window.

Each time you create a report, these files are generated:

- the report in either HTML, PDF, or RTF format

  Note: The Loss Given Default and Probability of Default Model Validation reports can be created only in PDF format.

- taskCode.log
- taskCode.sas

Here is a description of the model comparison output files:

Report File	Description
report-name.html	This file is the report output in HTML format.
report-name.pdf	This file is the report output in PDF format.

Report File	Description
report-name.rtf	This file is the report output in RTF format.
taskCode.log	This file is the log file that contains messages from running the SAS code to create the report.
taskCode.sas	This file is the SAS code that is used to create the report.

After you create a report, you can view the report from the **Reports** tab.

Note: If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.

Champion and Challenger Performance Reports

About the Champion and Challenger Performance Report

After you execute a performance definition for the champion model, you can execute a performance definition for the challenger model using the same performance data sets. SAS Decision Manager updates the output data sets with the performance data for the challenger model. You can create a Champion and challenger performance report that compares the performance of the two models.

The Champion and challenger performance report contains these charts:

Number of Predictors Exceeding Deviation Threshold
: This characteristic report creates a chart for each index that exceeds a deviation threshold (either 0.1 or 0.25) as indicated in the define performance definition. The characteristic report detects shifts in the distribution of input variables over time.

Lift Trend Chart
: A Lift Trend chart displays the cumulative lift of the champion model over time.

Gini - Trend
: When the Gini - ROC Chart is created, the Gini index for each ROC curve is also created. The Gini coefficient represents the area under the ROC curve and is a benchmark statistic that can be used to summarize the predictive accuracy of a model. The Gini - Trend Chart plots a model's Gini index scores over time, and these are used to monitor model degradation over time.

Gini - ROC Chart
: Sensitivity is the proportion of true positive events, and specificity is the proportion of true negative events. The Gini - ROC Chart plots Sensitivity on the Y axis and 1 - Specificity on the X axis.

KS Trend Chart
: When you create a Kolmogorov-Smirnov report, the KS statistic and the corresponding probability cutoff are computed for each Kolmogorov-Smirnov table. The KS Trend Chart uses a summary data set that plots the KS Statistic and the probability cutoff values over time. The KS Trend Chart is used to monitor model degradation over time.

KS Chart
: The KS Chart uses the Kolmogorov-Smirnov statistic to measure the maximum vertical separation, or deviation between the cumulative distributions of events and non-events.

Score Histogram
: The Score Histogram compares the scoring result distribution at different time periods using a histogram.

Score Distribution Line Plot
: The Score Distribution Line Plot compares the scoring result distribution at different time periods using a line plot.

Before you create a Champion and Challenger Performance report, verify the performance data and model status.

Verify Performance Data and Model Status

Before you can create a Champion and challenger performance report:

1. Click the **Models** tab of a project and verify that a champion model has been set. The champion model is designated as **Champion** in the **Role** column. If a champion has not been set, select a model from the list, and click ⋮. Select **Set as champion** to set the model as the project champion model.

2. Ensure that a challenger model has been set. The challenger model is designated as **Challenger** in the **Role** column. If it is not, select a model from the list, and click ⋮. Select **Set as challenger** to set the model as the project challenger model.

3. Verify that performance monitoring data is available for the champion model and the challenger model. Performance monitoring results must exist for the same performance data using the same time periods and data labels. Navigate to **Performance** ⇨ **Results** ⇨ **Data Sets** and select the file **jobstatus**.

   Note: In order to view all of the columns in an embedded table, you must vertically scroll to the bottom of the content page to access the horizontal scroll bar.

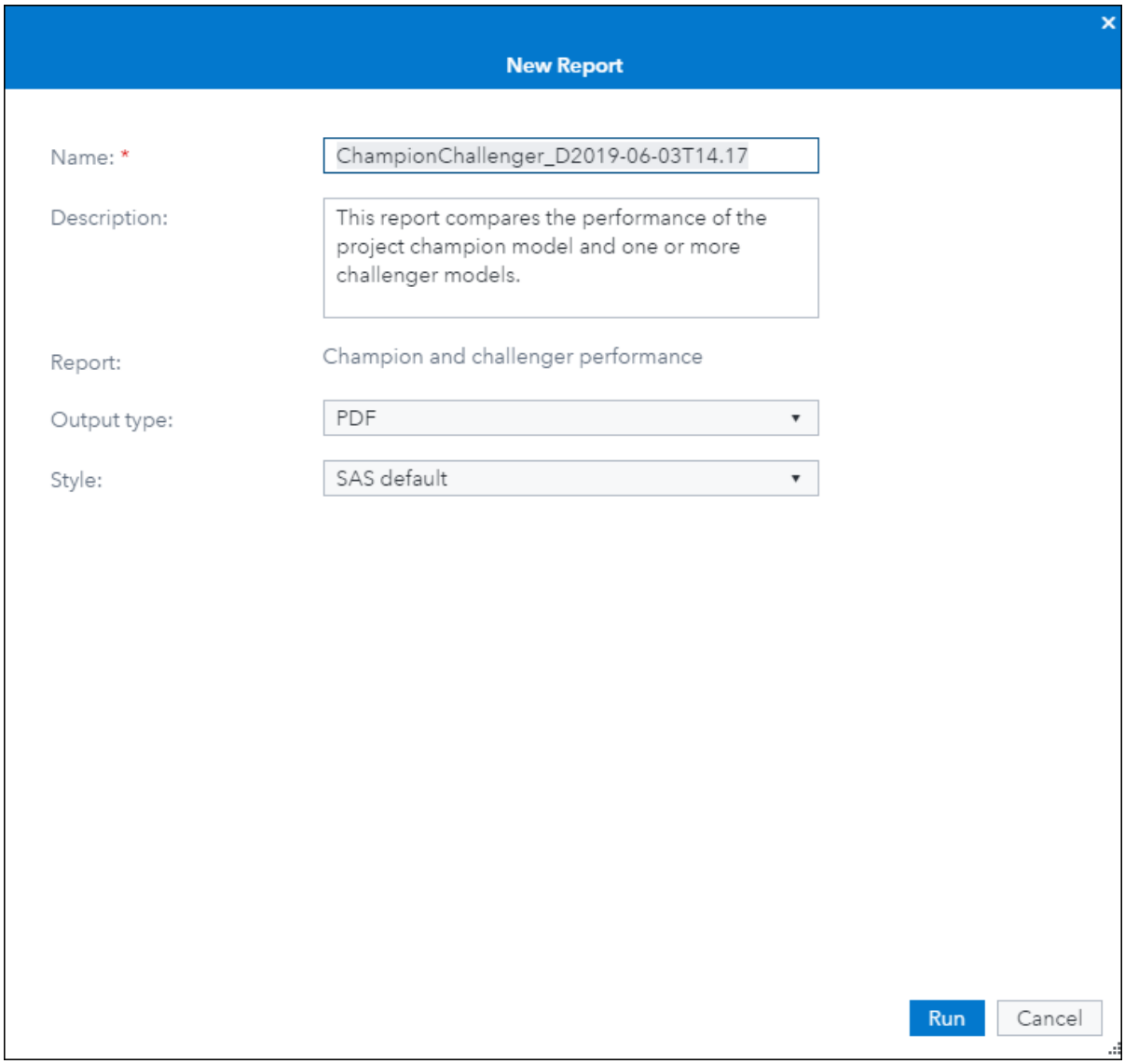
   a. Verify the UUID in the **Model UUID** column matches the UUID for your models. Both Champion and Challenger model UUIDs are recorded in this column.

b In the **Champion Model** column, verify if the model is the champion or challenger. The value of `0` indicates the model is the champion. The value of `1` indicates the model is a challenger.

c Using the **name** column and the **time** column, verify that matching date labels exist for the champion and challenger models for each type of report. If there are multiple date labels for a model for any given report, SAS Decision Manager uses the most recent job.

Create a Champion and Challenger Performance Report

1 Click **New report** and select **Champion and challenger performance**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

3 Select an output type. The default is PDF.

4 Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report.

5 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

"View Reports" on page 222

Delta Reports

About Delta Reports

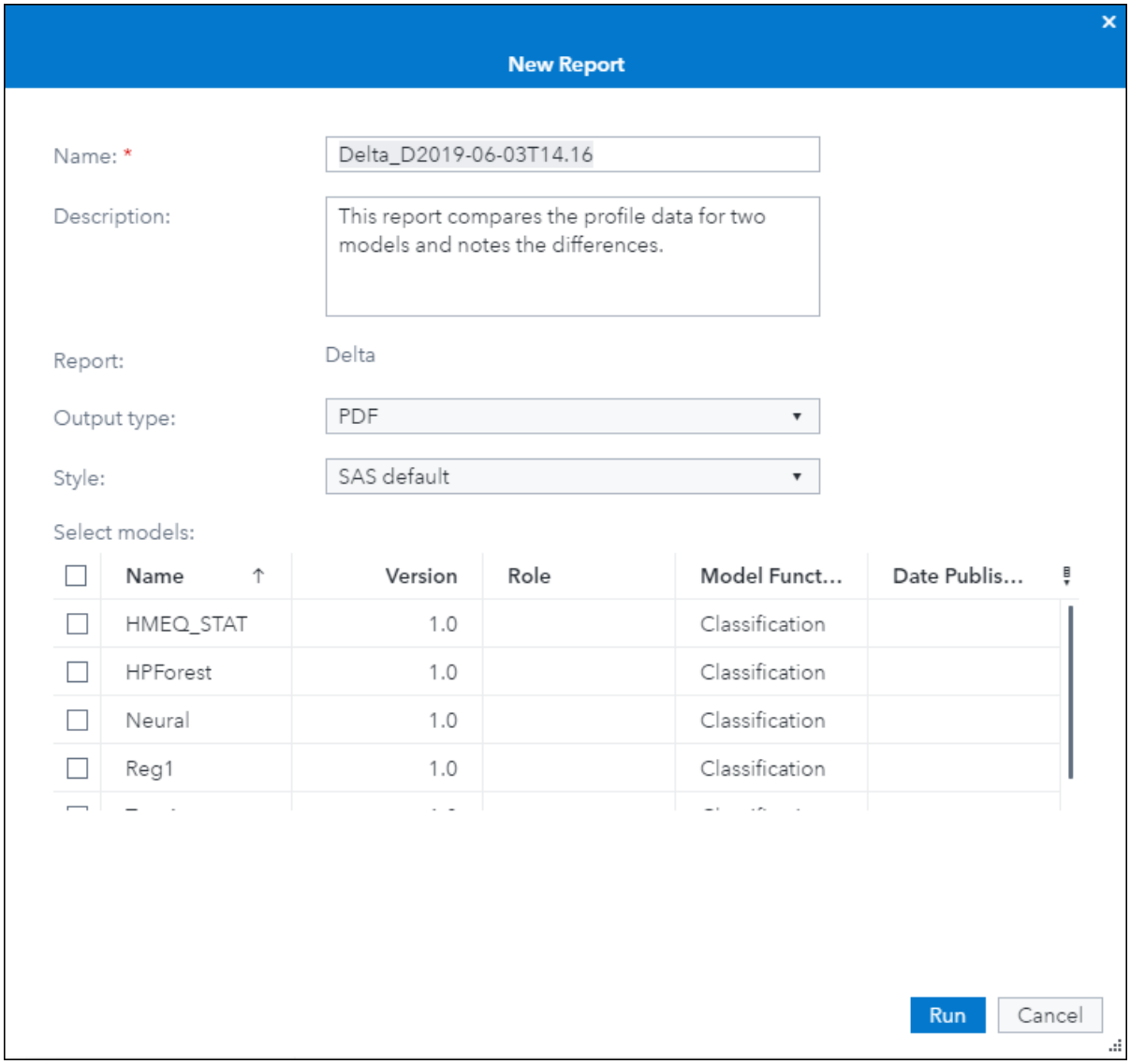
A Delta report compares the input, output, and target variable attributes for each of the variables that are used to score two candidate models. Delta reports display the differences in the variables of competing candidate models. The report output is a table that groups the variables by the variable name. For each variable, the reports lists the attribute value for each model and whether the attribute value is the same or different from the other attribute values.

Here is a description of each of the columns in the output of a Delta report:

Column	Description
Role	Specifies the function that a variable performs in determining a score code.
Name	Specifies the name of the variable that is being compared.
Variable Attribute	Specifies the name of the variable attribute that is being compared.
Model Name-1	Contains the value of the attribute for the first model.
Model Name-2	Contains the value of the attribute for the second model.
Difference	Specifies an X if the value of the variable attribute is different from the value of the variable attributes in the other model. If the value of the variable attribute is the same, this column is blank.

Create a Delta Report

1 On the **Reports** tab of a project, click **New report** and select **Delta**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

3 Select an output type. The default is PDF.

4 Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report.

5 From the list, select the models that you want to include in the report. The report can contain only two models.

6 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

"View Reports" on page 222

Dynamic Lift Reports

About Dynamic Lift Reports

The Dynamic lift report enables you to view a model's lift at a given point in time or to compare the lift performance of several models on one chart. The Dynamic lift report creates the following charts:

- Lift
- Cumulative Lift
- Percent Response
- Cumulative Percent Response
- Captured Response
- Cumulative Captured Response

A Dynamic lift report can be created only for classification and analytical models with a binary target.

The charts that are created for a Dynamic lift report are also created in the Monitoring Report, which creates multiple types of model comparison reports. Before you can create a Dynamic lift report, certain project and model property settings must be set.

For models that are created with PMML 4.2, the **Valid variable name** option in SAS Management Console must be set to **Yes** by a SAS Decision Manager administrator. In addition, the PMML variable names cannot be more than 20 characters. For more information, see *SAS Decision Manager: Administrator's Guide*.

Verify Project and Model Property Settings

Verify Project Properties

Select the project name and verify that the following project properties are set:

Training target variable
Specifies the name of the target variable that was used to train the model. The model must have the same training target variable as the project.

Target event value
Specifies the value for the desired target variable event or state. For example, if a model predicts when RESPONSE=YES, then the target event value is `YES`.

Output event probability variable
Specifies the name of the output event's probability variable.

Verify Model Properties

For each model in the Dynamic lift report, open the model and verify the following properties on the **Model Properties** tab:

Properties

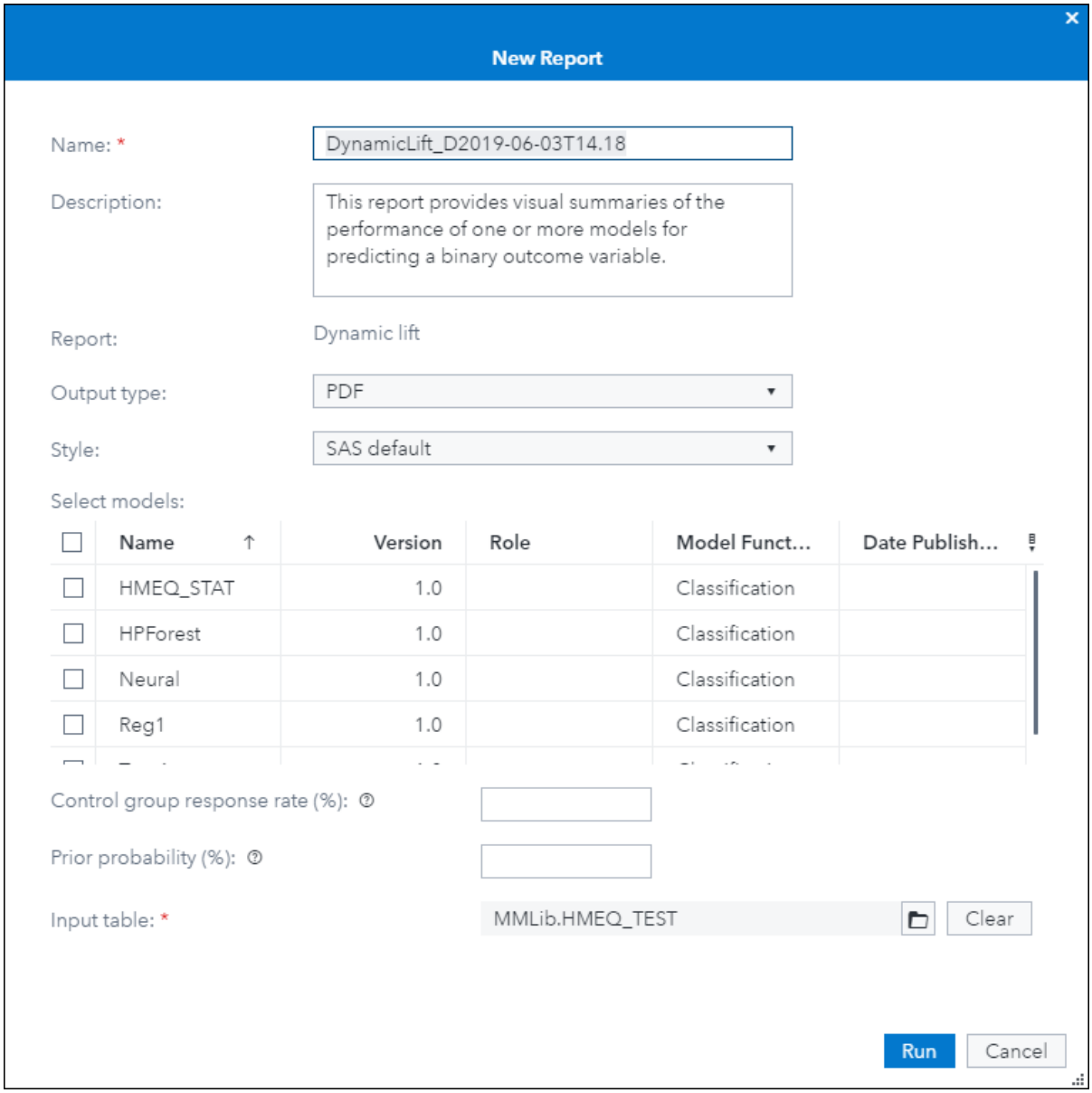
Property	Description
Target variable	Specifies the name of the target variable. For example, if a model predicts when RESPONSE=YES, then the target variable is `RESPONSE`.
Score code type	Specifies whether the score code type is Analytic store, DS2, DATA step, PMML, or SAS program.

Note: Dynamic lift reports are not applicable to models whose **Score code type** property has a value of PMML or DS2. A Dynamic lift report can be created for a PMML model that was created using PMML 4.2 and whose **Score code type** is DATA step.

Create a Dynamic Lift Report

After ensuring that the appropriate project and model properties have been set, create the report.

1. On the **Reports** tab of a project, click **New report** and select **Dynamic lift**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

3 Select an output type. The default is PDF.

4 Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report.

5 From the list, select the models that you want to include in the report.

6 Specify the **Control group response rate**. The control group response rate calculates the adjusted lift values for a model. If the control group response rate is not specified, the default response rate in the test table is used to calculate the adjusted lift values.

7 Specify the **Prior probability**. The prior probability is the proportion of event observations to the total observations in the whole population. In this case, the whole population is the entire train table. Specify a value for the prior probability to be used as the true event proportion when assessment values are computed for the lift of a model.

8 Accept the default value for **Input table** or click 🗀 to navigate to the appropriate folder to select an input table. Click **Open**.

9 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

"View Reports" on page 222

Interval Target Variable Report

About Interval Target Variable Reports

The Interval target variable report creates two plots for you to view the actual versus predicted values for a model and the actual versus residual values for a model. The Interval target variable report can be created only for prediction models. Before you can create an Interval target variable report, certain project and model property settings must be set.

Verify Project and Model Properties

Before you can run an Interval target variable report, you must set the following project properties:

Default test table
Specifies a test table that is registered in the SAS Metadata Repository. You can view the table in the Data category view. The test table must contain the target variable, as well as values for the variables that are defined by the project input variables.

Training target variable
Specifies the name of the target variable that was used to train the model. The model must have the same training target variable as the project.

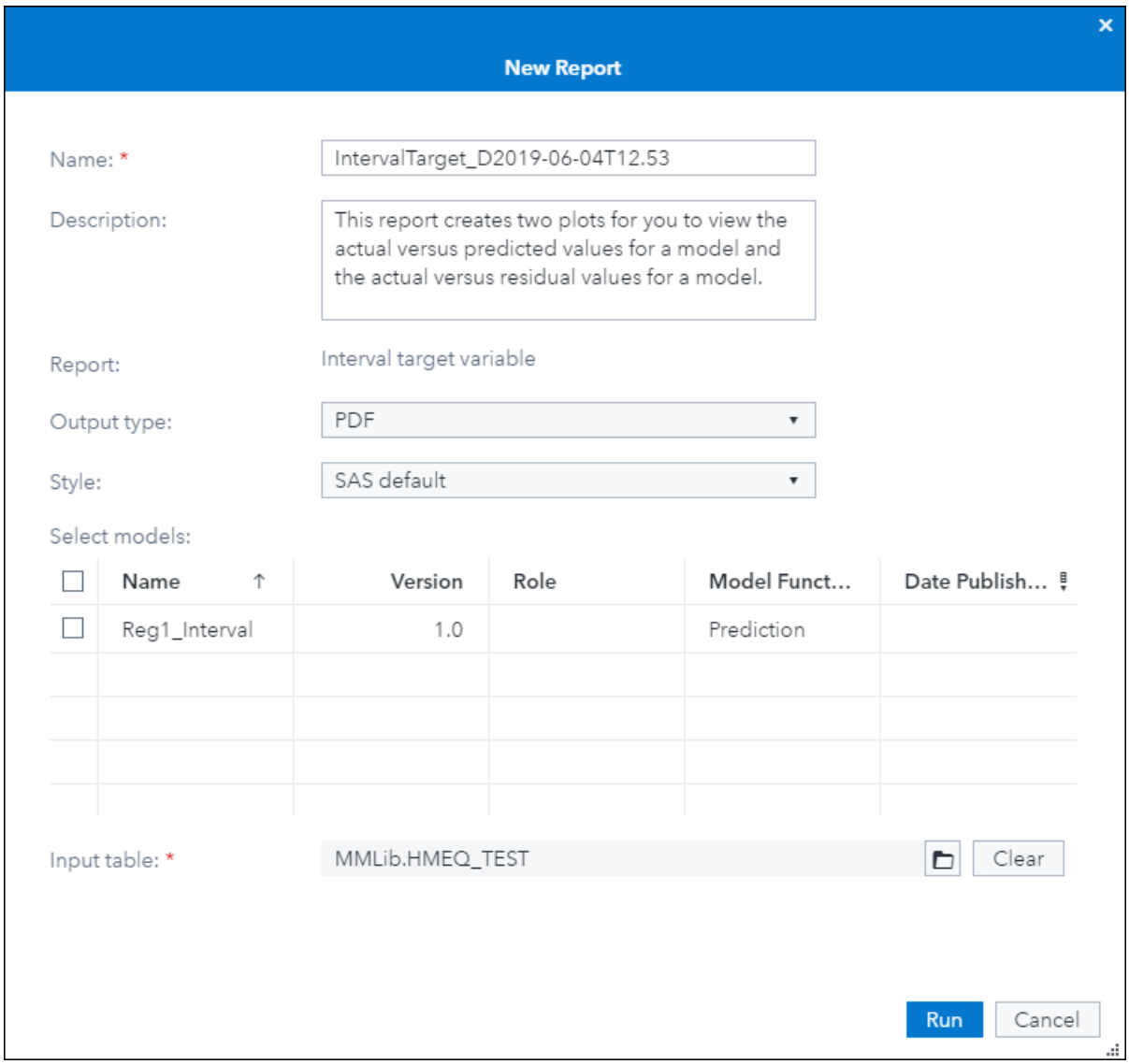
Output prediction variable
Specifies the name of the output prediction variable.

To verify the model mapping, select and open the model from the Models tab. Select **Model Properties** ⇨ **Variables** to verify that the model variables are mapped to the project variables. If the variable names are the same, you do not need to map the variables. If they are not mapped, for each project variable, select the project variable and select a variable name.

Create an Interval Target Variable Report

You must have a prediction model with an Interval target variable in order to create the Interval target variable report. After ensuring that the appropriate project properties have been set and the model mapping is set, create the report.

1 Click **New report** and select **Interval target variable**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

3 Select an output type. The default is PDF.

4 Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report.

5 From the list, select the models that you want to include in the report.

6 Accept the default value for **Input table** or click 🗀 to navigate to the appropriate folder to select an input table. Click **Open**.

7 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

"View Reports" on page 222

Loss Given Default Reports

About Loss Given Default Reports

Loss Given Default (LGD) models help validate the stability, performance, and calibration of models with the following statistical measures and tests:

Model stability measures
: The model stability measures track the change in distribution of the modeling data and the scoring data.

Model performance measures
: The model performance measures report this information:

- The model's ability to discriminate accounts that have defaulted with those that have not defaulted. The score difference between the accounts that default and those that do not helps determine the cut-off score, which is used to predict whether a credit exposure is a default.
- The relationship between the actual default probability and the predicted probability. This information is used to understand a model's performance over a period of time.

Model calibration measures
: The model calibration measures check the accuracy of the LGD models by comparing the correct quantification of the risk components with the available standards.

For a description of the statistical measures, see Appendix 5, "Statistical Measures Used in Basel III Reports," on page 403.

The Loss Given Default Report Properties

In order to create the reports, SAS Decision Manager must know the input and output variables for the model. The input table can contain only input variables, or it can contain input and output variables. If the input table contains only input

variables, a scoring test must be run to obtain the output variable. If the input table contains the input and output variables, no scoring is necessary. You specify whether a scoring test must be run by setting the **Run score code** property in the New Report window. If the input table contains output variables, the value of the **Run score code** can be **No**. If the input table contains only input variables, the **Run score code** property must be set to **Yes**.

The report properties require the names of the variables from the input and output tables in order to map these variables to variables that are used to create the reports. The LGD report properties map these variables:

Time period variable	specifies the variable that is used to indicate a time period. The first time period begins with 1 and typically increments by 1. The default is **period**.
Time label variable	(optional) specifies a label for the time period. If this variable exists in the input table, the report output contains a table that maps time periods to time labels.
Actual variable	specifies the actual LGD variable. The default is **lgd**.
Predicted variable	specifies the output prediction variable that is used only if scoring for the report is not performed by SAS Decision Manager. If the report scoring is done by SAS Decision Manager, this variable should be excluded by the input data set. The default is **p_lgd**.
Pool variable	specifies the variable that names pool IDs. The default is **pool_id**.

Prerequisites for Loss Given Default Reports

Before you run an LGD report, select the project name and verify that the following project properties are set:

Training target variable
Specifies the name of the target variable that was used to train the model. The model must have the same training target variable as the project.

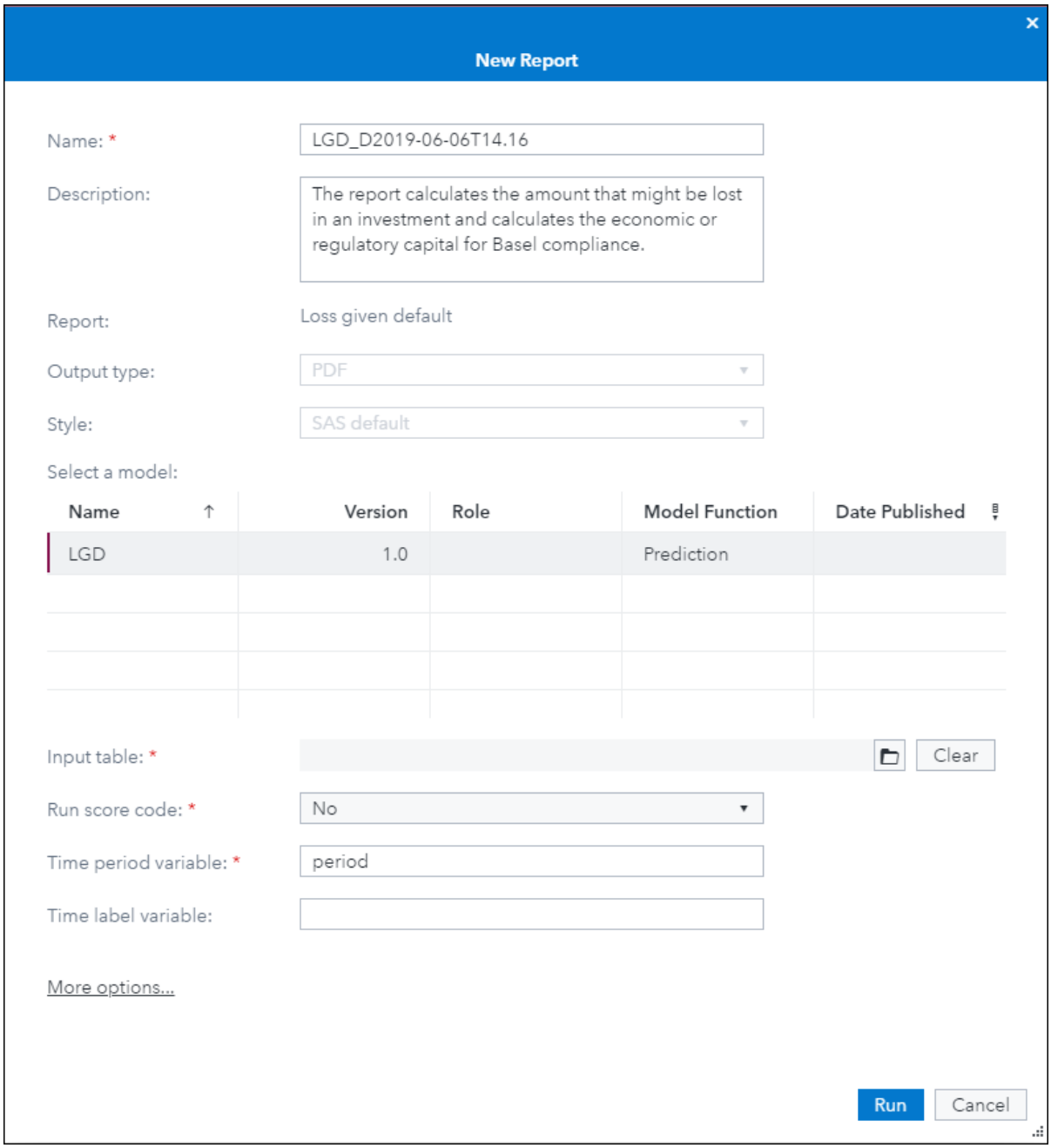
Model function
Specifies the type of model function. For an LGD report, the model function must be Prediction.

Class target level
Specifies an **Interval** class target level.

Output prediction variable
Specifies the name of the output prediction variable.

Create a Loss Given Default Report

1. Click **New Report** and select **Loss given default**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

Note: The default output type is PDF.

The default style is SAS Default.

3 From the list, select the model that you want to include in the report.

4 Select an **Input table**. Click 🗀 to navigate to the appropriate folder. Select an input table and click **Open**. The table can contain only input variables or it can contain input and output variables.

5 Select whether to run the score code. If the input table contains only input variables, set **Run score code** to **Yes**. If the input table contains output variables, set **Run score code** to **No**. The default for **Run score code** is **No**.

6 The **Time period variable** specifies the variable from the input table whose value is a number that represents the development period. This value is numeric. The time period for PD reports begin with 1. The default is **period**.

7 (Optional) In the **Time label variable** field, enter the variable from the input table that is used for time period labels. When you specify the time label variable, the report appendix shows the mapping of the time period to the time label.

8 Click **More Options** to set the following:

Actual variable
Specifies the actual LGD variable. The default is **lgd**.

Predicted variable
Specifies the project scoring output variable. If the scoring for the LGD report is performed outside SAS Decision Manager, the input data set must include this variable. If the scoring for the LGD report is done by SAS Decision Manager, the input data set should not include this variable. The default is **p_lgd**.

Pool variable
Specifies the variable from the input table that is used to identify a two-character pool identifier. The default is **pool_id**.

Note: The variable names that you specify can be user-defined variables. A variable mapping feature maps the user-defined variables to required variables.

9 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

"View Reports" on page 222

Model Profile Reports

About Model Profile Reports

A Model profile report displays the profile data that is associated with the model input variables, output variables, and target variables. The report creates three tables, one each for the model input, output, and target variables.

Here is a description of the model profile data:

Profile Data	Description
Name	The name of the variable.

Profile Data	Description
Type	The data type of the variable: character (C) or numeric (N).
Length	The length of the variable.
Label	A label that is associated with the variable.
Format	The SAS format that is associated with formatting the variable.
Level	The measurement level: nominal, ordinal, interval, or binary.
Role	The type of variable: input, output, or target.

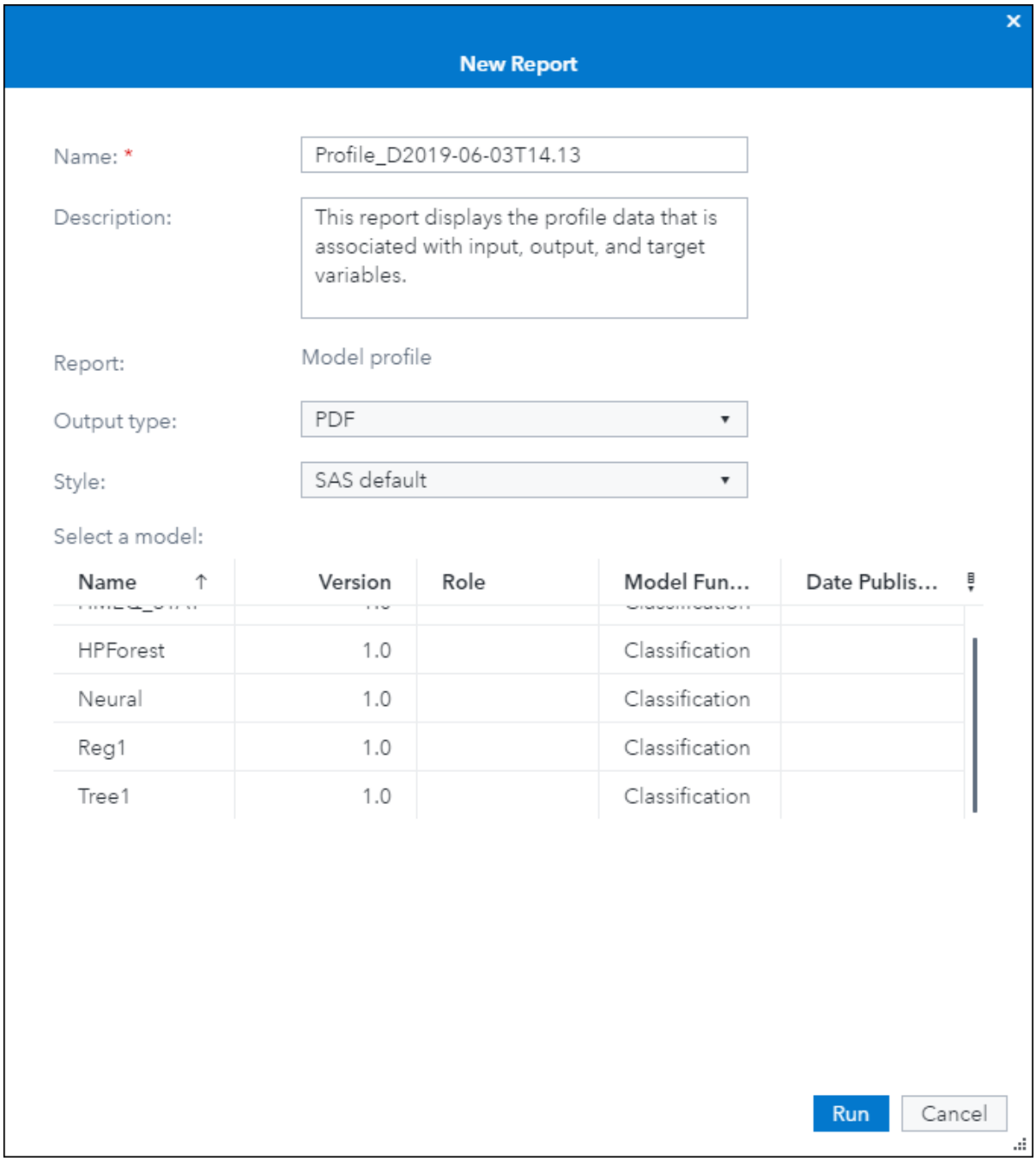
The reports are created using these auxiliary model files:

- inputvar.xml
- outputvar.xml
- targetvar.xml

Note: The target variable property must be set for a model in order to be able to run the Model profile report.

Create a Model Profile Report

1. On the **Reports** tab of a project, click **New report** and select **Model profile**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

3 Select an output type. The default is PDF.

4 Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report.

5 From the list, select the model that you want to include in the report.

6 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

"View Reports" on page 222

Monitoring Reports

About Monitoring Reports

After you execute a performance definition or run the %MM_RunReports() macro in production mode, as a batch job, SAS Decision Manager stores the output data sets on the SAS Content Server. You can view the performance monitoring results on the **Results** tab of the **Performance** tab or on the **Attachments** tab.

When you create monitoring reports using the New Report window, the report creates the following charts:

Assessment charts
: Assessment charts summarize the utility that you can expect by using the respective models, as compared to using only baseline information. Assessment charts can present a model's lift at a given point in time or the sequential lift performance of a model's lift over time. A monitoring report creates the following assessment charts:

- Lift
- Cumulative Lift
- Percent Response
- Cumulative Percent Response
- Captured Response
- Cumulative Captured Response
- Actual versus Predicted for prediction models
- Actual versus Residual for prediction models
- Population Stability Trend for prediction models

Assessment charts are created for the Monitoring Report.

Lift Trend chart
: A Lift Trend chart displays the cumulative lift of the champion model, over time.

Gini - ROC chart
: Sensitivity is the proportion of true positive events, and specificity is the proportion of true negative events. The Gini - ROC chart plots Sensitivity on the Y axis and 1 - Specificity on the X axis.

Gini - Trend Chart
: When the Gini - ROC chart is created, the Gini index for each ROC curve is also created. The Gini index represents the area under the ROC curve and is a benchmark statistic that can be used to summarize the predictive accuracy of a

model. The Gini - Trend chart plots a model's Gini index scores over time, and these are used to monitor model degradation over time.

KS Chart
: The KS chart uses the Kolmogorov-Smirnov statistic to measure the maximum vertical separation, or deviation between the cumulative distributions of events and non-events.

KS Trend Chart
: When you create a Kolmogorov-Smirnov report, the underlying KS statistic and the corresponding probability cutoff are read from a summary data set in the Resources folder. The KS Trend chart uses a summary data set that plots the KS Statistic over time. The KS Trend chart is used to monitor model degradation over time.

Actual versus Predicted
: You use the Actual versus Predicted plot to see how predicted values match actual values.

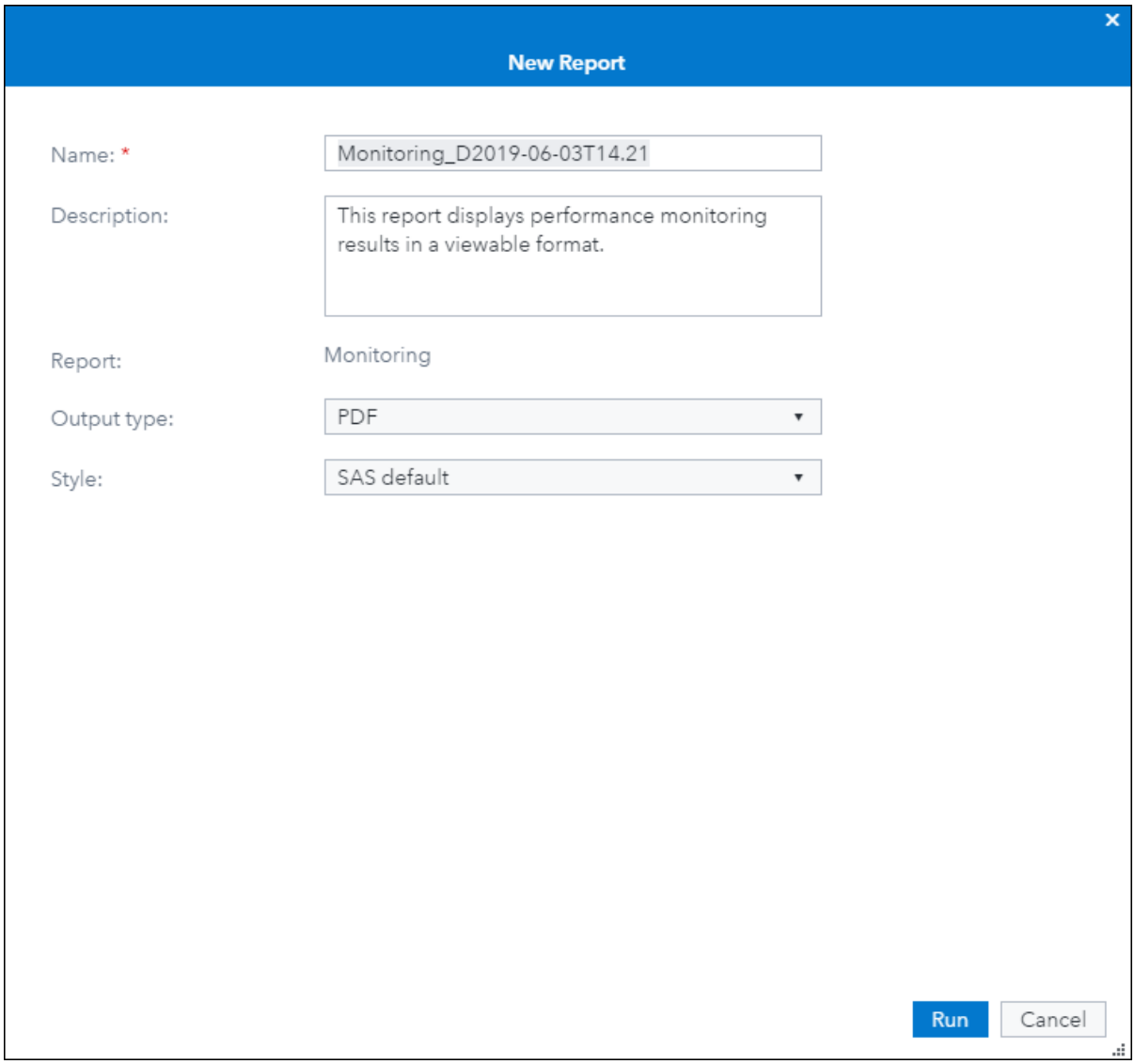
Actual versus Residual
: You use the Actual versus Residual plot to determine how good the model is at predicting values by examining errors and error trending, and comparing them to the actual values.

Population Stability Trend
: The Population Stability Trend chart measures the shift of the scoring output variable distribution over time. Scoring output that is based on a development sample is used as the baseline distribution. The deviation index is used to indicate the shift for a given point in time.

Before you create a Monitoring Report, you must ensure that certain project and model properties are set. For more information, see “Verify Project and Model Property Settings” on page 202.

Create a Monitoring Report

1. Click **New report** and select **Monitoring**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

3 Select an output type. The default is PDF.

4 Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report.

5 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

"View Reports" on page 222

Probability of Default Model Validation Reports

About Probability of Default Model Validation Reports

Probability of Default (PD) models help validate the stability, performance, and calibration of models with the following statistical measures and tests:

Model stability measures
: The model stability measures track the change in distribution of the modeling data and the scoring data.

Model performance measures
: The model performance measures report this information:

- The model's ability to discriminate accounts that have defaulted with those that have not defaulted. The score difference between the accounts that default and those that do not helps determine the cut-off score, which is used to predict whether a credit exposure is a default.
- The relationship between the actual default probability and the predicted probability. This information is used to understand a model's performance over a period of time.

Model calibration measures
: The model calibration measures check the accuracy of the PD model by comparing the correct quantification of the risk components with the available standards.

For a description of the statistical measures, see Appendix 5, "Statistical Measures Used in Basel III Reports," on page 403.

Default Model Validation Report Properties

In order to create the reports, SAS Decision Manager must know the input and output variables for the model. To run the reports, the New Report window requires the name of an input table. The input table can contain only input variables, or it can contain input and output variables. If the input table contain only input variables only, a scoring test must be run to obtain the output variable. If the input table contains the input and output variables, no scoring is necessary. You specify whether a scoring test must be run by setting the **Run score code** property in the New Report window. If the input table contains output variables, the value of the **Run score code** can be **No**. If the input table contains only input variables, the **Run score code** property must be set to **Yes**.

The report properties require the names of the variables from the input and output tables in order to map these variables to variables that are used to create the reports. The report properties map these variables:

Time period variable	specifies the variable that is used to indicate a time period. The first time period begins with 1 and typically increments by 1. The default is **period**.
Time label variable	(optional) specifies a label for the time period. If this variable exists in the input table, the report output contains a table that maps time periods to time labels.
Scorecard bin variable	specifies the scoring output variable that names the scorecard bins. The input table must include this variable if scoring for the PD report is performed outside SAS Decision Manager. If scoring is done by SAS Decision Manager, do not include this variable in the input data set. The default is **scorecard_bin**.
Scorecard points variable	specifies the scoring output variable that names the scorecard points. The input table must include this variable if scoring for the PD report is performed outside SAS Decision Manager. If scoring is done by SAS Decision Manager, do not include this variable in the input data set. The default is **scorecard_points**.
Cut-off value	specifies the variable that is used to derive whether a credit exposure is a default. The cut-off value is also used to compute accuracy, sensitivity, specificity, precision, and error rate measures. You can use the score difference between accounts that default on loans and those that do not default on loans to determine the cut-off value. The default is **100**.

Prerequisites for Probability of Default Model Validation Reports

Before you can create a Probability of default model validation report, verify that the following project settings are specified and that the output variables have been mapped:

Training target variable
Specifies the name of the target variable that was used to train the model. The model must have the same training target variable as the project.

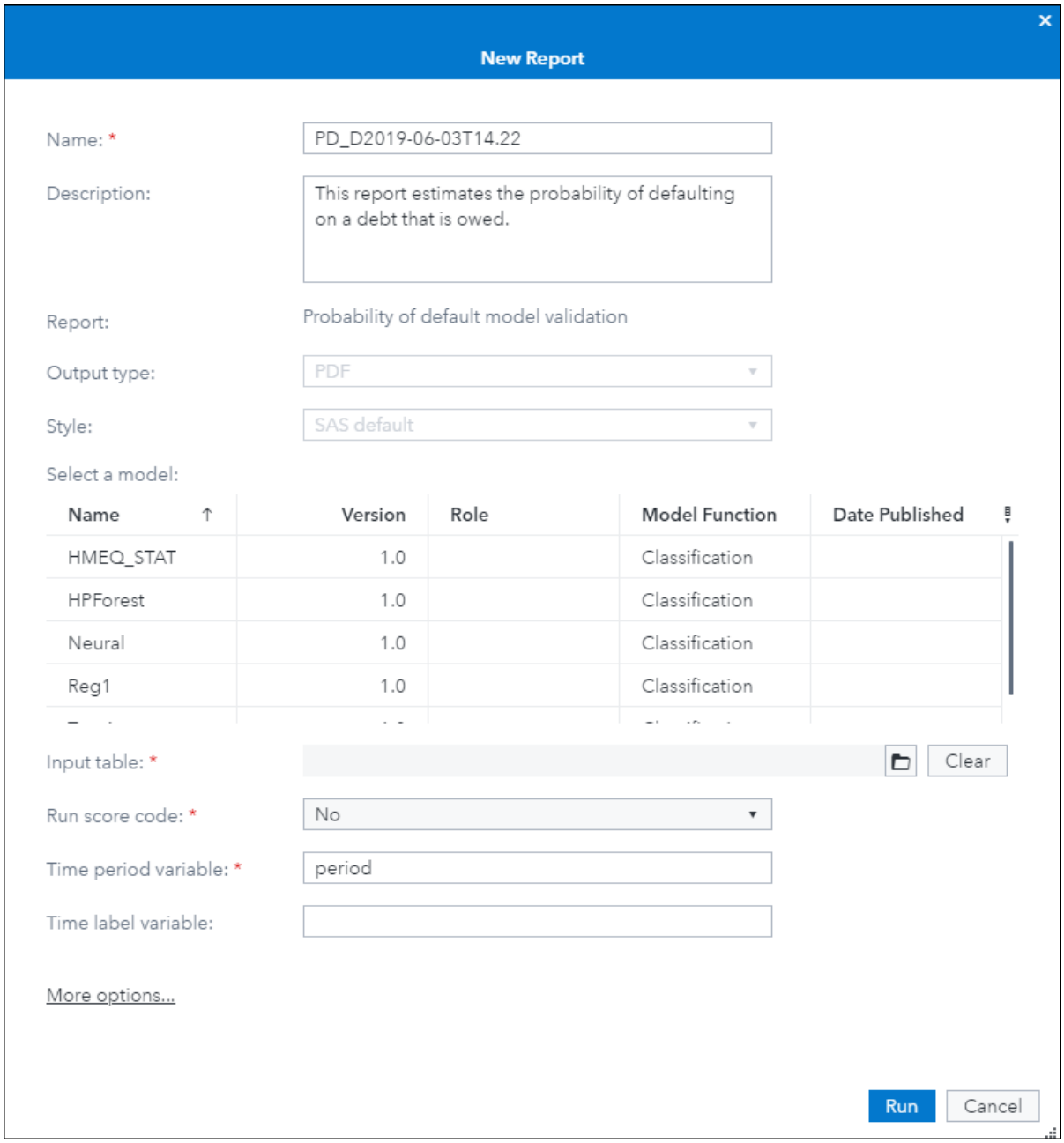
Class target level
Specifies a **Binary** class target level.

Output event probability variable
Specifies the name of the output event probability variable.

Model function
Specifies the type of model function. The model function must be `Classification` in order to create a PD report.

Create a Probability of Default Model Validation Report

1 Click **New report** and select **Probability of default model validation**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

Note: The default output type is PDF and the default style is SAS default.

3 From the list, select the model that you want to include in the report.

4 Click 🗀 to navigate to the appropriate folder and select an input table and click **Open**. The table can contain only input variables or both input and output variables.

Note: When a scoring input table for a PD report contains data and one or more time periods do not contain default or non-default loan information, these time periods are not used to calculate the PD measurements. In a chart, time periods that are not used to calculate the PD measurements are represented with dashed lines.

5 Select whether to run the score code. If the input table contains only input variables, set **Run score code** to **Yes**. If the input table contains output variables, set **Run score code** to **No**.

6 The **Time period variable** specifies the variable from the input table whose value is a number that represents the development period. This value is numeric. The time period for PD reports begin with 1. The default is **period**.

7 (Optional) In the **Time label variable** field, enter the variable from the input table that is used for time period labels. When you specify the time label variable, the report appendix shows the mapping of the time period to the time label.

8 Click **More Options** to set the following:

Scorecard bin variable
Specifies the variable from the input table that contains the scorecard bins. If the scoring job for the PD report is run outside SAS Decision Manager, the scorecard bin variable must be a variable in the input table. If scoring is done within SAS Decision Manager, do not include the variable in the input table. The default is **scorecard_bin**.

Scorecard points variable
Specifies the variable that contains the scorecard points. If the scoring job for the PD report is run outside SAS Decision Manager, the scorecard points variable must be a variable in the input table. If scoring is done within SAS Decision Manager, do not include the variable in the input table. The default is **scorecard_points**.

Cut-off value
Specifies the maximum value that can be used to derive the predicted event and to further compute accuracy, sensitivity, specificity, precision, and error rate. The default is **100**.

9 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

"View Reports" on page 222

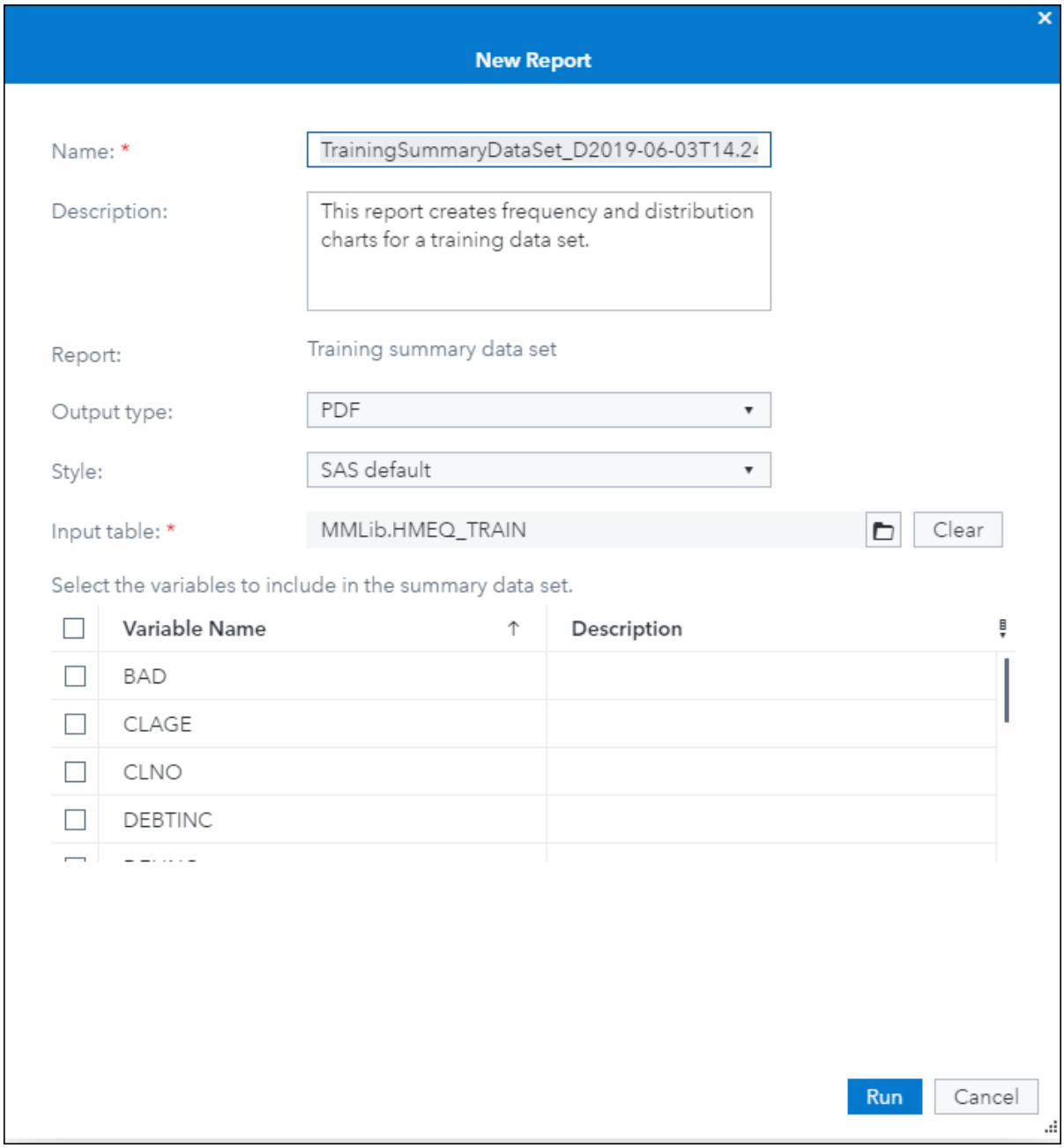
Training Summary Data Set Reports

About Training Summary Data Set Reports

A training summary data set report creates frequency and distribution charts that summarize the train table variables. Using the default train table, SAS Decision Manager generates data sets that contain numeric and character variable summaries, and variable distributions. These data sets are used to create the summary report. Before you can create the report, you must generate the training summary data sets.

Create a Training Summary Data Set Report

1. Click **New report** and select **Training summary data set**. The New Report window appears.



2 Enter a name and description if you do not want to use the default values.

3 Select an output type. The default is PDF.

4 Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report.

5 A Default train table is specified in a project's specific properties. Accept the default value for **Input table** or click 🗀 to navigate to the appropriate folder to select an input table. Click **Open**.

6 Select the variables to include in the summary data set.

7 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

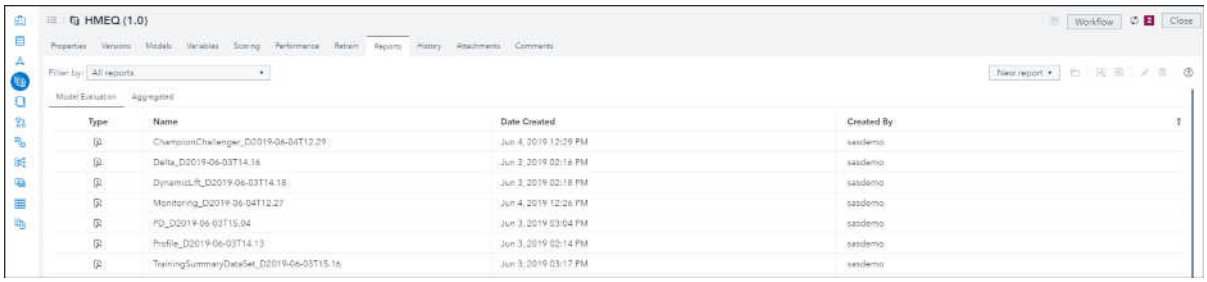
"View Reports" on page 222

View Reports

1. On the **Reports** tab of a project, in the **Model Evaluation** tab, select the report that you would like to view. You can filter the type of reports displayed from the drop-down menu.
2. To view a report:
   - Click the report type icon in the list.
   - Select a report from the list and click .

   Note: You can also view the SAS code and SAS log.
   - Click to view the SAS code.
   - Click to view the SAS log.

Note: If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.



14

Validating Models Using User Reports

Overview of User Reports

Ad Hoc Reports and User-Defined Reports

User reports are SAS programs that you create and import to SAS Decision Manager so that you can customize reports to meet your business requirements. The ad hoc report enables you to develop, test, and run your report within SAS

Decision Manager. The user-defined report can be developed either within or external to SAS Decision Manager. It requires a SAS program and the associated auxiliary files to be installed in a directory that is available to SAS Decision Manager. Using ad hoc reports, you modify and submit your code from the SAS Editor within the Create an Ad Hoc Report window.

A user-defined report is a report that is available for reporting on all models in SAS Decision Manager. The user-defined report requires three files to be installed in your server's file structure:

- a SAS program to create the report
- a report template XML file that specifies the report requirements, such as report name and the number of required models to run the report
- a SAS program file that lists the SAS Decision Manager global macro variables and macros that are used in your report

After you have these three files, you use the Manage Templates function to upload the files to the SAS Content Server.

The ad hoc report can be used to develop, test, and debug user-defined reports. When your ad hoc report is ready for a production environment, you can create the report template XML file and the macro file, and install the three files in the user-defined report file structure.

Comparison of Ad Hoc and User-Defined Reports

Report Difference	Ad Hoc Report	User-Defined Report
Version	An ad hoc report is defined and can be run only under the version where it was created.	A user-defined report can be run under any project version.
Report template	An ad hoc report does not require a template.	A user-defined report requires a template to define the report parameters.
Report results	Each time an ad hoc report is run, the existing report is overwritten.	Each time a user-defined report is run, a new report is created on the **Reports** tab.
Location of SAS files used to generate the report	The ad hoc report SAS program is stored on the **Reports** tab for the version where it was created.	The user-defined report SAS files are uploaded to the SAS Content Server.

Output Created by User Reports

The first time you create a report, SAS Decision Manager creates a report on the **Reports** tab.

Each time you create a new ad hoc report, the following files are created:

- the report in either HTML, PDF, or RTF format
- smm_userCode.sas
- taskCode.log
- taskCode.sas

Each time you create a new user-defined report, the following files are created:

- the report in either HTML, PDF, or RTF format
- taskCode.log
- taskCode.sas

CAUTION
The wizard overwrites the output files if an output file of the same name already exists.

Here is a description of the ad hoc report output files:

Report File	Description
report-name.html	This file is the report output in HTML format.
report-name.pdf	This file is the report output in PDF format.
report-name.rtf	This file is the report output in RTF format.
smm_userCode.sas	This file contains the SAS program report code that was submitted in the Create an Ad Hoc Report window.
taskCode.log	This file is the log file that contains messages from running the SAS code to create the report.
taskCode.sas	This file is the SAS code that is used to create the report. The file contains the user-defined report code as well as code that was generated by SAS Decision Manager to create the report.

You can see the contents of these files by selecting them on the **Reports** tab. You can also see the taskCode.sas file and the taskCode.log files.

Ad Hoc Reports

Overview of Ad Hoc Reports

To create an ad hoc report, you must first write a SAS report program. When the report code is ready, you copy your code to the **SAS Editor** tab in the New Ad Hoc Report window. You then submit your program. Unlike the user-defined report, the ad hoc report does not require auxiliary files to be uploaded to the SAS Content Server.

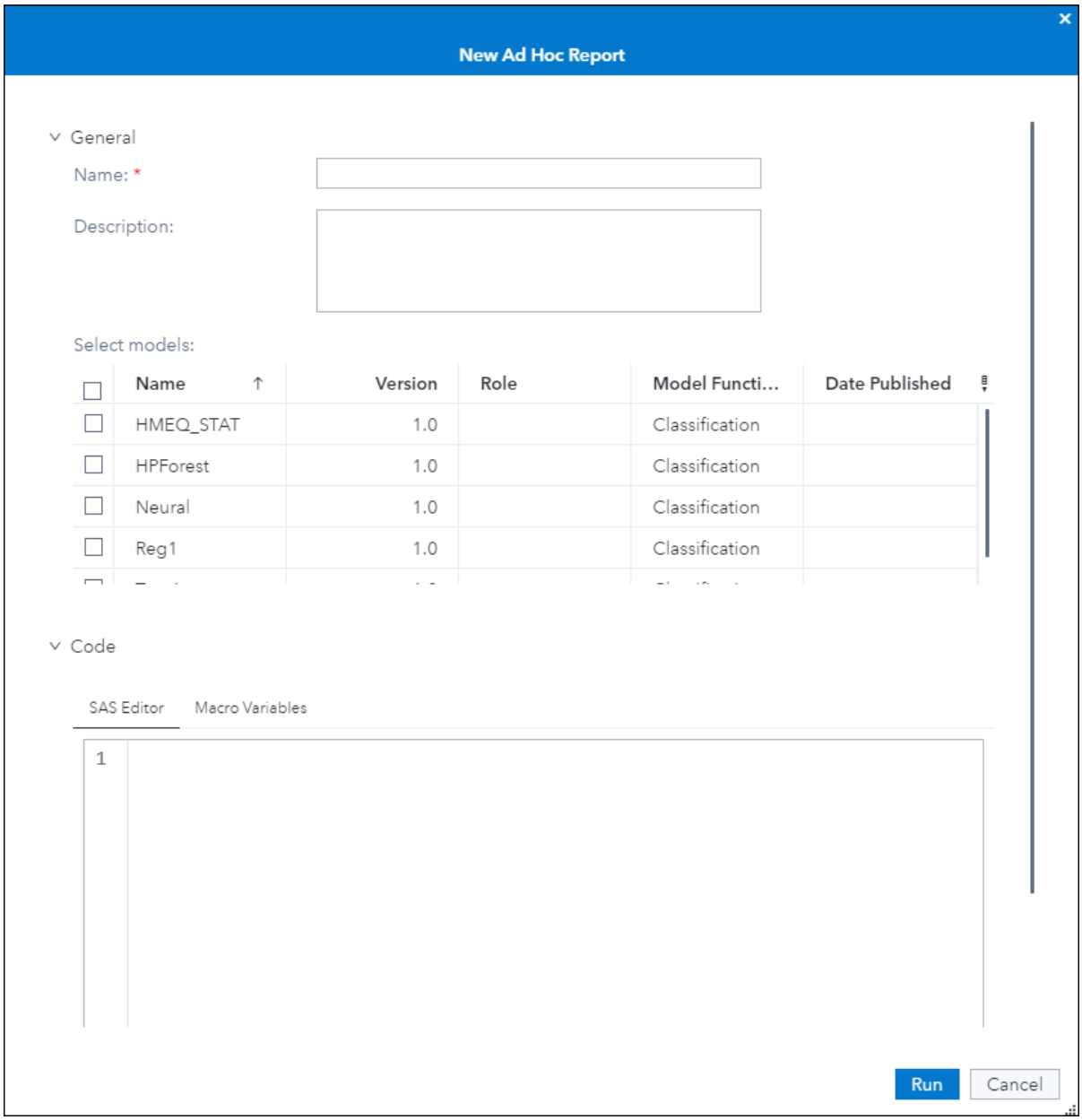
To create your report output in either HTML, PDF, or RTF, or to specify a style other than the default style for your report, you modify your report with code that is provided by SAS and that enables you to specify the report output format and style. The code that you need to add to your program is included in the steps to create an ad hoc program.

If you find an error in your report code, you must delete the report in the project, fix your code in your source file, and submit the code in the New Ad Hoc Report window again.

Create an Ad Hoc Report

To create an ad hoc report, you must first create a SAS program. Test your program in SAS before you run your program as an ad hoc report. After the code runs successfully, you can create the ad hoc report.

1. On the **Reports** tab of your project, click **New report** and select **Ad Hoc**. The New Ad Hoc Report window appears.



2 Enter a name and an optional description for the report.

3 Select one or more models.

4 Add or copy SAS code to the **SAS Editor** tab. Make sure that your report program is enclosed by the SAS code that defines the report output format. Click the **Macro Variables** tab to view a list of the variables that can be accessed by your program.

5 Click **Run**. The report is generated and appears in the default viewer for the selected output type.

6 The report appears in a list on the **Model Evaluation** reports tab.

Example Ad Hoc Report

The following example code lists the score results in an HTML output format:

```
Filename mmreport catalog "sashelp.modelmgr.reportexportmacros.source";
%include mmreport;

%MM_ExportReportsBegin(reportFormat=html, reportStyle=Meadow,
fileName=PerfDS);
proc print data=myTable.scoretable;
var loan delinq score;
run;
quit;


%MM_ExportReportsEnd(reportFormat=html);
```

After you click **Run**, the report is created and placed on the **Reports** tab of your project. The following HTML output displays selected rows of the output.

Obs	LOAN	DELINQ	score
1	1100.00	0	0.08918
2	162.06	2	0.08918
3	1292.02	0	0.08918
4	783.13	.	0.08918
5	1700.00	0	0.08918

User-Defined Reports

Overview of User-Defined Reports

User-defined reports require the following files to be uploaded to the SAS Content Server:

- the SAS program that creates the report.
- a SAS program file that lists the SAS Decision Manager global macro variables that are used in your report.
- a report template XML file that specifies the report requirements, such as report name and the number of required models to run the report.

After these three files have been uploaded to the SAS Content Server, the user-defined report type is included as a report type in the new report drop-down list on the **Reports** tab of your project.

The New Report window includes controls to specify the type of output that the report creates, such as HTML or PDF, and a style for the report. You can modify your report to include the SAS code so that the New Report window offers the report output controls for your report.

Create a User-Defined Report

1. Write and test your SAS program that creates a report.
2. To format the output for a user-defined report, add the SAS code below to your report code in order to select the **Output type** and the **Style** in the New Report window. The **Output type** enables you to select a report output format of HTML, PDF, or RTF. The **Style** enables you to select a report output style for your report.

   Replace *report-name* with the name of your user-defined report. The name can contain letters, the underscore (_), hyphen (-), and the period (.). End your user-defined report with the %MM_ExportReportsEnd macro.

   ```
   Filename mmreport catalog "sashelp.modelmgr.reportexportmacros.source";
   %include mmreport;
   %MM_ExportReportsBegin(fileName=report-name);
             …
      your-user–defined-code
             …
   %MM_ExportReportsEnd;
   ```

3. In the report XML file, add this SAS program name to the FILENAME= argument of the <Code> element (for example, `<Code filename="myUserReport.sas"/>`). For more information, see "Report Templates" on page 231.

For an example of a report, see "Example User-Defined Report" on page 235.

Defining Macro Variables for a User-Defined Report

Executing a user-defined report requires a SAS program that lists the report code's macro variables. If you do not have macro variables in your report, create a SAS program file with a comment in it. This file is required.

Here is an example program to define macro variables:

```
%let _MM_User=miller;
%let _MM_Password=Rumpillstillskin3;
```

In the report XML file, add this SAS program name to the FILENAME= argument of the <PreCode> element (for example, `<PreCode filename="myMacroDefs.sas"/>`). For more information, see "Report Templates" on page 231.

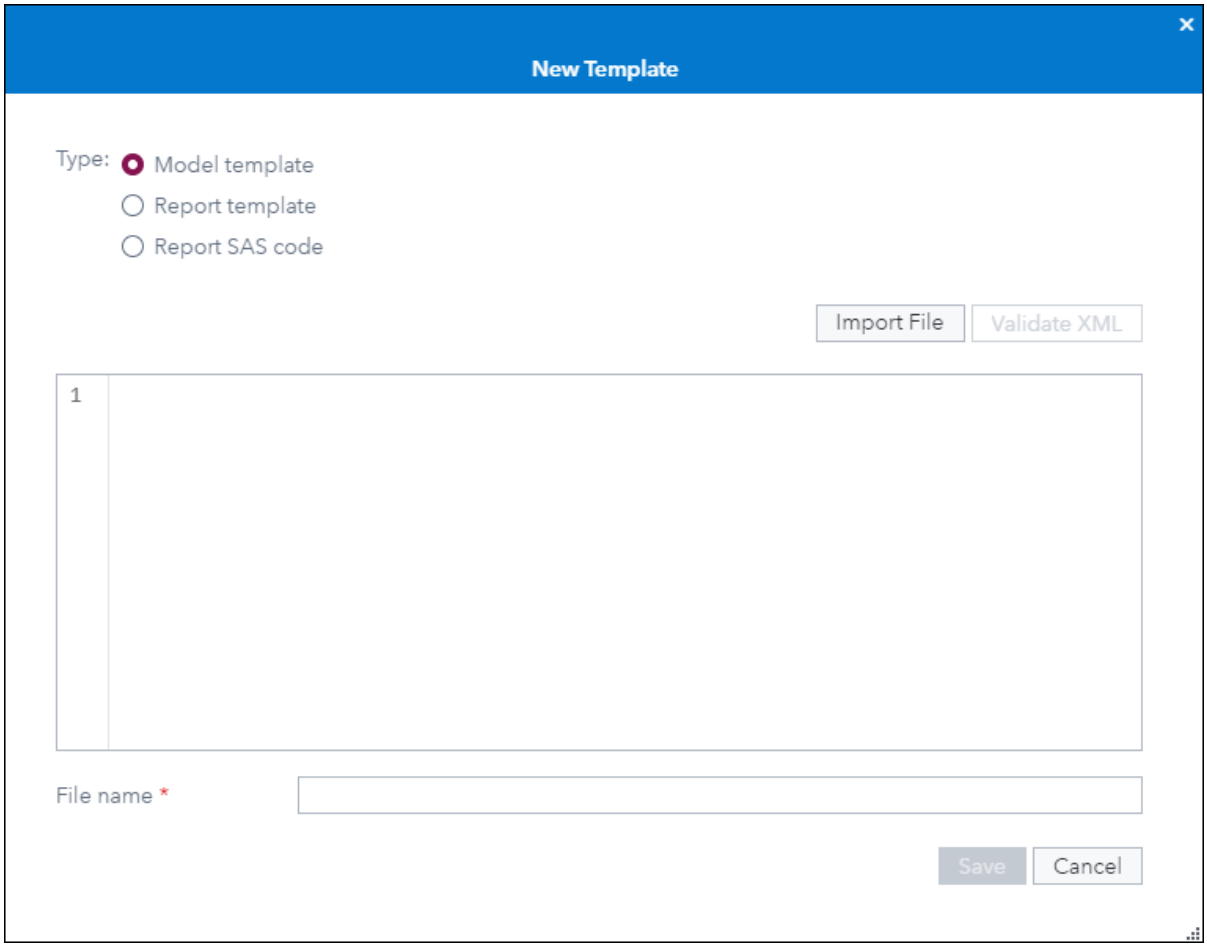
For an example of a macro variable program, see "Example User-Defined Report" on page 235.

For a list of macro variables, see "Macro Variables" in *SAS Decision Manager: Macro Guide*.

Upload SAS Programs to the SAS Content Server

After you have the two SAS programs for your user report, follow these steps to upload them to the SAS Content Server:

1 From the Projects category view, click ⋮, and select **Templates** ⇨ **New Template**. The New Template window appears.



2 Select **Report SAS code** .

3 Click **Import File** to select a SAS code file. Click **Open**. You can also copy and paste the SAS code in the text box.

4 Enter a file name.

5 Click **Save**.

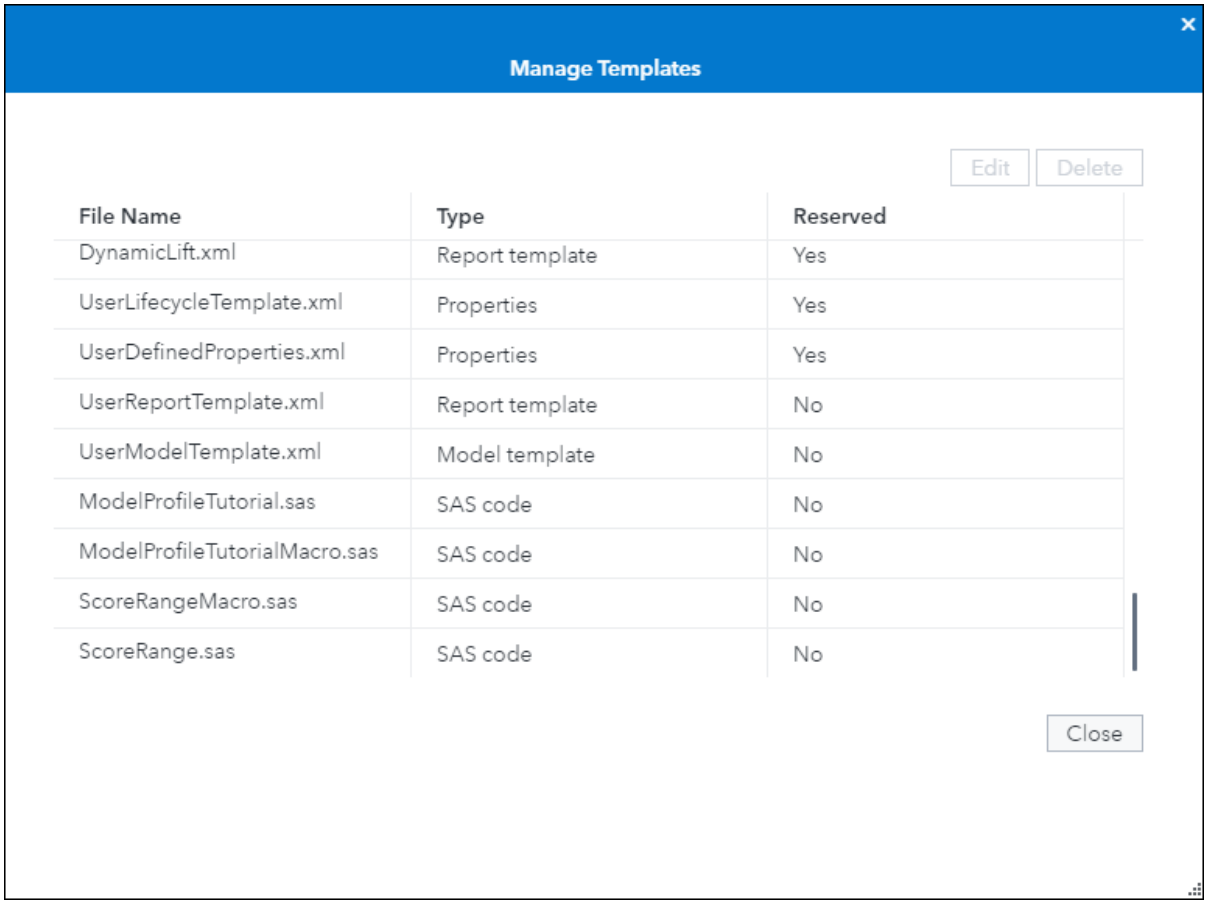
6 Repeat the steps to upload the second file.

Report Templates

You create a report template XML definition file to describe your user-defined report. After you create the report template, upload the template to the SAS Content Server.

SAS Decision Manager provides a sample report template that you can use as a model for your XML template. You can use any template as a model or you can create an XML file with the required XML elements. A best practice is to open the model XML template and save the template using another name.

1 From the Projects category view, click ⋮, and select **Templates** ⇨ **Manage Templates**. The Manage Templates window appears.



2 Select **UserReportTemplate.xml** and click **Edit**. The UserReportTemplate.xml file has arguments in quotation marks that you modify for your report. Replace the text in quotation marks with values that are appropriate for your report. See the argument descriptions below. Make your changes and click **Save** to upload the report template to the SAS Content Server.

3 Click **Close**.

Here is the report template XML definition:

```
<?xml version="1.0" encoding="UTF-8" ?>
<ReportTemplate
```

```
        name="report-name"
        type="UserDefinedReport"
        displayName="display-name"
        description="model-description"
        >
        <Report>
            <Data datasetName="input-data-set-name"/>
            <Models expectedModelType="model-type"
               requiredNumberOfModels="1"
               level="level">
       </Models>
            <SourceCode>
                <PreCode filename="pre-code-filename.sas"/>
                <Code filename="score-code-filename.sas"/>
            </SourceCode>
            <Output format="output-format" filename="output-name"/>
        </Report>
        <Parameters>
            <Parameter name="parameter-name" value="parameter-value" />
        </Parameters>
    </ReportTemplate>
```

<ReportTemplate> element arguments

name="*report-name*"
specifies the name of the report. The characters @ \ / * % # & $ ( ) ! ? < > ^ + ~ ` = { } [ ] | ; : ‘ " cannot be used in the name.

displayName="*display-name*"
specifies the name of the report that is displayed in the **Report** section of the New Report window.

description="*model-description*"
specifies a description of the report that is displayed at the bottom of the New Report window when the report is selected in the window.

<Report> element arguments

<Data datasetName="*input-data-set-name*"/>
specifies the name of a data source data set that is used for input to the report. The data set must be in the form *libref.filename*. You can use the following global macro variables as a value for input-data-set-name as long as the value of the macro variable is in the form of *libref.filename*:

- &_MM_InputLib
- &_MM_OutputLib
- &_MM_PerformanceLib
- &_MM_TestLib
- &_MM_TrainLib

<Models
expectedModelType="*model-type*"
requiredNumberOfModels="*number-of-models*"
level="*level*">
</Models>
specifies information about the model.

expectedModelType="*model-type*"
specifies the model type.

Valid values: ANALYTICAL, CLASSIFICATION, PREDICTION, SEGMENTATION, ANY

requiredNumberOfModels="*number-of-models*"
specifies the number of models that are processed in this report.

level="folder"
specifies where the report is to obtain a list of models. If folder is VERSION, the report creates a list of models in the version. If folder is PROJECT, the report creates a list of models from all versions in the project.

Valid values: VERSION, PROJECT

<SourceCode>
<PreCode filename="*pre-code-filename*.sas"/>
<Code filename="*report-code-filename*.sas"/>
</SourceCode>
specifies the files that are used to execute the report.

<PreCode filename="*pre-code-filename*.sas"/>
specifies the name of the SAS program that contains macro variable definitions.

<Code filename="*report-code-filename*.sas"/>
specifies the name of the SAS program that creates the report.

<Output format="*output-format*" filename="*output-report-name*"/>
specifies the output format arguments:

format="*output-format*"
specifies the format of the report output.

Valid values: HTML, PDF, or RTF

filename="*output-report-name*"
specifies the name of the output report.

<Parameters> Element Argument

<Parameter name="*parameter-name*" value="*parameter-value*" />
This element is not used. It is reserved for future use.

Edit a SAS Program on the SAS Content Server

1. From the Projects category view, click ⋮, and select **Templates** ⇨ **Manage Templates**. The Manage Templates window appears.
2. Select an XML template, SAS code file, or user-defined properties template to edit. In order for the template to be editable, the **Reserved** column must be marked as **No**. Life cycle templates cannot be edited but can be viewed.
3. Click **Edit**. Make your changes and click **Save**.
4. Click **Close**.

Delete a SAS Program from the SAS Content Server

Deleting a User Report SAS Content Server is a two-step process. You must delete the SAS program and the report template.

1. From the Projects category view, click ⋮, and select **Templates** ⇨ **Manage Templates**. The Manage Templates window appears.
2. Select an XML template, SAS code file, or user-defined properties template to delete. The **Reserved** column must be marked as **No** to delete a file. The user-defined properties template file cannot be deleted.
3. Click **Delete**. A confirmation window appears.
4. Click **Delete** to delete the file.
5. Click **Close**.

Run a User-Defined Report

1. On the **Reports** tab of your project, click **New report** and select your user-defined report. The New Report window appears.
2. Enter a name and description if you do not want to use the default values.
3. Select an output type. The default is PDF.
4. Select a style for the report. When the SAS default option is selected, the default style and themes are used in generating the report.
5. From the list, select the models that you want to include in the report.
6. Click **Run**. The report is generated and appears in the default viewer for the selected output type.

See Also

“View Reports” on page 222

Example User-Defined Report

Overview of the Example User-Defined Report

The example user-defined report categorizes scoring values into score ranges and then graphs the results. The program name is Score Range Report. The following SAS programs and report template file are required to create this report:

- The SAS report program is the file ScoreRange.sas
- The SAS program file that contains macro variables is ScoreRangeMacro.sas
- The report template XML file is ScoreRangeTemplate.xml

SAS Report Program

Here is the SAS code for a user-defined report to categorize score codes:

```
filename mmreport catalog "sashelp.modelmgr.reportexportmacros.source";
%include mmreport;

%MM_ExportReportsBegin(fileName=scoreRange);

options NOmprint NOdate;
%let _MM_PosteriorVar=P_1;


proc format;
  value score
    low - 400 = '400 and Below'
    401 - 450 = '401 - 450'
    451 - 500 = '451 - 500'
    501 - 550 = '501 - 550'
    551 - 600 = '551 - 600'
    601 - 650 = '601 - 650'
    651 - 700 = '651 - 700'
    701 - 750 = '701 - 750'
    751 - 800 = '751 - 800'
    801 - high= '801 and Above';
run;
quit;

%Macro scoreRange();

  %if &_MM_ScoreCodeType = %str(SAS Program) %then
```

```
    %do;
       %let _MM_OutputDS=work.scoreresult;
       %inc &_MM_Score;
    %end;
  %else
    %do;
       data work.scoreresult;
       set &_MM_InputDS;
       %inc &_MM_Score;
       run;
    %end;

  data work.scoreresult2;
    set work.scoreresult;
    keep score;
    if &_MM_PosteriorVar =. then delete;
    score = int (((1-&_MM_PosteriorVar) * 480) + 350 + 0.5);
  run;

  proc freq data=work.scoreresult2;
    table score/out=scoresummary;
    format score score.;
    title 'Credit Score Range';
  quit;

  proc gchart data=work.scoresummary;
    hbar score / sumvar=count discrete;
    title 'Credit Score Range';
  run;
  quit;
%Mend scoreRange;

/*   Reporting section */

ods listing close;

%getModelInfo(0);

/* Define libref and data source for _MM_InputDS */
libname MMLib 'C:\SMM143Samples\Data';
%let _MM_InputDS=MMLib.DELINQUENCY_SCORING_INPUT;

%scoreRange();
%closeLibsAndFiles();

%MM_ExportReportsEnd;
```

SAS Program File for Macro Variables

The file ScoreRangeMacro.sas contains only a comment in it because macro variables are not used in the report code:

```
/* ScoreRangeMacro.sas empty file   */
```

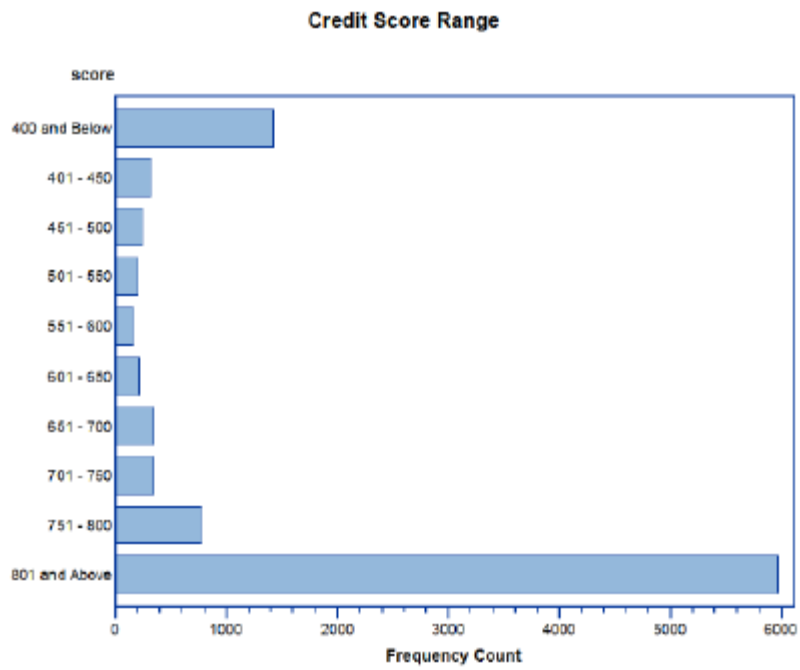
Report Template XML File

Here is the report template XML file for the user-defined Score Range report:

```
<?xml version="1.0" encoding="UTF-8" ?>
<ReportTemplate
    name="Score Range Report"
    type="UserDefinedReport"
    displayName="Score Range Report"
    description="Score Range Report"
    >
    <Report>
        <Data datasetName=""/>
        <Models expectedModelType="ANALYTICAL"
           requiredNumberOfModels="1" level="VERSION">
        </Models>
        <SourceCode>
            <PreCode filename="ScoreRangeMacro.sas"/>
            <Code filename="ScoreRange.sas"/>
        </SourceCode>
        <Output format="PDF" filename="ScoreRange"/>
    </Report>
    <Parameters>
    </Parameters>
</ReportTemplate>
```

Score Range Report Output

The Credit Score Range graph is one of the output pages in the PDF report output.


Credit Score Range
score
400 and Below
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 750
751 - 800
801 and Above
0
1000
2000
3000
4000
5000
6000
Frequency Count

15

Combining Reports

About Aggregated Reports

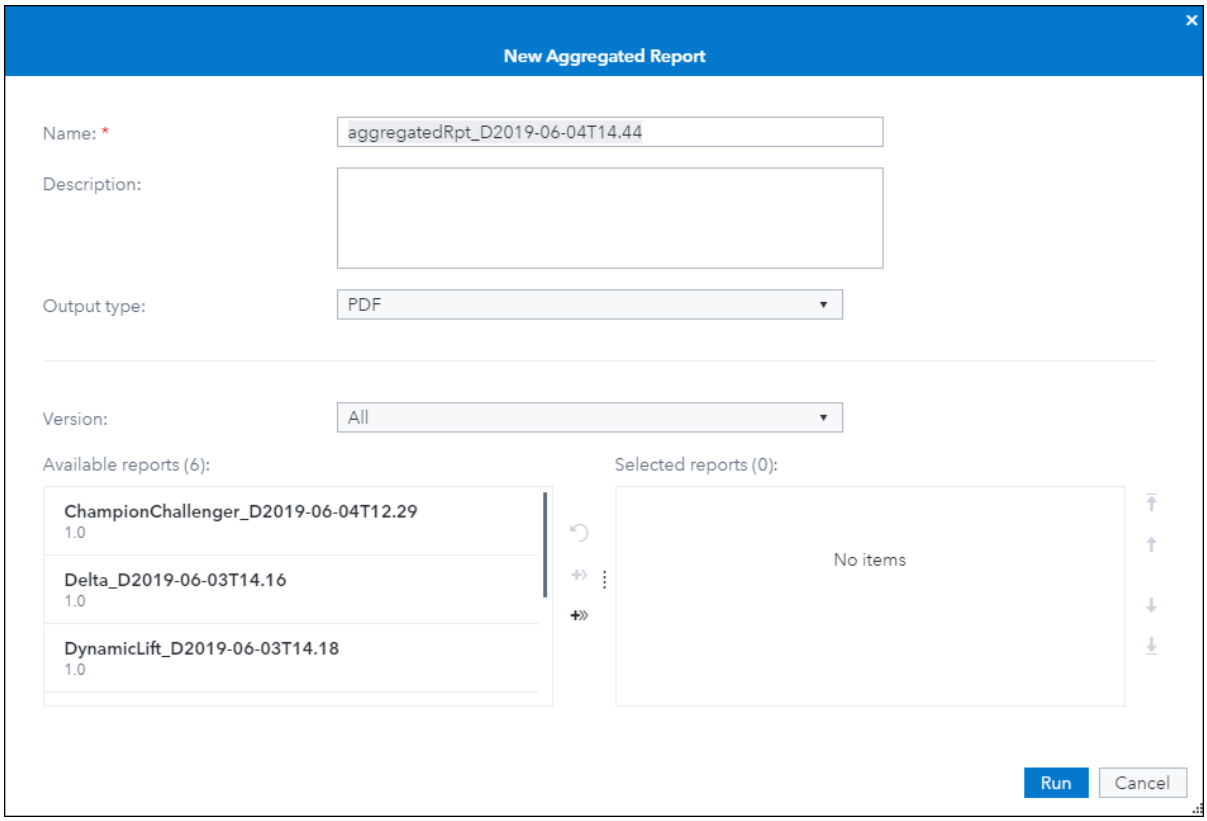
SAS Decision Manager administrators and advanced users can combine multiple reports from the **Reports** tab to create a single, aggregated report. Using reports that reside in the **Reports** tab, you select the reports that you want in your aggregated report. The format of the report can be PDF, HTML, or RTF. Aggregated reports are stored on the **Aggregated** tab.

Ad hoc reports, Loss Given Default (LGD) reports, and Probability of Default Model Validation (PD) reports cannot be added to an aggregated report.

Create an Aggregated Report

Note: To create an aggregated report, you must have existing reports on the **Reports** tab.

1. On the **Aggregated** tab on the **Reports** tab, click **New Report**. The New Aggregated Report window appears.



2 (Optional) Enter a name and a description for the report.

3 Select an output type. The default is PDF.

4 (Optional) To filter the version of the available reports, select a version from the drop-down menu. **All** is selected by default.

5 To add reports from the **Available reports** section, select a report. Click ›+ to move one report. You can also Ctrl + click to select multiple reports to move. Click »+ to move all reports. The report or reports appear in the **Selected reports** section.

6 To order the reports, select a report and use the up and down arrows.

7 To remove reports from the **Selected reports** section, select a report. Click ‹– to remove one report. You can also Ctrl + click to select multiple reports to remove. Click «– to remove all reports.

Note: Click ↺ to remove the last report or reports added to **Selected reports**.

8 When all of the reports are in the **Selected reports** section and in the correct order, click **Run**. The report is generated and appears in the default viewer for the selected output type.

9 The report appears in a list on the **Aggregated** reports tab.

View an Aggregated Report

1. On the **Aggregated** tab, select a report from the list.
2. To view an aggregated report:
   - Click the report type icon in the list.
   - Select a report from the list and click .

   Note: You can also view the SAS code and SAS log.
   - Click to view the SAS code.
   - Click to view the SAS log.

Note: If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.

Delete an Aggregated Report

1. On the **Aggregated** tab, select a report from the list.
2. Click .
3. Click **Delete** in the confirmation message.

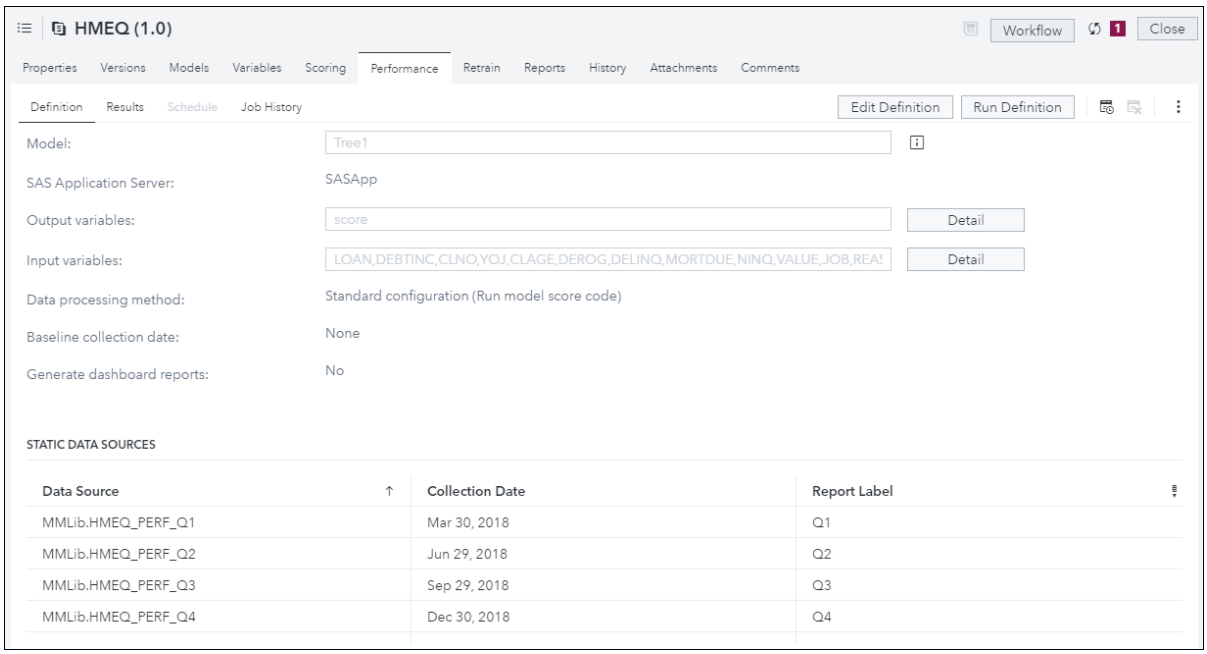
16

Monitoring Performance of Models

Overview of Performance Monitoring

To ensure that a champion model in a production environment is performing efficiently, you can collect performance data that has been created by the model at intervals that are determined by your organization. A performance data set is used to assess model prediction accuracy. It includes all of the required input variables as well as one or more actual target variables. For example, you might want to create performance data sets monthly or quarterly and then use SAS Decision Manager to create a performance definition that includes each time interval. After you create and execute the performance definition on the **Performance** tab, you can view the performance data through report charts in SAS Decision Manager. These report charts give a graphical representation of the model's performance. SAS Decision Manager also enables you to create performance monitoring reports in PDF, HTML, and RTF output formats from the **Reports** tab.

Note: Performance monitoring is designed to work only with a project that is associated with a classification model function and has a binary target, or with a prediction model function and has an interval target. Only models that are associated with the classification and prediction model types and that are set as champion and challenger models can be monitored for performance.



The following types of output for performance monitoring are available:

- Summaries of the types of information in project folders such as the number of models, model age distribution, input variables, and target variables.
- Reports that detect and quantify shifts in the distribution of variable values over time that occur in input data and scored output data.

- Performance monitoring reports that evaluate the predicted and actual target values for a champion model at multiple points in time.

You can create the performance monitoring output, except for summaries, using either of the following methods:

- On the **Performance** tab, generate the SAS code that creates the performance output and then run the generated code.
- Write your own SAS program using the report creation macros that are provided with SAS Decision Manager and submit your program as a batch job. You can run your SAS program in any SAS session as long as the SAS session can access the SAS Content Server.

After you create and execute a performance definition, you view the report charts by selecting the **Results** tab on the **Performance** tab. The report charts are interactive, and you can modify them to help you assess the champion model performance. For example, you can show markers in the charts and show tables for the different types of reports. You can also select different variables for the X axis and display them in the chart for the Variable Distribution Report.

If you have flagged a challenger model to compare with the champion model, you can use the performance data that you collected for the champion model to create reports for the challenger model. After all of the performance monitoring definitions have been run, you can create a Champion and Challenger Performance report that compares the champion model to the challenger model.

Types of Performance Monitoring

Overview of the Types of Performance Monitoring

After a champion model is in production, you can monitor the performance of the model by analyzing the performance results. You can create the performance output interactively using the performance definition on the **Performance** tab of a project or you can submit batch programs within SAS.

You can create the following types of performance output:

Summary Results
: The summary results include the number of models, the number of versions, the number of scoring tests, and the number of reports. The summary information enables you to compare the contents of folders, projects, and versions. You can view the summary results at the project-level or folder level. For more information, see “Summary Results” on page 246.

Data Composition Reports
: The Variable Distribution report shows you the distributions for a variable in one or more time periods, which enables you to see the differences and changes over time. The Characteristic and Stability reports detect and quantify shifts in the distribution of variable values that occur in input data and scored output data over time. By analyzing these shifts, you can gain insights on scoring input and output variables. For more information, see “Data Composition Reports” on page 247.

Model Monitoring Reports

The model monitoring reports are a collection of performance assessment reports that evaluate the predicted and actual target values. The model monitoring reports create several charts:

- Characteristic and Stability
- Lift
- Gini - ROC (Receiver Operating Characteristic)
- Gini - Trend
- KS
- MSE (Mean Squared Error) for prediction models

For more information, see "Model Monitoring Reports" on page 248.

When you create Data Composition reports and Model Monitoring reports, you can set performance index warnings and alerts. When certain thresholds are met, SAS Decision Manager can send a warning and alert notification to email addresses that you configure either in the performance definition or in a SAS program.

You view the Data Composition reports and the Model Monitoring reports on the **Results** tab on the **Performance** tab.

Summary Results

The summary results include the contents of different folders and projects.

The contents of the Summary results is dynamic and is updated according to the selected project. The scope of the information that is reported is defined by the collection of folders and objects that exist beneath the folder that is selected.

You can view the summary results at the project-level by selecting a project, clicking ⋮, and then selecting **View summary** ⇨ **for a project**. The Project Summary window displays the summary information for the selected project.

You can also view the summary information at the folder level by clicking ⋮, and then selecting **View summary** ⇨ **for folder**. In the Folder Summary window click 🗀. The summary information is displayed for the selected folder.

Use the following sections to evaluate and compare the contents of the project:

General

Use the **General** section to browse the number of models, the number of versions, the number of scoring tests, and the number of reports.

Model Target Variables

Use the **Model Target Variables** section to see the frequency with which target variables are used in the models that exist for the selected object. Each unique model target variable is reported, listing the number of models that use that variable as a target variable.

Model Input Variables

Use the **Model Input Variables** section to see the frequency with which input variables are used in the models for a folder or project. Each unique model input variable is reported, listing the number of models that use that variable as an input variable.

Data Composition Reports

Variable Distribution Report

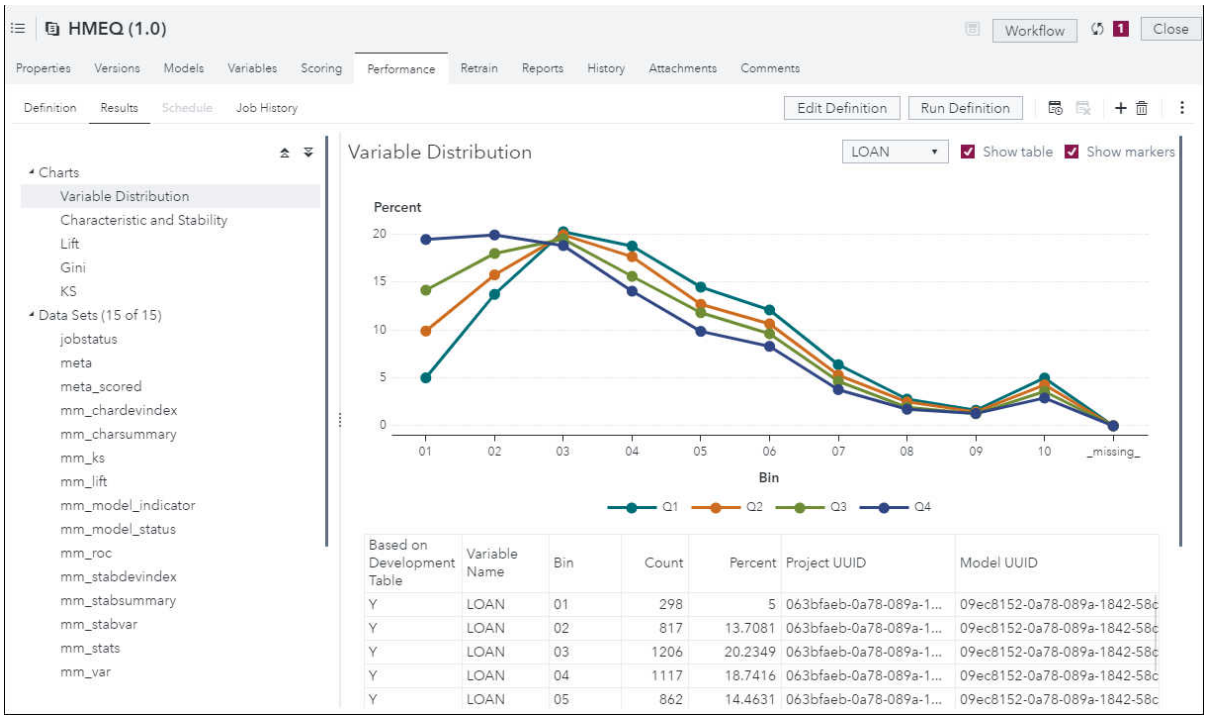
Select the **Results** tab on the **Performance** tab to view the **Variable Distribution** report.

Note: If there are multiple project versions, you must make sure that the displayed version is the champion version in order to see the performance results.

The variable distribution chart is a graphical representation of distributions over a period of time for the selected variable. Each line plot represents the data for a specific period of time. The Y axis is the percentage of observations in a bin that is proportional to the total count.

To change the variable that appears in the chart, select a variable from the drop-down list.

Here is an example of a Variable Distribution report. By placing the cursor over a point in the chart, you can view the data for that point.



Model Monitoring Reports

Characteristic and Stability Reports

Together, the Characteristic and Stability reports detect and quantify shifts that can occur in the distribution of model performance data, scoring input data, and the scored output data that a model produces.

Note: For each time period that you execute a performance definition, SAS Decision Manager creates a new point on the charts. Line segments between points in time do not appear on the charts unless you specify at least three data sources and collection dates as part of the performance definition.

Characteristic Report

The Characteristic report detects and quantifies the shifts in the distribution of variable values in the input data over time. These shifts can point to significant changes in customer behavior that are due to new technology, competition, marketing promotions, new laws, or other influences.

To find shifts, the Characteristic report compares the distributions of the variables in these two data sets:

- the training data set that was used to develop the model
- a current data set

If large enough shifts occur in the distribution of variable values over time, the original model might not be the best predictive or classification tool to use with the current data.

The Characteristic report uses a deviation index to quantify the shifts in a variable's values distribution that can occur between the training data set and the current data set. The deviation index is computed for each predictor variable in the data set, using this equation:

$$\text{Deviation\_Index} = \sum \left(\%\,Actual - \%\,Expected \right) \times ln \left(\frac{\%\,Actual}{\%\,Expected} \right)$$

Numeric predictor variable values are placed into bins for frequency analysis. Outlier values are removed to facilitate better placement of values and to avoid scenarios that can aggregate most observations into a single bin.

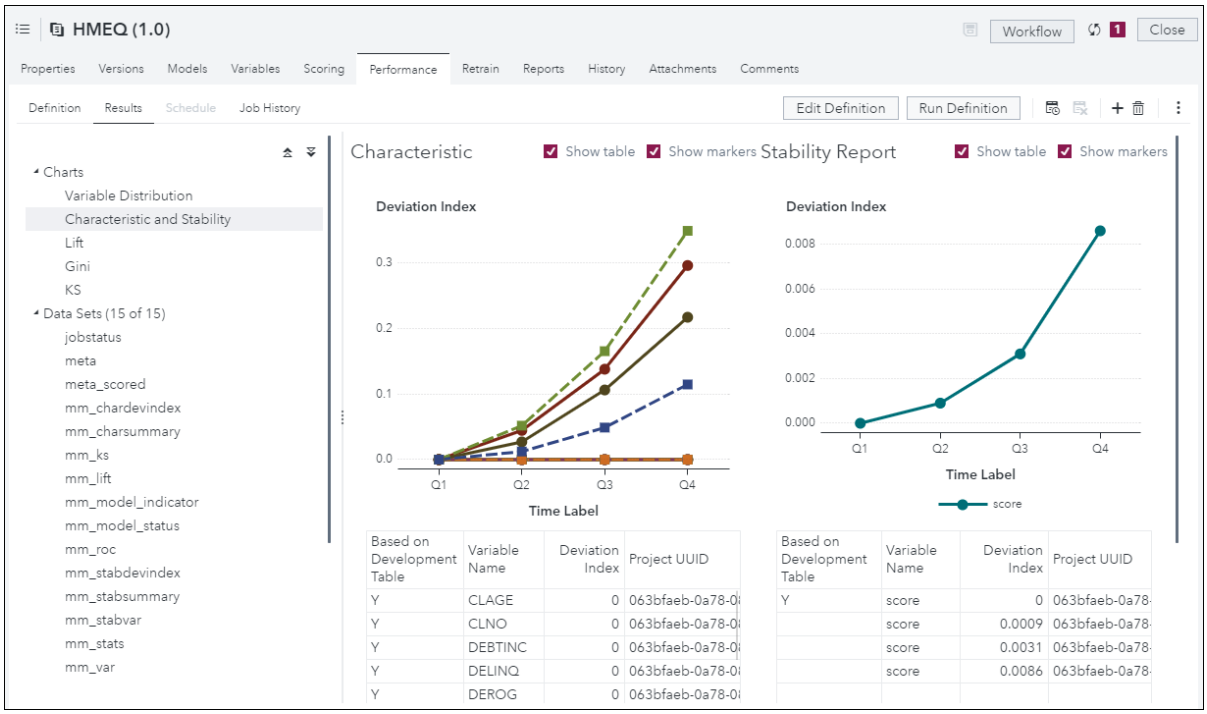
If the training data set and the current data set have identical distributions for a variable, the variable's deviation index is equal to 0. A model with a deviation index value that is P1>2 is classified as having a mild deviation. The Characteristic report uses the performance measure P1 to count the number of variables that receive a deviation index value that is greater than 0.1.

A model that has a deviation index value that is P1>5 or P25>0 is classified as having a significant deviation. A performance measure P25 is used to count the number of variables that have significant deviations, or the number of input variables that receive a deviation index score value that is greater than or equal to 0.25.

Stability Report

The Stability report evaluates changes in the distribution of scored output variable values as models score data over time, and detects and quantifies shifts in the distribution of output variable values in the data that is produced by the models. If an output variable from the training data set and the output variable from the current data set have identical distributions, then that output variable's deviation index is equal to 0. An output variable with a deviation index value that is greater than 0.10 and less than 0.25 is classified as having a mild deviation. A variable that has a deviation index value that is greater than 0.30 is classified as having a significant deviation. Too much deviation in predictive variable output can indicate that model tuning, retraining, or replacement might be necessary.

Here is an example of Characteristic and Stability reports. By placing the cursor over a point in the chart, you can view the data for that point.

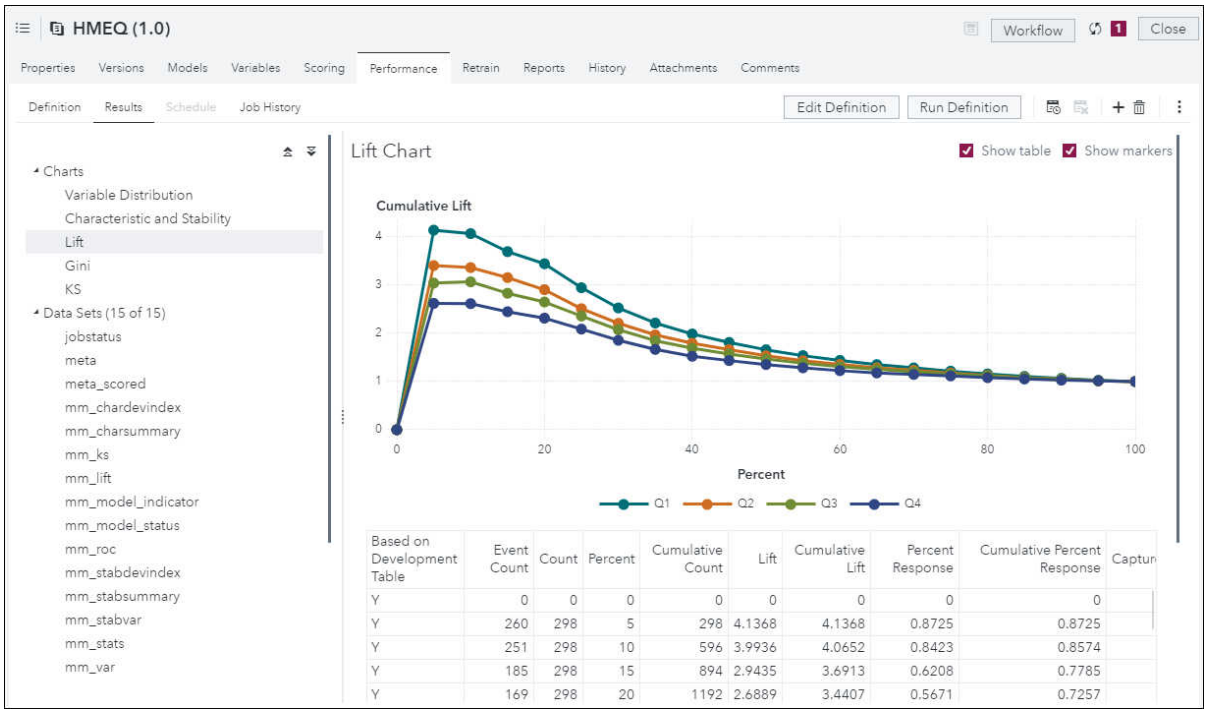


Lift Report

The Lift report provides a visual summary of the usefulness of the information that is provided by a model for predicting a binary outcome variable. Specifically, the report summarizes the utility that you can expect by using the champion model as compared to using baseline information only. Baseline information is the prediction accuracy performance of the initial performance monitoring definition or batch program using operational data.

A monitoring Lift report can show a model's cumulative lift at a given point in time or the sequential lift performance of a model's lift over time. To detect model performance degradation, you can set the Lift report performance indexes Lift5Decay, Lift10Decay, Lift15Decay, and Lift20Decay. The data that underlies the Lift report is contained in the report file mm_lift.sas7bdat. This file is available on the **Attachments** tab.

Here is an example of a monitoring Lift report. By placing the cursor over a point in the report, you can view the data for that point.



Based on Development Table	Event Count	Count	Percent	Cumulative Count	Lift	Cumulative Lift	Percent Response	Cumulative Percent Response	Captur
Y	0	0	0	0	0	0	0	0	
Y	260	298	5	298	4.1368	4.1368	0.8725	0.8725	
Y	251	298	10	596	3.9936	4.0652	0.8423	0.8574	
Y	185	298	15	894	2.9435	3.6913	0.6208	0.7785	
Y	169	298	20	1192	2.6889	3.4407	0.5671	0.7257	

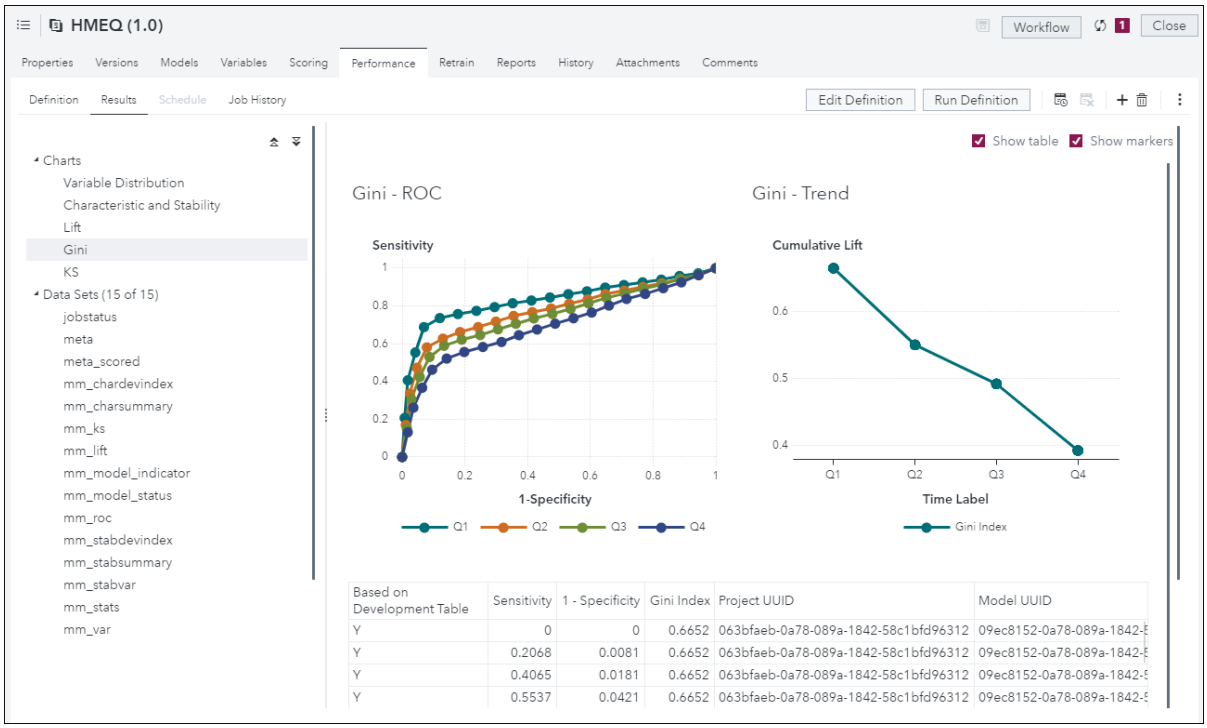
Gini (ROC and Trend) Report

The **Gini (ROC and Trend)** reports show you the predictive accuracy of a model that has a binary target. The plot displays sensitivity information about the Y axis and 1-Specificity information about the X axis. Sensitivity is the proportion of true positive events. Specificity is the proportion of true negative events. The Gini index is calculated for each ROC curve. The Gini coefficient is a benchmark statistic that can be used to summarize the predictive accuracy of a model.

Use the monitoring **Gini (ROC and Trend)** report to detect degradations in the predictive power of a model, and is directly related to the area under the ROC curve (2*AUC-1).

The data that underlies the monitoring **Gini (ROC and Trend)** report is contained in the report component file mm_roc.sas7bdat.

Here is an example of a monitoring **Gini (ROC and Trend)** report. By placing the cursor over a point in the chart, you can view the data for that point.



KS Report

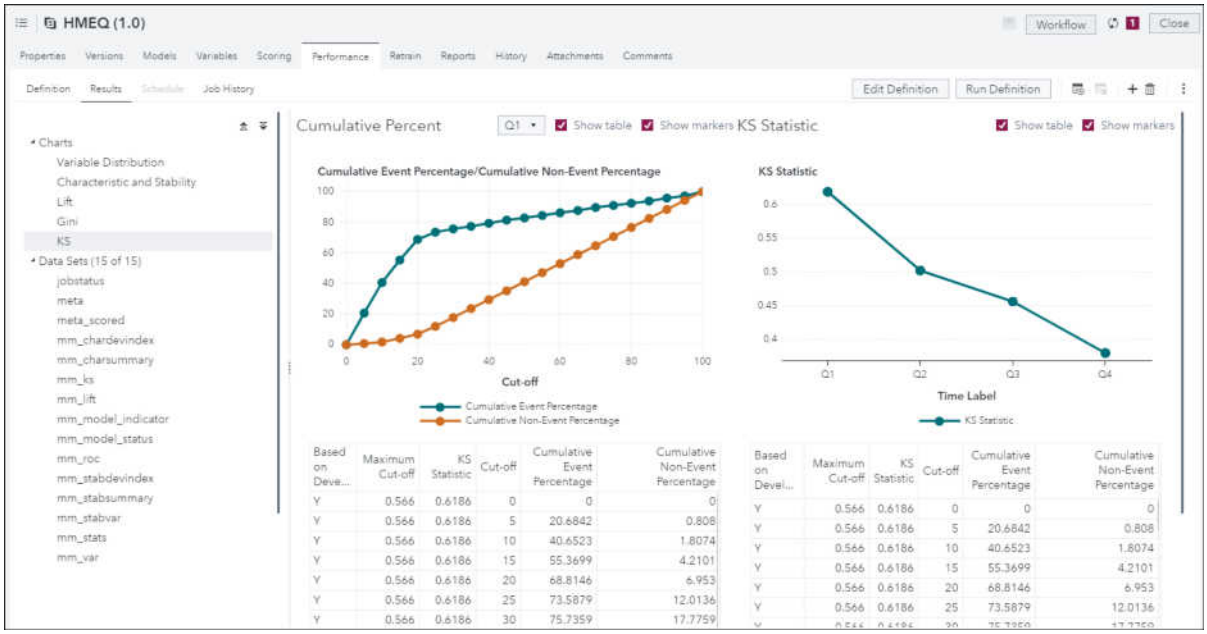
The KS report contains the Kolmogorov-Smirnov (KS) test plots for models with a binary target. The KS statistic measures the maximum vertical separation, or deviation between the cumulative distributions of events and non-events. This trend report uses a summary data set that plots the KS statistic and the KS probability cutoff values over time.

Use the KS report to detect degradations in the predictive power of a model. To scroll through a successive series of KS performance depictions, select a time interval from the **Time Interval** list box. If model performance is declining, it is indicated by the decreasing distances between the KS plot lines.

To detect model performance degradation, you can set the ksDecay performance index in the KS report.

The data that underlies the KS chart is contained in the report component file mm_ks.sas7bdat.

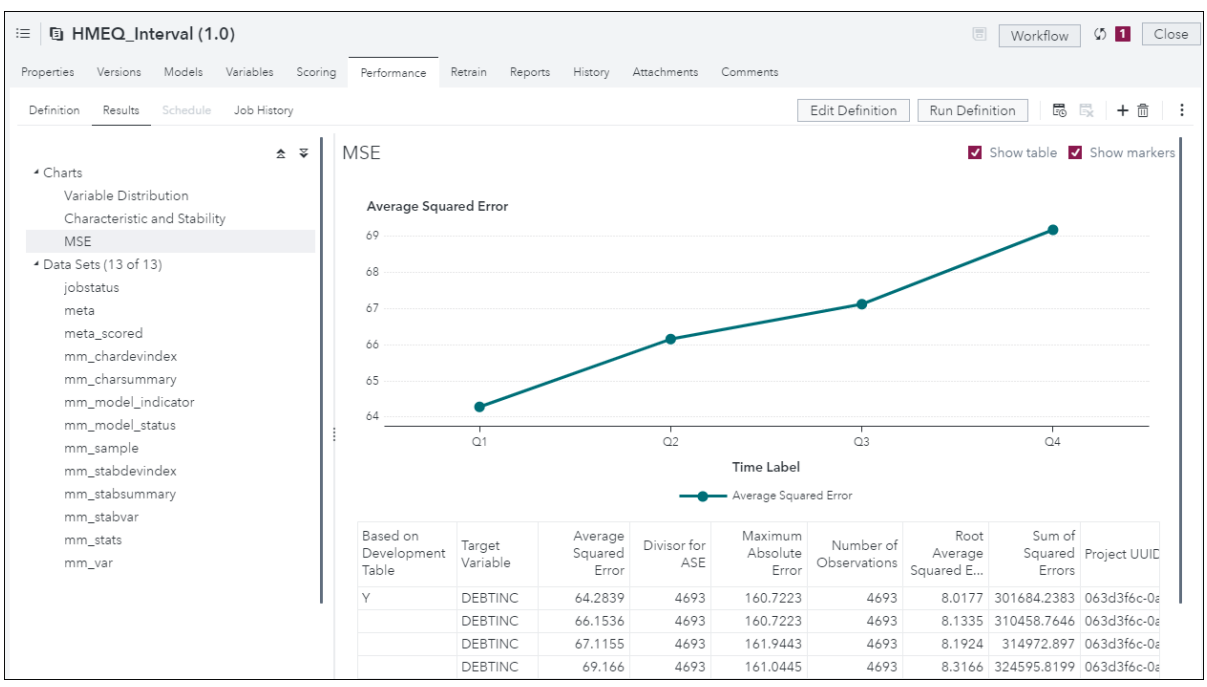
Here is an example of a KS report. By placing the cursor over a point in the chart, you can view the data for that point.



Mean Squared Error Report

The Mean Squared Error (MSE) report checks the accuracy of a prediction model with an interval target by comparing the estimation derived from the test data and the actual outcomes that are associated with the test data for different time periods.

Here is an example of an MSE report.



Performance Index Warnings and Alerts

The production model performance reports use performance measurement thresholds to benchmark and gauge the performance of a predictive model. When one of the performance measurements exceeds one or more specified indexes or thresholds, warning and alert events occur. When warning or alert events occur, warning and alert notifications are automatically sent by email to recipients whose email address is configured either in the Edit Performance Definition wizard or in the batch program that runs the reports.

Use the following assignment statements to set warning and alert conditions:

```
alertCondition='alert-condition';
warningCondition='warning-condition';
```

Note: The condition must be enclosed in quotation marks if you use SAS code to create the report. An error occurs if you enclose the condition in quotation marks in the Edit Performance Definition wizard.

The following indexes and thresholds can be configured in either the Edit Performance Definition wizard or in a batch program that creates the report specifications:

Characteristic report
: You can configure the thresholds for the performance indexes P1 and P25. The P1 and P25 indexes represent the count of input variables with deviation index scores exceeding 0.1 and 0.25, respectively. Here is an example of alert and warning thresholds:

```
alertCondition='p1>5 or p25>0';
warningCondition='p1>2';
```

Stability report
: You can configure output deviation index scores for a model's output variable. The output deviation index scores represent the deviation levels in the distribution of the model's scored output variables. Here is an example of alert and warning thresholds:

```
alertCondition='outputDeviation>0.03';
warningCondition='outputDeviation>0.01';
```

Model Assessment reports
: For the Lift, Gini (ROC and Trend), and KS reports, you can configure threshold values for the following decay statistics.

  lift5Decay
  : is the lift performance decay based on the top 5% of the target population of interest from time A to time B.

  lift10Decay
  : is the lift performance decay based on the top 10% of the target population of interest from time A to time B

lift15Decay
: is the lift performance decay based on the top 15% of the target population of interest from time A to time B.

lift20Decay
: is the lift performance decay based on the top 20% of the target population of interest from time A to time B.

giniDecay
: is the performance decay of the Gini index from time A to time B.

ksDecay
: is the performance decay of the KS statistic from time A to time B.

For the prediction model MSE report, you can configure the mseDecay statistic threshold values. The mseDecay statistic is the performance decay of the MSE statistic from time A to time B.

Here is an example of alert and warning thresholds:

```
alertCondition='(lift5Decay>0.15 and lift10Decay>0.12)
                            or giniDecay>0.1 or ksDecay>0.1';
warningCondition='lift5Decay>0.05';
```

Monitoring Champion Models

Your project plan might include a schedule to monitor the champion model performance, or your plan might require that you monitor the performance at any time. For each time period that you monitor the champion model, you take a snapshot of the data for that time period and use that data as the performance data source for creating the monitoring reports.

You can create monitoring reports by creating and executing a performance definition, or you can submit batch programs to create the reports. Both methods require the same information. Both methods can process one or more performance data sources. When you create a performance definition, you can specify one or more data sources to process. When you use a batch program, you use a separate DATA step to process each data source.

If you run batch programs, you can find example programs in the sashelp.modelmgr.source catalog. These reports' filenames are **reportexample** *x*, where *x* is a number from 1 to 4.

The following table lists the definitions that are required to create performance reports:

Definition	Reports Created by Using the Performance Definition	Reports Created Using SAS Programs That Run in Batch
Create a folder structure for report files	The folder structure is inherent in the Project. No action is necessary.	Create a folder structure on a local drive of the SAS Model Manager server.

Definition	Reports Created by Using the Performance Definition	Reports Created Using SAS Programs That Run in Batch
Obtain performance data	The performance data is one or more SAS data sets that are a snapshot of model output. They can be registered in SAS Management Console or they can be accessed by using a libref that has been defined by using the Edit Start-up Code window.	The performance data is used to assess model prediction accuracy. It includes all of the required scoring input variables as well as one or more actual target variables. You can store performance data sets anywhere as long as they can be accessed by the SAS session that runs the batch program. The data sets do not need to be registered with SAS Management Console.
Ensure access to the champion or challenger model	This process is performed by the Edit Performance Definition wizard. No action is necessary.	Run the %MM_GetModels() macro to extract the champion model in a channel to a local drive of the SAS Model Manager server.
Map model and project output variables.	Map the model and project output variables using the Project Tree.	Map the model and project output variables using the Project Tree.
Define report specifications	The report specification are derived from project data and input that you specify in the Edit Performance Definition wizard. The wizard generates the SAS code to create the performance reports.	Write the following DATA steps: ■ mm_jobs.project ■ mm_jobs.emailaddr ■ mm_jobs.reportdef ■ mm_jobs.jobtime
Specify the report execution operational environment	The operational environment is known to SAS Decision Manager. No action is necessary.	Define the required macro variables that are used by the %MM_RunReports() macro.
Run the reports	Run the code from the **Performance** tab that was generated by the performance definition or schedule the performance definition from the **Performance** tab. The data sets that underlie the monitoring reports are stored in the **Results** tab.	Create a DATA step that points to the performance data sets and execute the %MM_RunReports() macro. The data sets that underlie the monitoring reports are stored in the **Results** tab when the reports are created in production mode. In Test mode, the monitoring reports data sets reside in the location specified in the mm_jobs.project data set.
View the reports	Select the **Performance** tab for the champion model to view the reports.	Select the **Performance** tab for the champion model to view the reports.

Creating Reports Using a Performance Definition

Overview of Creating Reports Using a Performance Definition

You define and execute a performance definition for a project. The model that you monitor is either the project champion model or a challenger model that is flagged in any version for the project. The process of creating performance reports is a two-step process. First, you run the Edit Performance Definition wizard to generate the code that creates the performance data results. Then, you execute the generated code. You can execute the code immediately, or you can schedule a date and time at which the definition is to run. Information about performance definitions is recorded and can be viewed on the **Results** tab of the **Performance** tab.

To create performance reports:

- Ensure that one or more performance data sources are registered using SAS Management Console or that a libref has been defined for the location where the performance data sets are stored.
- Ensure that all prerequisites have been completed.
- Create a performance definition to generate the SAS code that is used to create the performance reports.
- Run the generated code or schedule when the generated code is to be executed.
- To view the reports, select the **Results** tab on the **Performance** tab.

Determine How to Use the Performance Data Sets

Before you run the Edit Performance Definition wizard, the performance data sets must be registered in the SAS Metadata Repository. You can register the data sets in the Data category view or you can add tables to an existing library that have already been registered using SAS Management Console. For each project, you can set up your environment to use the performance data source that is most appropriate for your business process. Here are two methods of collecting performance data:

- Method 1: You periodically take a snapshot of an operational data set to create a performance data set. Each time you take a snapshot, you give the performance data set a new name. Each performance data set must be registered in the SAS

Metadata Repository and it must be available in the **Data** category view. You can create and execute a performance monitoring definition each time you take a snapshot, or you can create a performance monitoring definition to execute multiple performance data sets in the same definition. The best practice is to use the dynamic data sources in the performance definition.

- Method 2: You take a snapshot of the operational data set to create a performance data set over time, and you reuse the same name for each performance data set every time you take a snapshot. You register the performance data set in the SAS Metadata Repository only once. The performance data set must be available in the **Data** category view. Each time you take a snapshot, you replace the performance data set at the location where the performance data set is registered.

  When you run the Edit Performance Definition wizard, the name of the performance data source does not change. The **Default performance table** project property is not populated in the Edit Performance Definition wizard. You modify only the **Collection Date** and **Report Label** columns in the table.

The following table summarizes the definitions that are performed if performance reports are run after six months or for reports that are run every month. Use this definition and example table to help you determine how you want to name your performance data sets and your performance data sources.

Definition	Method 1: The Performance Data Set Name Changes	Method 2: The Performance Data Set Name Remains Static
Create a performance data set from model output data	Each month, take a snapshot of the operational data and create a performance data set with a different name: ■ Jul13 ■ Aug13 ■ Sep13 ■ Oct13 ■ Nov13 Dec13	Every month, take a snapshot of the operational data and name the performance data set using the same name: 2013perf
If you are registering the performance data sets in the SAS Metadata Repository, register the performance data sets using SAS Management Console	Register the data sets monthly or register them all at once before you run the reports.	Register the data sets the first month only.
If the performance data set is accessed by using a libref, store the data set in the SAS library.	Save the performance data set in the SAS library that is defined by a libref in SAS Decision Manager.	Save the performance data set in the SAS library that is defined by a libref in SAS Decision Manager.

Definition	Method 1: The Performance Data Set Name Changes	Method 2: The Performance Data Set Name Remains Static
Modifications to make in the Edit Performance Definition wizard	In Step 3, select one or more performance data sources. For each data source, select a data collection date and enter a date label.	In Step 3, select a data collection date and enter a date label. The **Performance data source** field contains the static name of the performance data source name because it was specified for the previous execution of the definition for this project.
Create the reports	Create a performance definition and run the definition from the **Performance** tab or schedule when the definition is to execute. Because each performance data source has a different name, you can run the performance definition as desired; the definition does not need to be run monthly.	Monthly, run the performance definition from the **Performance** tab or schedule when the definition is to execute. To ensure that you do not write over important performance data, run the performance definition before a new snapshot of the operational data is taken.

Prerequisites for Creating a Performance Definition

Overview of Prerequisites

Before you create a performance definition, the environment must be set appropriately as follows:

- Ensure that the champion model is set.
- Ensure that the champion or challenger model is within a project that is associated with a classification model function and has a binary target, or that is associated with a prediction model function and has an interval target.

- Ensure that the champion or challenger model contains a score.sas file. If the performance data set contains the predicted values, the score.sas file can be empty. For more information, see "Monitoring Performance of a Model without Score Code" on page 272.
- Ensure that the performance data sets for the time period that you want to monitor are registered in SAS Management Console or that a libref has been defined for the SAS library where the performance data sets are saved.
- Ensure that the appropriate project and model properties are set.

After the environment is set, you can run the Edit Performance Definition wizard.

Ensure That Champion and Challenger Models Are Set

The performance definition generates report code for the champion model in the champion version or challenger models.

You can determine the champion version by looking at the specific properties section of the **Properties** tab of a project. You can determine the project champion model by looking in the **Role** column on the **Models** tab of a project. If the project champion is not set, see "Set a Champion Model" on page 301.

You can determine the challenger model by looking at the **Role** column on the **Models** tab.

If a challenger model is not set, see "Set a Challenger Model" on page 302.

Ensure That the Champion Model Function and Class Target Level Are Valid

Performance monitoring is valid only for a project that is associated with a classification model function and has a binary target, or for a prediction model function that has an interval target. You should define only performance definitions for classification and prediction models. The champion model must either have a function type of classification and must contain a binary target, or have a function type of prediction and must contain an interval target.

From the **Models** tab of a project, select the champion model name and verify that the **Model function** property in the specific properties section is set to `Classification` or `Prediction`. For models that are created using SAS Enterprise Miner, verify that **Class target level** is set to `Binary` for a classification model or to `Interal` for a prediction model.

Ensure That the Performance Data Source Is Available

The performance definition requires that the performance data sources be registered in the SAS Metadata Repository. You can register the tables using SAS Management Console and then add the registered tables in the Data category of SAS Decision Manager.

If your performance table is not available for selection, contact your administrator to add the table to the Data Library Manager using SAS Management Console. For more information, see the *SAS Decision Manager: Administrator's Guide*.

Ensure That Project and Model Properties Are Set

Several properties must be defined in order to generate the model performance reports. Verify that the appropriate project and model properties are set. Here is a list of properties.

Classification Project Properties

- Training target variable
- Target event value
- Class target level
- Output event probability variable

Prediction Project Properties

- Training target variable
- Class target level
- Output prediction variable

Model Properties

- Score code type

Map Model and Project Output Variables

In order to create the model performance reports, you must map the model output variable to the project output variable if the corresponding project variable and the model variable have different names.

To map the model variables to the project variables:

1. Click the model name to open it.
2. Select **Model Properties** ⇨ **Output Mapping**.

3 Click the box in the **Value** column beside the variable in the **Property** column to display a list of project variables.

4 Select a model output variable.

5 Repeat steps 3 and 4 for each model variable that requires mapping.

6 Click .

Create and Run a Performance Definition

To create the monitoring reports, you specify a performance definition to generate SAS code. You then execute the generated code or create a schedule to execute the generated code on a specific day and time. Execution of the generated code creates the SAS data sets that are used to display reports: either the monitoring reports from the project **Performance** tab, or the Monitoring report or Champion and Challenger Performance report that you create from the New Report window.

Create a New Performance Definition

If a performance definition does not already exist, you can create a new performance definition.

> **IMPORTANT** Ensure that the prerequisites for creating a performance definition on page 258 have been completed.

To create a performance definition:

1 Click to navigate to the Projects category view.

2 Open a project and click the **Performance** tab.

3 Click **New Definition**. The New Performance Definition window appears.

4 On the **Settings** page, perform the following steps:

   a Click **Choose Model** and select a champion or challenger model.

   b Select a SAS Application Server.

   c Select the data processing method:

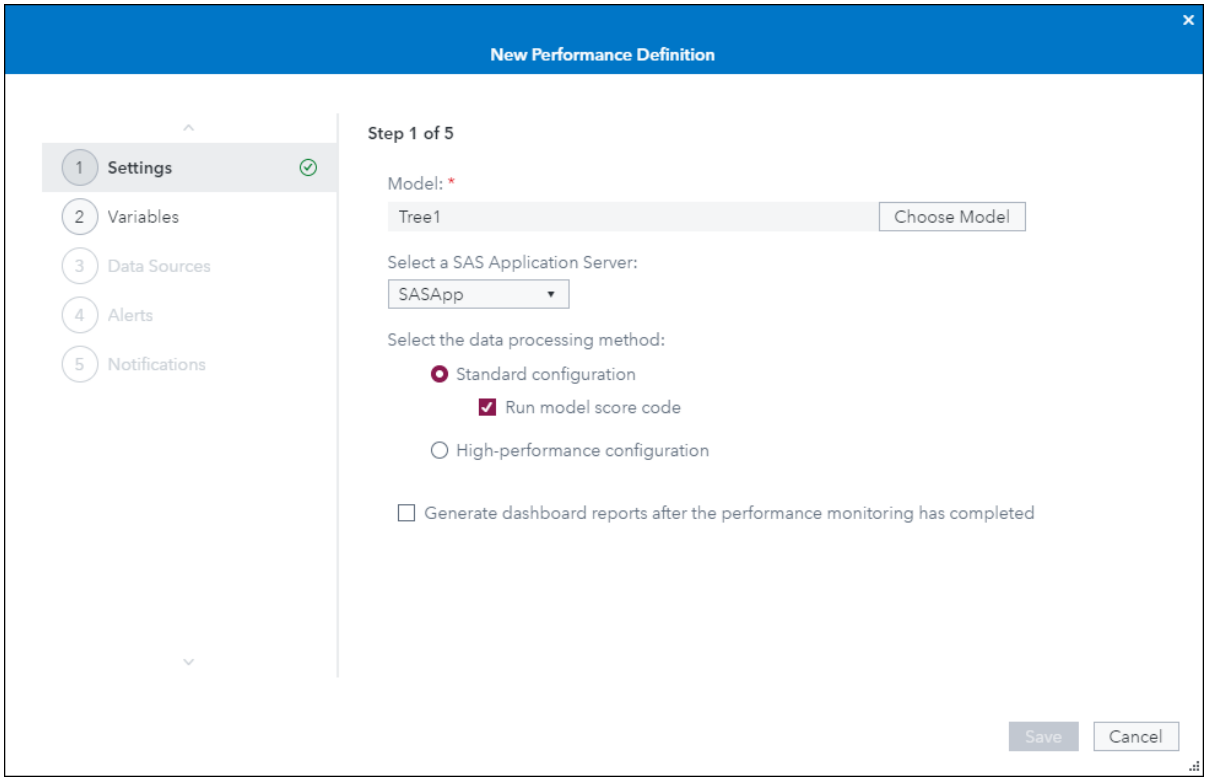
      - To run a standard environment, select **Standard configuration**.

        To run the score code in the performance monitor job, select the **Run model score code** check box.

      - To run the performance monitoring definition in a High-Performance Analytics environment, select **High-performance configuration**.

Note: The score code is not run when **High-performance configuration** is selected.

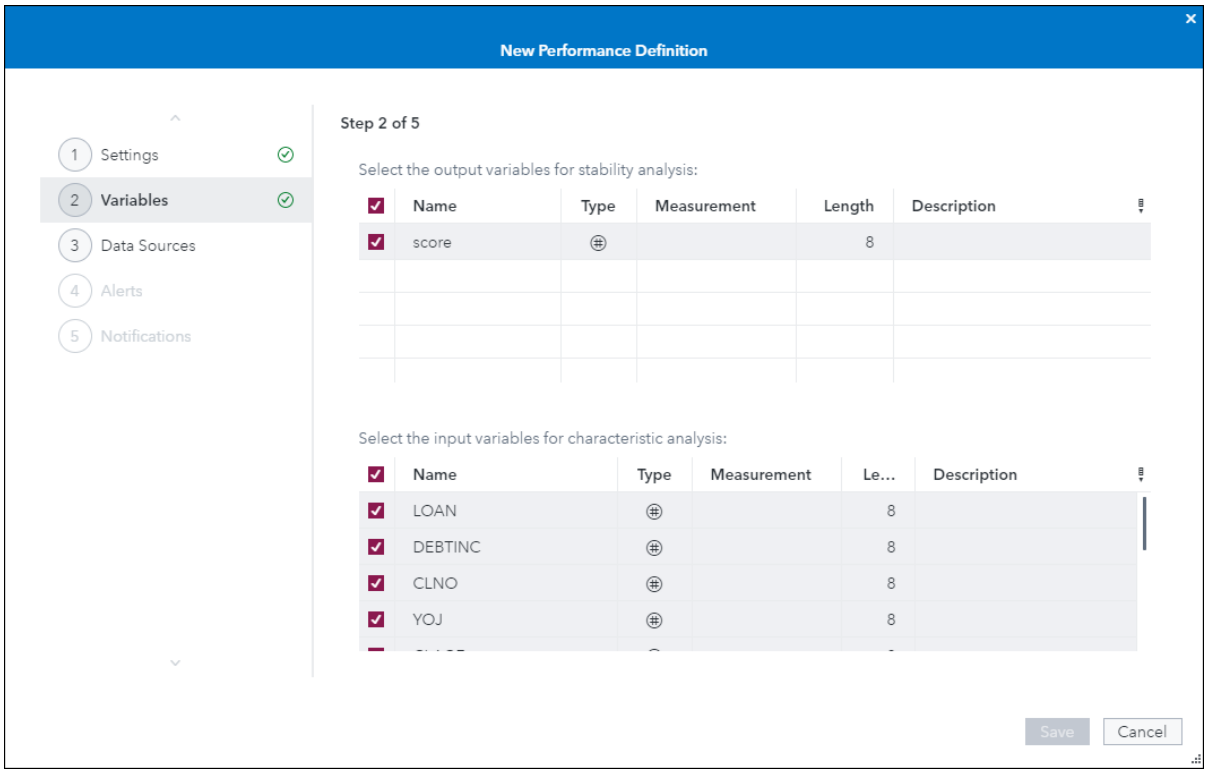
d (Optional) Select **Generate dashboard reports after the performance monitoring has completed**. The dashboard definition must already exist for this option to work.



5 Select the **Variables** page, and perform the following steps:

a Select one or more output variables for stability analysis. To select all output variables, select the check box in the first column title.

b Select one or more input variables for characteristic analysis. To select all input variables, select the check box in the first column title.



6 Select the **Data Sources** page. Select **Static data sources** or **Dynamic data sources** as the data source method, and then specify the data source information.

Note: Ensure that the data source information is complete before saving the definition. If you start adding information for static data sources and then decide to use dynamic data sources instead, be sure to delete the information added for static data sources before adding the dynamic data source information, and vice versa.

To use static data sources:

a Click . The Add Static Data Source window appears.

Note: If you are adding multiple tables in the first performance definition, the data table whose collection date is the earliest is set as the baseline performance data table.

b Click and select a performance data source. Click **Open**.

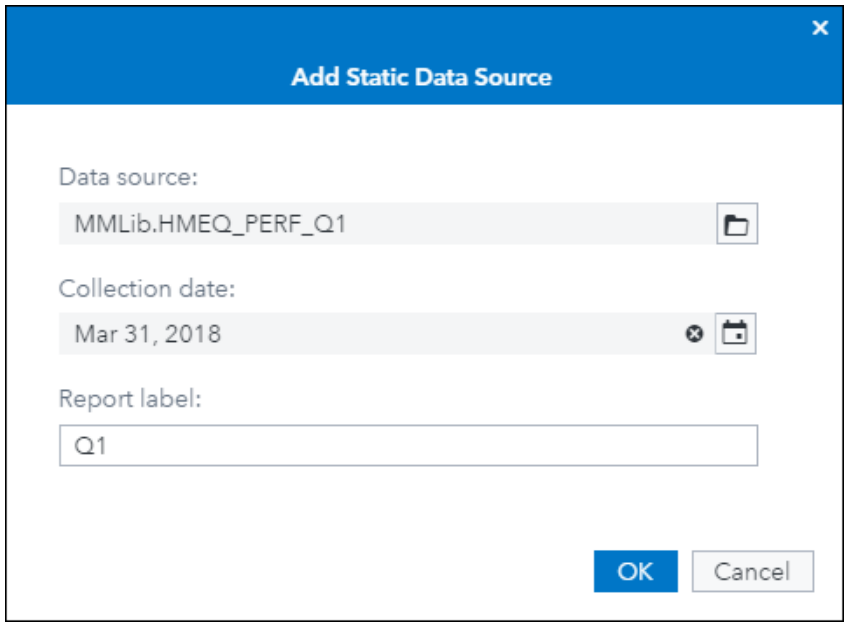
c Click and select a collection date. The date can be any date in the time period when the performance data was collected.

Note: After you run performance, the baseline collection date is based off the earliest collection date. If you edit the performance definition, any additional or modified collection dates must be later than the baseline.

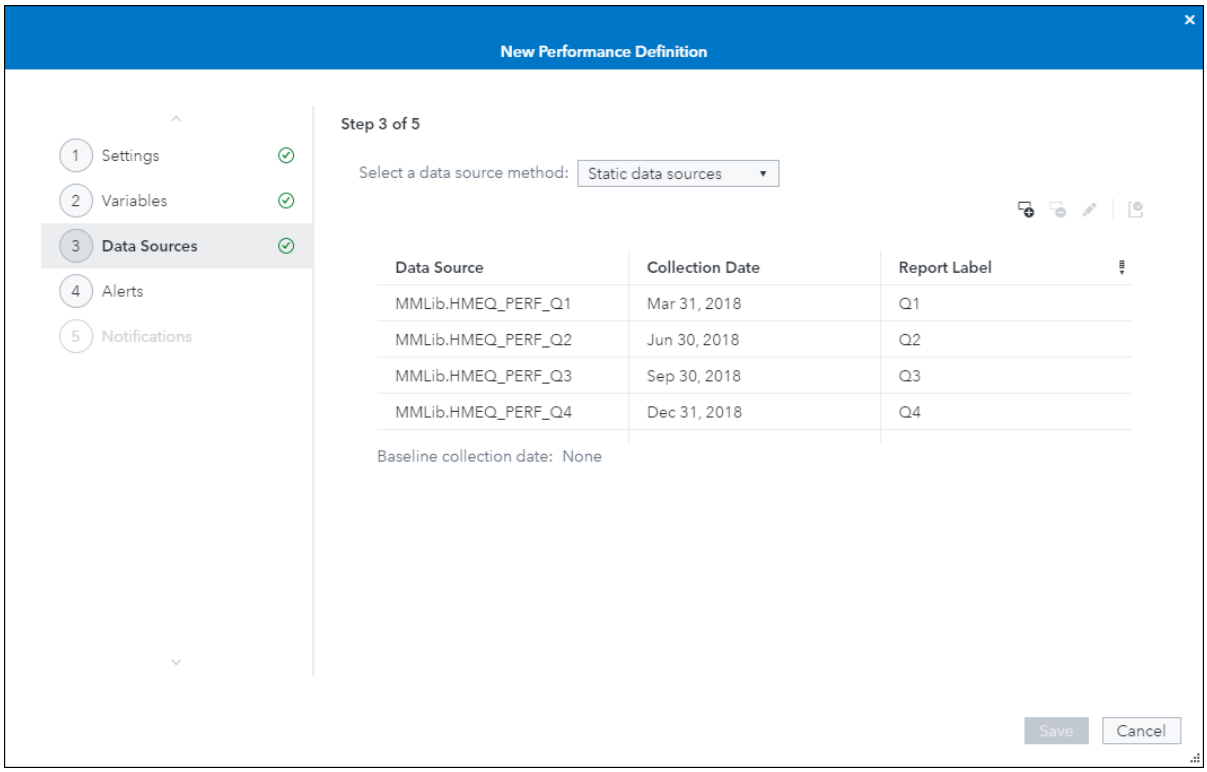
d Enter a report label to represent the time point of the performance data source. Because the report label appears in the performance charts, use a

label that has not been used for another time period, is short, and is understandable (for example, Q1).

Note: Duplicate report labels result in previous performance results being overwritten.



e Click **OK**.



f (Optional) Select a data source and click to verify that the selected input variables and target variable are included in the performance data source, and that the data source is not empty.

g (Optional) Repeat the above steps to add multiple performance data sources to the performance definition.

h (Optional) To remove a data source from the performance definition, select the data source and click . Click **Remove** in the warning message.

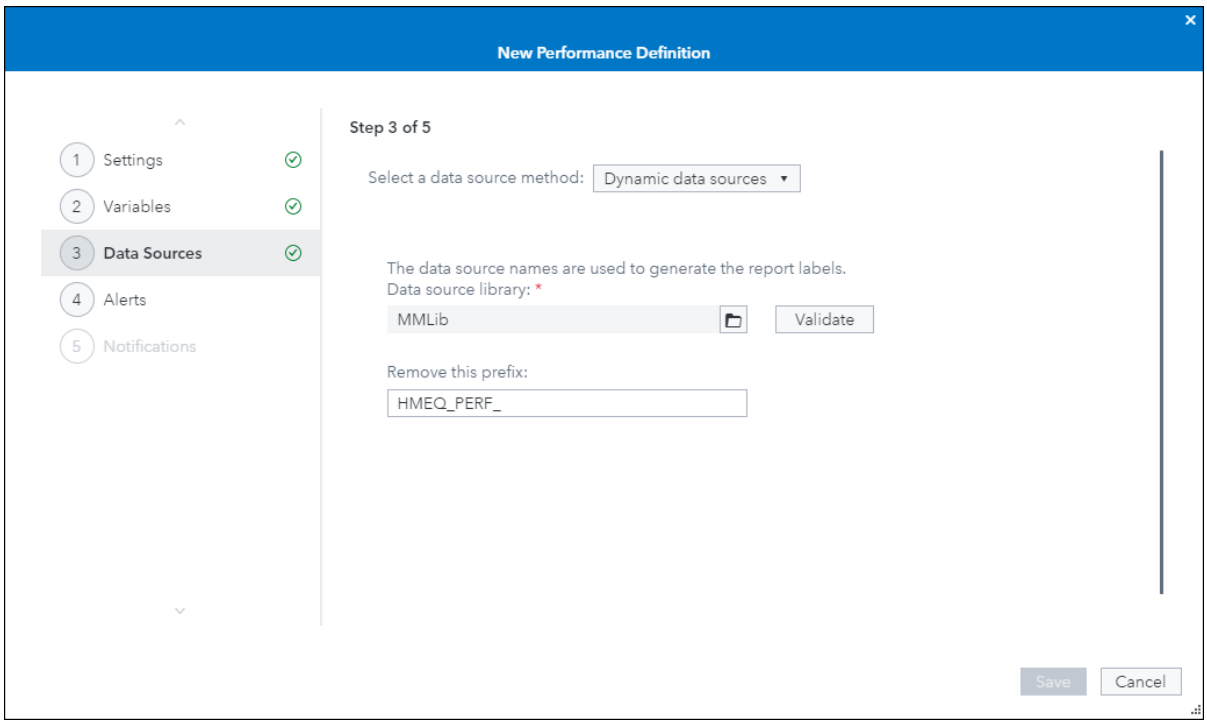
i (Optional) To edit a data source from the performance definition, select the data source and click . The Edit Static Data Source window appears. Make any necessary changes and click **OK**.

To use dynamic data sources:

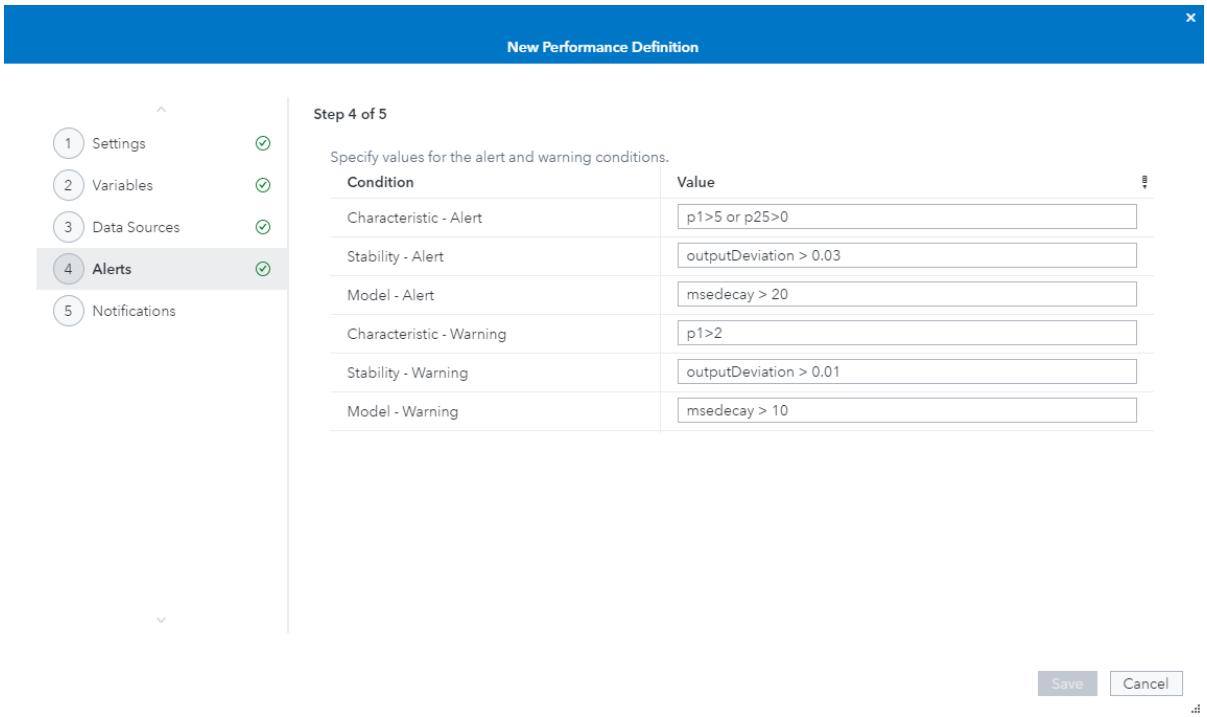
a Click to select a data source library.

b (Optional) Specify the prefix to remove from the data source names in the selected library. The data source name is used for the report label. You can remove the prefix so that it does not show as part of a report label on the charts.

Note: If you do not specify a prefix and you click **Validate** for the data source library, you might receive an error message. The error message can be due to missing user-defined formats, tables within the library that are not valid performance data sources, or tables that do not contain the required project input variables for performance monitoring. It is recommended that you provide a valid prefix, if your data source library contains data other than performance data sources.



7 Select the **Alerts** page and either specify values for the alert and warning conditions or accept the defaults.

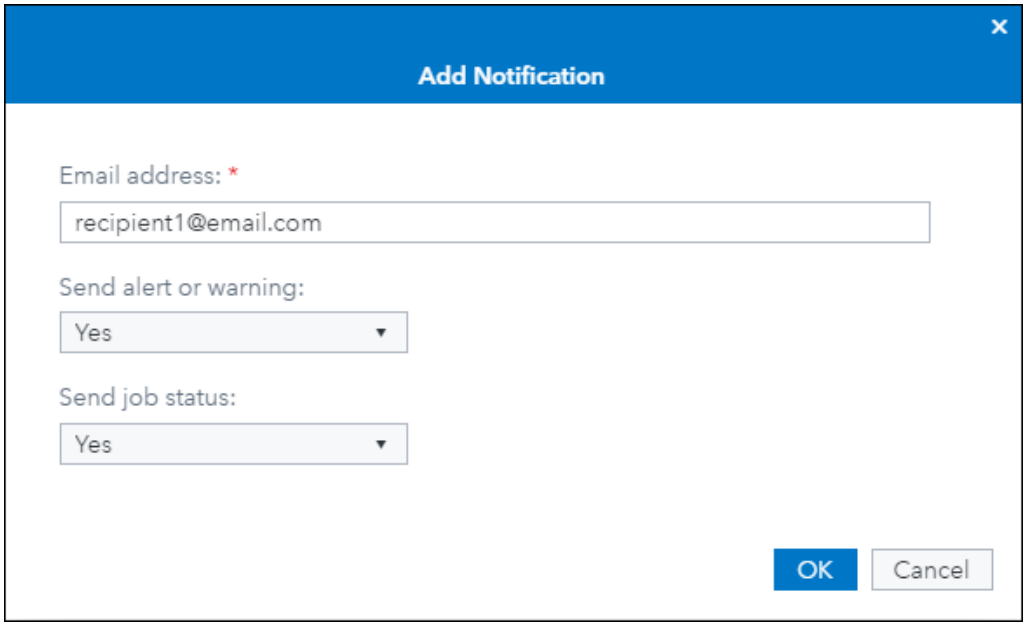


8 Select the **Notifications** page. To specify who should receive the results notifications and when by email, click . The Add Notification window appears.

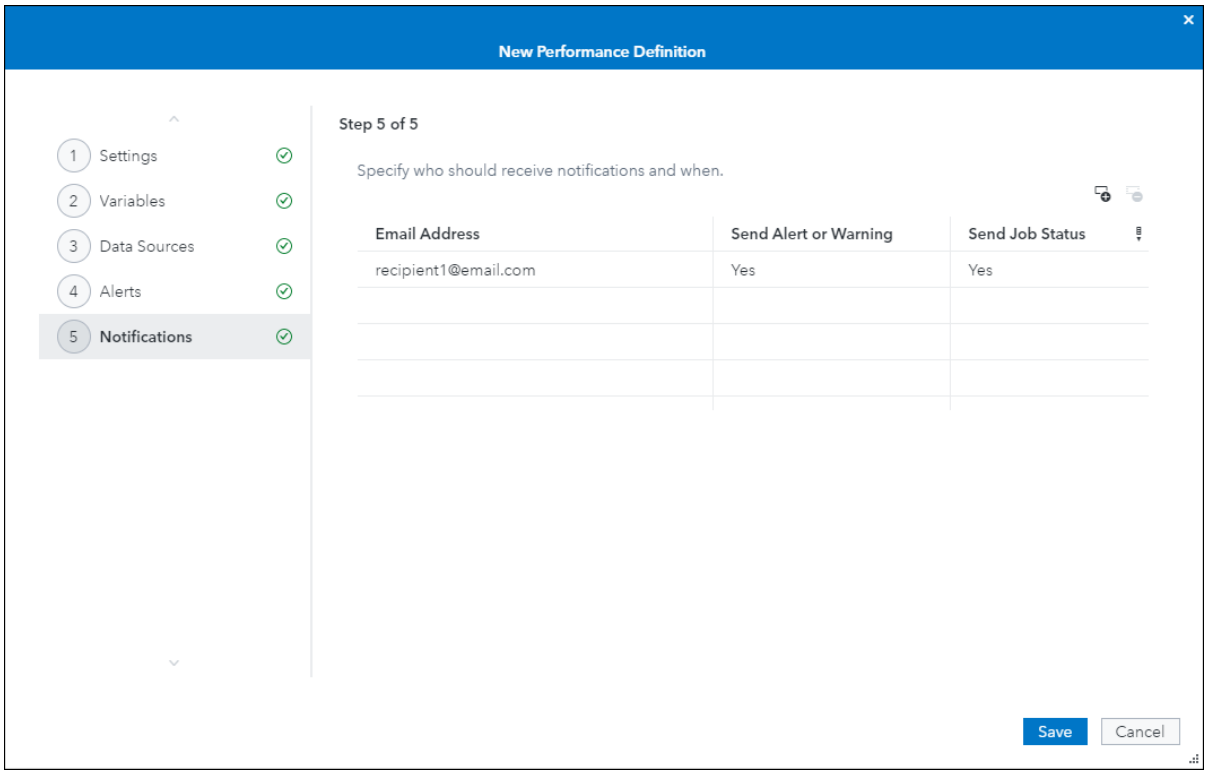
a Enter an email address.

b Select either **Yes** or **No** if you want an alert or warning to be sent by email when alert or warning thresholds have been exceeded.

c Select either **Yes** or **No** if you want a completion notice with the job status to be sent by email every time the report runs.



d Click **OK**.



9 Click **Save**.

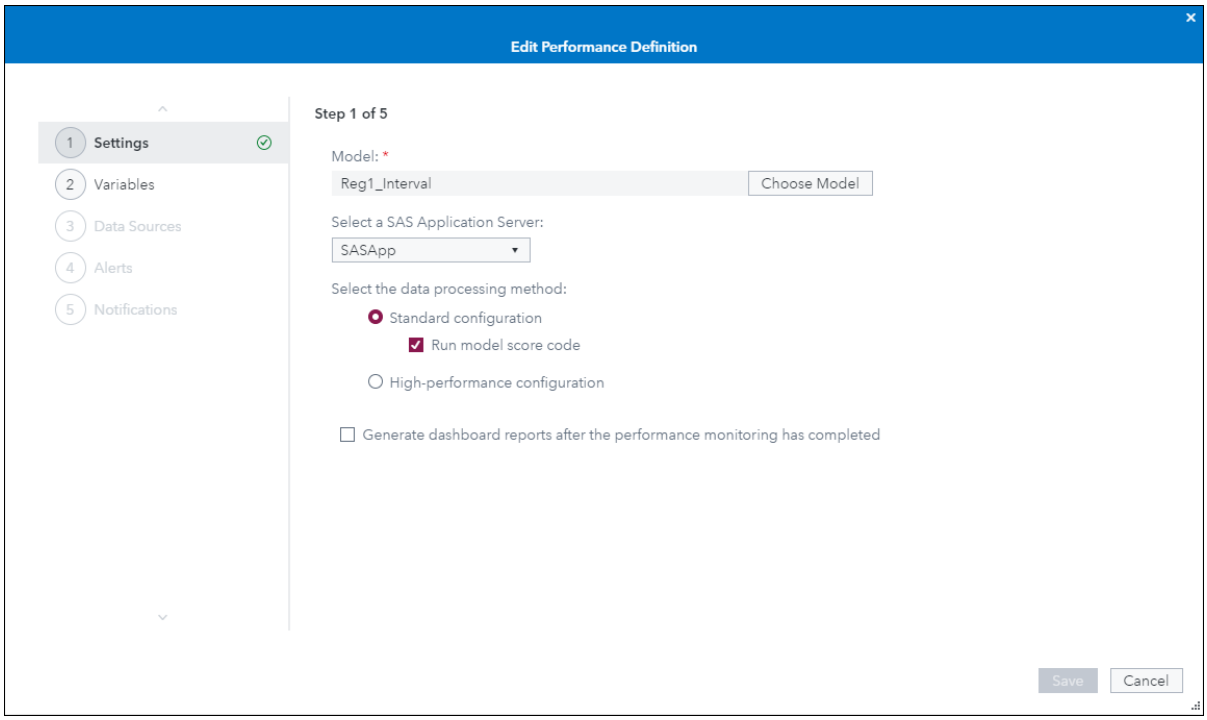
Edit a Performance Definition

To edit the performance definition:

1 Click to navigate to the Projects category view.

2 Open a project and click the **Performance** tab.

3 Click **Edit Definition**. The Edit Performance Definition wizard appears.



4 Modify the content on the **Settings** page or continue to the next step.

5 Select the **Variables** page. Modify the content or continue to the next step.

6 Select the **Data Sources** page. Modify the content or continue to the next step.

7 Select the **Alerts** page. Modify the content or continue to the next step.

8 Select the **Notifications** page. Modify who should receive the results notifications and when they should receive them by email or continue to the next step.

9 Click **Save**.

For more information, see "Create a New Performance Definition" on page 261.

Run a Performance Definition

To run a performance definition:

1 Select the **Performance** tab of a project.

2 Click **Run Definition**.

Note: After the performance monitoring has been completed, a confirmation message appears.

3 Click the **Results** tab to view the performance results.

Note: You can check the status of a job by selecting the **Results** tab or the **Job History** tab. If there are multiple project versions, you must make sure that the

displayed version is the champion version in order to see the performance results.

Note: You can overwrite or delete previously created performance data sets. For more information, see "Manage Performance Data Sets" on page 272.

Schedule Performance Definitions

After you create a performance definition, you can create a schedule to execute the definition to run on a specific day and at a specific time. You can schedule the definition to run hourly, daily, weekly, monthly, or yearly.

Before you can schedule a performance definition, your user ID and password must be made available to the SAS Metadata Repository. You must also sign in to SAS Decision Manager using your full user credentials that were specified for your user account in SAS Management Console. For user accounts where a Microsoft Windows user ID is specified, you must enter your user ID in the format of *domain \userID*. Contact your system administrator to add or update your password, and to determine the correct user credentials for your user account.

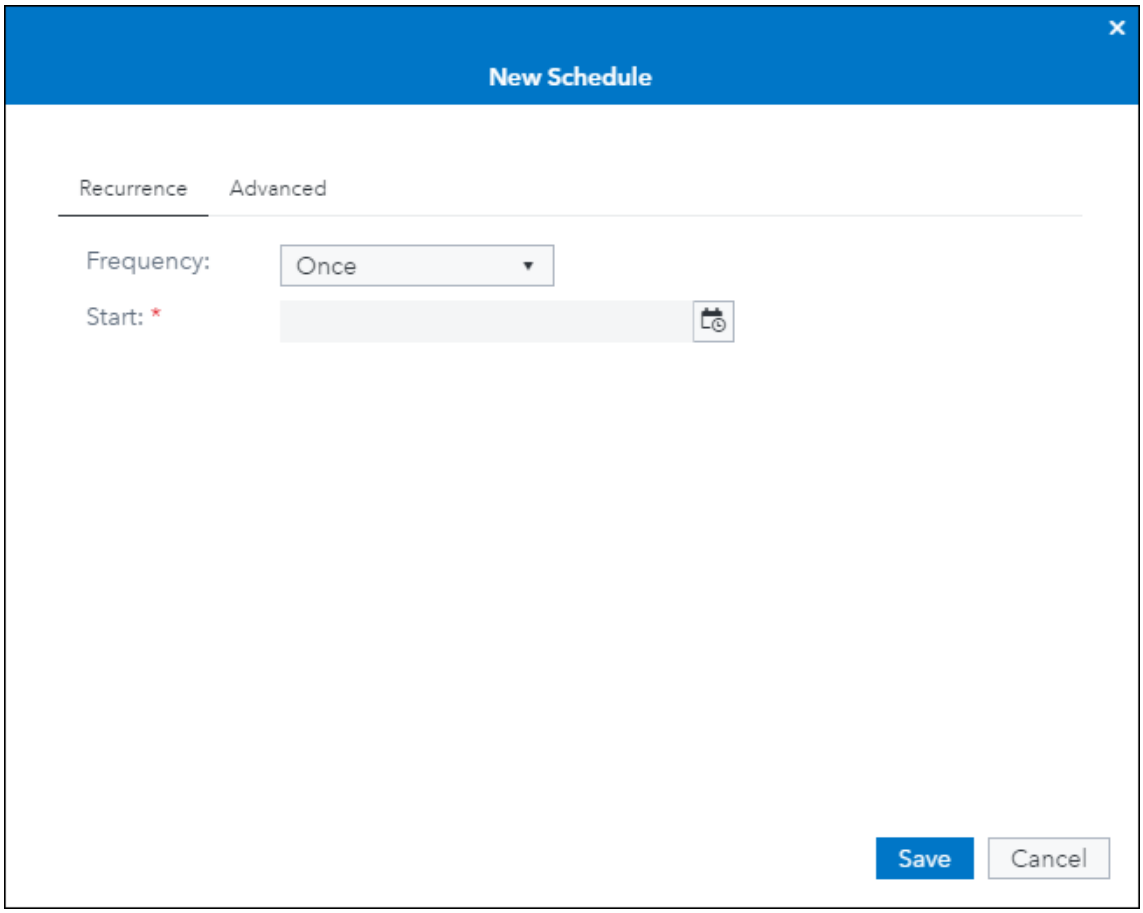
CAUTION
Check your configuration settings before scheduling jobs. Users who are configured for single sign-on authentication by Kerberos cannot schedule jobs.

You cannot edit a schedule for a performance definition. To modify a schedule, delete the schedule and create a new schedule.

After performance monitoring jobs execute, you can view the job history using the **Job History** tab on the **Performance** tab.

To schedule a performance monitoring definition:

1 Click .



2 On the **Recurrence** tab, select the recurrence pattern.

3 Specify the criteria for when and how often the job should be run.

4 (Optional) Select the **Advanced** tab.

   a Select the server that schedules the job from the **Scheduling server** list box.

   Note: The Operating System Services Scheduling Server is not supported.

   b Select the batch server that runs the job from the **Batch server** list box.

   c Click 🗀 to select a location for the performance monitoring output. Click **OK**.

5 Click **Save**.

6 After the job has been scheduled, a confirmation message appears. Click **Close**.

7 Click the **Results** tab to view the performance results.

   Note: If there are multiple project versions, you must make sure that the displayed version is the champion version in order to see the performance results.

Note: Performance schedules cannot be edited. To change the schedule, delete the schedule and create a new schedule.

Here is a list of the **Schedule** properties for **Performance**:

Property Name	Description
Job Name	Specifies the name of the performance monitoring definition. This name cannot be changed.
Location	Specifies the location of the performance monitoring definition in the SAS Metadata Repository.
Scheduling Server	Specifies the name of the server that schedules the job for the performance monitoring definition.
Batch Server	Specifies the name of the server that executes the job for the performance monitoring definition.
Recurrence	Specifies how often the scheduled job for the performance monitoring definition is to be executed.
SAS Application Server	Specifies the name of the SAS Application Server where the performance monitoring definition is to be executed.

To delete a schedule, select the schedule and then click .

View Performance Monitoring Job History

Use the **Job History** tab on the **Performance** tab to verify whether a performance monitoring task was run. The performance monitoring job appears on the **Job History** tab only after the job has begun.

To view the job history of a performance monitoring task:

1. Select a project and click the **Performance** tab.
2. Click the **Job History** tab. A table appears that lists the performance monitoring jobs that have been executed.

Here is a description of the columns in the job history table:

Job Name
is the name of the performance monitoring task.

Status
shows a green indicator for a successful job execution. A yellow indicator shows that the performance monitoring task ran with warnings. A red indicator shows that the performance monitoring task ran with errors.

Date Started
is the date and time that the performance monitoring task started.

Date Completed
is the date and time that the performance monitoring task ended.

Log
is the revision number for the SAS log.

Output
is the revision number for the job output.

SAS Code
is the revision number for the performance monitoring task program.

Manage Performance Data Sets

After a performance monitoring task has run, the summary data sets reside on the **Results** tab on the **Performance** tab of a project.

To add a performance data set:

1. Click the **Results** tab.
2. Click +.
3. Navigate to the location of the data set and select the file to add.
4. Click **Open**.

Note: Fifteen tables are shown for the classification model function and thirteen are shown for the prediction model function. The table name must be the same as one of the shown tables; otherwise the uploaded table cannot be displayed. Tables with the same name are overwritten.

To delete the performance data sets:

1. Click the **Results** tab.
2. Click 🗑.
3. Click **Delete** in the warning message.

Monitoring Performance of a Model without Score Code

If you want to monitor the performance of a model for which you no longer have the score code, you can import a model without SAS score code. If the performance data set contains the predicted values, the score.sas file can be empty.

To monitor the performance of a model without score code:

1. Prepare the following model files:
   - XML file that defines the model input variables (inputvar.xml)
   - XML file that defines the model output variables (outputvar.xml)
   - XML file that defines the model target variables (targetvar.xml)
   - empty SAS score code file (score.sas)
2. Click .
3. Create a project that has a model function type of **Classification** or **Prediction**. You can skip this step if you have already created a project.
4. Open a project and verify that the project properties are set.
   a. If it is a project that has a model function property value of **Classification**, verify that the following project properties are set:
      - Training target variable (for example, *bad*)
      - Target event value (for example, *1*)
      - Class target level as `Binary`
      - Output event probability variable (for example, `score`)
   b. If it is a project that has a model function property value of **Prediction**, verify that the following project properties are set:
      - Training target variable (for example, *lgd*)
      - Class target level as `Interval`
      - Output prediction variable (for example, `p_lgd`)
5. Select the **Models** tab.
6. Click **Import model** and select **from local files**.

   Note: If the model already exists, you can open a model to add model files to an existing model. For more information, see "Add Model Files to an Existing Model" on page 148.

7. Navigate to the folder on your computer that contains the component files for your model.
8. Enter a text value in the **Model name** field.
9. (Optional) Enter a text value in the **Description** field.
10. Select a classification or prediction template from the **Model template** list.
11. Click **Properties** and specify the model properties.
12. Click **Files** and select the local files from the SAS Workspace Server that match the template files. You cannot delete a file after you have added it. To replace the file, select another file or cancel the import and start over. The following files are required:
    - inputvar.xml

- outputvar.xml
- targetvar.xml
- score.sas

Note: The filenames that you created for the model do not have to match the template filenames. However, the file contents must meet the file property requirements. For more information, see "Model Template Component Files" on page 362 or "Model Template Component Files" on page 362.

13 Click **OK**.

14 Open the model and set the model-specific properties. The value for the **Score code type** property must be set to **DATA step** or **Analytic store**.

15 Expand **Variables** and select **Output Mapping** in order to set the output variable mappings for the model. Select a value for each variable and click ⊟.

16 Click **Close.**

17 Select the model, click ⋮, and select **Set as champion** to set the model as the project champion model. For more information, see "Ensure That Champion and Challenger Models Are Set" on page 259.

18 Before defining performance, verify that the performance data set is registered in the SAS Metadata Repository and is available in the Data category view. Make sure that the data set contains the following variables:

- model input variables

  Note: You must have the variable columns in the table, but the values can be missing.

- target variable
- prediction variables
- variables for characteristic analysis

19 Edit a project's performance definition on the **Performance** tab. Specify the performance data set that contains the predicted values. Also, be sure to clear the **Run model score code** option on the **Settings** page of the **Edit Performance Definition** wizard. For more information, see "Create and Run a Performance Definition" on page 261.

17

Using Dashboard Reports

Overview of Dashboard Reports

The SAS Decision Manager dashboard can provide reports that show the overall state of projects that are being monitored. The dashboard reports are produced from existing performance monitoring reports. For each project, you can define dashboard report indicators by creating a dashboard report definition. The dashboard report definition is used to create the dashboard reports. You view the dashboard reports through the **Dashboard** actions menu. These reports are generated in HTML.

Note: The dashboard reports can be defined and generated only by SAS Decision Manager administrators and advanced users.

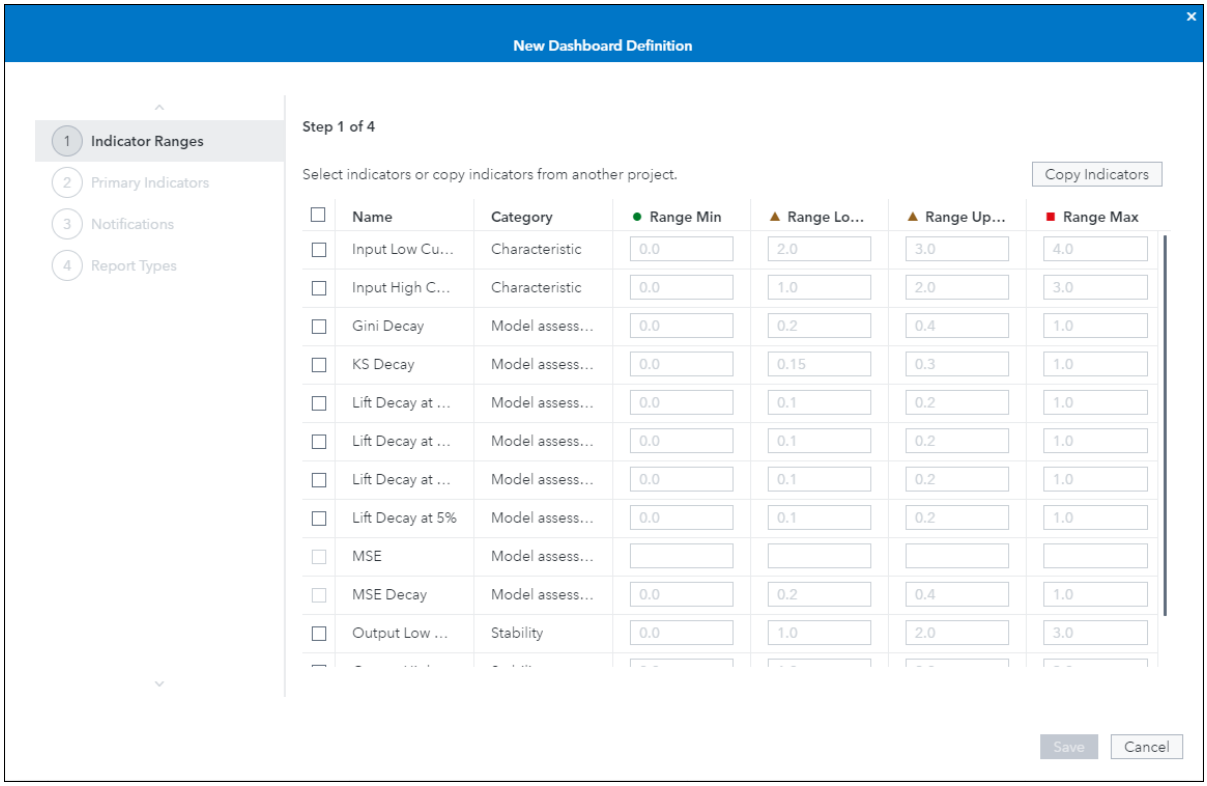
Create a Dashboard Report Definition

To create a new dashboard definition:

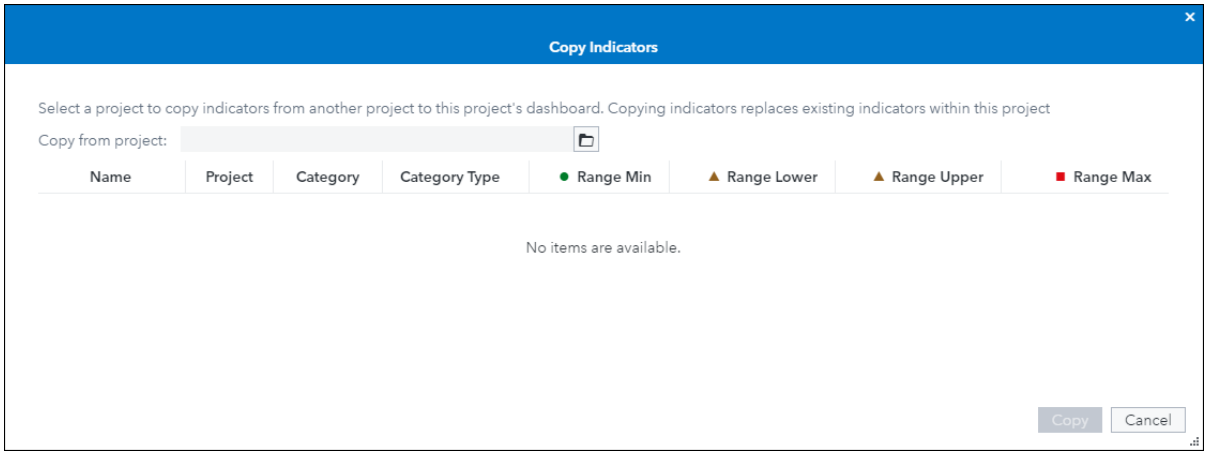
1 Click to navigate to the Projects category view.

2 Select a project, click ⋮, and then select **Dashboard** ⇨ **New definition**. The New Dashboard Definition window appears.

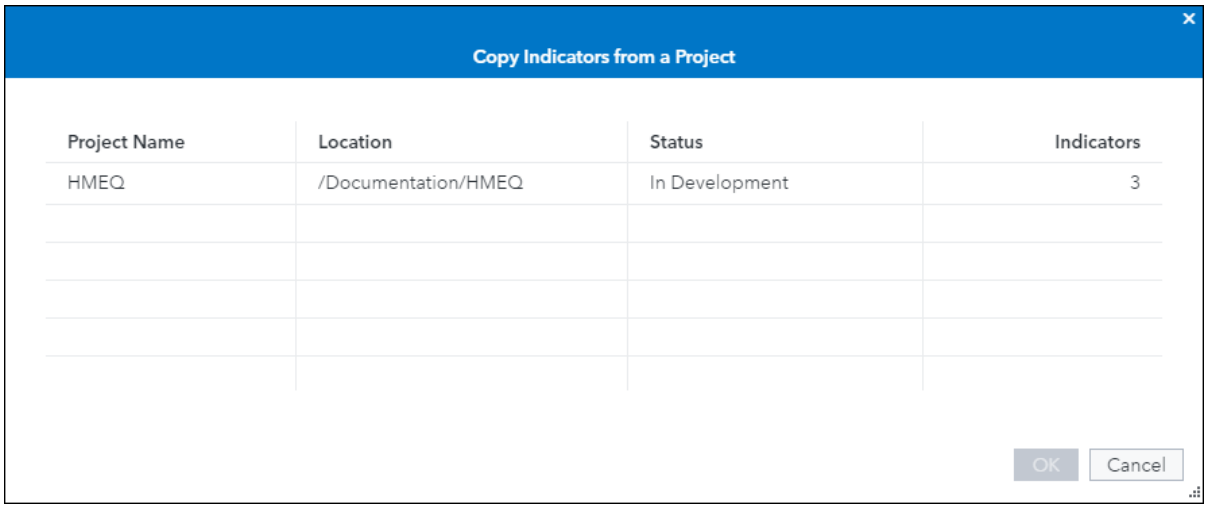
Note: Only the indicators that are supported for the project's model function are enabled.



3 (Optional) Click **Copy Indicators** to copy indicators from another project. The Copy Indicators window appears.



a Click . The Copy Indicators from a Project window appears.



b Select a project to copy indicators from that project's dashboard definition to the current project's dashboard definition, and then click **OK**.

Note: Only projects with the same mode function are displayed. In addition, copying indicators replaces existing indicators within the current project.

c Click **Copy**.

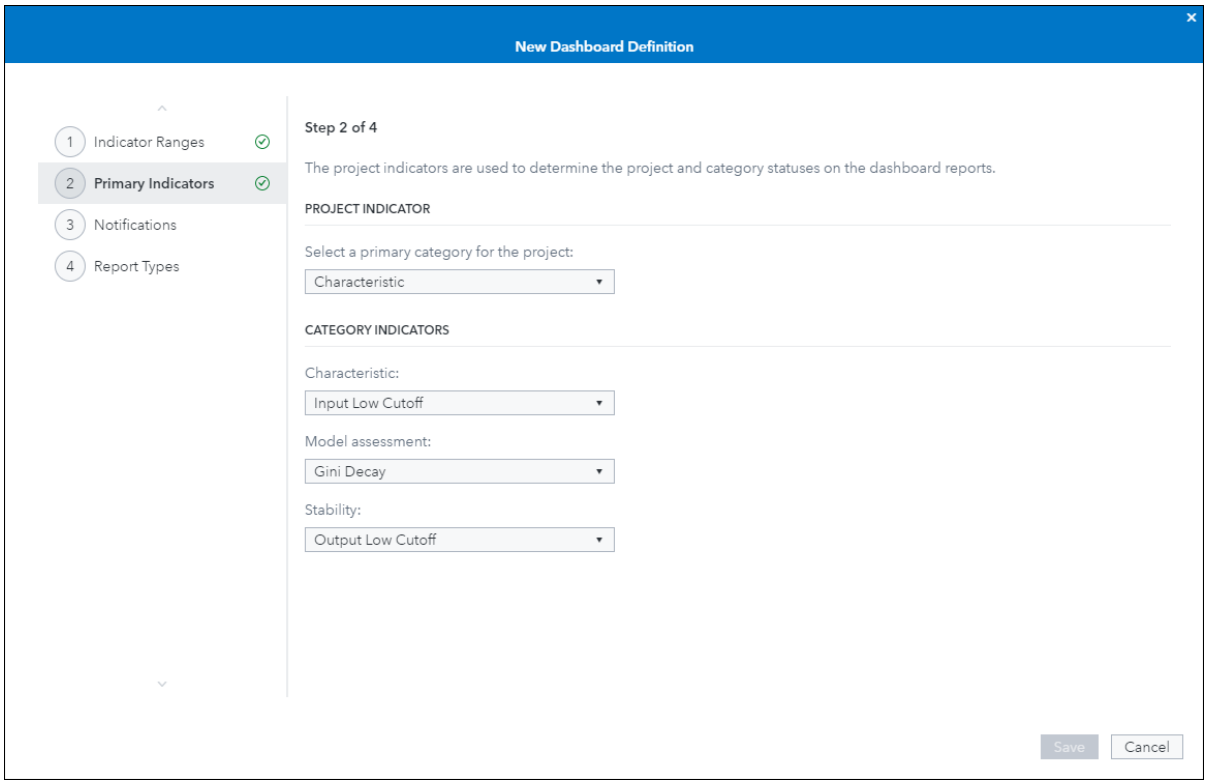
4 Select the indicators for the new dashboard definition.

5 Accept the default values or enter normal, warning, and alert values for the range definitions for each indicator that you have selected.

Note: The Mean Squared Error (MSE) indicator does not have default values, since the values are based on the data source. The MSE measures the differences between the actual values and estimated values of the variable. For an ideal model, MSE should be 0. A model with a lower MSE has a smaller difference between the estimated value and the actual value.

6 Select the **Primary Indicators** page.

7 Select a primary category for the project, and a primary indicator for each category.

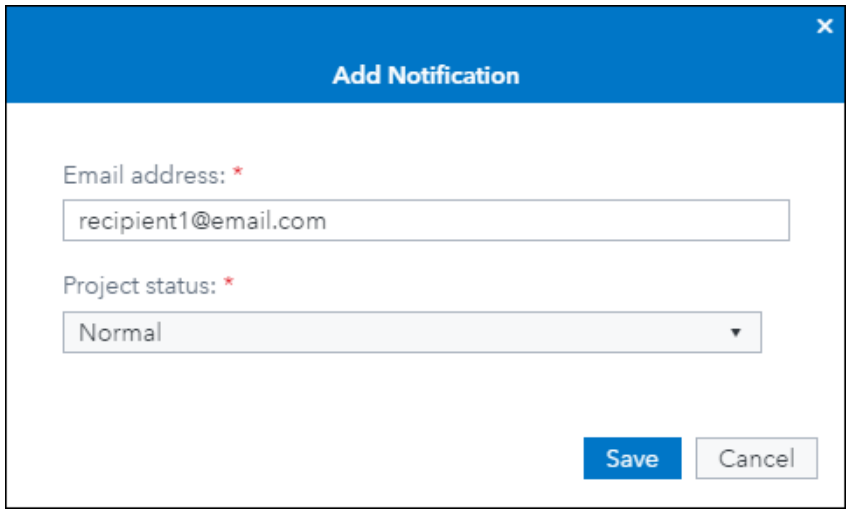


8 Select the **Notifications** page.

9 (Optional) Specify an email address for each recipient who should receive an email notification about the project status.

a Click . The Add Notification window appears.

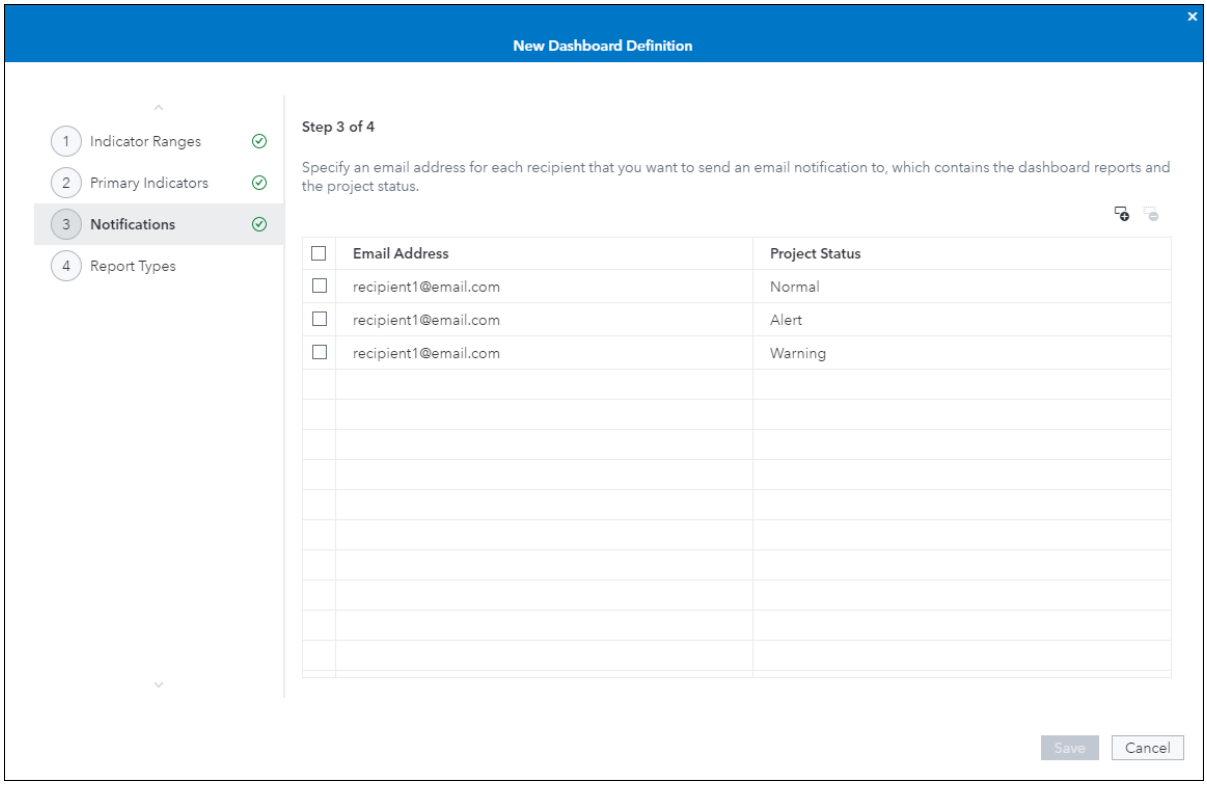
b Enter an email address and select a project status.



c Click **Save**.

d Repeat the above steps for each recipient that you want to send an email notification to. The notification contains the dashboard reports and the project status.

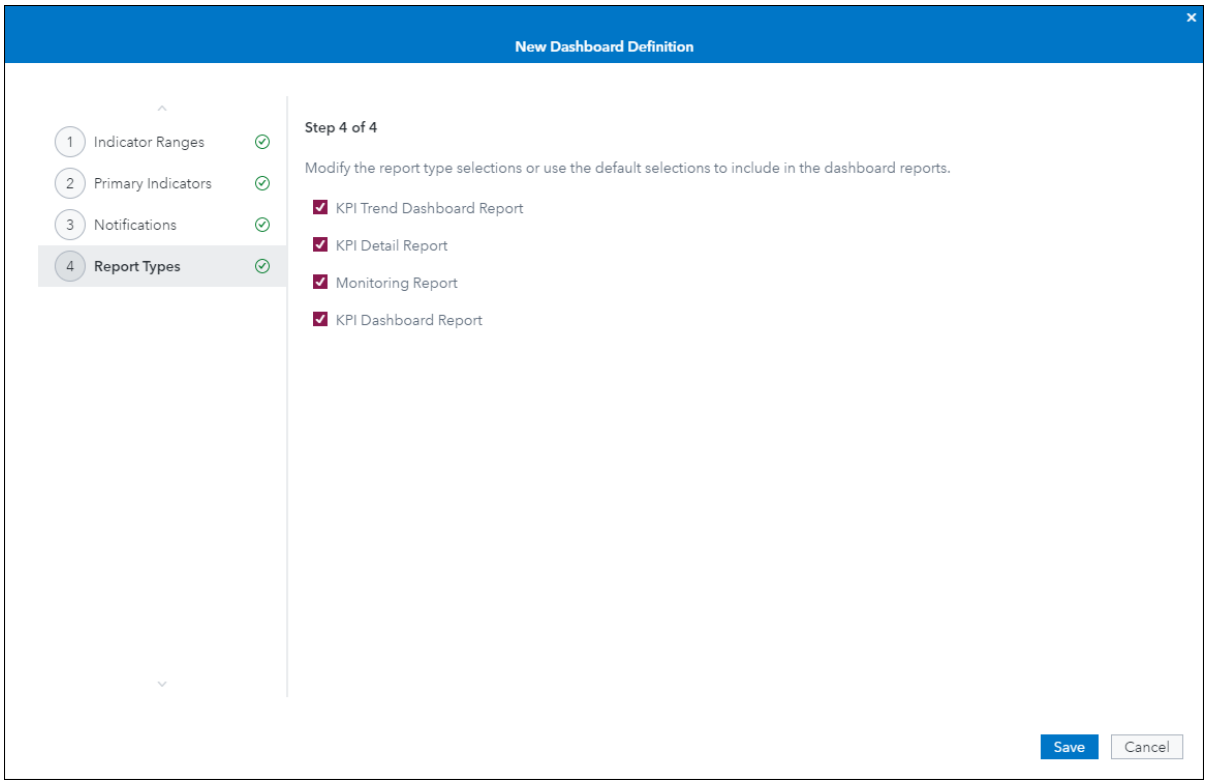
Note: You cannot edit a notification after it has been added, but you can remove it and add a new notification. Click to remove a notification.



Note: If you send email notifications as part of the dashboard definition, the email notification contains a ZIP file (DashboardReports.zip) with the Dashboard reports in HTML format with the contents of the reports when they were generated. It also contains a link to the latest dashboard reports and status on the SAS Content Server.

10 Select the **Report Types** page.

11 Use the default selections, or select one or more reports to include in the dashboard reports.



12 Click **Save**.

Note: You must define dashboard report indicators for all projects that you want to be included in your dashboard reports.

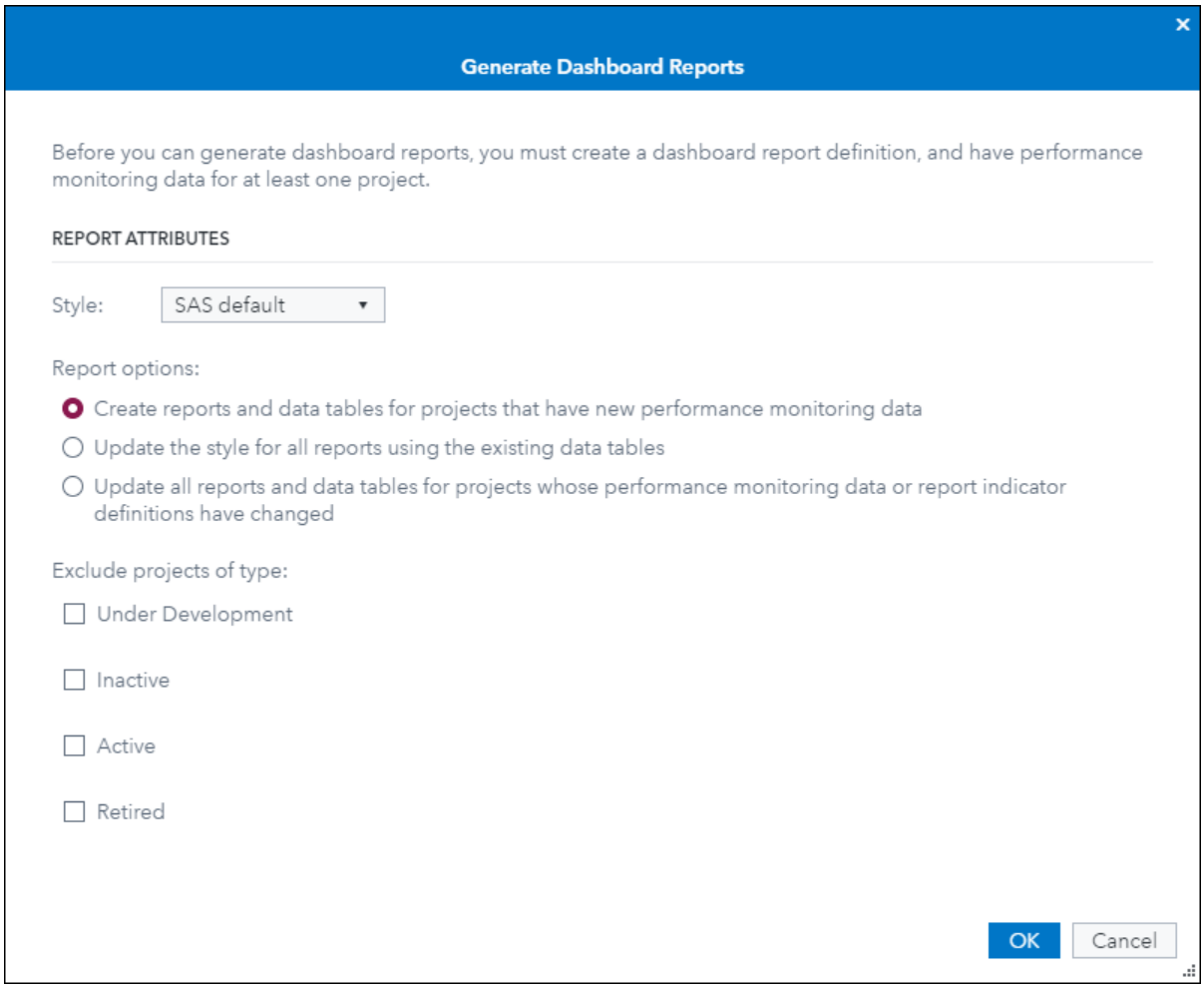
13 Click **Close**.

Generate Dashboard Reports

Note: Before you generate the dashboard reports, ensure that at least one project contains performance data. At least one dashboard report indicator must also be defined in that project.

To generate dashboard reports:

1 From the Projects category view, click ⋮ and select **Dashboard** ⇨ **Generate reports**. The Generate Dashboard Reports window appears.



2 Select a style.

3 Select a report option:

- Create reports and data tables for projects that have new performance monitoring data.
- Update the style for all reports, using the existing data tables.
- Update all reports and data tables for projects whose performance monitoring data or report indicator definitions have changed.

  Note: This option regenerates the dashboard reports, even if the performance monitoring data or report indicator definitions have not changed.

4 (Optional) Select an option if you want to exclude one or more project types from the report.

5 Click **OK**. A confirmation window appears, stating that the dashboard reports were created.

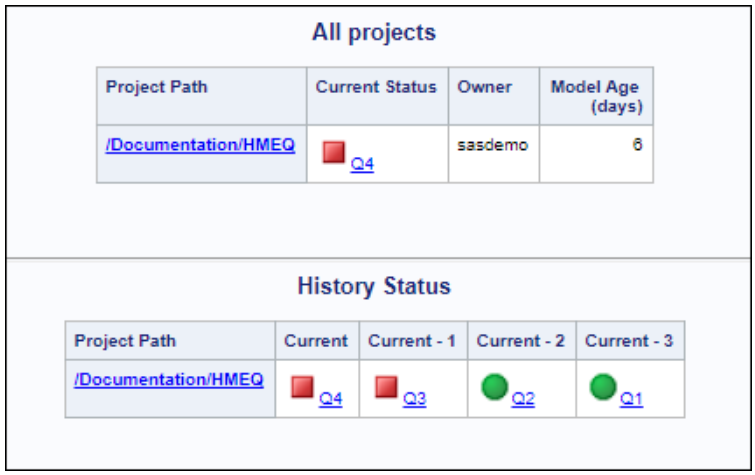
6 Click **Close**.

View Dashboard Reports

To view the dashboard reports:

1 From the Projects category view, click ⋮ and select **Dashboard** ⇨ **View reports**. A web page displays all of the dashboard reports for each project that has a dashboard definition.

Note: If prompted, enter your user name and password to view the reports.



2 Select a project name or status link to view the associated dashboard report.

Project Reports Index

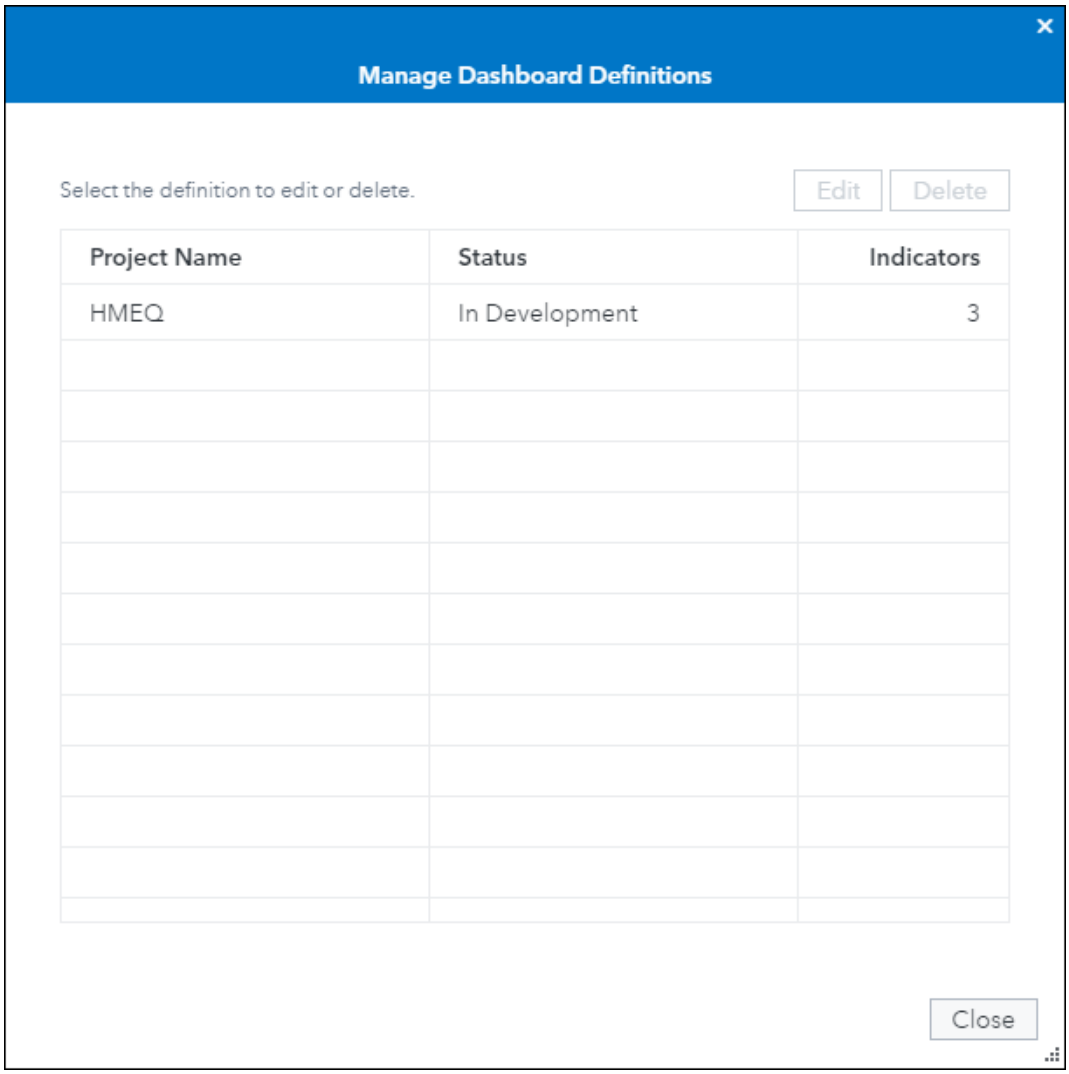
Time	Status	Project Indicator	Report
Q4		Number of predictors with deviation index exceeding 0.1	KPI Dashboard Report
			KPI Detail Report
			KPI Trend Dashboard Report
			Monitoring Report
Q3		Number of predictors with deviation index exceeding 0.1	KPI Dashboard Report
			KPI Detail Report
			KPI Trend Dashboard Report
			Monitoring Report
Q2		Number of predictors with deviation index exceeding 0.1	KPI Dashboard Report
			KPI Detail Report
			KPI Trend Dashboard Report
			Monitoring Report
Q1		Number of predictors with deviation index exceeding 0.1	KPI Dashboard Report
			KPI Detail Report
			KPI Trend Dashboard Report
			Monitoring Report

3 Select a link from the report column to view the report details.

Note: If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.

Manage Dashboard Definitions

1 From the Projects category view, click ⋮ and select **Dashboard** ⇨ **Manage definitions**. The Manage Dashboard Definitions window appears.



2 Select a definition to edit or delete.

To edit a definition, click **Edit**.
The Edit Dashboard Definition window appears. Make your changes and click **Save**.

To delete a definition, click **Delete**.
Click **Delete** in the warning message.

3 Click **Close**.

Edit a Dashboard Definition for a Specific Project

To edit a dashboard definition for a specific project:

1. From the Projects category view, select a project, click ⋮, and then select **Dashboard** ⇨ **Edit definition**. The Edit Dashboard Definition window appears.
2. Make your changes.
3. Click **Save**.
4. Click **Close**.

18

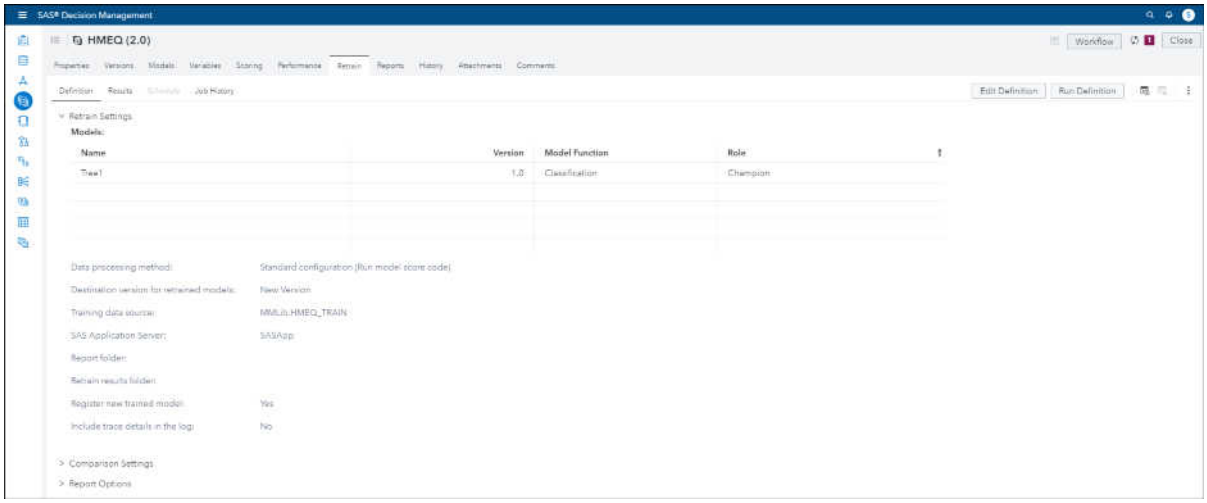
Retraining Models

Overview of Retraining Models

You can retrain models to respond to data and market changes. Retraining models enables you to update out-of-date models and improve model performance. When you edit a model retrain definition, you can select multiple models to be retrained at the same time. The retrain definition for a model includes the destination version and training data source. The destination version is an existing version or new version that is associated with the selected project and stores the retrained model information.

The training data source contains new data for retraining the selected models. You can also specify a location to store the comparison reports and retrain results. When you select the models to include in the comparison report, you can use the training data source or select a different data source to compare the performance of the new models. You can also specify the report options, including the name, format, and style of the comparison report. Email notifications can also be specified as part of a model retrain definition and are sent after you execute a model retrain definition.

By default, the champion model for the selected project is selected for retrain. If the **Register new trained model** option was selected after you execute a model retrain definition, the new models are registered to the destination version. The comparison report is available on the **Results** tab of the **Retrain** tab. The definition is executed on the SAS Application Server that is specified. The report folder is stored on the SAS Content Server.



Note: Only R models and those that were created with SAS Enterprise Miner, SAS/STAT, and SAS/ETS can be retrained. SAS Factory Miner models and SAS Viya models that were created with SAS Visual Data Mining and Machine Learning modeling procedures cannot be retrained in SAS Decision Manager. Also note this: if a SAS model package (SPK) file was created with the **Model Comparison** node in SAS Enterprise Miner, the SPK file contains the score code for the best model and the training code for all of the models that were part of the model comparison. Therefore, when you are retraining the model in SAS Model Manager, be aware that the algorithm that is used for the retrained model could be different.

To retrain a model:

- Ensure that all prerequisites have been completed
- Edit the model retrain definition for a project to generate the SAS code that retrains models
- Execute the generated SAS code
- View the new models and comparison report

Prerequisites for Retraining a Model

Before you can retrain a model, complete the following prerequisites:

- If you want to retrain the project champion model, ensure that the champion model is set. For more information, see “Champion Models” on page 300.
- Verify that the training data set that you want to use as the training data source has been registered in the SAS Metadata Repository, and is available in the Data category view.
- Verify that the appropriate project and model properties are set:

  Classification Model Project Properties
  - Training target variable
  - Target event value

- Class target level
- Output event probability variable

Prediction Model Project Properties
- Training target variable
- Class target level
- Output prediction variable

Model Properties
- Score code type

For more information, see "Project Properties" on page 109 and "Scoring Model Properties" on page 191.

- Verify that all of the project output variables are mapped to the corresponding model output variables. For more information, see "Map Model Variables to Project Variables" on page 151.
- Verify that the retrain file that is specified in the model template exists in the list of model files. The retrain file must appear on the **Model Properties** page for the model that you want to retrain. Ensure that the content is correct.
- In order to retrain SAS/STAT linear models, you must modify the training code in the train code file (for example, batch.sas).

To edit the model train code file:

1. Select and open a model.
2. On the **Model Properties** tab, select **Advanced** ⇨ **Model Files**.
3. Double-click the train code file (batch.sas) to open it.
4. Click in the text box to edit the code. Make the following modifications:
   - Replace the name of the training data set with the macro variable **`&_MM_InputDS`**.
   - Replace the name of the outmodel with **`smmmodel.outmodel`**.
   - Make sure that the name of the item store is **`work.itemstore`**.

   Example Code 18.1 *SAS/STAT Logistic Model Training Code*

```
proc logistic data=&_MM_InputDS outmodel=smmmodel.outmodel;
class mstr_cstmr_age_grp days_claim_grp odm_last_veh_prchsd_grp
highest_edu_grp;
model bcr_ind=mstr_cstmr_age_grp days_claim_grp odm_last_veh_prchsd_grp
highest_edu_grp;
;
store work.itemstore;
quit;
```

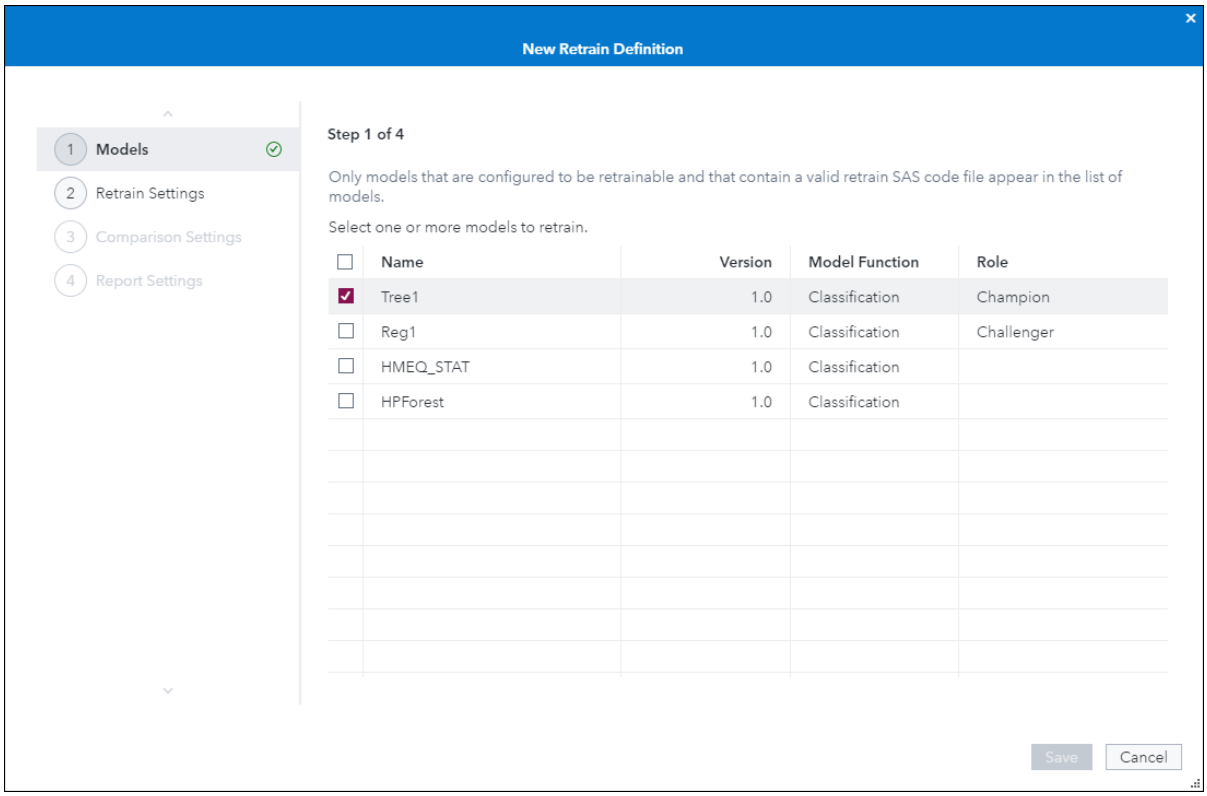
5. Click . The revision number is modified once the file has been saved.

For more information, see "Using Macros to Register Models Not Created by SAS Enterprise Miner" in *SAS Decision Manager: Macro Guide*.

Edit a Model Retrain Definition

1 On the **Definition** tab of the **Retrain** tab, click **New Definition** and select one or more models to retrain on the **Models** tab. By default, the champion model is selected if it can be retrained.

Note: Once a definition has been created, click **Edit Definition** to make additional changes to the retrain definition.



Note: You cannot proceed to the next page until the completed icon is present next to the page header.

2 On the **Retrain Settings** page, select a data processing method.

- To run a standard environment, select **Standard configuration**.
- To run the performance monitoring definition in a High-Performance Analytics environment, select **High-performance configuration**.

3 Click the **SAS Application Server** list and select a server. If multiple servers were created during the deployment process, the first **SAS Application Server** is selected by default.

4 Verify that the value you previously specified for the Default train table project property appears in the **Training data source** box. To select a table, click 🗀 to select a training data source from a library. Click **Open**.

5 (Optional) Click 🗀 to select a report folder in which to store the comparison report.

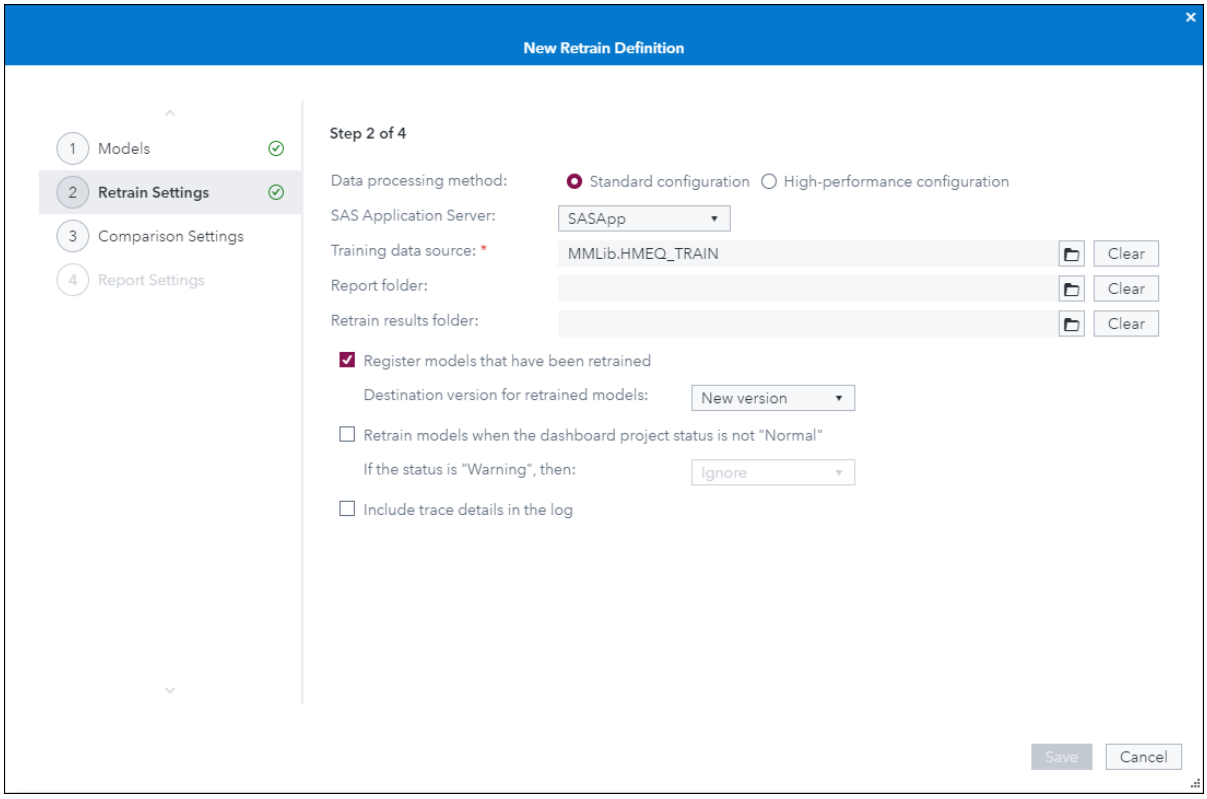
6 (Optional) Click 🗀 to select a retrain results folder to store the model training results.

7 (Optional) Select **Register models that have been retrained** to register the new models in the destination version on the SAS Content Server.

8 (Optional) If **Register models that have been retrained** is checked, select a destination version for new models. Select **New version** from the drop-down menu to create a new version for the models.

9 (Optional) Select **Retrain models when the dashboard project status is not "Normal"**. If the dashboard project status is Alert, the model is automatically retrained. If the dashboard project status is Warning, select whether to retrain the model or ignore the task. If the dashboard project status is Normal, the model will not be retrained.

10 (Optional) Select **Include trace details in the log** to print trace information to the SAS log file.

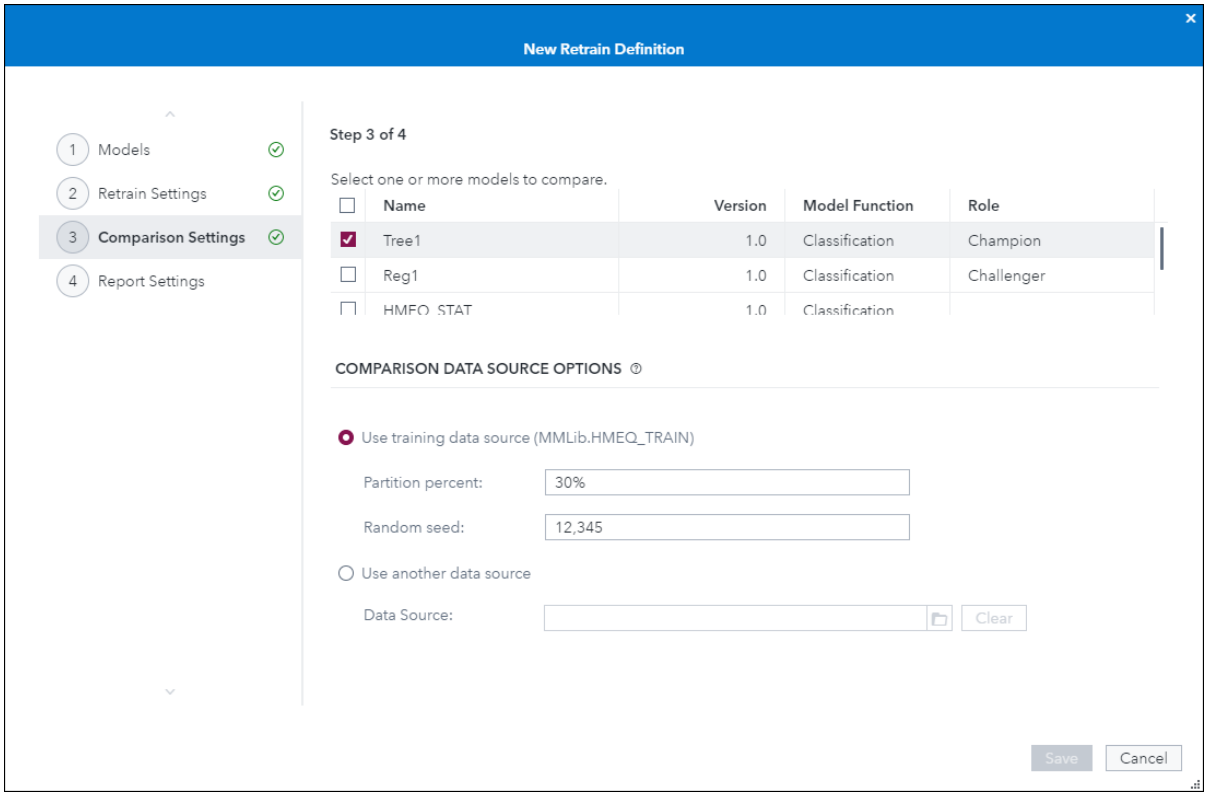


11 On the **Comparison Settings** page, select the models to compare.

Note: If you do not select a model, the champion model is used to perform the comparison.

12 Specify the data source options:

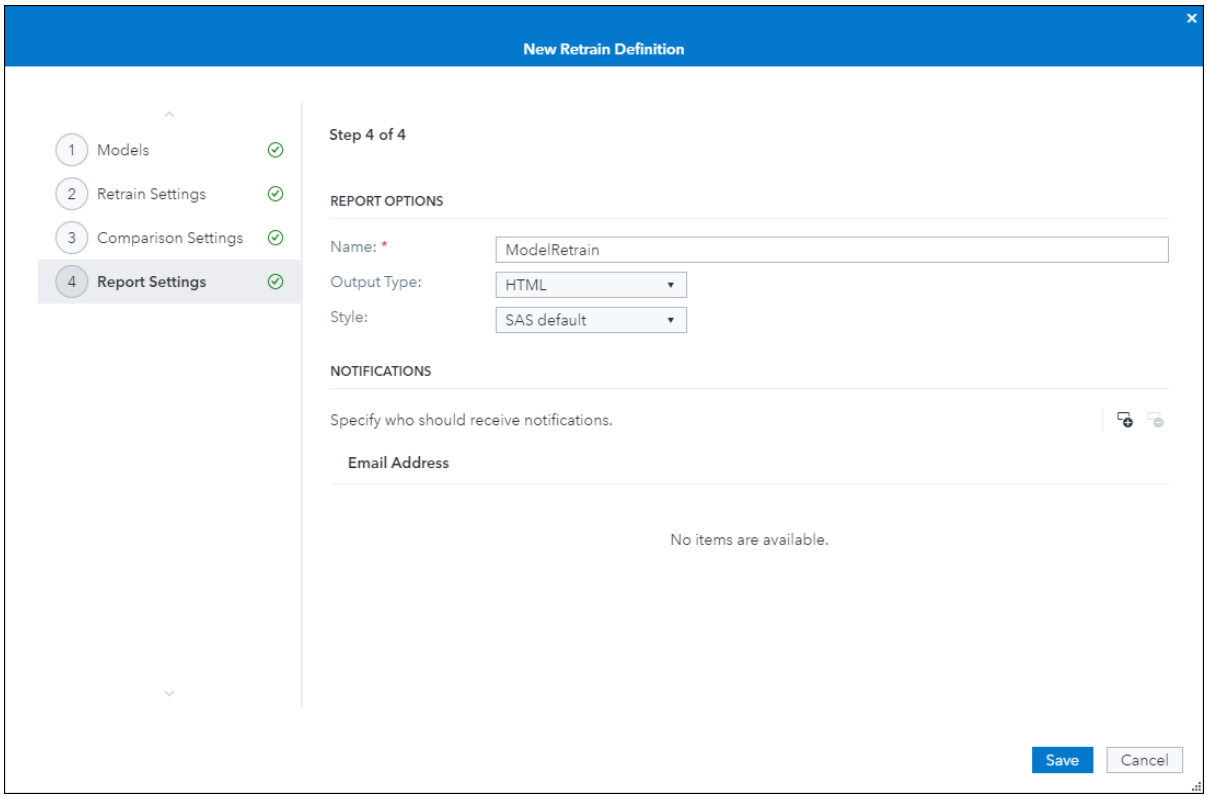
- Select **Use training data source** (`Training data source name`) to use the whole training data source to compare or partition it into two parts, based on partition percent and random seed. The percent that is specified is the percentage of data that is used for model comparison; the other part of the data is used for training. The random seed value is used to generate the training data based on the random sampling method.
- To use a different comparison data source, select **Use another data source**. Click 🗀 to select a performance data set as the comparison data source.



13 On the **Report Settings** page, specify the report options:

- Enter a report name.
- Select a format for the report output. The standard formats that are available are **RTF**, **PDF**, and **HTML**. The default is **HTML**.
- Select a style for the report. The available styles are **SAS default**, **Seaside**, **Meadow**, and **Harvest**. The default is **SAS default**.

14 (Optional) To send the retrain results by email, click 🗨⊕, and enter an email address. Click **OK**.



15 Click **Save**.

Execute a Model Retrain Definition

The prerequisites for retraining a model must be completed and a model retrain definition must exist before you can execute a model retrain definition.

1 Click **Run Definition**.

2 Click the **Results** tab to view the results.

Note: You can check the status of a job by clicking ↻ and then selecting the **Results** page or the **Job History** page.

Schedule a Retrain Definition

After you create a retrain definition, you can create a schedule to execute the definition to run on a specific day and at a specific time. You can schedule the definition to run hourly, daily, weekly, monthly, or yearly.

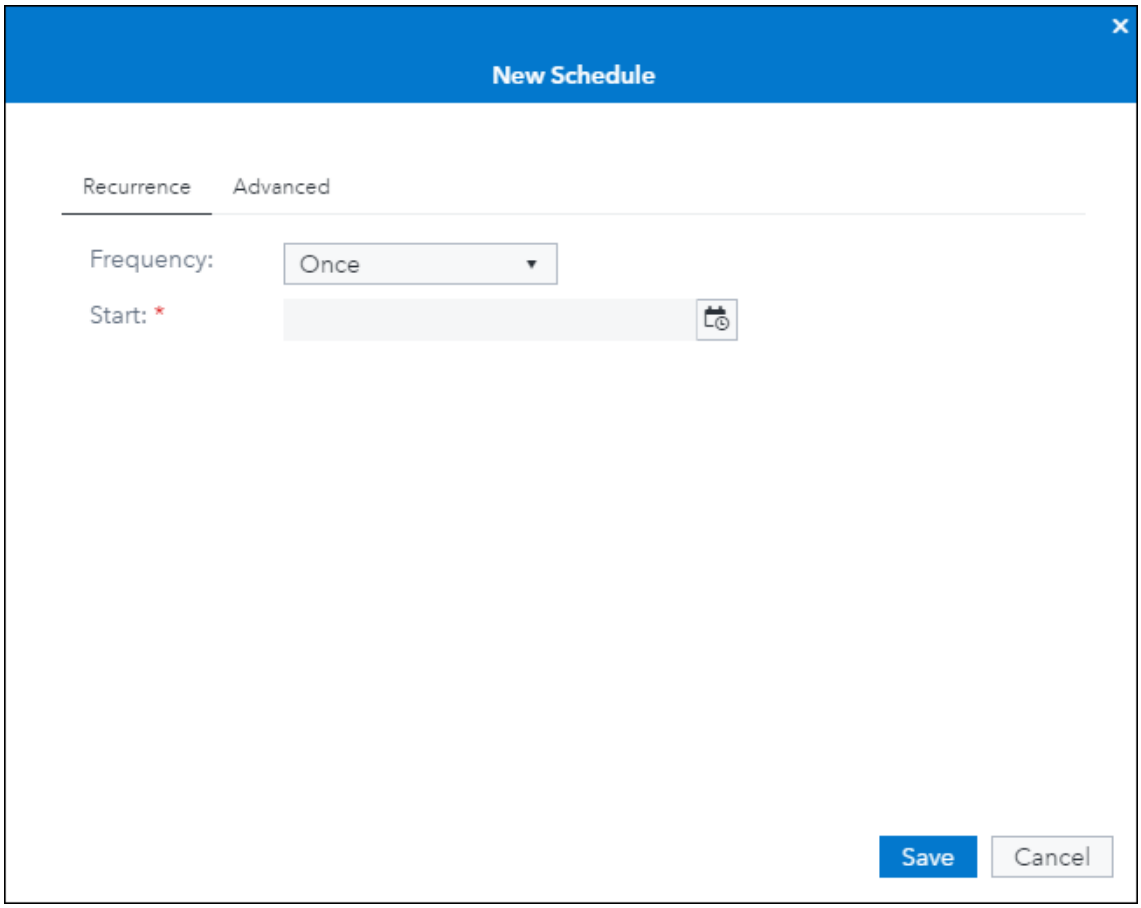
Before you can schedule a retrain definition, your user ID and password must be made available to the SAS Metadata Repository. You must also sign in to SAS Decision Manager using your full user credentials that were specified for your user account in SAS Management Console. For user accounts where a Microsoft Windows user ID is specified, you must enter your user ID in the format of *domain \userID*. Contact your system administrator to add or update your password, and to determine the correct user credentials for your account.

CAUTION
Check your configuration settings before scheduling jobs. Users who are configured for single sign-on authentication by Kerberos cannot schedule jobs.

You cannot edit a schedule for a retrain definition. To modify a schedule, delete the schedule and create a new schedule.

After retrain jobs execute, you can view the job history using the **Job History** tab on the **Retrain** tab.

1 On the **Retrain** tab, click .



2 On the **Recurrence** tab, select the recurrence pattern.

3 Specify the criteria for when and how often the job should be run.

4 (Optional) Click the **Advanced** tab.

   a Select the server that schedules the job from the **Scheduling server** list box.

Note: The Operating System Services Scheduling Server is not supported.

b Select the batch server that runs the job from the **Batch server** list box.

c Click to select a location for the output and click **OK**.

5 Click **Save**.

6 Click the **Job History** tab to view the job status.

7 After the job has completed, click the **Results** tab to view the retrain results.

Note: Schedules cannot be edited. To change the schedule, delete the schedule and create a new schedule.

To delete a schedule, select the schedule and then click .

Viewing Retrained Models and Model Comparison Reports

After a model retrain definition is executed and if you chose to register the retrained models in the model retrain definition, the new retrained models are available in the destination version. In addition, the model retrain job creates a model comparison report, which is available in the **Results** tab of the **Retrain** tab.

1 Click the **Results** tab of the **Retrain** tab.

2 To view the model comparison reports:

- Click the report type icon in the list.
- Select a result from the list. Click ⋮ and select **Open**.

Note: You can also view the SAS code and SAS log.

- Click ⋮ and select **View SAS code**.
- Click ⋮ and select **View SAS log**.

Note: If you are configured for single sign-on web authentication and you try to view a report, the report is downloaded to your local drive. To view an HTML report, you must unzip the file.

PART 5

Deploying and Publishing Models

19

Deploying Models

Overview of Deploying Models

The goal of a modeling project is to identify a champion model that a scoring application uses to predict an outcome. SAS Decision Manager provides tools to evaluate candidate models, declare champion models, and inform your scoring officer that a predictive model is ready for validation or production.

To deploy a model, you might use the following scenario:

1. Identify the model that outperforms other candidate models and declare this model to be the project champion model. You can also flag challenger models for the champion model.
2. Test and validate the model before you declare the model ready for production.
3. Lock the champion version for the project to prevent changes to the champion model.

4 Publish the champion model and challenger models (optional) so that you can deploy them to a production environment.

Champion Models

About Champion Models

The champion model is the best predictive model that is chosen from a pool of candidate models. Before you identify the champion model, you can evaluate the structure, performance, and resilience of candidate models. When a champion model is ready for production scoring, you set the model as the champion model. The project version that contains the champion model becomes the champion version for the project. You can publish the champion model to a database, Hadoop, the SAS Metadata Repository, and a SAS channel.

Requirements for a Champion Model

Before you identify a model as the champion, perform the following tasks:

- Register at least one model.
- Verify that the model is active. If the model expiration date has passed, you cannot set the model as a champion model.

  Note: However, an authorized user can reset the expiration date to a later date in order to set the champion model. To reset the expiration date, select the **Model Properties** tab for the model.

You might use the following criteria to identify a champion model:

- model comparison reports that validate and assess the candidate models.
- business decision rules. For example, you might use a decision tree model because of difficulty interpreting results from a neural network model even when the neural network model outperforms the decision tree model.
- regulatory requirements, such as when the champion model should exclude certain specific attributes (age or race).

You can flag and publish a challenger model specifically for the purpose of comparison with the champion model. For example, your champion model for a production environment might omit restricted attributes during operational scoring because of regulatory requirements. You can use a challenger model that includes the restricted attributes in the development environment to evaluate its prediction power against the prediction of the champion model. Then you can determine the amount of predictive power that is lost because of the regulatory requirements.

Set a Champion Model

1. On the **Models** tab of a project, select a model.
2. Click ⋮ and select **Set as champion** to set the model as the project champion model.
3. If the **Select Project Output Variables** window appears, select the model output variables to use as project level output variables. You can use the same variable names or specify different names for the project output variables.

   Click **Save**.
4. If the model input variables are not project input variables, you are prompted to add the input variables to the project.

   In the confirmation message, click **Yes**.

   Note: If you click **No**, the model is not set as the project champion.

The value in the **Role** column changes to **Champion**.

Clear a Champion Model

To clear a champion model:

On the **Models** tab of a project, select a model that is marked as Champion, click ⋮, and select **Clear role** to clear a flagged champion model.

Challenger Models

About Challenger Models

You use challenger models to test the strength of champion models. The champion model for a project can have one or more challenger models. A model can be flagged as a challenger model only after a champion model for the project has been selected. A challenger model can be flagged in any version of a project.

Verify that the model is active. If the model expiration date has passed, you cannot set the model as a challenger model.

Note: An authorized user can reset the expiration date to a later date so that it is possible to set the challenger model.

To compare a challenger model to a champion model, you can create and run performance monitoring tasks for the champion model and any challenger models. Then, using the performance data, you can create a Champion and Challenger Performance report. You can also compare challenger models to the champion model using other reports such as the Delta report and Dynamic Lift report that are available through the **Reports** tab. For more information, see "Champion and Challenger Performance Reports" on page 197.

Note: The batch programs for performance monitoring do not support creating challenger model performance reports.

Challenger models can be published to a database, Hadoop, the SAS Metadata Repository, or to a SAS channel that contains the champion model. They can also be published by themselves. If testing determines that the challenger model is the better model, you can replace the champion model by setting the challenger model as the champion model.

Set a Challenger Model

1. On the **Models** tab of a project, select a model.
2. Click ⋮ and select **Set as challenger** to set the model as a challenger to the project champion model.
3. If the **Select Project Output Variables** window appears, select the model output variables to use as project level output variables. You can use the same variable names or specify different names for the project output variables.

   Click **Save**.
4. If the model input variables are not project input variables, you are prompted to add the input variables to the project.

   In the confirmation message, click **Yes**.

   Note: If you click **No**, the model is not set as a challenger model.

The value in the **Role** column changes to **Challenger**.

Clear a Challenger Model

To clear a challenger model:

On the **Models** tab of a project, select a model, click ⋮, and select **Clear role** to clear a flagged challenger model.

Locking Versions

About Locking Versions

You must be a SAS Decision Manager administrator to lock and unlock a version. Administrators can lock a project version to prevent users from modifying some properties and files for the version's models. The champion version can be locked when the project champion model is approved for production or is pending approval. After a project version is locked, users cannot perform the following tasks:

- import, delete, or copy and paste a model
- rename a model
- change the champion model
- set a model as a challenger
- clear the role for champion and challenger models

SAS Decision Manager administrators remain authorized to perform these activities. If the champion model is not deployed to an operational environment, then an administrator can unlock a version so that users can change the models. Advanced users can still modify the **Attachments**, **Reports**, and **Scoring** pages after a version is locked.

When the champion model has been used in production scoring, you must unlock the model if you want to change the contents of the champion version. However, use caution in modifying the version content. If the model UUID and revision number for the score code in production scoring environments are always recorded, then you can modify a version even after the version is deployed to production environment.

If you attempt to delete a project that contains a locked version, SAS Decision Manager displays a message indicating that you cannot delete a project that contains locked versions. An administrator must unlock the versions before the project can be deleted.

Lock a Version

Locking a version restricts the activities that you can do with the project. You normally lock a version after you declare a champion model in preparation for deploying the champion model to a production environment.

To lock a version:

1. Open a project and select the **Versions** tab.
2. Select a version and click 🔒 to lock the version.

The 🔒 icon appears to the left of the version name

Unlock a Version

If changes to a model are required after the version is locked, a SAS Decision Manager administrator can unlock the version.

To unlock a version:

1. Open a project and select the **Versions** tab.
2. Select a version and click 🔓 to unlock the version.

For more information about versions, see “Lock and Unlock a Project Version” on page 118.

20

Publishing Models

Overview of Publishing Models

SAS Decision Manager provides a comprehensive publishing environment for model delivery that supports sharing performance and scoring data. SAS Decision Manager publishes models to different channels, and to the SAS Metadata Repository. SAS Decision Manager can also publish classification, prediction, and segmentation (cluster) models that have the score code type of DATA step to a database or Hadoop. Models that have a score code type of analytic store can be published only to Hadoop and Teradata. Application software, such as SAS Data Integration Studio or SAS Enterprise Guide, enables you to access models through the SAS Metadata Server and to submit on-demand and batch scoring jobs.

SAS Decision Manager publishes models to defined publication channels. Authorized users who subscribe to a channel can choose to receive email notifications when updated models are ready to deploy to testing or production

scoring servers, and are published to a publication channel. From a publication channel, you can extract and validate the scoring logic, deploy champion models to a production environment, and monitor the performance of your models.

Champion and challenger models can be published to the SAS Metadata Repository, a SAS channel, a database, or Hadoop from the Projects category view. Models can also be published from the **Models** tab of a project to the SAS Metadata Repository. The publish history of models can be viewed on the **Models** tab and on the **Published** tab on the **History** tab. You can also remove models that have been published to a database.

Publishing Models to a SAS Channel

SAS Decision Manager uses the SAS Publishing Framework to publish models to defined channels. The SAS Publishing Framework notifies subscribers of the publication channel when the models are delivered. You can publish models in the Projects category view. SAS Decision Manager creates a SAS package (SPK) file for the model in a publication channel. A user who subscribes to the publication channel can choose to receive email that includes the SAS package as an attachment.

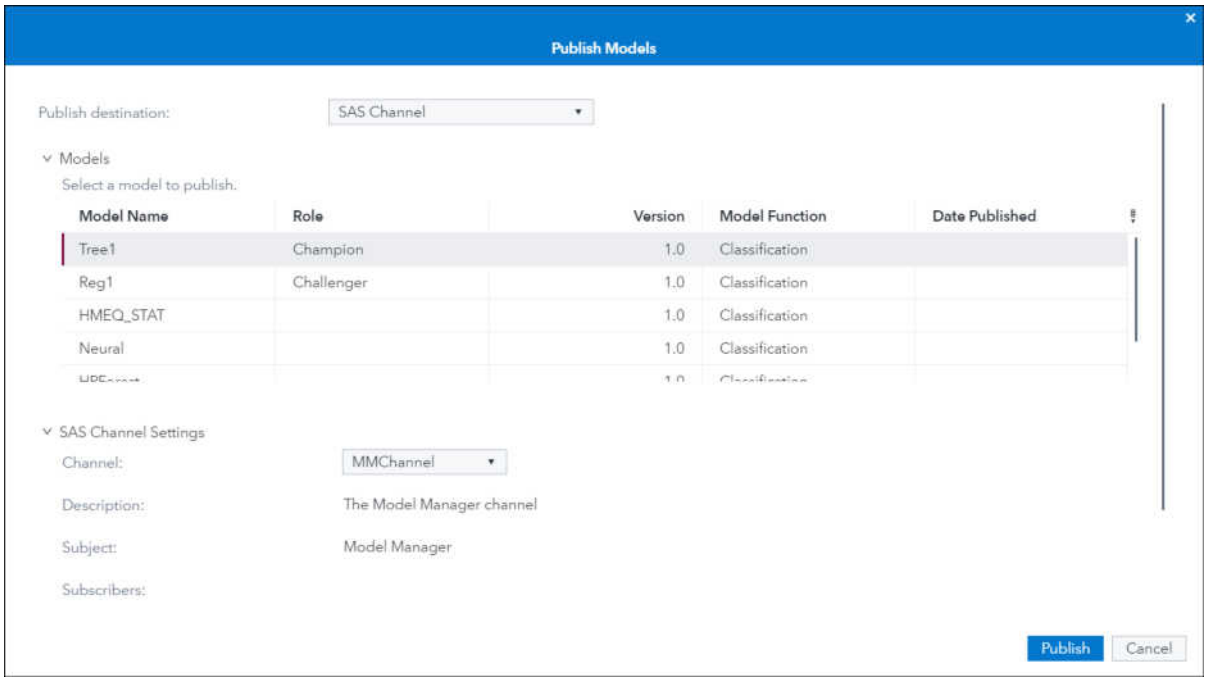
Note: Before you can deploy a model to a publications channel, a SAS administrator must configure the publication channel in SAS Management Console to publish models as archive (binary .SPK) files to a persistent store location. The archive persistent store location is specified as a physical file location, an FTP server, an HTTP server, or a path in WebDAV.

The **Report** attribute for a file element in a model template indicates whether SAS Decision Manager includes a file in the SAS package. You use the SAS Package Reader or a file archiver and compression utility, such as WinZip, to view the contents of the SPK file. SAS Decision Manager provides SAS macro programs to extract published models and deploy the models on testing and production scoring servers. The SAS package might contain additional files, depending on the number of file elements in the model template that have a Report attribute.

Note: The REF file contains the URL for a folder location in the project, such as `http://` *MMServer:7980* `/SASContentServer/repository/default/ModelManager/MMRoot/` *organizational folder/project/version/Models/model_name* `/score.sas`.

To publish a model to a channel:

1. Click to navigate to the Projects category view.
2. Select a project, click ⋮, and select **Publish**.
3. Select **SAS Channel** from the publish destination list.
4. Select the model that you want to publish from the models list.
5. Select a publication channel from the **Channel** drop-down list.



6 (Optional) Click **More options...** to specify a message subject, notes, and user-defined properties. Click **Save**.

7 Click **Publish**.

Publishing Models to the SAS Metadata Repository

About Publishing Models to the SAS Metadata Repository

SAS Decision Manager publishes a model by creating a MiningResults object in the SAS Metadata Repository. You can use the model information in the MiningResults object to set up a scoring environment. A scoring application can use SAS Data Integration Studio or SAS Enterprise Guide to access the metadata and run a batch job or stored process that executes the score code. SAS Real-Time Decision Manager can also read the metadata and use it in that process environment. Therefore, when you publish a project champion model, challenger model, or other models (with proper configuration), the scoring application always uses the most current champion model. The project champion and challenger models can be published from the project level and only the project champion models can be published from the portfolio level.

Note: SAS Decision Manager cannot publish R models.

A user can publish a model to any accessible folder with Write permission, including all folders in the SAS Foundation repository and folders in custom repositories that are created in SAS Management Console to reflect the structure of your business organization.

Publish Project Champion and Challenger Models to the SAS Metadata Repository

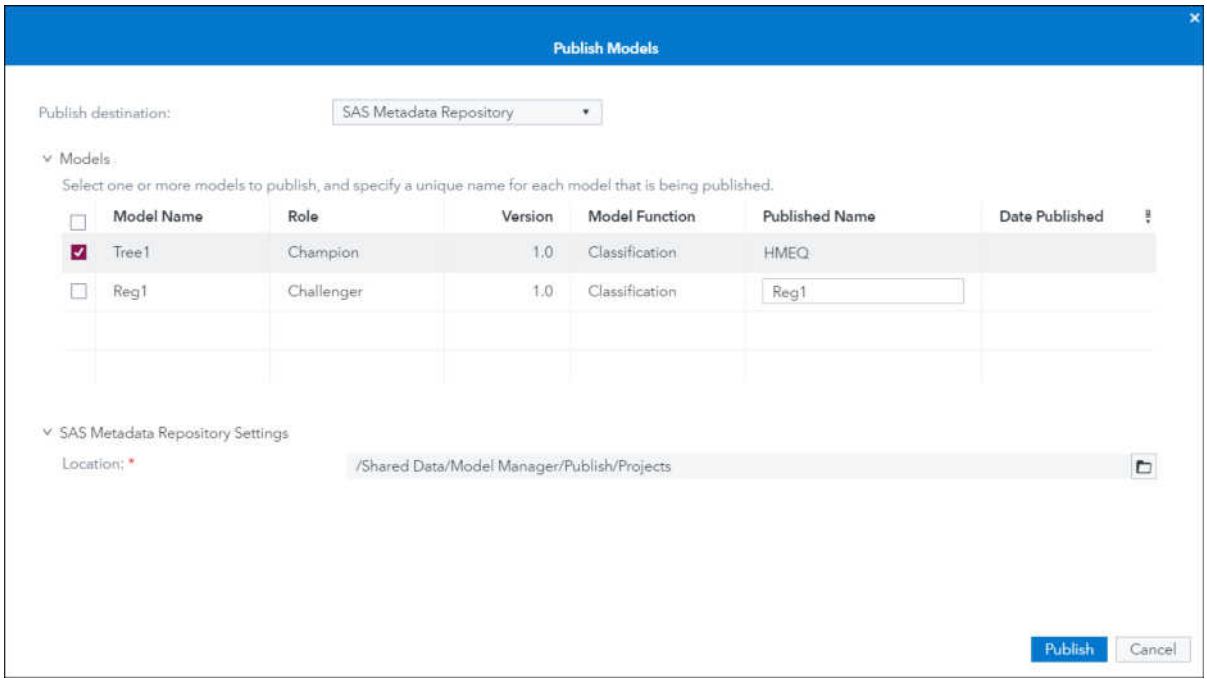
To publish champion and challenger models from a model project to the SAS Metadata Repository:

1. Click to navigate to the Projects category view.
2. Select a project, click ⋮, and select **Publish**.
3. Select **SAS Metadata Repository** from the publish destination list.
4. Select one or more models to publish from the models list.
5. Specify a **Published Name** for each model.

   Note: You cannot modify the published name for a champion model.

6. Click and select the location to publish the model to.

   Note: You must have the appropriate permissions to the location that you are publishing to.



7 Click **Publish**.

8 Click **Close** in the confirmation message.

Publish a Model to the SAS Metadata Repository

To publish a model to the SAS Metadata Repository:

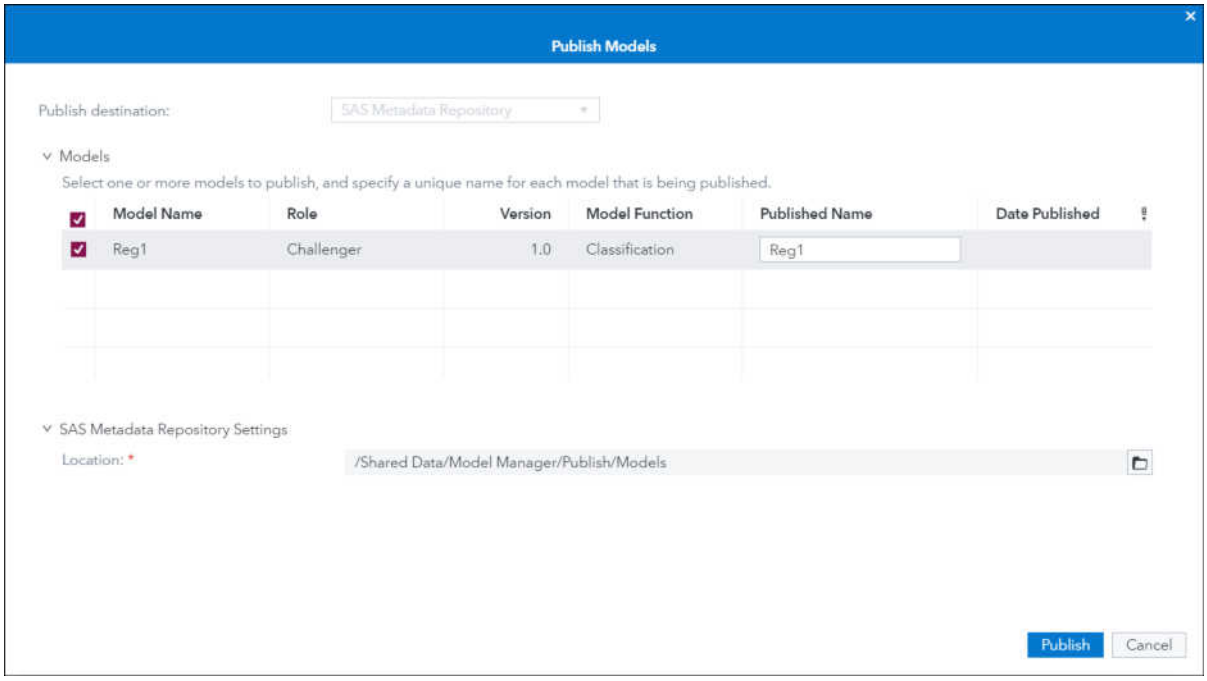
1 Open a project and click the **Models** tab.

2 Select a model, click ⋮, and select **Publish**.

3 Specify a **Published Name** for the model.

4 Select the location to publish the models to.

Note: You must have the appropriate permissions to the location that you are publishing to.



5 Click **Publish**.

6 Click **Close** in the confirmation message.

Publishing Models to a Database or Hadoop

About Publishing Models to a Database or Hadoop

SAS Decision Manager enables you to publish the project champion model and challenger models that are associated with the **DATA Step** score code type to a configured database. SAS Decision Manager uses the SAS Scoring Accelerator and SAS/ACCESS interface to the database to publish models to the database or Hadoop Distributed File System (HDFS). The Scoring Accelerator takes the models from SAS Decision Manager and translates them into scoring files or functions that can be deployed inside the database. After the scoring functions are published using the SAS/ACCESS interface to the database, the functions extend the database's SQL language and can be used in SQL statements such as other database functions. After the scoring files are published, they are used by the SAS Embedded Process to run the scoring model.

If the scoring function publish method is chosen, the scoring metadata tables in the database are populated with information about the project and pointers to the scoring function. This feature enables users to review descriptions and definitions of the published model. The audit logs track the history of the model's usage and any changes that are made to the scoring project.

For more information about the SAS Scoring Accelerator, see the SAS In-Database Technology page available at http://support.sas.com.

Prerequisites for Publishing to a Database or Hadoop

The following prerequisites must be completed before users can publish a model scoring function using the scoring function publish method, or publish a model's scoring files using the SAS Embedded Process publish method:

- The user must have the proper authorization to publish approved models from SAS Decision Manager to the database or HDFS for SAS In-Database scoring.

  Note: When using the SAS Embedded Process publish method to publish models from SAS Decision Manager to a Teradata database, you must have a user database with the appropriate user permissions in order to validate the scoring results. For more information, see "Teradata Permissions for Publishing Formats and Scoring Models" in *SAS and SAS Viya In-Database Products: Administrator's Guide*.

Note: If your system is configured for Kerberos authentication, each user must have a valid Kerberos ticket. Also, you must complete post-installation configuration steps to enable users to publish models from the SAS Decision Manager application. For more information, see "Configure Users Authenticated by Kerberos for Publishing Models" in *SAS Decision Manager: Administrator's Guide*.

- The champion model for the project must be set.
- SAS Decision Manager can publish models to a database or Hadoop when they are associated with the **DATA step** score code type. Models that have a score code type of **Analytic store** can be published only to Hadoop and Teradata. Models that have a score code type of **SAS Program**, **PMML**, or **DS2** cannot be published to a database.

  The score code component file (score.sas) is DATA step score code and is used as input by the SAS Scoring Accelerator when publishing a model to a database. When you use the scoring function publish method, some SAS language elements and syntax are not supported when you create or modify your score code. Only the SAS language elements and syntax that are required to run critical data transformations and model scoring functions are available. If you use a statement or function that is not supported, an error occurs and your model is not published to the database. For more information, see "Considerations When Creating or Modifying DATA Step Score Code" in *SAS In-Database Products: User's Guide*.

  The SAS Scoring Accelerator requires three files when you are publishing a SAS analytic store model. The files are score.sas, score.sasast, and score.xml. The score.xml file is generated at publish time by SAS Decision Manager. For more information, see "Introduction to Analytic Store Scoring" in *SAS In-Database Products: User's Guide*.
- A database must have been configured to install scoring functions or model scoring files.
- If the model contains user-defined formats, a file that contains the user-defined formats must be attached to the version and stored in a format catalog.
- The following prerequisites are only for the scoring function publish method.
  - (Optional) A project user-defined property **DbmsTable** is defined for the champion version of the project from which to publish the scoring function.

    Note: The **DbmsTable** property must be defined if you plan to use a scoring application or SQL code to score your model.
  - The JDBC driver must be accessible from the middle-tier server when using the scoring function publish method.
  - The scoring function metadata tables are required in the target database if the **Metadata usage** option is enables in SAS Management Console.

Make User-Defined Formats Available When Publishing Models to a Database

In order to publish models with user-defined formats to a database, you must make the user-defined formats available to SAS Decision Manager.

To make the user-defined formats available for publishing:

1. Translate the user-defined formats SAS catalog (formats.sas7bcat) that was created with the model into a formats.cport file.

   Here is an example:

   ```
   filename tranfile "C:\formats.cport";
   libname source "C:\myformats";

   proc cport library=source file=tranfile memtype=catalog;
   run;
   quit;
   ```

2. Attach the formats.cport file to the version that contains the project champion model or challenger models. For more information, see "Attach a Portable Formats File" on page 119.

3. Send a request to the SAS administrator and ask them to either put the user-defined formats catalog (formats.sas7bcat) in the *SASConfigDirectory*\Lev1\SASApp\SASEnvironment\SASFormats directory or add the LIBNAME definition for the formats library to the *SASConfigDirectory*\Lev1\SASApp\appserver_autoexec_usermods file.

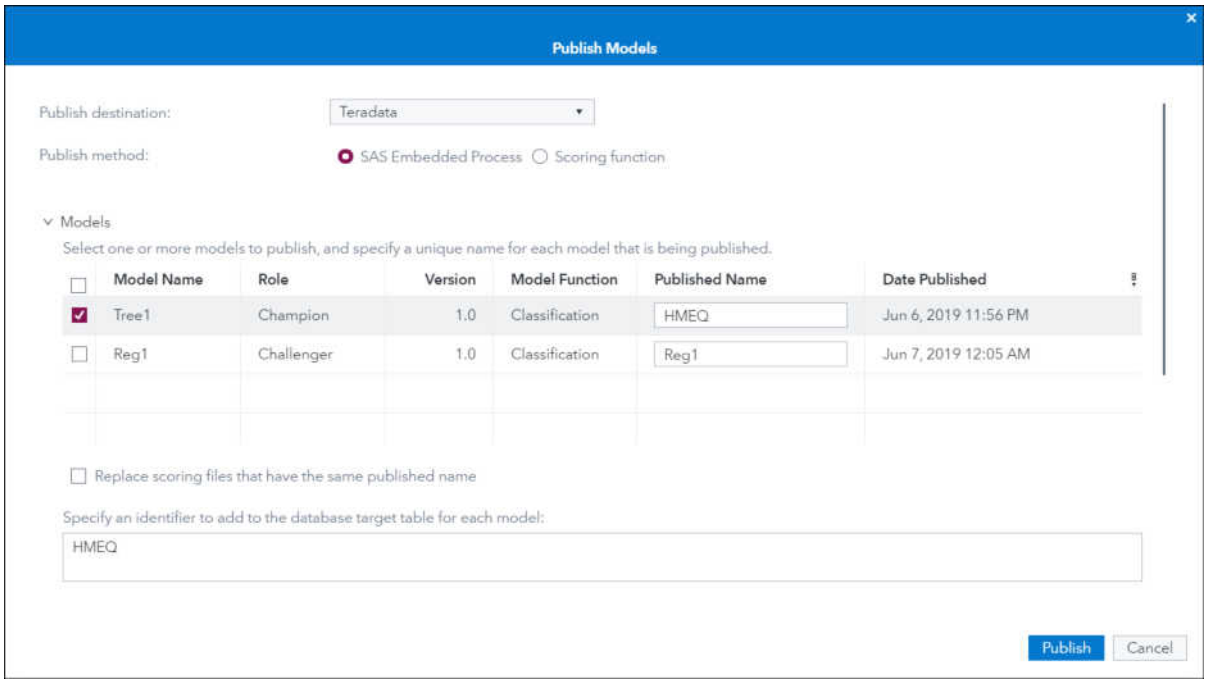
   Here is an example of a LIBNAME definition:

   ```
   libname mylib "C:\myformats";
   options fmtsearch = (mylib.formats);
   ```

How to Publish Models to a Database or Hadoop

To publish a model to a database:

1. Click ⧉ to navigate to the Projects category view.
2. Select a project, click ⋮, and select **Publish**.
3. Select a database or Hadoop for the publish destination.



4 Select a publish method. Specifies the method to use when publishing the scoring function or model files to the database.

5 Select one or more models to publish from the models list.

6 To specify a new published name, click in the **Published Name** column for a selected model. Specifies the name to use when publishing a scoring function or model files to the database. The published name is a user-defined value that can be modified. The SAS Embedded Process publish method uses the **Published Name** as the model name to publish the model files to the database. The scoring function publish method has a system-generated **Prefix** and the **Published Name** that makes up the scoring function name. These are used to publish the model scoring function. The prefix portion of the scoring function name is 11 characters long and is in the format of `Yyymmddnnn_`:

- `Y` is a literal character and is fixed for all prefixes.
- `yy` is the two-digit year.
- `mm` is the month and ranges from 01 to 12.
- `dd` is the day and ranges from 01 to 31.
- `nnn` is a counter that increments by 1 each time that a scoring function completes successfully. The value can range from 001 to 999.
- _ is the underscore that ends the prefix.

The `yymmdd` value in the prefix is the GMT timestamp that identifies the date on which you published the model. An example of a function name is `Y081107001_` *user_defined_value*. Here are the naming convention requirements:

Here are the naming convention requirements for the published name:

- The user-defined value is case insensitive. The maximum length of alphanumeric characters is determined by the database type and publish method that is selected. No spaces are allowed. An underscore is the only special character that can be included in the published name.

- The recommended maximum lengths of the published name for the scoring function publish method are the following:
  - 19 alphanumeric characters for Teradata
  - 32 alphanumeric characters for Netezza, Greenplum, and DB2

  Note: The published name (user-defined) portion of the function name in an AIX environment has a maximum length of 16 alphanumeric characters for Teradata.

- The recommended maximum length of the published name for the SAS Embedded Process publish method is 32 alphanumeric characters for all database types. The database types that are currently supported by SAS Decision Manager are Teradata, Oracle, Greenplum, and DB2.

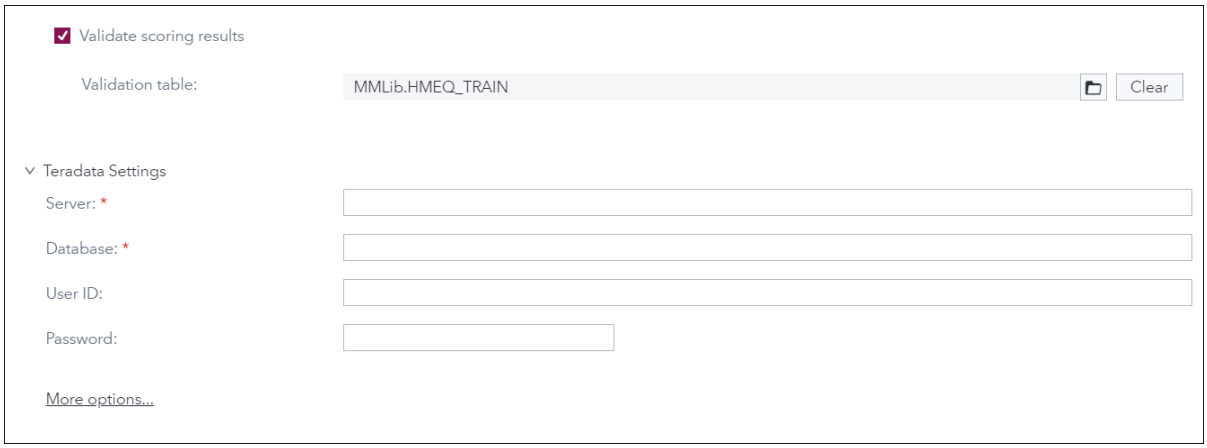
The value of the published name is validated against the target database, when the option **Replace scoring files that have the same published name** is not selected for the SAS Embedded Process publish method. If the published name is not unique, an error message is displayed.

7 (Optional) Select whether to **Replace scoring files that have the same published name**. Specifies to replace the model scoring files that have the same published name when you are using the SAS Embedded Process publish method. The value of the published name is validated against the target database when this option is not selected. If the published name is not unique, an error message is displayed.

8 Specify an identifier to add to the database target table for each model. Specifies the value of the identifier that is added to each model in the database so that the Database administrator or other users can query the database. The default value is the project name. This option is available only for the SAS Embedded Process publish method.

9 (Optional) Select whether to **Validate scoring results**. Specifies to validate the scoring results when publishing a model scoring function or model scoring files. This option creates a benchmark scoring result on the SAS Workspace Server using the DATA Step score code. The scoring input data set is used to create an equivalent database table. Scoring is performed using the new scoring function or model scoring files and database table. The scoring results are then compared. If selected, click **Browse** to navigate to the appropriate training table. The default train table that is specified in the properties of the published model is used by default.

Note: When using the SAS Embedded Process publish method to publish models from SAS Decision Manager to a Teradata database, your user database must have the appropriate user permissions to validate the scoring results. For more information, see "Teradata Permissions for Publishing Formats and Scoring Models" in *SAS and SAS Viya In-Database Products: Administrator's Guide*.



10 Specify the database settings.

Note: For Hadoop and Teradata, when you are using the SAS Embedded Process publish method, the User ID and Password settings are optional, if your system is configured for Kerberos authentication. For Netezza, when you are publishing using the Scoring function publish method, the name of the database is case sensitive.

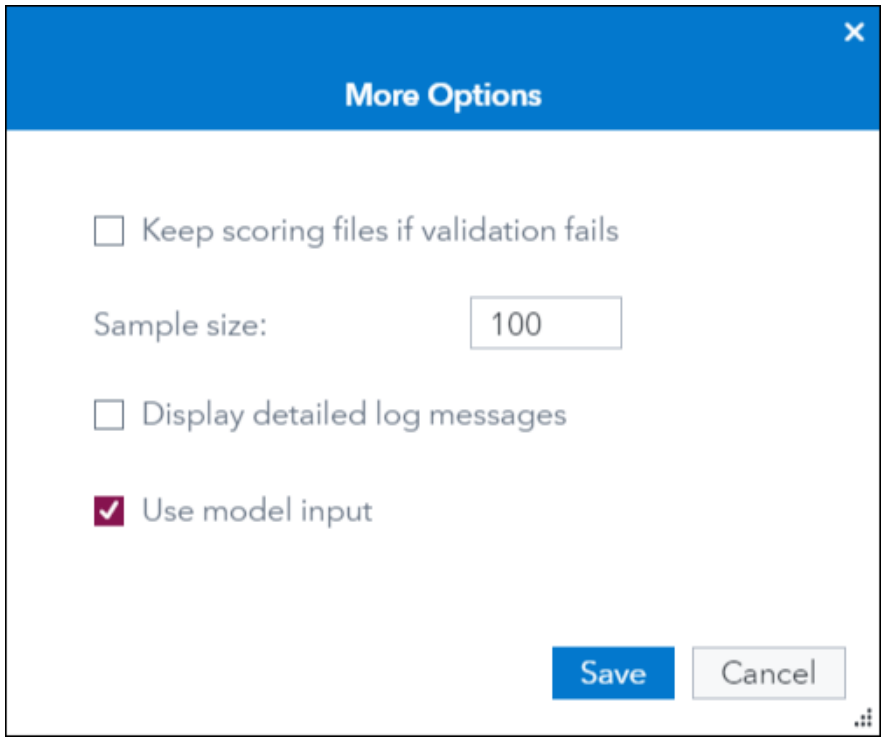
Here are the available database settings according to the publish method and database type:

Database Settings	SAS Embedded Process	Scoring Function
Server	■ Teradata ■ Oracle ■ Netezza ■ Greenplum ■ Hadoop ■ DB2 ■ SAP HANA	■ Teradata ■ Netezza ■ Greenplum ■ DB2
Database	■ Teradata ■ Oracle ■ Netezza ■ Greenplum ■ DB2	■ Teradata ■ Netezza ■ Greenplum ■ DB2
Instance number	SAP HANA	Not applicable
User ID	■ Teradata ■ Oracle ■ Netezza ■ Greenplum	■ Teradata ■ Netezza ■ Greenplum ■ DB2

Database Settings	SAS Embedded Process	Scoring Function
	■ DB2 ■ Hadoop ■ SAP HANA	
Password	■ Teradata ■ Oracle ■ Netezza ■ Greenplum ■ DB2 ■ Hadoop ■ SAP HANA	■ Teradata ■ Netezza ■ Greenplum ■ DB2
Server user ID	Not applicable	DB2
Compile database	Not applicable	Netezza
Jazlib database	Not applicable	Netezza
Schema	■ Oracle ■ Greenplum ■ DB2 ■ SAP HANA	■ Greenplum ■ DB2
Initial wait time (in seconds)	Not applicable	DB2
FTP time out (in seconds)	Not applicable	DB2
Directory path	Hadoop	Not applicable

For a description of each database setting, see “Descriptions of Database Settings” on page 319.

11 Click **More options...** to specify other options for the database.



Keep scoring function if validation fails (scoring function) or **Keep scoring files if validation fails** (SAS Embedded Process)
specifies to save the scoring function or model scoring files if the validation of the scoring results fails. Saving the scoring function or model scoring files is useful for debugging if validation fails.

Sample size
specifies the size of the sample to use for validating the scoring function or model files. The default value is 100. The maximum number of digits that are allowed is 8.

Display detailed log messages
provides detailed information, which includes warnings and error messages that occur when you publish a scoring function or scoring model files.

Use model input
specifies to use the selected model input when publishing the scoring function or model files instead of using the project input, which is the default. This is useful when the project input variables exceed the limitations for a database.

Here are the limitations for the number of model input variables when publishing a champion model or challenger model to a database:

Database Type	SAS Embedded Process	Scoring Function
DB2	The maximum depends on the page size of the database tablespace. For a 4K page size database, the limit is 500. If you have it configured for any of the larger page sizes	90

Database Type	SAS Embedded Process	Scoring Function
	(8K, 16K, 32K), then the limit is 1012.	
Greenplum	1660	100
Hadoop	No limit	Not applicable
Netezza	1600	64
Oracle	1000	Not applicable
SAP HANA	1000	Not applicable
Teradata	If you use Teradata version 13.1 or 14.0, the maximum is 1024. If you use the SAS Embedded Process and Teradata version 14.10, the maximum is 2048.	128

Protected mode (Teradata only)
specifies the mode of operation to use when publishing a model using the scoring function publish method. There are two modes of operation, protected and unprotected. You specify the mode by selecting or deselecting the **Protected mode** option. The default mode of operation is protected. Protected mode means that the macro code is isolated in a separate process from the Teradata database, and an error does not cause database processing to fail. You should run the Publish Scoring Function in protected mode during validation. When the model is ready for production, you can run the Publish Scoring Function in unprotected mode. You might see a significant performance advantage when you run the Publish Scoring Function in unprotected mode.

Fenced mode (DB2 and Netezza only)
specifies the mode of operation to use when publishing a model using the scoring function publish method. There are two modes of operation, fenced and unfenced. You specify the mode by selecting or deselecting the **Fenced mode** option. The default mode of operation is fenced. Fenced mode means that the macro code is isolated in a separate process from the DB2 database, and an error does not cause database processing to fail. You should run the Publish Scoring Function in fenced mode during validation. When the model is ready for production, you can run the Publish Scoring Function in unfenced mode. You might see a significant performance advantage when you run the Publish Scoring Function in unfenced mode.

12 Click **Publish**.

13 Click **Close** in the confirmation message.

Descriptions of Database Settings

The following are descriptions of the database settings that are used for publishing models.

Server
specifies the name of the server where the database resides. The port can be included as part of the server name (for example, *server-name*:*port*). When you are using the scoring function publish method, the default port is used if you do not specify the port as part of the server name.

Note: The port must be included as part of the server name for SAP HANA SPS09 or higher. For SAP HANA SPS08, you must use the instance number setting instead of adding the port to the server name.

Database
specifies the name of the database.

Note: For Netezza, the name of the database is case sensitive if you are publishing models using the Scoring function publish method.

User ID
specifies the user identification that is required to access the database.

Note: For Hadoop or Teradata, this setting is hidden if your system is configured for Kerberos authentication.

Password
specifies the password that is associated with the **User ID**.

Note: For Hadoop or Teradata, this setting is hidden if your system is configured for Kerberos authentication.

Server user ID (DB2 only)
specifies the user ID for SAS SFTP. This value enables you to access the machine on which you have installed the DB2 database. If you do not specify a value for **Server user ID**, the value of **User ID** is used as the user ID for SAS SFTP.

Schema (Greenplum, Oracle, and DB2)
specifies the schema name for the database. The schema name is owned by the user that is specified in the **User ID** field. The schema must be created by your database administrator.

Initial wait time (DB2 only)
specifies the initial wait time in seconds for SAS SFTP to parse the responses and complete the SFTP –batch file process.

Default: 15 seconds

FTP time out (DB2 only)
specifies the time-out value in seconds if SAS SFTP fails to transfer the files.

Default: 120 seconds

Compile database (Netezza only)
specifies the name of the database where the SAS_COMPILEUDF function is published.

Default: SASLIB

See Also: For more information about publishing the SAS_COMPILEUDF function, see the *SAS and SAS Viya In-Database Products: Administrator's Guide*.

Jazlib database (Netezza only)
specifies the name of the database where the SAS 9.3 Formats Library for Netezza is published.

Default: SASLIB

Instance number (SAP HANA only)
specifies the instance number.

Note: The instance number must be used for SAP HANA SPS08, instead of adding the port to the server name. For SAP HANA SPS09 or higher the port must be included as part of the server name and the instance number is ignored.

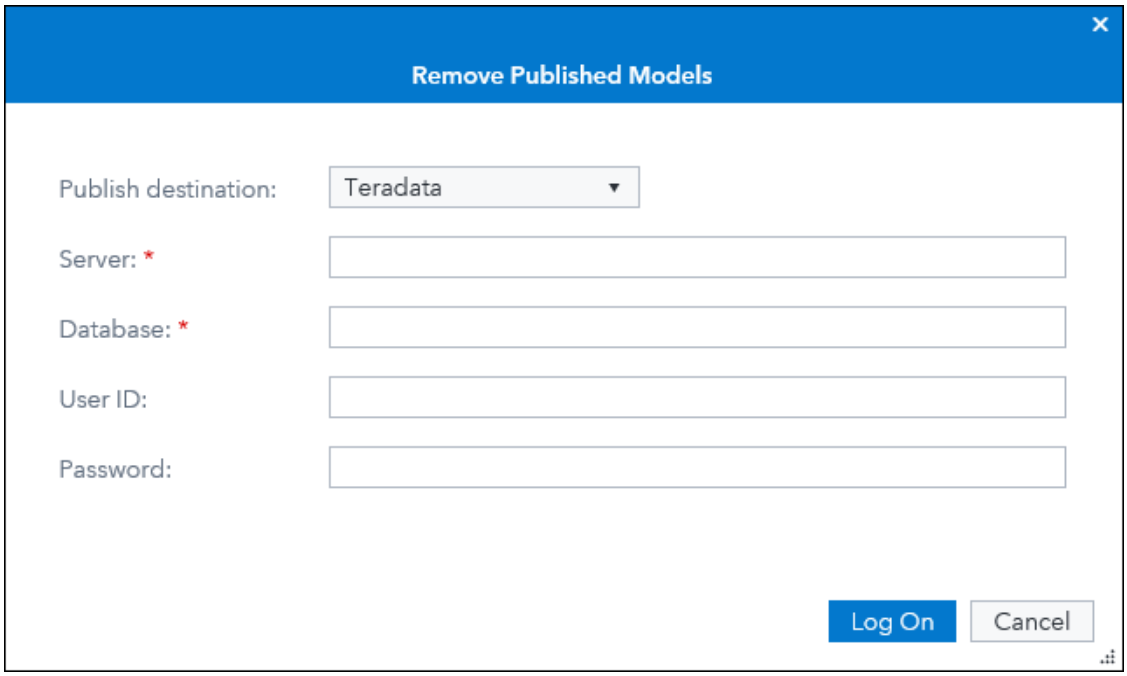
Directory path (Hadoop only)
specifies the directory path for the server.

Remove Published Models

The SAS Embedded Process publish method enables you to replace the model scoring files, but the scoring function publish method publishes the model as a separate entry in the database each time. The Remove Published Models feature enables you to remove previously published models, so that you can clean up the test or production database. If you modify the previously published models or change the champion model or challenger models after you have published models to a database or Hadoop, you can remove them to clean up the database for future publishing of models.

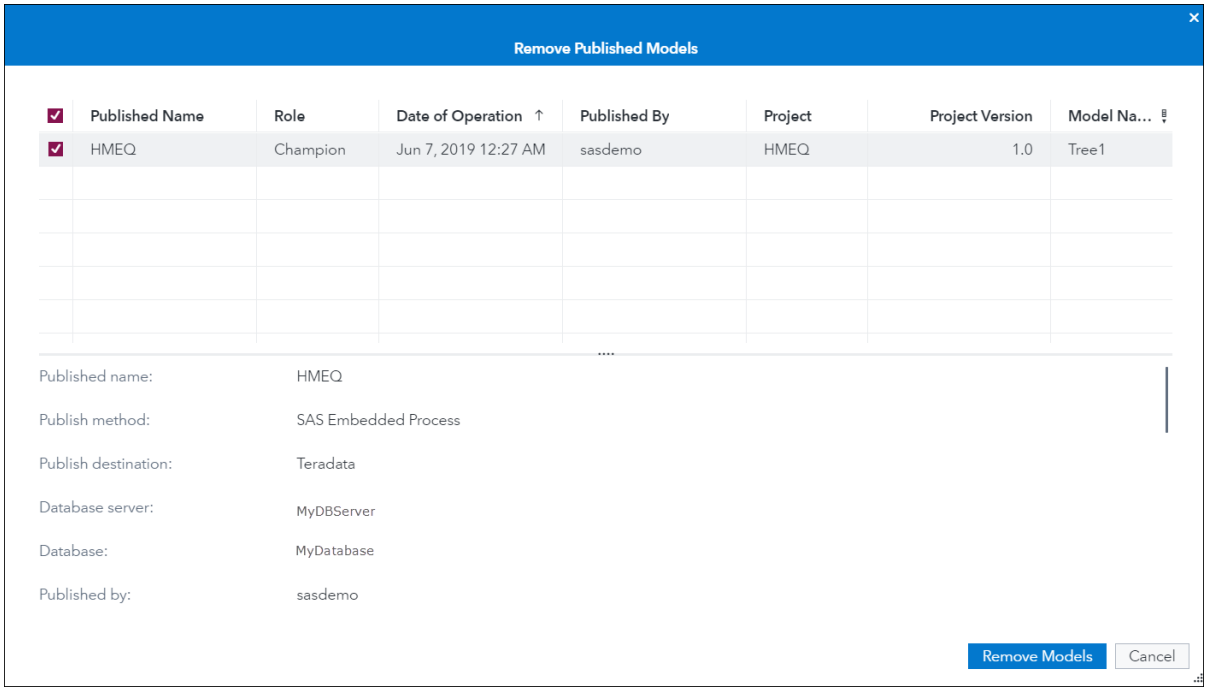
To remove published models:

1. Click to navigate to the Projects category view.
2. Select a project, click ⋮, and select **Remove published models**.



3 Select the publish destination and then specify the database or Hadoop settings. Click **Log On**.

4 Select the models that you want to remove from the database.



5 Click **Remove Models**.

6 Click **Close** in the confirmation message.

View Publish History and Results

To view the publish history of a model, select the **Models** tab. To view the publish history of all models, select the **Published** tab on the **History** tab. All models that have been published to a SAS Channel, to the SAS Metadata Repository, and to a database are displayed. Select a model from the list to view the full publish details.

To view the full publish details for a model:

1 Open a model and click the **Model Properties** tab.

2 Select **History** ⇨ **Published** to view the publish history.

To view the full publish details for all models:

1 Open a project and click the **History** tab.

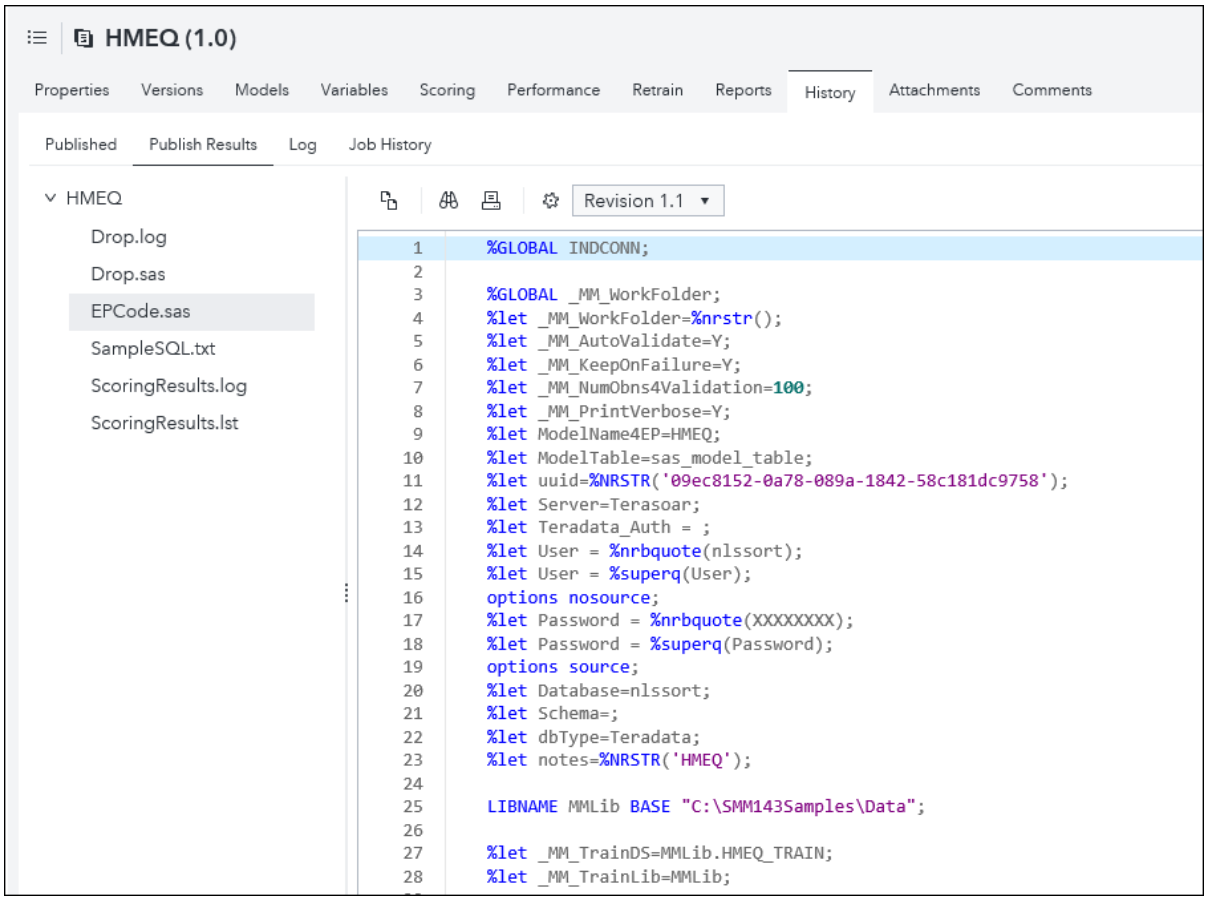
2 Click the **Published** tab to view the publish history.

To view the publish results for a project:

1 Open a project and click the **History** tab.

2 Click the **Publish Results** tab, expand the project section, and select each individual file.

   Here is an example of the publishing results for the HMEQ project:


HMEQ (1.0)
Properties
Versions
Models
Variables
Scoring
Performance
Retrain
Reports
History
Attachments
Comments
Published
Publish Results
Log
Job History
HMEQ
Drop.log
Drop.sas
EPCode.sas
SampleSQL.txt
ScoringResults.log
ScoringResults.lst
Revision 1.1
%GLOBAL INDCONN;
%GLOBAL _MM_WorkFolder;
%let _MM_WorkFolder=%nrstr();
%let _MM_AutoValidate=Y;
%let _MM_KeepOnFailure=Y;
%let _MM_NumObns4Validation=100;
%let _MM_PrintVerbose=Y;
%let ModelName4EP=HMEQ;
%let ModelTable=sas_model_table;
%let uuid=%NRSTR('09ec8152-0a78-089a-1842-58c181dc9758');
%let Server=Terasoar;
%let Teradata_Auth = ;
%let User = %nrbquote(nlssort);
%let User = %superq(User);
options nosource;
%let Password = %nrbquote(XXXXXXXX);
%let Password = %superq(Password);
options source;
%let Database=nlssort;
%let Schema=;
%let dbType=Teradata;
%let notes=%NRSTR('HMEQ');
LIBNAME MMLib BASE "C:\SMM143Samples\Data";
%let _MM_TrainDS=MMLib.HMEQ_TRAIN;
%let _MM_TrainLib=MMLib;

PART 6

Using SAS Workflow with SAS Decision Manager

21

Starting a Workflow and Working with Tasks

Overview of Using Workflows

SAS Decision Manager uses the Workflows and My Tasks category views to use SAS Workflow. A *workflow* is an instance of a workflow template. A workflow can be used to track the progress of objects, such as model projects and rule flows at the version level. An authorized user can use SAS Workflow Studio to define workflow templates and to make them available to SAS Decision Manager for use. Workflow templates contain the set of tasks, participants, policies, statuses, and data objects that comprise a business task. The status that you select when completing a task determines the path to the next task in the workflow.

All users can access the My Tasks category view. By default, only users that are in the Decision Manager Common Administrators group can access the Workflows category view.

For more information about user permissions, see *SAS Decision Manager: Administrator's Guide*

The SAS Decision Manager Quick Start Tutorial contains sample workflow templates that can be used to perform basic workflow tasks. For more information,

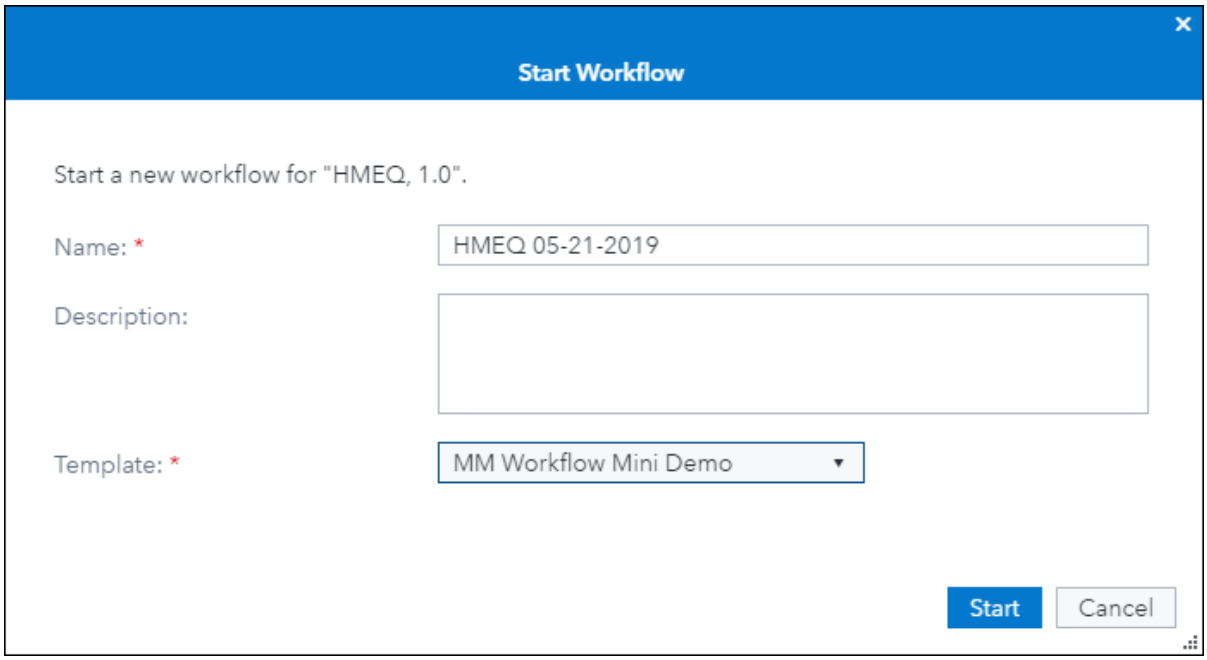
see "Make the Tutorial Files Available" in *SAS Decision Manager: Quick Start Tutorial*.

Start a New Workflow

When you start a new workflow, it is associated with the selected version of a project or rule flow. For a specific version, only one workflow can be in progress at a time. To start another workflow for the same version, you must first complete the in-progress workflow, or terminate the in-progress workflow process. A workflow can be started only for a version of a rule flow that is in the state of Current.

1 Open a project or rule flow.

2 Click **Workflow**. The Start Workflow window appears.



3 Enter a name for the new workflow.

4 (Optional) Enter a description for the workflow.

5 Select a template from which to create the workflow.

6 Click **Start**.

See Also

- Overview of Managing Workflows
- Working with Workflow Tasks

Working with Workflow Tasks

About Working with Workflow Tasks

The My Tasks category view displays the tasks for In Progress workflows that you have been assigned to as a potential owner or that have been claimed by you.

Click to navigate to the My Tasks category view.

From the My Tasks category view, you can perform the following:

- claim a task
- claim and open an object (project or rule flow) that is associated with a task
- open an object that is associated with a task
- release a task
- view the task details and workflow diagram

Claim a Task

Select a task and click **Claim**. Your user name appears in the **Claimed By** column.

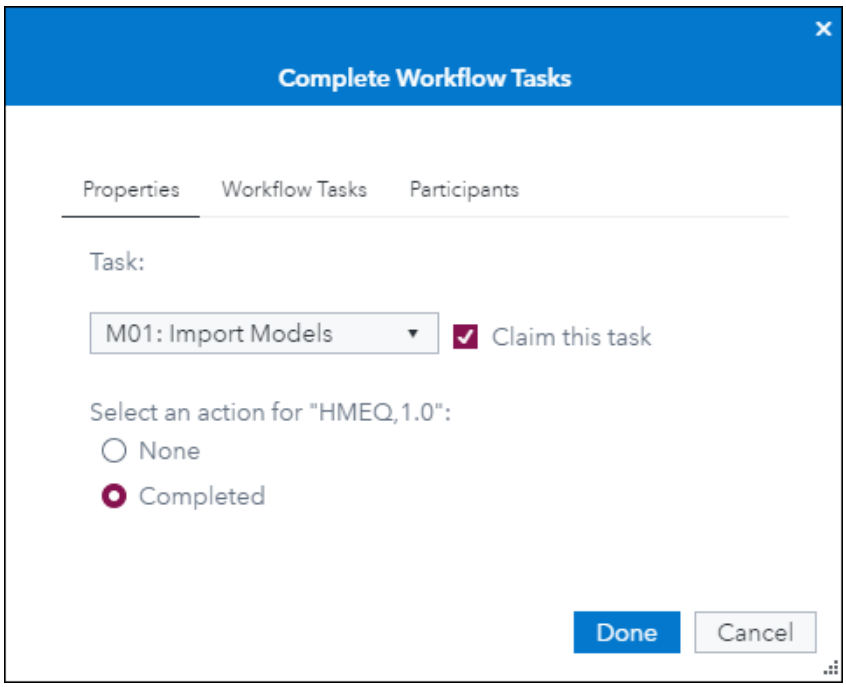
Note: The task must be claimed before an action can be selected. You can also claim a task from the Complete Workflow Tasks window by selecting the **Claim this task** check box.

Complete a Task

1. Select the task from the My Task category view and click **Claim and Open**. The task is claimed, and the associated project or rule flow opens.

2 Click **Workflow**. The Complete Workflow Tasks window appears.

3 Select an action to take for the selected task. The actions that are available are the status values for the task in the workflow.



4 Click **Done**. The workflow process continues to the next task.

Open an Associated Object

Select the task from the My Task category view and click 🗀 to open the associated project or rule flow.

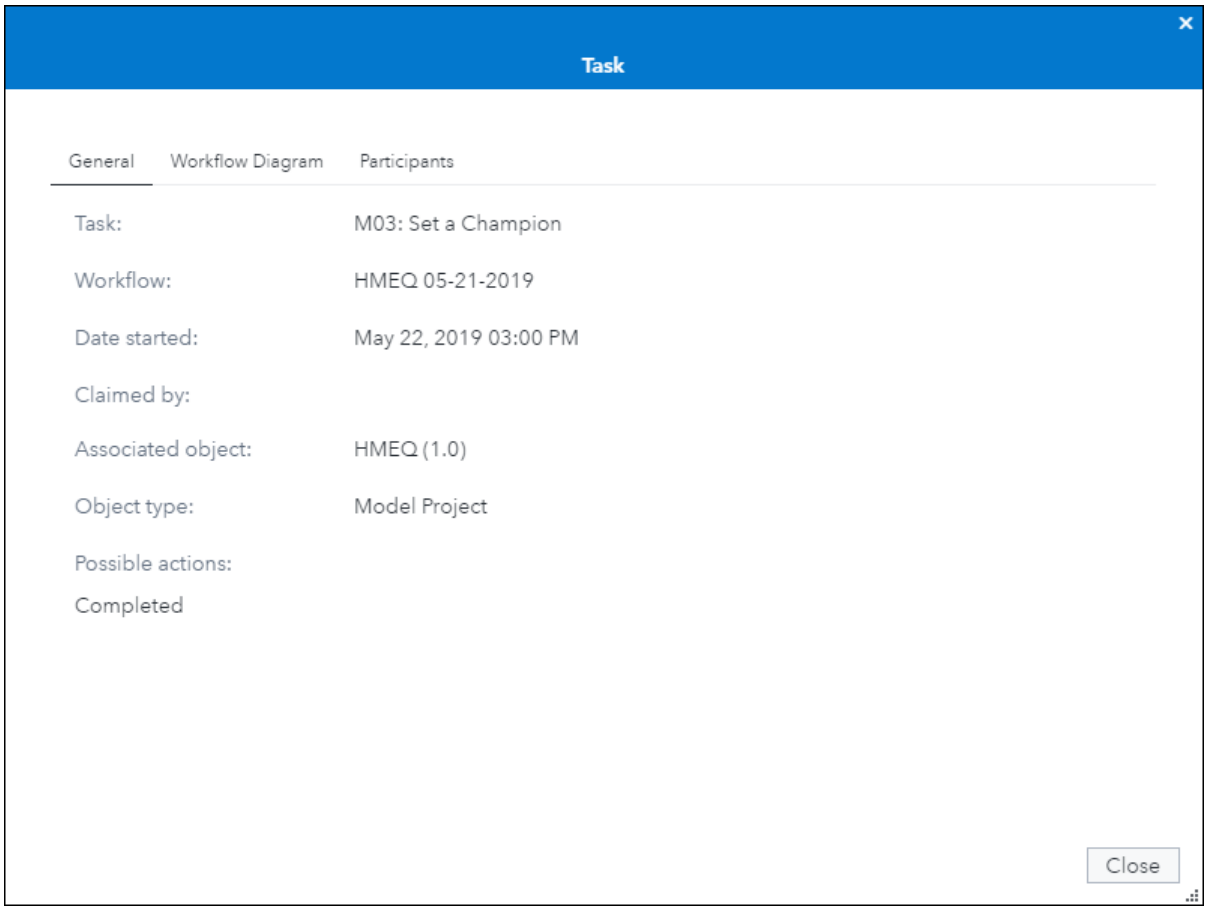
Release a Task

A task can be released from the My Task category view by clicking **Release**.

Note: Only a business administrator who has access to the Workflows category view can release a task that has been claimed by another participant. For more information, see "Release a Task" on page 339.

View Task Details

Click the task name. The Task window appears. Here you can view general task information, the workflow diagram, and the participants.



22

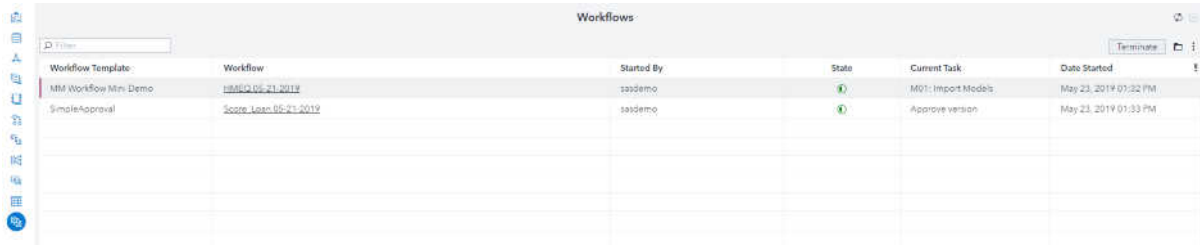
Managing Workflows

Overview of Managing Workflows

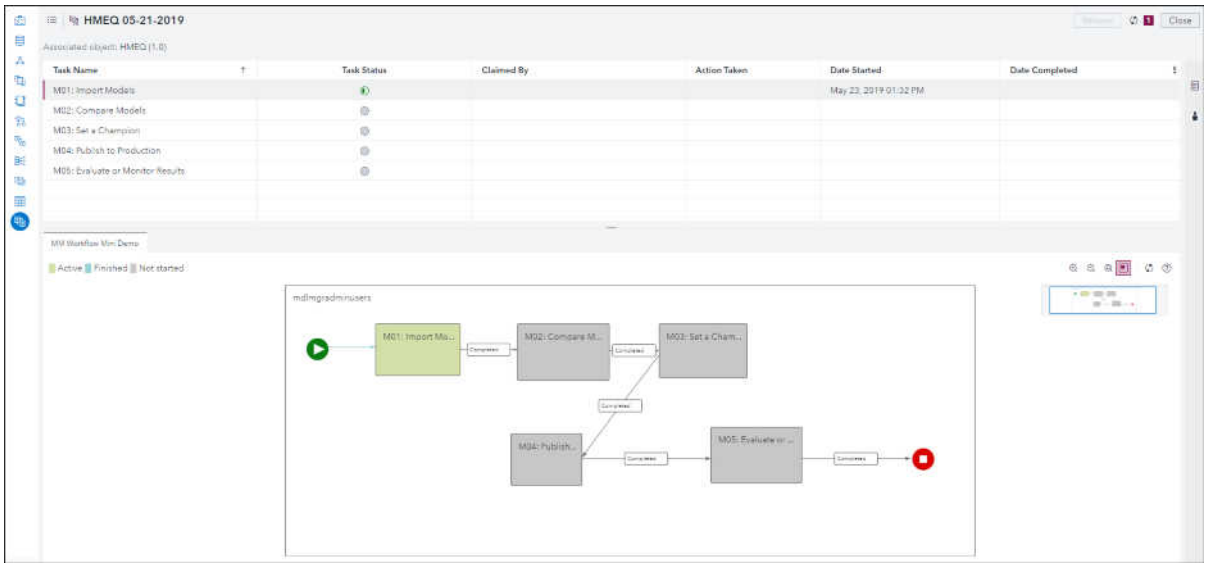
SAS Decision Manager can be used to manage workflows. You can create new workflows, view workflows, and interact with tasks that are associated with a workflow. If a user is a business administrator, they can influence the progress of a task by assigning a task, or releasing a task that is claimed by another user. An administrator can also specify values for properties to share information with other users. After the workflow templates are made available, an application administrator can set the object mappings using the Workflows category view. Each workflow consists of tasks.

Note: By default, only users that are in the Decision Manager Common Administrators group can access the Workflows category view.

Click to view a list of available workflows in the Workflows category view.



In the Workflows category view, click a workflow name to view the workflow details.



Viewing Workflows

Only a user who is able to access the Workflows category view can manage workflows. Other users can view the list of tasks by clicking the **Workflow** button, which is accessible from the project or rule flow toolbar. If a user is the owner of a task, or assigned as a potential owner, they can view the workflow diagram and tasks that are in the My Tasks category view. Workflows are associated with a project or rule flow at the version-level.

From the Workflows category view, you can perform the following actions:

- set mappings
- terminate a workflow process
- view a workflow template

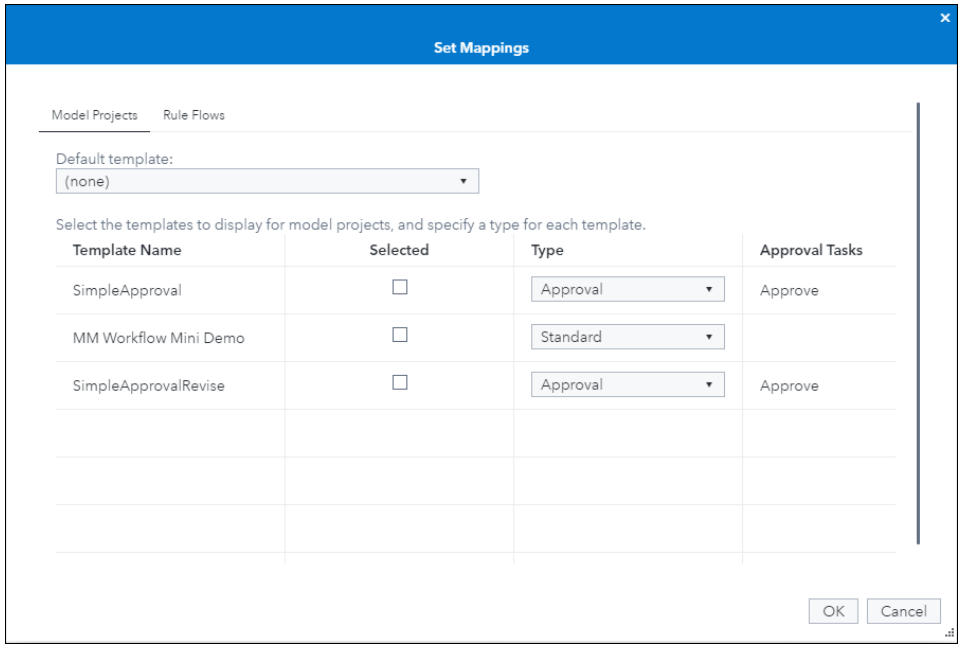
To view detailed information for a workflow, click the workflow name. The list of tasks, the task status, action taken, and who the task is claimed by are displayed. You can then view the properties and participants that are associated with a task by selecting a task. The workflow diagram is also displayed with the current status of the workflow and its tasks.

For more information, see “Working with Workflow Participants” on page 336.

Set Mappings

There are two different types of workflow templates that can be configured for use with SAS Decision Manager. Workflow templates that contain tasks that are configured with an approval status are considered an approval workflow. Workflow templates that do not contain tasks with an approval status are considered a standard workflow. The rule flows object can be associated with only an approval type. After you define your workflow template, save and activate it using SAS Workflow Studio. You must specify the templates to map to each type of object. This enables you to start a new workflow using one of the templates that are associated with the specific object.

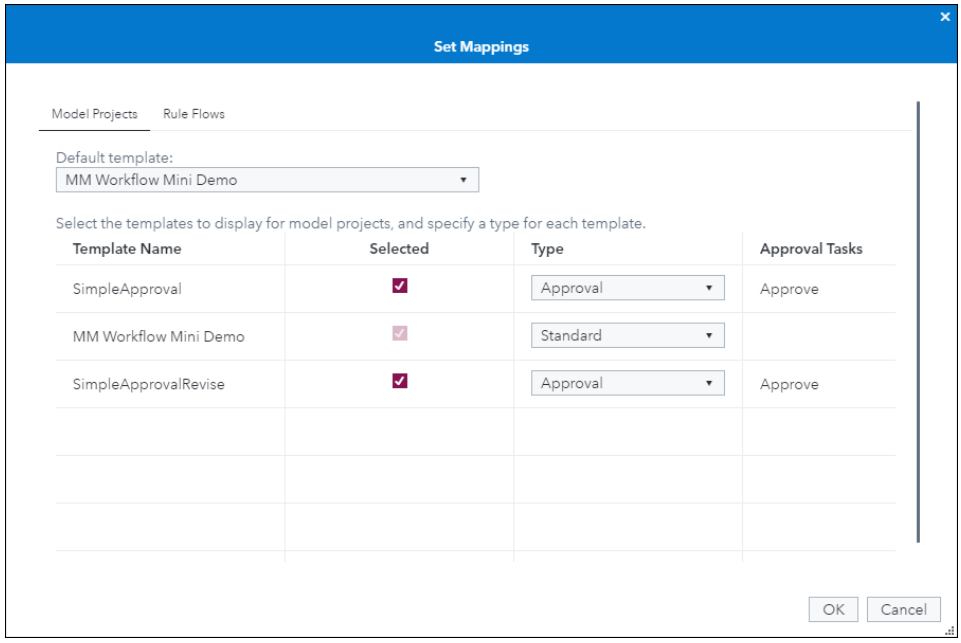
1 Click ⋮ and select **Set Mappings**. The Set Mappings window appears.



2 Select an object and then select one or more templates to map to the object.

3 Select a type for each template. The types of templates that are available are **Approval** and **Standard**.

4 Select the default template for the object from the drop-down menu.



5 Click **OK**.

Working with Workflow Participants

From the Workflow details view you can access the properties and participants that are associated with a task by selecting a task. If you are business administrator, you can assign or remove participants, and release tasks that have been claimed by another user.

Assign Participants to Tasks

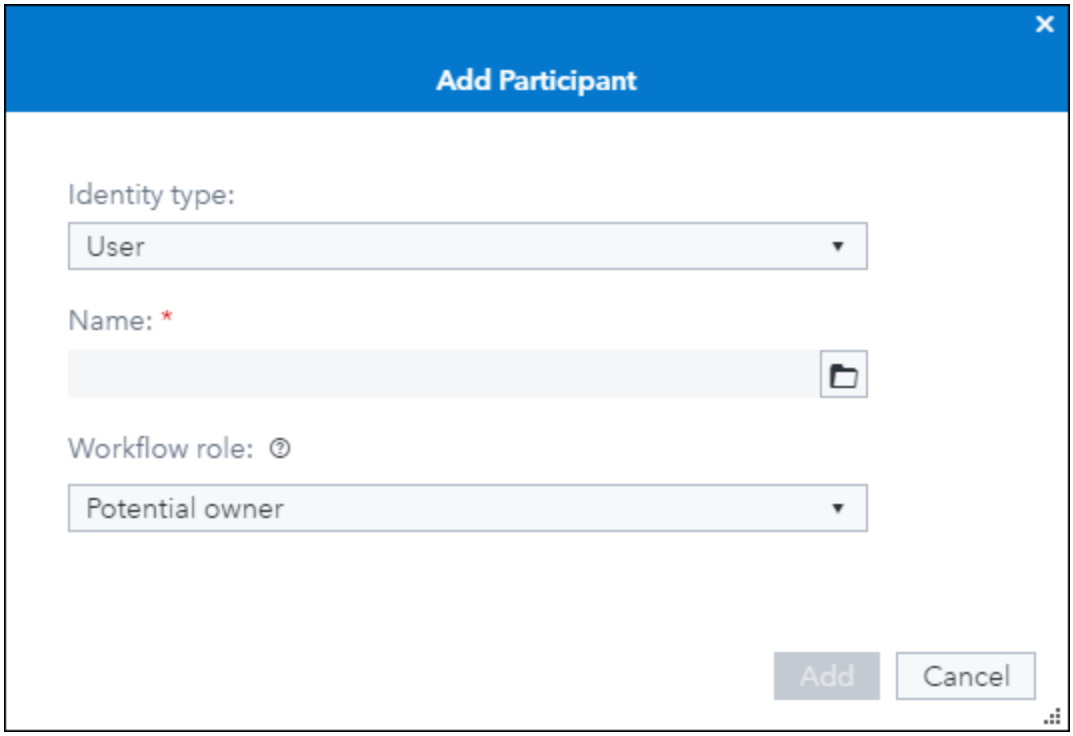
Default participants might have been assigned already to tasks when a workflow definition was created.

To assign an additional participant to a task:

1 From the Workflows category view, click a workflow name. The Workflow details view is displayed.

2 Select a task, and then click to access the Participants pane.

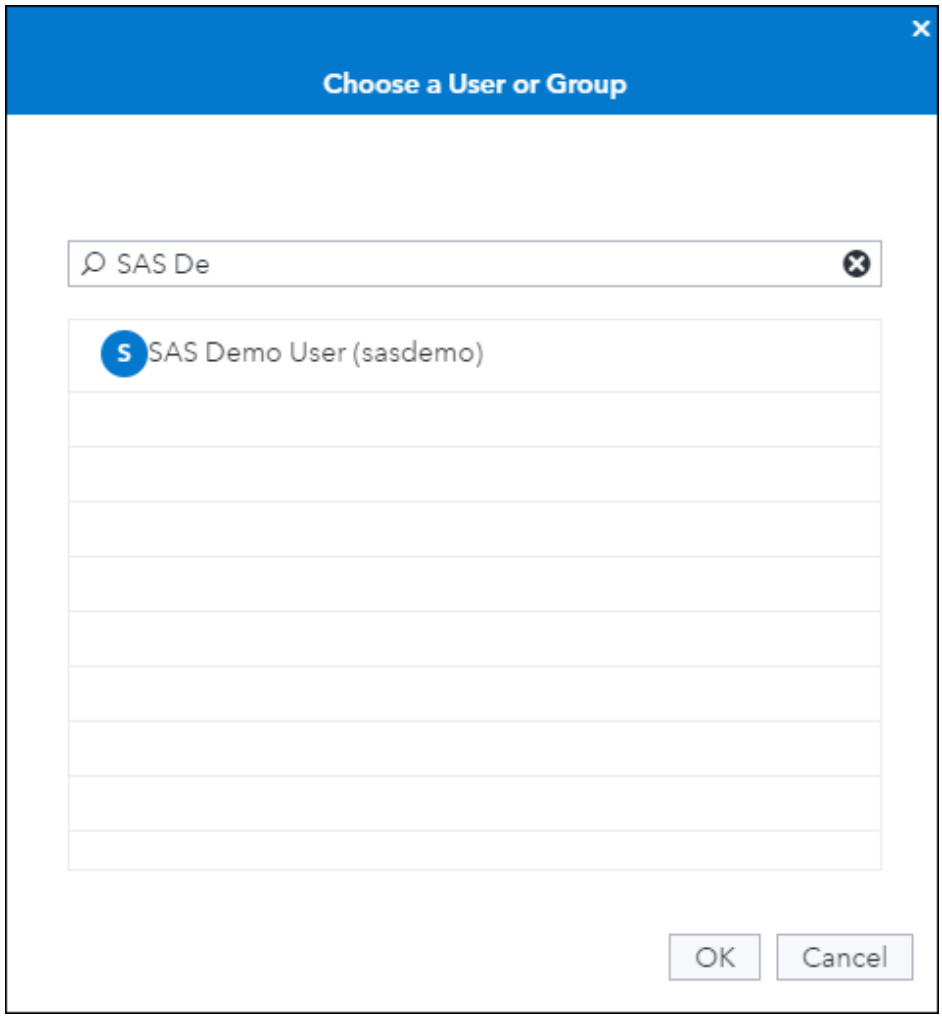
3 Click . The Add Participant window appears.



4 Select an identity type.

5 Click 🗀 and enter part of the user or group name.

Note: If you do not enter part of the name, all of the names for the selected identity type are displayed.



Select a name and click **OK**.

6 Select a workflow role for the participant.

Here are the workflow roles that you can assign to participants for a workflow task:

- **Business administrator**: a participant who can influence the progress of a task by actions such as assigning a task, or releasing the task claimed by another user.
- **Potential owner**: a participant who can claim a task in a workflow process and who becomes the actual owner of a task.

7 Click **Add**. The new participant is added to the list in the Participants pane.

Remove Participants from a Task

To remove a participant from a task:

1 From the Workflows category view, click a workflow name.

2 Select a task, and then select a participant from the Participants pane.

Note: You cannot remove a participant who is associated with the workflow roles of business administrator or actual owner.

3 Click . A message is displayed asking if you are sure that you want to remove the participant from the task.

4 Click **Remove**. The user is removed from the list in the Participants pane.

Release a Task

An authorized user with the capability to access the Workflows category view can release a task that has been claimed by a workflow participant. The name of the actual owner is displayed in the Participants pane.

To release a task:

1 In the Workflows category view, click a workflow name. The Workflow details view is displayed.

2 Select a task name, and click **Release**. The **Claimed By** value for the selected task is cleared.

Note: You can also release a task from the My Tasks category view.

Note: Once a task has completed (or if a workflow was terminated), task participants can no longer be changed.

Edit Task Properties

A task can contain properties. Properties that are editable display a text box beneath the property value.

To edit the properties for a task:

1 From the Workflows category view, open a workflow, and select a task. Click to access the properties that are associated with the task.

2 Click on the text box beneath the property value, and then enter a value or change the existing value.

Note: If you enter an invalid value for an XML or URL data object, the value is reverted to the original value, after you save the changes to the properties.

3 To save the changes to the properties, click .

If you do not want to save the changes to the properties, click |↺.

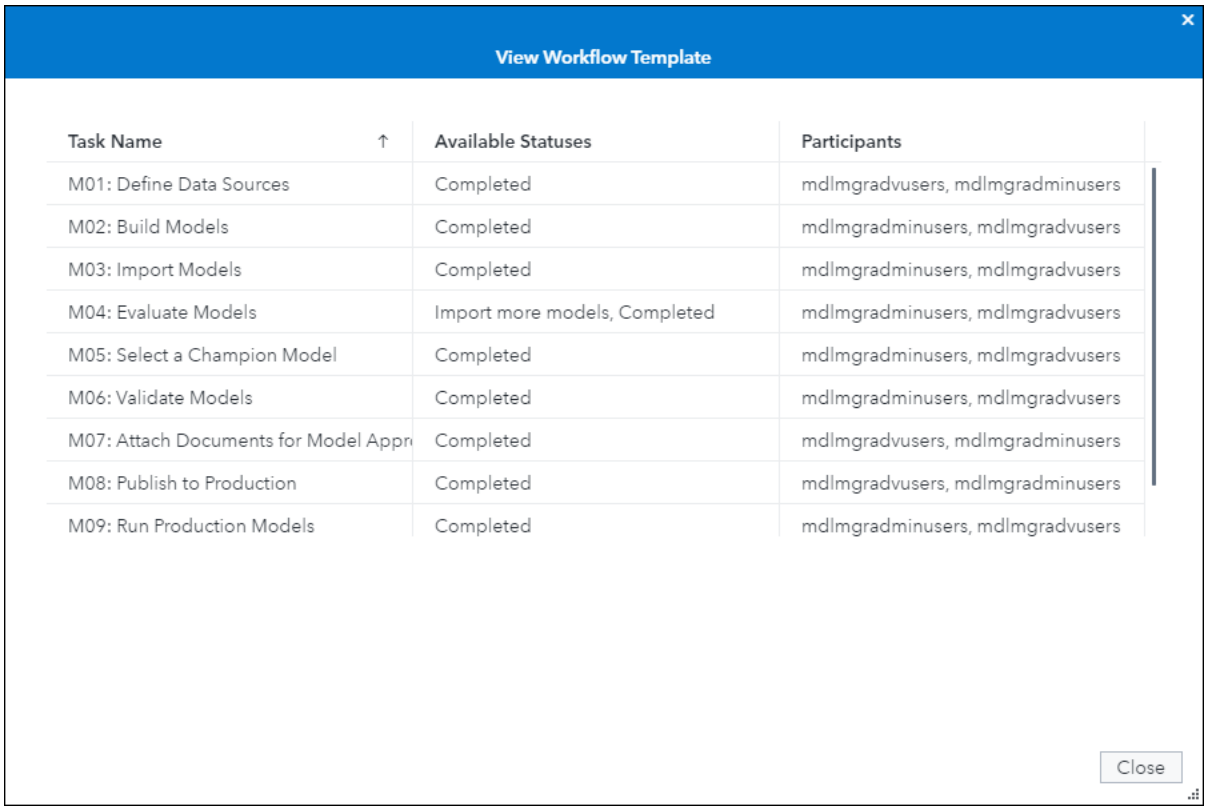
CAUTION
Clicking reset clears all property values in the Properties pane. If you click |↺, all of the property values are cleared. To restore the property values, click ▣, close the **Properties** pane, and then reopen the **Properties** pane.

View a Workflow Template

View a workflow template to view the tasks, available statuses, and participants associated with a workflow.

1 From the Workflows category view, select a row for a workflow.

2 Click ⋮ and select **View workflow template**. The View Workflow Template window appears.



Terminate a Workflow

When you terminate a workflow process, all tasks that have not yet been completed are changed to a state of Terminated. After you terminate a workflow process, it cannot be restarted. However, you can start a new workflow for the same template version.

From the Workflows category view, select a row for a workflow and click **Terminate**. The terminated icon appears in the **State** column for the task.

PART 7

Working with Decisions

23

Creating and Publishing Decisions

About Decisions

Decisions enable you to combine analytical models, rule flows, and conditional logic. You can investigate various scenarios, test and refine the decision logic, and then publish the decisions for use in batch applications and online transactions.

Decisions enable you to automate the decision-making process. Automating decisions provides a streamlined mechanism for controlling and monitoring the rules and processes used by your organization.

Create a New Decision

1. In SAS Decision Manager, click to navigate to the Decisions category view.
2. Click **New Decision**. The New Decision window appears.
3. Enter a name for the decision. Names are limited to 100 characters and must be unique. The first character must be an alphabetic character. Subsequent characters can be a number or any character except forward slash (/), backslash (\), left brace ({), right brace (}), left bracket ([), right bracket (]), colon (:), plus sign (+), and question mark (?).
4. (Optional) Enter a description. Descriptions are limited to 1024 characters.
5. Click , select the vocabulary for the decision, and click **Open**.
6. Click **Save** to create the new decision. SAS Decision Manager opens the new decision and displays the **Decision** tab.

   TIP Click the **Properties** tab to display the properties of a decision. The properties include the date on which the decision was created and the user ID that created it, in addition to the name, description, and vocabulary.

7. Click **Add** and select the object type that you want to add to the decision. A decision can contain any combination of rule flows, models, and conditions. See "Editing a Decision" on page 347 for more information.
8. Click .

TIP Click at any time to return to the list of all decisions.

Open Existing Decisions

To open a single decision, select the decision in the Decisions category view.

To multiple decisions:

1. In the Decisions category view, select the check boxes for the decisions that you want to open.
2. Click to open the decisions.

The opened items icon in the upper right of the window shows how many decisions are open. For example, 2 indicates that two decisions are open.

To switch between open decisions, click 2, and select the decision that you want to display.

Editing a Decision

A decision can contain rule flows, models, and conditions, which consist of IF clauses and ELSE clauses. The IF and ELSE clauses of a condition can contain additional rule flows, models, and conditions.

Control the Order of Elements in a Decision

When you add a new item to a decision, the decision editor adds the item to the decision based on whether another item is currently selected and, if so, what the selected item is.

- If no item is currently selected, the decision editor adds the new item at the beginning of the decision.
- If the currently selected item is a rule flow or a model, the decision editor adds the new item immediately below it.
- If the currently selected item is a condition, placement depends on whether the condition is collapsed or expanded.
  - If the condition is collapsed, the decision editor adds the new item immediately below it.
  - If the condition is expanded and the currently selected item is the IF or ELSE clause, the decision editor adds the new item to the content of the selected clause.

To move an item up or down, including into and out of a condition, select the item and click ↑ or ↓. You can also move the selected item using Shift + ↑ and Shift + ↓ on the keyboard.

Add a Rule Flow

1. Click **Add** ⇨ **Rule Flow**. The Open window appears.
2. Select the rule flow and click **Open**. The Select Rule Flow Version window appears.

   Note: You cannot add complex rule flows to a decision.

3. Select the version of the rule flow that you want to add to the decision, and click **OK**.

Add a Model

1. Click **Add** ⇨ **Model**. The Open window appears.

   Note: Only models with a **Score Type Code** of **DS2** or **Data step** are supported in SAS Decision Manager.

   TIP You can reorder the elements in a decision by clicking ↑ or ↓.

2. Select the model and click **Open**.

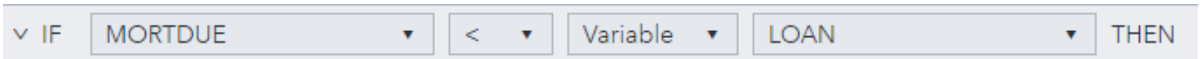
Add a Condition

1. Click **Add** ⇨ **Condition**.
2. Enter the expression for the IF clause.
   a. In the first field, select a variable for the left side of the expression.
   b. Select the operator.
   c. For the right side of the expression, select **Value** or **Variable**.
      - To compare the first variable to a constant, select **Value**.
      - To compare the value of the first variable to the value of another variable, select **Variable**.

d In the last field, either enter the constant or select the comparison variable.

For example, the expression `BadLoanFlag == 'True'` appears in SAS Decision Manager as shown in the following figure.

The expression `MORTDUE < LOAN` appears in SAS Decision Manager as shown in the following figure.



3 Add content to the IF and ELSE clauses. Select the clause to which you want to add content, then click **Add**.

A clause can contain any combination of rule flows, models, and conditions. You can leave an IF or ELSE clause empty.

Note: If there is already a rule flow or model added to the decision before a condition is added, then the rule flow or model is automatically added to the ELSE statement.

Exclude Variables from Input or Output

SAS Decision Manager expects all input variables in a decision to be mapped to columns in an input table. All output variables are included in the output data sets by default. You can exclude variables from the mapping process and from the output data sets.

To exclude variables:

1 Click the **Variables** tab.

> **TIP** You can use the radio buttons and the **Filter** field to limit the display to variables of certain object types or to a specific model or rule flow.

2 (Optional) For each variable that you do not want to map to an input column, clear the **Input** check box.

3 (Optional) For each variable that you do not want included in the output, clear the **Output** check box. To exclude all variables from the output, clear the check box next to the Output column heading.

> **TIP** To create a temporary variable for use only while a decision is executing, clear both the **Input** and **Output** check boxes.

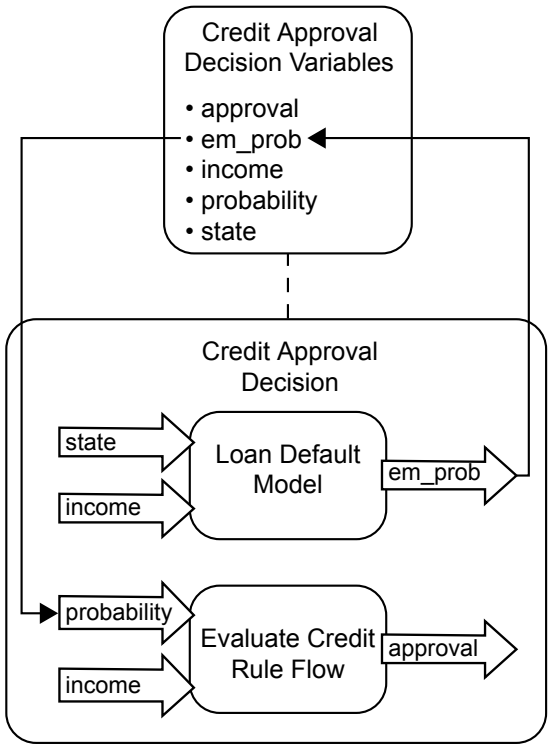
Mapping Variables within a Decision

About Decision Variables and Mapping

The objects, such as models and rule flows, that you add to a decision define their own variables (terms). When you add an object to a decision, SAS Decision Manager automatically defines decision variables that have the same name and data type as the object's variables. SAS Decision Manager automatically maps the object's variables to the decision variables that have the same name and data type.

You can create decision variables with different names, and then change the decision variable mappings on the **Variables** tab in the **Properties** windows for the objects in the decision.

For example, suppose you have a decision named Credit Approval, and this decision contains a model named Loan Default and a rule flow named Evaluate Credit. The model has an output variable named **em_prob**. The value of this variable must be passed as input to the Evaluate Credit rule flow, but the rule flow is expecting a variable named **probability**. In order for the value to be passed to the rule flow, you must map the output variable of the model, **em_prob**, to the decision variable **em_prob**, and you must map the input variable **probability** of the rule flow to the decision variable **em_prob**.



Ouput Variables

Variable	Maps To
em_prob	em_prob ▾

Input Variables

Variable	Maps To
probability	em_prob ▾
income	income ▾

IMPORTANT When the decision is published and run in a production environment, the decision expects the input data to contain variables that have the same name and data type as the decision's input variables.

Map Object Variables to Decision Variables

To map decision variables, complete these steps:

1. Select the rule flow or model for which you want to map variables.
2. Click ☰. The Properties window appears.
3. On the **Variables** tab, for each of the object's variables (terms) listed under the **Input** and **Output** columns, select the decision variable in the **Maps To** columns.
4. Click **Close**.

Change a Rule Flow or Model Used in a Decision

1. Select the rule flow or model that you want to change.
2. Click ✎. The Open window appears.
3. Navigate to the rule flow or model that you want to use in the decision, and click **Open**.

Delete an Item in a Decision

To delete a rule flow, model, or condition, click 🗑 for that object.

If you delete a condition, the contents of the condition's IF and ELSE clauses are retained in the same position that the condition occupied.

Note: You cannot delete empty ELSE clauses.

Close Decisions

To close a single decision, click **Close**.

To close all open decisions, click 2 and select **Close All**.

Duplicate a Decision

1. In the Decisions category view, select the check box for the decision that you want to duplicate.
2. Click ⋮ and select **Duplicate**. The Duplicate Decision window appears.
3. Enter a name for the new copy, and click **OK**.

Delete Decisions

Note: You cannot delete open decisions. If a decision that you want to delete is open, close it first.

To delete decisions:

1. In the Decisions category view, select the check boxes for the decisions that you want to delete.
2. Click ⋮ and select **Delete**. The application asks you to confirm that you want to delete the selected items.
3. Click **Yes**.

Testing a Decision

Input Data for Decision Tests

SAS Decision Manager expects the input data for the decision test to already exist and to be defined as a table in the Data category. See "About Managing Data Tables" on page 15 for information about defining data sources. Your user ID must have permission to access the data.

Create and Run a New Decision Test

1 Open the decision that you want to test.

Note: If you make any changes to the decision, click . You cannot create a test for a decision that contains unsaved changes.

2 Click **Test**. The New Test window appears.

3 Enter a name for the test. Names are limited to 100 characters and must be unique. The first character must be alphabetic. Subsequent characters can be numbers, alphabetic characters, or underscores (_).

4 (Optional) Enter a description. Descriptions are limited to 1024 characters.

5 Select the data source for the test, and click **Open**.

The application automatically maps input variables in the decision to columns in the test data source if the variable and column have the same name and the same data type. For other variables, you must manually map the variables to columns in the input data source. For more information, see "Mapping Variables within a Decision" on page 350.

6 On the **Variables** tab, under **Table Column**, select the table column for each input variable.

Note: The application automatically maps variables only when the decision is created. If input or output variables are added later to the decision, you can reselect the input data source to automatically map the additional variables.

7 (Optional) On the **Preprocessing Code** tab, enter any SAS code, such as initialization code or setup code, that you want to run before the decision is run.

TIP You can use the &DCM_LIBS_OPTION macro variable to specify librefs for libraries that your decision needs to access when it is run. By default, SAS Decision Manager restricts the libraries to the minimum set of required libraries, lib4Rst and Work. If you specify this variable, you must include lib4Rst and Work in your specification. The minimum specification is as follows:

```
%let dcm_libs_option=lib4Rst work;
```

You can add additional librefs to this statement if needed.

8 Click to save the decision test.

9 Click **Run** to run the test. SAS Decision Manager runs the test and, if the test completely successfully, displays the results. See "View Test Results" on page 354 for more information.

10 Click **Close** to close the test.

Open an Existing Decision Test

1. Open the decision.
2. Click ⋮ and select **View Tests**. The All Tests window appears.
3. Select the test that you want to open.

Run an Existing Test

To run an existing test, open the test, and click **Run**.

If you make any changes to the test, click to save the test. You cannot run a test with unsaved changes.

SAS Decision Manager runs the test and, if the test completely successfully, displays the results. See "View Test Results" for more information.

View Test Results

When you run a test, SAS Decision Manager automatically displays the test results. It also adds a link on the main page for the test to the test results. To view the results that were generated the last time a test was run, open the test, and click **View the results**. SAS Decision Manager displays

- the output of the decision

  Note: Decision test output tables are limited to 1000 rows.

- the SAS code that was generated and run when the test was submitted
- the SAS log
- information about the output table such as its name and location
- information about the test itself, including the date on which the test was last run

Delete a Decision Test

1. Open the decision.
2. Click ⋮ and select **View Tests**. The All Tests window appears.

3 Select the test that you want to delete.

4 Click 🗑.

Publish a Decision

Publishing is the process of making the decision available to be run by other applications. You can choose to publish a decision as a SAS Micro Analytic Service module or as a Decision Logic metadata object. The method that you choose depends on how other applications will run the decision. To publish a decision:

1 Open the decision.

2 Click **Publish**. The Publish Decision window appears.

3 Select the method that you want to use to publish the decision.

Use the SAS Micro Analytic Service to process transactions
creates a REST endpoint in the SAS Micro Analytics Service instance that is running within your current SAS deployment. Any application that can call REST services can use the module to process web service transactions. See "SAS Micro Analytic Service REST API" in *SAS Micro Analytic Service: Programming and Administration Guide* for more information.

Use a Decision Logic object in batch applications
writes a Decision Logic metadata object to the SAS Metadata Repository. Batch applications such as SAS Data Integration Studio jobs can then use the object. For information about metadata objects, see "SAS Metadata Server" in *SAS Intelligence Platform: Overview*.

4 Select whether you want to publish a new module or object, or replace a previously published one. If you publish the decision as a Decision Logic object, the **Location** field is enabled.

Note: If you replace a previously published module, SAS Decision Manager replaces the last module that was published for the decision. If you replace a previously published Decision Logic object, SAS Decision Manager replaces the last object that was published for the decision in the location that you select in Step 5.

5 (Optional) Select the location in metadata where you want to publish the Decision Logic object.

6 Click **Publish**. SAS Decision Manager notifies you whether the decision was successfully published, and if so, provides additional information about the published object or module.

7 Click **Close** to close the decision.

See "Deploy the Decision in SAS Data Integration Studio" in *SAS Decision Manager: Quick Start Tutorial* for an example of how you can run the published decision in a SAS Data Integration Studio job.

View the Publish History for a Decision

1. Open the decision.
2. Click ⋮ and select **View Publish History**. The information for each object or module includes the date on which it was published, the method used to publish it, and the user ID that published it.

   Decisions that were published as Decision Logic objects display **Batch** as the publish method. Decisions that were published as SAS Micro Analytic Service modules display **Web service** as the publish method.
3. Click **Close** to close the **Publish History** window.

Writing to Output Tables from SAS Data Integration Studio Jobs

When you run a published decision in a SAS Data Integration Studio job, the following naming guidelines apply:

- You can write to output tables by using two-level or three-level names. Two-level names follow the format Libref.Tablename. Three-level names follow the format Libref.Schema.Tablename.
- To use three-level names, the schema name for the output library must be defined in SAS Management Console with the same name and case (uppercase or lowercase) that appears in database user interface.
- For Oracle, the output table name is case-insensitive.
- For Postgres, the output table name must be all lowercase. Also, for Postgres on UNIX, you must set the PRESERVE_COL_NAMES and PRESERVE_TAB_NAMES options for the output library in SAS Management Console to `Yes`.

For example, if your schema is XRTEST, then you might access the output library in Oracle with the following LIBNAME statement in the preprocessing code for your job:

```
LIBNAME olib ORACLE PATH=edmdb SCHEMA=XRTEST USER=user_ID PASSWORD=password;
```

For Postgres, the LIBNAME statement might appear as follows:

```
LIBNAME plib POSTGRES PRESERVE_COL_NAMES=YES PRESERVE_TAB_NAMES=YES
DATABASE=dcmdb SERVER="server" PORT=10482 SCHEMA=XRTEST USER=dcmdb
PASSWORD=password;
```

Executing Published Content

When you publish content by selecting **Use the SAS Micro Analytic Service to process transactions**, a REST endpoint is created in the SAS Micro Analytics Service instance that is running within your current SAS deployment. Any application that can call REST services can use the module to process web service transactions. For more information, see "SAS Micro Analytic Service REST API" in *SAS Micro Analytic Service: Programming and Administration Guide*.

> **IMPORTANT** To execute a decision by using a SAS Micro Analytic Service REST API call, append an underscore (_) to the name of each decision variable (*variableName*_) that is both an input and an output variable when you specify the REST API call. Do not add underscores to the names of input-only variables.

When you publish content by selecting **Use a Decision Logic object in batch applications**, a Decision Logic metadata object is written to the SAS Metadata Repository. Batch applications such as SAS Data Integration Studio jobs can then use the object. For an example of using a published decision in a SAS Data Integration Studio job, see "Deploy the Decision in SAS Data Integration Studio" in *SAS Decision Manager: Quick Start Tutorial*. For information about specifying output table names in a SAS Data Integration Studio job, see "Writing to Output Tables from SAS Data Integration Studio Jobs" on page 356.

Viewing Lineage Information for a Decision

About Lineage Information

The lineage viewer is provided by SAS Lineage. The relationship information displayed by SAS Lineage is taken from the Relationship database that is a part of the Web Infrastructure Platform Data Server. SAS Lineage can display most types of SAS metadata. This data includes models, rule flows, and data objects, including columns, tables, external files, stored processes, and more.

SAS Lineage displays three types of diagrams:

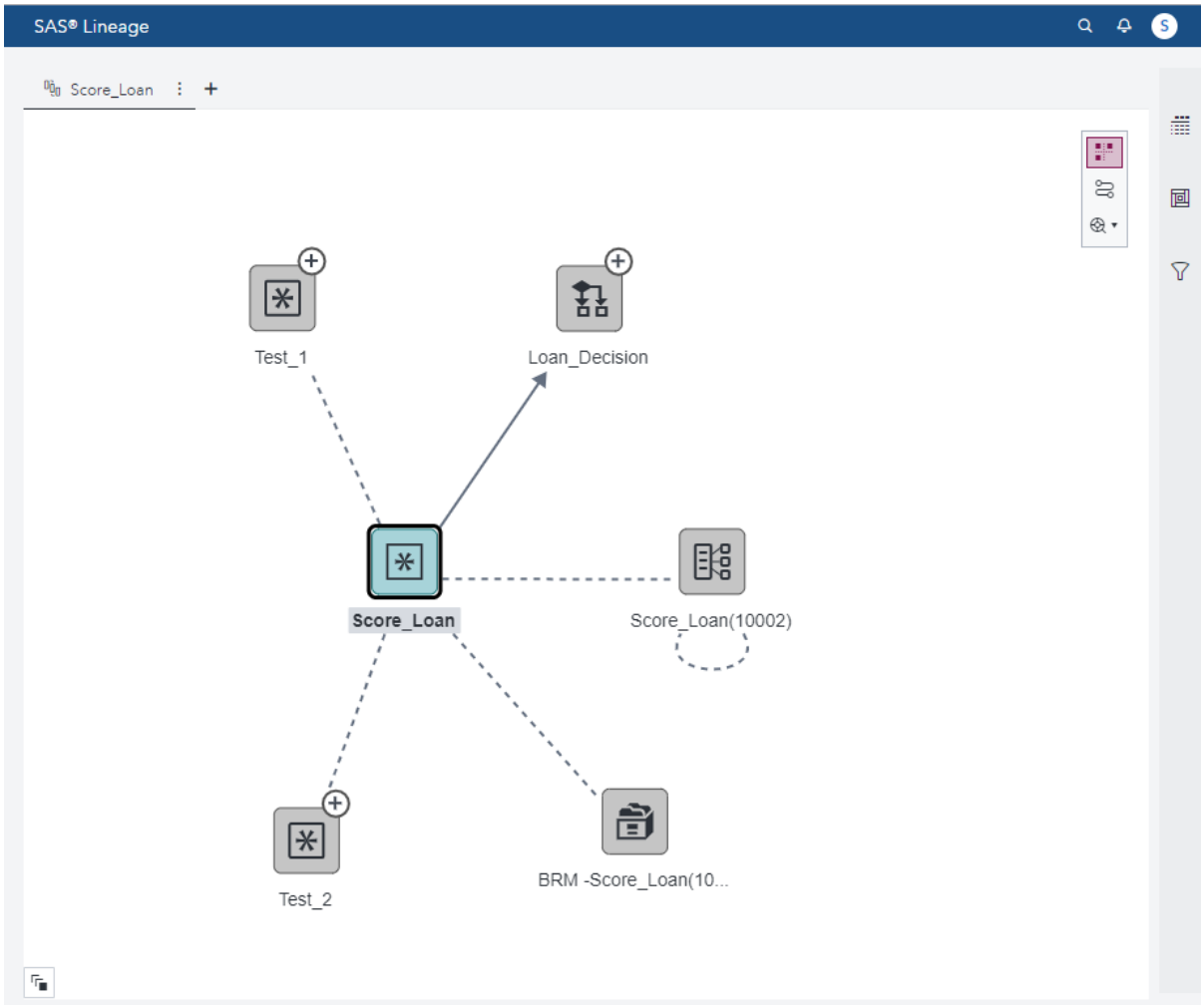
- a network diagram that displays all relationships
- a dependency diagram that displays governance information
- a dependency diagram that displays parent and child relationships

View Lineage Information for a Decision

1. Open the decision.
2. Click ⋮ and select **View Lineage**. If you are not already signed in to SAS Lineage, it prompts you to sign in.
3. Enter your user ID and password, and click **SIGN IN**. SAS Lineage displays the All Relationships diagram for the decision.

For additional information about SAS Lineage, select **Help** or see *SAS Lineage Viewer: User's Guide*.

The following image shows the All Relationships diagram for a simple decision that uses one rule flow.



PART 8

Appendixes

Appendix 1

Model Templates

What Is a Model Template?

Models that you import into SAS Decision Manager are associated with a specific model template. A model template has properties and component files that define a type of model. SAS Decision Manager processes four types of models: analytical, classification, prediction, and segmentation. You can create your own model template if your model requires files other than those named in the SAS Decision Manager templates.

A model template is an XML file that has three sections. The **General** section names and describes the model template. The **Properties** section provides properties to name the model algorithm, the modeler, and a model label. The **Files** section contains the component files that can be used in the template for that model function type. You associate your component file with the appropriate model template component file. Your component file filenames do not need to be the same name as the filenames in the model template.

Model templates provide you with a way to define metadata about your own model. Most users do not need to write model templates because SAS Decision Manager delivers a list of model templates that handle SAS Enterprise Miner models as well as analytical, prediction, classification, and segmentation models. However, you can write your own model templates if the model templates that are provided do not satisfy your requirements. For more information, see “Creating and Managing Templates” on page 121.

Model Types

SAS Decision Manager provides model templates for analytical, classification, prediction, and segmentation models.

Model Type	Description
Analytical	The **Analytical** model template is the most generic template that is designed for models whose model function does not fall in the prediction, classification, and segmentation category.
Classification	You use the **Classification** model template if your model is a prediction model that has a categorical, ordinal, or binary target, or if your model is a LOGISTIC procedure regression model. Examples of classification models are models that might classify a loan applicant as Approved or Not Approved, or models that might assess a potential customer's risk of default as Low, Medium, or High.
Prediction	The **Prediction** model template is used for predictive models. Predictive models declare in advance the outcome of an interval target. A model that assigns a numeric credit score to an applicant is an example of a prediction model.
Segmentation	The **Segmentation** model template is used for segmentation or cluster models that are written in SAS code. Segmentation models are unsupervised models that have no target variable. A segmentation or cluster model is designed to identify and form segments, or clusters, of individuals or observations that share some affinity for an attribute of interest. The output from a segmentation model is a set of cluster IDs. R models cannot have segmentation model function.

Model Template Component Files

Here is a list of the component files that are associated with the model templates:

Filename	Analytical	Classification	Prediction	Segmentation
IGN_STATS.csv on page 364	—	✓	—	—
EMPublishScore.sas on page 364	—	✓	—	—
Scorecard_GainsTable.csv on page 364	—	✓	—	—
score.sas on page 365	✓	✓	✓	✓
modelinput.sas7bdat on page 365	✓	✓	✓	✓
modeloutput.sas7bdat on page 365	✓	✓	✓	✓
target.sas7bdat on page 365	—	✓	✓	—
inputvar.xml on page 366	✓	✓	✓	✓
outputvar.xml on page 366	✓	✓	✓	✓
targetvar.xml on page 367	—	✓	✓	—
smmpostcode.sas on page 368	✓	✓	✓	✓
trainingvariables.csv on page 368	—	✓	—	—
training.sas on page 368	✓	✓	✓	✓
training.log on page 368	✓	✓	✓	✓
training.lst on page 368	✓	✓	✓	✓
outest.sas7bdat on page 368	✓	✓	✓	—
outmodel.sas7bdat on page 368	✓	✓	✓	—
output.spk on page 368	✓	✓	✓	✓

Filename	Analytical	Classification	Prediction	Segmentation
miningResult.spk on page 368	✔	✔	✔	—
layout.xml on page 368	—	✔	✔	—
format.sas7bcat on page 369	✔	✔	✔	✔
dataprep.sas on page 369	✔	✔	✔	✔
batch.sas on page 369	✔	✔	✔	✔
pmml.xml on page 369	✔	✔	✔	—
training.r on page 369	✔	✔	✔	—
outmodel.rda on page 369	✔	✔	✔	—
score.r on page 369	✔	✔	✔	—
fitstats.xml on page 369	—	✔	✔	—
HPDMForest_VARIMPORT.csv on page 369	—	✔	✔	—
HPDMForest_ITERATION.csv on page 369	—	✔	✔	—
outmdlfile.bin on page 369	—	✔	✔	—

IGN_STATS.csv

The value of IGN_STAT.csv is the name of a file whose values are separated by commas, and whose values are bin definitions for input variables. This is a component file that is generated by SAS Enterprise Miner for a scorecard model and is not needed for SAS code models.

EMPublishScore.sas

The value of EMPublishScore.sas is the name of a SAS code file that is used to change input variables into bins and is a component of a SAS Enterprise Miner scorecard model. This file is needed to define a performance task. This file is not needed for SAS code models.

Scorecard_GainsTable.csv

This file includes the bin score definitions and is not used in reporting by SAS Decision Manager. The file's content can be viewed by users.

score.sas

The value of score.sas is the name of a filename for the SAS score code for the model.

For R models, this file transforms a scoring data set to an R data frame.

The score.sas file is DATA step score code and is used as input by the SAS Scoring Accelerator when publishing a model to a database. When you are using the scoring function publish method, some SAS language elements and syntax are not supported when you create or modify your score code. Only the SAS language elements and syntax that are required to run critical data transformations and model scoring functions are available. If you use a statement or function that is not supported, an error occurs and your model is not published to the database. For more information, see "Considerations When Creating or Modifying DATA Step Score Code" in *SAS In-Database Products: User's Guide*.

modelinput.sas7bdat

The value of modelinput.sas7bdat is the name of a sample data set that is used to create an inputvar.xml file for the model if one does not exist. When no inputvar.xml file exists for the model, SAS Decision Manager creates the inputvar.xml file using the variable name and attributes in the modelinput.sas7bdat file. Observation values are not used. Therefore, the sample data set can have no observations or it can have any number of observations. If an inputvar.xml is specified in the model template, modelinput.sas7bdat is ignored.

When you import a SAS code model, the data set that you used to test your score code can be used as the value for the modelinput.sas7bdat file.

Note: If the same variables appear in your modelinput.sas7bdat file and your modeloutput.sas7bdat file, when you import the model, SAS Decision Manager removes the duplicate variables in the outputvar.xml file.

modeloutput.sas7bdat

The value of modeloutput.sas7bdat is the name of a sample data set that is used to create an outputvar.xml file for the model if one does not exist. When no outputvar.xml file exists for the model, SAS Decision Manager creates the outputvar.xml file using the variable name and attributes in the modeloutput.sas7bdat file. Observation values are not used. Therefore, the sample data set can have no observations or it can have any number of observations. If an outputvar.xml is specified in the model template, modeloutput.sas7bdat is ignored.

You can create a modeloutput.sas7bdat file by running the score.sas file against the modelinput.sas7bdat file.

target.sas7bdat

The value of target.sas7bdat is the name of a sample data set that is used to create a targetvar.xml file for the model if one does not exist. When no targetvar.xml file exists for the model, SAS Decision Manager creates the targetvar.xml file using the variable name and attributes in the target.sas7bdat file. Data set values are not used. Therefore, the sample data set can have no observations or it can have any number of observations. If a targetvar.xml file is specified in the model template, target.sas7bdat is ignored.

You can create a target.sas7bdat file by creating a data set that keeps only the target variables that are taken from the training data set, as in this example:

```
data mydir.target;
```

```
    set mydir.myModelTraining (obs-1);
    keep P_BAD;
run;
```

inputvar.xml

The value of inputvar.xml is the name of an XML file that defines the model input variables. When your model template includes a file for modelinput.sas7bdat, SAS Decision Manager creates the model inputvar.xml file. Otherwise, you must create the XML file.

The following XML file is a sample inputvar.xml file that has one variable, CLAGE. You can use this model to create an inputvar.xml file that contains a VARIABLE element for each model input variable.

```
<?xml version="1.0" encoding="utf-8"?>
<TABLE>
   <VARIABLE>
         <NAME>CLAGE</NAME>
         <TYPE>N</TYPE>
         <LENGTH>8</LENGTH>
         <LABEL Missing=""/>
         <FORMAT Missing=""/>
         <LEVEL>INTERVAL</LEVEL>
         <ROLE>INPUT</ROLE>
        </VARIABLE>
   </TABLE>
```

NAME
: specifies the variable name.

TYPE
: specifies the variable type. Valid values are N for numeric variables and C for character variables.

LENGTH
: specifies the length of the variable.

LABEL Missing=""
: specifies the character to use for missing values. The default character is a blank space.

FORMAT Missing=""
: specifies a SAS format to format the variable.

LEVEL
: specifies either NOMINAL, ORDINAL, INTERVAL, or BINARY.

ROLE
: specifies INPUT for input variables.

outputvar.xml

The value of outputvar.xml is the name of an XML file that defines the model output variables. When your model template includes a file for modeloutput.sas7bdat, SAS Decision Manager creates the model outputvar.xml file. Otherwise, you must create the XML file.

The following XML file is a sample outputvar.xml file that has one variable, I_BAD. You can use this model to create an outputvar.xml file that contains a VARIABLE element for each model output variable.

```
<?xml version="1.0" encoding="utf-8"?>
<TABLE>
   <VARIABLE>
```

```
        <NAME>I_BAD</NAME>
        <TYPE>C</TYPE>
        <LENGTH>12</LENGTH>
        <LABEL>Into: BAD</LABEL>
        <FORMAT Missing=""/>
        <LEVEL>NOMINAL</LEVEL>
        <ROLE>CLASSIFICATION</ROLE>
   </VARIABLE>
 </TABLE>
```

NAME
: specifies the variable name.

TYPE
: specifies the variable type. Valid values are N for numeric variables and C for character variables.

LENGTH
: specifies the length of the variable.

LABEL Missing=""
: specifies a label for the output variable.

FORMAT Missing=""
: specifies a SAS format to format the variable.

LEVEL
: specifies either NOMINAL, ORDINAL, INTERVAL, or BINARY.

ROLE
: specifies the type of model output. Valid values are CLASSIFICATION, PREDICT, SEGMENT, and ASSESS.

targetvar.xml

The value of targetvar.xml is the name of an XML file that defines the model target variables. When your model template includes a file for target.sas7bdat, SAS Decision Manager creates the targetvar.xml file. Otherwise, you must create the XML file.

The following XML file is a sample targetvar.xml file that has one variable, I_BAD. You can use this model to create an outputvar.xml file that contains a VARIABLE element for each model output variable.

```
<?xml version="1.0" encoding="utf-8"?>
<TABLE>
   <VARIABLE>
        <NAME>BAD</NAME>
        <TYPE>N</TYPE>
        <LENGTH>8</LENGTH>
        <LABEL>Missing=""/>
        <FORMAT Missing=""/>
        <LEVEL>BINARY</LEVEL>
        <ROLE>TARGET</ROLE>
  </VARIABLE>
 </TABLE>
```

NAME
: specifies the variable name.

TYPE
: specifies the variable type. Valid values are N for numeric variables and C for character variables.

LENGTH
specifies the length of the variable.

LABEL Missing=""
specifies a label for the target variable.

FORMAT Missing=""
specifies a SAS format to format the variable.

LEVEL
specifies either NOMINAL, ORDINAL, INTERVAL, or BINARY.

ROLE
specifies TARGET for the role of the variable.

smmpostcode.sas
SAS Decision Manager creates this file to document the mapping that the user specified between the model variables and the project variables.

trainingvariables.csv
This optional file contains a list of the training variables.

training.sas
This file is the optional SAS code that was used to train the model that you are importing. If at some time, SAS Decision Manager reporting utilities detect a shift in the distribution of model input data values or a drift in the model's predictive capabilities, the training.sas code can be used to retrain the model on the newer data. If it is not available at import time, the training.sas code can be added at a later point using the Add Local Files feature.

training.log
This file is the optional log file that was produced when the model that you are importing was trained. The information in the optional SAS training log can be helpful if the model must be retrained in the future.

training.lst
This file is the optional text output that is produced when the training.sas code is run. The information in the optional SAS training.lst table can be helpful if the model must be retrained in the future.

outest.sas7bdat
This data set contains output estimate parameters that are produced by a few SAS procedures, including the LOGISTIC procedure.

outmodel.sas7bdat
This data set contains output data that is produced by a few SAS procedures, including the LOGISTIC procedure and the ARBORETUM procedure. It contains complete information for later scoring by the same SAS procedure using the SCORE statement.

output.spk
This file is the SAS package file that contains the SPK collection of model component files.

miningresult.spk
This is a SAS package file that stores detailed information about SAS Enterprise Miner nodes in the flow from which the model is created and the detailed information for SAS/STAT item store models.

layout.xml
This optional file contains information about the SAS Enterprise Miner diagram topology.

format.sas7bcat
This file is the optional SAS formats catalog file that contains the user-defined formats for their training data. If the model that you are importing does not use a user-defined format, then you do not need to import a format.sas7bcat catalog file.

dataprep.sas
This file contains optional SAS code that is intended to be executed before each run of score code.

batch.sas
This file is created by SAS Enterprise Miner and is used for model retraining by SAS Decision Manager.

pmml.xml
This file contains score code in PMML format.

training.r
This is an optional R script file that is used to retrain R models in SAS Decision Manager.

outmodel.rda
SAS Decision Manager requires this file to save the output parameter estimate for R models.

score.r
This file is an R script that is used to predict new data.

fitstats.xml
This file is created by SAS Enterprise Miner and contains the basic Fit Statistics for the model.

HPDMForest_VARIMPORT.csv
This CSV file contains the variable importance data for a PROC HPFOREST model.

HPDMForest_ITERATION.csv
This CSV file contains statistics across each iteration of a PROC HPFOREST model.

OUTMDLFILE.bin
This is a binary file that contains the PROC HPFOREST model information to be used for scoring.

For information about preparing R model component files, see Appendix 4, “R Model Support,” on page 393.

Model Template Properties

Template Properties

Here is a list of the general properties that define the model template.

Property Name	Description
Name	Identifies the name of the template. This property is required. The characters @ \ / * % # & $ ( ) ! ? < > ^ + ~ ` = { } [ ] | ; : ‘ " cannot be used in the name.
Description	Specifies user-defined information about the template.
Type	Specifies the type of the model. SAS Decision Manager supports the following model types: **Analytical Model** specifies the type of model that is associated with the Analytical model function. **Classification Model** specifies the type of model that is associated with the Classification model function. **Prediction Model** specifies the type of model that is associated with the Prediction model function. **Clustering Model** specifies the type of model that is associated with the Segmentation model function.
Tool	Specifies a text value that describes which tool is used to produce this type of model.
Validate	When this property is set to Y, it indicates that SAS Decision Manager verifies that all of the required files are present when users try to import a model. If validation fails, the model will not be successfully imported.
Display name	Specifies a text value that is displayed as the name of the model template.
Score code type	Specifies whether the imported model score code runs by using a **DATA Step** fragment, **SAS Program** code, **PMML**, **Analytic store**, or **DS2**. **Note:** Only models with a score code type of DATA step or DS2 are supported by SAS Decision Manager.

File List Properties

Here is a list of the File List properties that specify the files that are contained in a model.

Property Name	Definition
Name	Identifies the name of the file. This property is required.
Description	Specifies user-defined information about the file.
Required	When this property is set to Y, it indicates that the file is a required component file of the model that must be imported before using the model. **Note:** The **Validate** property for the model template must also be set to Y. See "Template Properties" on page 369.
Report	When it is selected, indicates that the file is to be included in a SAS package file when a model is published to a channel.
Type	Specifies a file whose type is text or binary.
Fileref	Specifies an eight-character (or fewer) SAS file reference to refer to this file in score.sas code. The fileref is assigned by SAS Decision Manager when a SAS job is submitted.

Note: All user-defined models must have three files.

- score.sas is the model's score code.
- modelinput.sas7bdat is a SAS data set whose variables are used by the model score code. The contents of the data set is not used by SAS Decision Manager.
- modeloutput.sas7bdat is a resulting data set when a user runs score.sas against modelinput.sas7bdat. The data set provides output variables that the model creates after a scoring test is executed. The contents of the data set is not used by SAS Decision Manager.

System and User Properties

Here is a list of the system-defined and user-defined properties for a model template. Users can set these properties when they import a model.

Property Name	Description
Name	Identifies the name of the property. This is a required field.
Description	Specifies user-defined information about the property.
Type	Specifies a property whose type is String or Date.

Property Name	Description
Edit	Indicates that the property can be modified when importing a model or after the model is imported.
Required	Indicates that the property is required.
Initial value	Specifies a text string for the initial value for the property.
Display name	Specifies a text value that is displayed as the name of the property.

Specific Properties

Here is a list of specific properties for a model that identify the fundamental model data structures and some of the critical model life cycle dates. Where applicable, project-based or version-based data structures automatically populate properties for model-based data structures.

Property Name	Description
Default scoring input table	Specifies a default SAS data set that is used as the input data table for all of scoring tests within the project. The model's **Default scoring input table** property inherits the property value from the associated version or project, if one is specified.
Default scoring output table	Specifies a default SAS data set that defines the variables to keep in the scoring results table and the scoring test output table. The model's **Default scoring output table** property inherits the property value from the associated version or project, if one is specified.
Default performance table	Specifies the default performance table for all model performance monitoring tasks within a project. A model's **Default performance table** property inherits the property value from the associated version or project, if one is specified. If you do not specify a performance table, some of the monitoring reports might not be enabled.
Default train table	The train table is optional and is used only as information. However, when a value is specified for a model's **Default train table** property.

Property Name	Description
Expiration date	Specifies a date property by which the selected model is obsolete or needs to be updated or replaced. This property is for informational purposes and is not associated with any computational action. This property is optional.
Model label	Specifies a text string that is used as a label for the selected model in model assessment charts. If no value is provided for the **Model Label** property, the text string that is specified for the **Model Name** property is used. The **Model Label** property can be useful if the Model Name property that is specified is too long for use in plots. This property is optional.
Subject	Specifies a text string that is used to provide an additional description for a model, such as a promotional or campaign code. This property is for informational purposes and is not associated with any computational action. This property is optional.
Algorithm	Specifies the computational algorithm that is used for the selected model. This property cannot be modified.
Function	Specifies the function class that was chosen when the associated project was created. The **Function** property specifies the type of output that models in the predictive model project generate.
Modeler	Specifies the Modeler ID or, when Modeler ID is missing, specifies the user ID of the individual who created the model that is stored in the SPK file for SAS Enterprise Miner models. Otherwise, the modeler can be specified during model import for local files.
Tool	Specifies whether the imported model came from SAS Enterprise Miner or from other modeling tools.
Tool version	Specifies the version number of the tool that is specified in the **Tool** property.
Score code type	Specifies whether the imported model score code is a DATA step fragment, ready-to-run SAS code, or a PMML file. Valid values are **DATA step**, **SAS Program**, **PMML**, **Analytic store**, and **DS2**.

Property Name	Description
	Note: If the model is created using PMML 4.2, the **Score Code Type** is **DATA step** and not **PMML**. For more information, see Appendix 3, "PROC PSCORE and PMML Support," on page 389. **Note:** SAS Decision Manager cannot publish models to a database whose **Score Code Type** model property is set either to **SAS Program**, **PMML**, or **DS2**. Models that have a score code type of **Analytic store** can be published only to Hadoop and Teradata. **Note:** Only models with a score code type of DATA step or DS2 are supported by SAS Decision Manager.
Template	Specifies the model template that was used to import the model and to create pointers to its component files and metadata.
Copied from	Specifies where the original model is if this model is copied from another model repository.
Target variable	Specifies the name of the target variable for a classification or prediction model. This property can be ignored for segmentation, cluster, and other models that do not use target variables. For example, if a model predicts when GENDER=M, then the target variable is **GENDER**.
Target event value	Specifies a value for the target event that the model attempts to predict. This property is used only when a value is specified for the **Target Variable** property. For example, if a model predicts when GENDER=M, then the target event value is **M**.

Appendix 2

Project Tables

Descriptions of Project Tables

Project Control Tables

A project control table is a data set that contains the projects, models, and segments that are used to create the structure of the projects within a portfolio. The project control table must at least contain a project variable with the name of project_name. If you want to monitor the performance of the champion models within a portfolio, then the project control table must also contain a segment ID variable. The segment ID variable must also be in the performance tables that are used to monitor performance. If you want to include the models for each project when creating a portfolio, then the control table must also contain the model variable.

Project Input Tables

A project input table is an optional SAS data set that contains the champion model input variables and their attributes. It is a prototype table that can be used to define the project input variables and the variable attributes such as data type and length. A project can have numerous candidate models that use different predictor variables as input. Because the project input table must contain all champion model input variables, the variables in the project input table are a super set of all input variables that any candidate model in the project might use.

A project input table can have one or more observations. Data that is in a project input table is not used by SAS Decision Manager.

If you use a prototype table to define the project input variables, either create the table and register the table to the SAS Metadata Repository in the Data category view or by using SAS Management Console. Tables that are registered using the SAS Management Console must be made available to SAS Decision Manager using the Data category view.

The project input variables must be available to SAS Decision Manager either by specifying a project input table or by defining individual variables before you set a champion model. You can view input variables for a project on the **Input** tab of the project's **Variables** page, or in the Data category view.

Note: An alternative to using prototype tables to define the project input and output variables is to copy the variables from the champion or challenger model, or to modify the project variables. For more information, see "Defining Project Input and Output Variables" on page 114.

See Also

- "Defining Project Input and Output Variables" on page 114
- "Creating Project Input and Output Tables" on page 381

Project Output Tables

A project output table is an optional SAS data set or database table that defines project output variables and variable attributes such as data type and length. It is a prototype table that contains a subset of the output variables that any model in the project might create.

A project output table can have one or more observations. Data that is in a project output table is not used by SAS Decision Manager.

If you use a prototype table to define the project output variables, either create the table and register the table to the SAS Metadata Repository in the Data category view or by using SAS Management Console. Tables that are registered using the SAS Management Console must be made available to SAS Decision Manager using the Data category view. For more information, see"Add Registered Tables from Metadata" on page 16.

The project output variables must be available to SAS Decision Manager either by specifying a project output table or by defining individual variables before you set a champion model. You can view output variables for a project on the **Output** tab of the project's **Variables** page or in the Data category view.

Note: An alternative to using prototype tables to define the project input and output variables is to copy the variables from the champion or challenger model, or to modify the project variables. For more information, see "Defining Project Input and Output Variables" on page 114.

See Also

- "Defining Project Input and Output Variables" on page 114
- "Creating Project Input and Output Tables" on page 381

Scoring Input Tables

A scoring input table is a SAS data set that contains the input data that is used in a scoring test.

Before you can create a scoring test, you must create a scoring input table and register it in the SAS Metadata Repository in the Data category view or by using SAS Management Console. Tables that are registered using the SAS Management

Console must be made available to SAS Decision Manager using the Data category view. In SAS Decision Manager, you can view scoring input tables in the Data category view.

See Also

"Creating Scoring Input and Output Tables" on page 382

Scoring Output Tables

A scoring output table is used by a scoring test to define the variables for the scoring results table.

Depending on the mode in which a scoring test is run, the scoring output table can be a prototype table or a physical data table. A scoring test can run in test mode, which is the default mode, or it can run in production mode. In both test mode and production mode, a scoring test output table is used by the scoring test to define the structure of the scoring results table. When the scoring test runs, it creates a scoring results table. In test mode, the scoring results table is stored in the SAS Decision Manager model repository or on a local or network drive. You can view the scoring results table on the **Results** tab of the **Scoring** page for a project. The scoring output table in the SAS Metadata Repository or on a local or network drive is not updated in test mode. In production mode, the contents of the scoring output table in the SAS Metadata Repository or the local or network drive are replaced by the contents of the scoring results table. The scoring results table is not stored in the SAS Decision Manager model repository or on a local or network drive.

Before you can create a scoring test, the scoring output table must be added and accessible from the Data category view. To add the scoring output table to SAS Decision Manager, perform one the following actions:

- Add the table manually by creating the table. Then, register the table in the SAS Metadata Repository in the Data category view or by using SAS Management Console.
- Use the Create a Scoring Output Table feature that is available from the toolbar on the project's **Models** page. When you use the Create a Scoring Output Table window, SAS Decision Manager creates the table in the library that is specified in the **Library** box. The table is registered in the SAS Metadata Repository and is available in the Data category view.

You can view scoring output tables in the Data category view.

See Also

"Creating Scoring Input and Output Tables" on page 382

Train Tables

A train table is used to build predictive models. Whether your predictive models are created using SAS Enterprise Miner or you created SAS code models, you used a train table to build your predictive model. SAS Decision Manager uses this same train table. The train table must be registered in the SAS Metadata Repository and accessible to SAS Decision Manager in the Data category view.

You specify a train table as a version-level property. When you define the train table at the version level, the table can be used to build all predictive models that are defined on the **Models** page for a project.

In SAS Decision Manager, train tables are used for information purposes only with one exception. SAS Decision Manager uses train tables to validate scoring results immediately after you publish a scoring function or model scoring files, and if the **Validate scoring results** box is selected when you publish scoring functions or model scoring files to a database.

Note: A train table cannot contain an input variable name that starts with an underscore.

For information about adding a registered train table using the Data category view, see "Add Registered Tables from Metadata" on page 16.

Test Tables

A test table is used to create the Dynamic Lift report and the Interval Target Variable report that can be used to identify the champion model. Test tables are typically a subset of a train table, and they are identical in table structure to the corresponding train table. Update test tables by creating a new subset of the corresponding train table.

To view test tables in SAS Decision Manager, the tables must be registered in the SAS Metadata Repository. In SAS Decision Manager, you can view test tables in the Data category view.

After a test table is added to SAS Decision Manager, you can specify the table in the **Default test table** field in the project properties.

For information about adding registered test tables using the Data category view, see "Add Registered Tables from Metadata" on page 16.

See Also

"Creating a Test Table" on page 384

Performance Tables

A performance table is a SAS data set that is used as the input table for each SAS Decision Manager performance definition. A performance definition is used to monitor a champion model's performance by comparing the observed target variable values with the predicted target variable values. A performance table is a sampling of operational data that is taken at a single point in time. Each time you run a performance definition, you use a new performance table to take a new sampling of the operational data. For example, a champion model is deployed to a production environment for the first time in March 2013. You might want to take a new sampling of the operational data in June 2013, September 2013, and January 2014. These new tables are performance tables in the context of SAS Decision Manager.

To view a performance table in SAS Decision Manager, you must register the tables in the SAS Metadata Repository using the Data category view or by using SAS Management Console. You can view performance tables in the Data category view. After a performance table is registered, you can specify the table in the **Default performance table** field in the project properties. The default performance table value at the project level is the default value for the **Performance data source** field in the Edit Performance Definition wizard.

Note: If you run SAS Decision Manager report macros outside of SAS Decision Manager to monitor a champion model's performance, the macros cannot access the performance tables in SAS Decision Manager to create model performance monitoring reports.

See Also

"Creating a Performance Table" on page 384

See Also

"Remove a Table" on page 22

Creating Project Input and Output Tables

Create a Project Input Table

You can create a project input table either from the train table that you used to develop your model, or you can define the project variables in a DATA step. The project input table must include the input variables that are used by the champion model. Therefore, if you have several candidate models for your project, make sure that all candidate model input variables are included in the project input table. If you create the project input table from the train table, be sure to exclude the target variable from the project input table.

Here is one method that you can use to create the project input table from the train table. Use the SET statement to specify the train table and the DROP or KEEP statements to specify the variables from the train table that you want in the project input table. You can drop the target variable or keep all variables except the target variable.

This DATA step creates the project input table from the train table and drops the target variable Bad:

```
data hmeqtabl.invars;
   set hmeqtabl.training (obs=1);
   drop bad;
run;
```

This DATA step creates the project input table from the train table and keeps all variables except for the target variable Bad:

```
data hmeqtabl.invars;
   set hmeqtabl.training (obs=1);
   keep mortdue reason delinq debinc yoj value ninq job clno derog
clag loan;
run;
```

You can also create the project input table using the LENGTH statement to specify the variables and their type and length. You could also specify the LABEL, FORMAT, or INFORMAT statements, or the ATTRIB statement to specify additional variable attributes. The following DATA step uses the LENGTH statement to specify the project input variables in the table:

```
data hmeqtabl.invars;
   length mortdue 8 reason $7 delinq 8
          debinc 8 yoj 8 value 8
          ninq 8 job $7 clno 8 derog 8
          clag 8 loan 8;
run;
```

If you find that you need to modify the project input variables after you have created a project input table, you can use the project's **Variables** page to modify the project variables. For more information, see "Defining Project Input and Output Variables" on page 114.

See Also

- *SAS 9.4 Statements: Reference*
- *SAS 9.4 Language Reference: Concepts*

Create a Project Output Table

You can create a project output table either from the train table that you used to develop your model, or you can define the project variables in a DATA step. The project output table includes only output variables that are created or modified by the champion model. Therefore, if you have several candidate models for your project, you must make sure that all project output variables are mapped to the champion model output variables.

To create the project output table using the training table, use the SET statement to specify the training table, and use the KEEP statement to specify the variables from the training table that you want in the project output table. The following DATA step creates the project output table Hmeqtabl.Outvars:

```
data hmeqtabl.outvars;
   set hmeqtabl.training (obs=1);
   %include "c:\temp\score.sas";
   keep score;
run;
```

The following DATA step creates the same project output table using the LENGTH statement to specify the output variable and its type and variable length:

```
data hmeqtabl.outvars;
   length score 8;
run;
```

If you find that you need to modify the project output variables after you have created a project output table, you can use the project's **Variables** page to modify the project variables. For more information, see "Defining Project Input and Output Variables" on page 114.

Creating Scoring Input and Output Tables

About Scoring Input and Output Tables

The scoring input table is a data table whose input is used by the scoring test to score a single model. The scoring input table must contain the variables and input data for the variables that the model requires. Typically, a scoring table is identical to its corresponding train table except that the target variables in the train table are not included in the scoring table.

A scoring output table contains the data that is produced when you execute a scoring test. You can provide a scoring output table or you can create a scoring output table definition in SAS Decision Manager. When a scoring test is executed, SAS Decision Manager uses the scoring output table definition to create the scoring output table. The name of the scoring output table definition is used as the name of the scoring output table.

You can create a scoring output table definition by using the Create a Scoring Output Table function on the **Models** page. In the Create a Scoring Output Table window, you select variables from a scoring input table as well as variables from the model's output. The variables in the **Input Variables** table are variables from the scoring input table if one is specified for the **Default scoring input table** property for a project or model property. Otherwise, the **Input Variables** table is empty. The **Output Variables** that appear in the window are model output variables. You use the variables from both tables to create the scoring output table.

SAS Decision Manager saves the table definition as metadata in the SAS Metadata Repository. The location of the metadata is defined by the SAS library that you specify when you create the output table definition. After SAS Decision Manager creates the table definition, the table can be selected as the output table for subsequent scoring tests.

A SAS Decision Manager scoring test can run in test mode, which is the default mode, or it can run in production mode. When the test runs, it populates a scoring output table. In test mode, the scoring output table is stored in the SAS Decision Manager model repository. You view the table under the scoring test on the project's **Scoring** page. In production mode, if the scoring output table is a table that you provided, that table is updated. If you created a scoring test output definition, the scoring output table is located in the designated SAS library that you specified when you created the table definition in the Create a Scoring Output Table window. The production scoring output table is not stored in the SAS Decision Manager repository.

Create a Scoring Input Table

This DATA step creates a scoring test input table from customer data, keeping 500 rows from the train table:

```
data hmeqtabl.scorein;
   set hmeqtabl.customer (obs=500);
   keep mortdue reason delinq debinc yoj value ninq job clno derog
clage loan;
run;
```

Create a Scoring Output Table

You can create a scoring output table using the Create a Scoring Output Table window that you open from the project's **Models** page. The Create a Scoring Output Table window enables you to select the variables that you want to include in your scoring output table. If the library that you select in the Create a Scoring Output Table window is a folder in the SAS Metadata Repository, SAS Decision Manager registers the table in the repository. You can view the table in the Data category view

of SAS Decision Manager. For information, see “Create Scoring Output Tables” on page 184.

You can also create a scoring output table using a DATA step to keep or drop variables from the train table.

The input variables that you might want to keep in the output data set are key variables for the table. Key variables contain unique information that distinguishes one row from another. An example would be a customer ID number.

This DATA step keeps the input variable CLNO, the client number, which is the key variable, and the output variable SCORE:

```
data hmeqtabl.scoreout;
   length clno 8 score 8;
run;
```

Creating a Test Table

The test table is used during model validation by the Dynamic Lift report. You can create a test table by taking a sampling of rows from the original train table, updated train table, or any model validation table that is set aside at model training time. This DATA step randomly selects approximately 25% of the train table to create the test table:

```
data hmeqtabl.test;
  set hmeqtabl.train;
  if ranuni(1234) < 0.25;
run;
```

See Also

“Create a Dynamic Lift Report” on page 203

Creating a Performance Table

About Performance Tables

Here are the requirements for a performance table:

- the input variables that you want reported in a Characteristic report
- if you have score code:
  - all input variables that are used by the champion model or challenger models

  - all output variables that are used by the champion model or challenger models
- if you have no score code:
  - the actual value of the dependent variable and the predicted score variable
  - all output variables that you want reported in a Stability Report

You create a performance table by taking a sampling of data from an operational data mart. Make sure that your sampling of data includes the target or response variables. The data that you sample must be prepared by using your extract, transform, and load business processes. When this step is complete, you can then use that data to create your performance table.

As part of the planning phase, you can determine how often you want to sample operational data to monitor the champion model performance. Ensure that the operational data that you sample and prepare represents the period that you want to monitor. For example, to monitor a model that determines whether a home equity loan could be bad, you might want to monitor the model every six months. To do this, you would have two performance tables a year. The first table might represent the data from January through June, and the second table might represent the data from July through December.

Here is another example. You might want to monitor the performance of a champion model that predicts the delinquency of credit card holders. In this case, you might want to monitor the champion model more frequently, possibly monthly. You would need to prepare a performance table for each month in order to monitor this champion model.

In addition to planning how often you sample the operational data, you can also plan how much data to sample and how to sample the data. Examples in this section show you two methods of sampling data and naming the performance tables. You can examine the sampling methods to determine which might be best for your organization.

Naming a Performance Table for Use with the Edit Performance Definition Wizard

The Edit Performance Definition wizard is a graphical interface to assist you in creating a performance definition to monitor the champion model performance. When you run the Edit Performance Definition wizard, you specify a performance table that has been registered to the SAS Metadata Repository. When you create a performance table, you can collect and name the performance table using a method that is most suitable for your business process.

See Also

“Overview of Performance Monitoring” on page 244

Create a Performance Table

You can use the following DATA steps as examples to create your performance tables.

This DATA step creates a performance table using 5,000 sequential observations from the operational data:

```
data hmeqtabl.perform;
   set hmeqop.JulDec (firstobs=12001 obs=17000);
run;
```

This DATA step creates a performance table from operational data for the past six months of the year. The IF statement creates a random sampling of approximately 10% of the operational data:

```
data hmeqtabl.perform;
  set hmeqop.JulDec;
  if ranuni(1234) < 0.1;
run;
```

Using Tables from a Local or Network Drive

About Using Tables from a Local or Network Drive

If you have migrated or upgraded from a previous release of SAS Decision Manager, the start-up code that enabled you to use tables from the local SAS Workspace Server or network drive is still available. In SAS Decision Manager 2.2 or later, tables must be registered in the SAS Metadata Repository and accessible in the Data category view. Therefore, you can no longer define a libref to use tables on a local or network drive for the following tasks.

- Create a project
- Create projects from a control table
- Specify project input and output variables
- Create a scoring test
- Create a model retrain definition
- Create reports

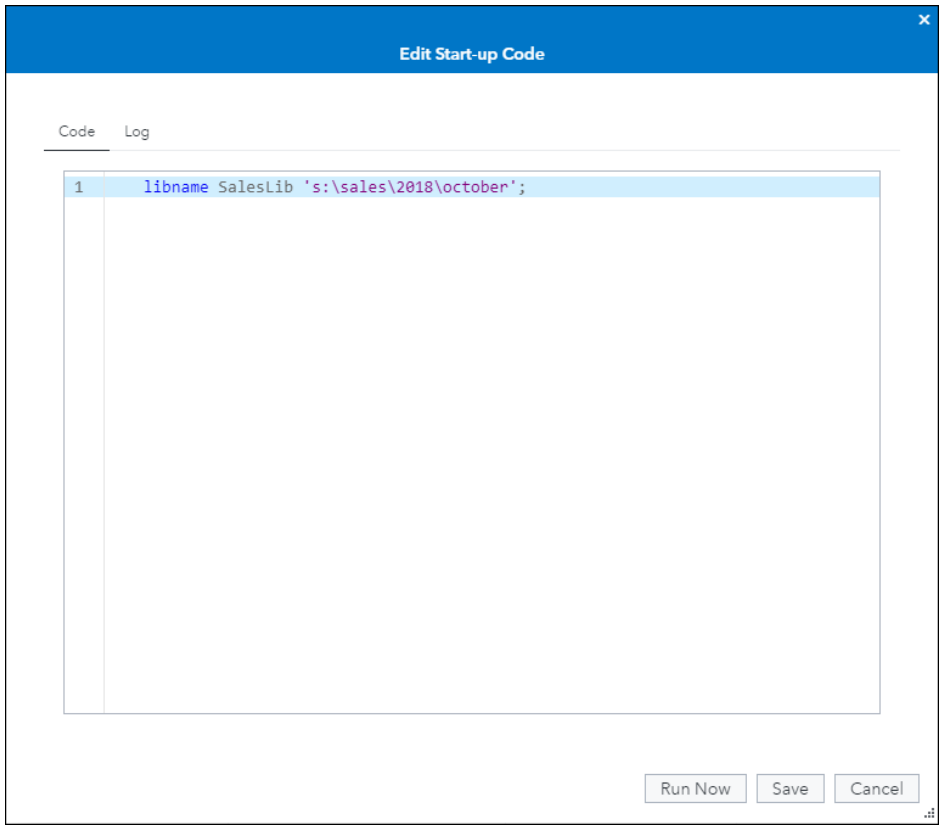
  Note: The exception is ad hoc or user-defined reports.

- Create a performance definition

The start-up code that was migrated can be viewed using the Edit Start-up Code window. You can access this window from the Projects and Portfolios category views, by clicking ⋮ on the toolbar and selecting **Edit start-up code**.

Here is an example LIBNAME statement:

```
libname SalesLib 's:\sales\2018\october';
```



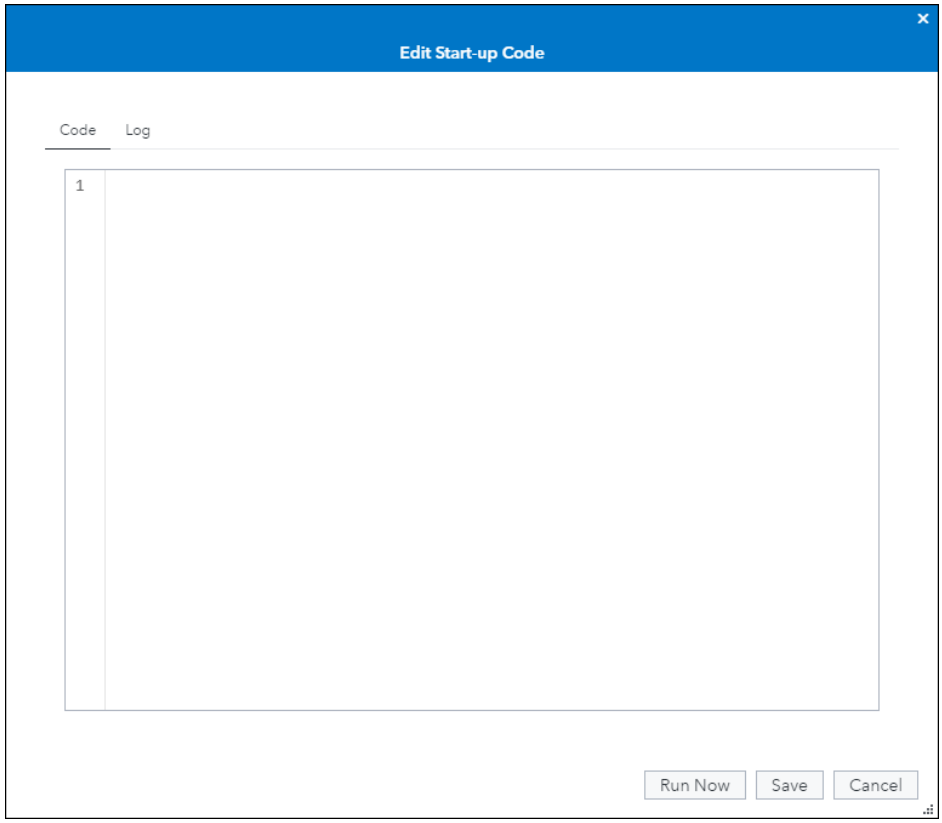
Edit Start-Up Code

You can use the Edit Start-Up Code window to define a libref to a local or network drive, which can then be used in ad hoc and user-defined reports. You can also add system options to the SAS log for debugging purposes.

Note: This feature is available from the Projects and Portfolios category views.

To edit the start-up code:

1 Click ⋮ and select **Edit start-up code**. The Edit Start-up Code window appears.



2 Enter the SAS code.

3 Click **Run Now**.

4 Click the **Log** tab to see the SAS log.

5 Click **Save**. The SAS code is saved in the Edit Start-up Code window.

Note: If you save the code without running it by clicking **Save**, the code automatically runs the next time a SAS code task is run.

Delete a Libref

To delete a libref:

Note: This feature is available from the Projects and Portfolios category views.

1 Click ⋮ and select **Edit start-up code**.

2 Enter the following code in the editor:

```
libname libref clear;
```

3 Click **Run Now**.

Appendix 3

PROC PSCORE and PMML Support

Overview of PROC PSCORE and PMML Support

PMML is an XML markup language that was developed to exchange predictive and statistical models between modeling systems and scoring platforms. Users can import the majority of standard-compliant PMML models and score them within a SAS environment via the SAS PSCORE procedure.

PROC PSCORE Functionality

The SAS PSCORE procedure generates SAS DATA step score code that is functionally equivalent to the PMML model. The generated score code can be

executed on all platforms that are supported by SAS to score the data sets. You can submit the score code in SAS Enterprise Miner via the Program Editor, SAS Enterprise Miner Project code, or within a SAS Enterprise Miner Process Flow Diagram, via the SAS Code node. However, the SAS Enterprise Miner UI environment is not necessary to run the score code.

Note: The PSCORE procedure generates both DATA step code and DS2 code. However, only DATA step model score code is generated when you are registering a PMML model into SAS Decision Manager.

See Also

SAS Enterprise Miner 15.1 PMML Support

Supported Versions

PROC PSCORE currently supports the use of PMML 4.2. Earlier versions of PMML are not supported for use with PROC PSCORE.

Supported PMML Models

SAS PROC PSCORE supports the following types of PMML models:

- Regression
- Trees
- Neural Networks
- Clustering models
- Scorecard
- Vector Machine
- Naïve Bayes
- Baseline models

The following models are supported on an experimental basis:

- Time Series
- General Regression

Requirements for PROC PSCORE

In order to use PROC PSCORE, you must have SAS 9 or later, a well formed PMML modeling file, and Write access to the output directory for the DATA step score file. A SAS Enterprise Miner license is not necessary to run PROC PSCORE.

PROC PSCORE Usage

```
PROC PSCORE PMML FILE = "<full-pathname-of-PMML-file>"
     DS FILE = "<full-pathname-of-output-DS-file>"
```

PROC PSCORE Example

/*Run the PSCORE procedure on a generated PMML file*/

```
PROC PSCORE PMML FILE = "C:\temp\heart_pmml1.xml"
     DS FILE = "C:\temp\ds_heart_score.sas";
  run;
```

Appendix 4

R Model Support

Overview of Using R Models with SAS Decision Manager

R is a freely available language and environment for statistical computing and graphics. Using the open architecture of SAS Decision Manager, you can register and import R models. SAS Decision Manager requires a model template file and model component files that are created specifically for R models.

The following SAS components are required to use R models in SAS Decision Manager:

- Ensure that the installed R language version is 2.13.0 or later.
- SAS/IML. You must license SAS/IML because the IML procedure is required to export SAS data sets to R and to submit R code.
- The RLANG system option. You must set this system option.
- The R language and SAS/IML must be installed on the same machine where the SAS Model Manager server is installed.

SAS Decision Manager supplies three R model templates that you can use, or you can create your own template as well. The R model templates that are provided by SAS Decision Manager support the analytic, classification, and prediction model functions. The segmentation model function is not supported for R models.

After the model component files are registered, you can perform all SAS Decision Manager functions except for exporting an R model to the SAS Metadata Repository.

To use R models in SAS Decision Manager, do the following tasks:

1. Ensure that the RLANG system option is set. To have the RLANG system option set when SAS starts, have your site administrator add the RLANG system option to the SAS configuration file.
2. Build an R model. For more information, see "Build an R Model" on page 394.

   SAS/IML must be installed before you build an R model.
3. Ensure that you have a model template file. For more information, see "Prepare an R Model Template File" on page 395.
4. Ensure that you have the required model component files. For more information, see "Prepare R Model Component Files" on page 397.
5. Import the R model. For more information, see "Import Models from Local Files" on page 134.

Preparing R Model Files to Use with SAS/IML

Build an R Model

Use the following SAS code to create an R model and save it in the outmodel.rda model component file:

```
/* Define the libref to the SAS input data set.   */

libname libref "path-to-input-data-set";

/* Use PROC IML to export the SAS input data set to the R input data
set. */

proc iml;
    run ExportDatasetToR("input-data-set" , "R-matrix-input");

/* Submit the model-fitting R code.   */

submit /R;
        attach(R-matrix-input)

        # ----------------------------------------------
        # FIT THE MODEL
        # ----------------------------------------------
        model-name<- model-fitting-function

        # ----------------------------------------------
        # SAVE THE PARAMETER ESTIMATE TO LOCAL FILE OUTMODEL.RDA
```

```
        # ---------------------------------------------
        save(model-name, file="path/outmodel.rda")
    endsubmit;
run;
quit;
```

Supply the following values:

path-to-input-data-set
is the path to the library where the input data set is stored.

input-data-set
is the name of the input data set.

R-matrix-input
is the R input data.

model-name
is the name of the model.

model-fitting-function
is the R formula that is used to fit the model.

path
is the path to where outmodel.rda is to be stored.

Here is an example of creating an R model using the HMEQ train data set as the SAS input data set:

```
libname mmsamp "!sasroot\mmcommon\sample";
proc iml;
    run ExportDatasetToR("mmsamp.hmeq_train" , "mm_inds");
    submit /R;
        attach(mm_inds)

        # ---------------------------------------------
        # FIT THE LOGISTIC MODEL
        # ---------------------------------------------
        logiten<- glm(BAD ~ VALUE + factor(REASON) + factor(JOB) +
DEROG +
                   CLAGE + NINQ + CLNO , family=binomial)

        # ---------------------------------------------
        # SAVE THE PARAMETER ESTIMATE TO LOCAL FILE OUTMODEL.RDA
        # ---------------------------------------------
        save(logiten, file="c:/RtoMMfiles/outmodel.rda")
    endsubmit;
run;
quit;
```

Prepare an R Model Template File

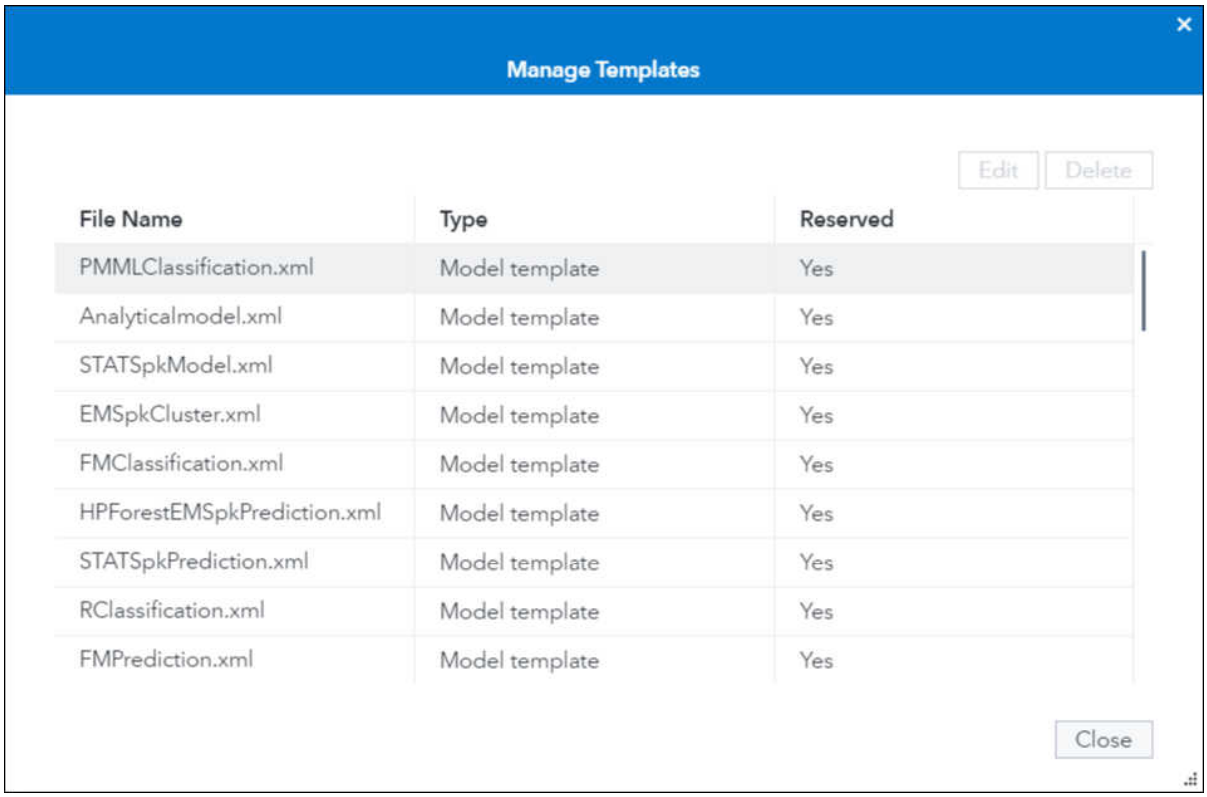
SAS Decision Manager provides three R model templates that you can use as a model template for your R model:

- RClassification
- RPrediction

- RAnalyticalmodel

To view these model templates:

1 From the Projects, Portfolios, or Models category views, click ⋮ and select **Templates** ⇨ **Manage templates**.The Manage Templates appears.



2 Select an R model template and click **Edit**.

3 Review the model template to make sure that it contains all of the model component files and properties for your model. If it does, you can use this template to import your R model. To customize the model template, you can copy the XML content from one of the supplied template files and make modifications using a text editor. You can then create a new model template using the modified XML content and the model template to the SAS Content Server.

To create a custom R model template, see "Model Template Component Files" on page 362 and "User-Defined Model Templates" on page 151.

Prepare R Model Component Files

R Model Component Files for Executing R Models Using SAS/IML

To submit R models from SAS Decision Manager using SAS/IML, you need several model component files:

- modelinput.sas7bdat
- modeloutput.sas7bdat
- target.sas7bdat
- inputvar.xml
- outputvar.xml
- targetvar.xml
- outmodel.rda
- score.r
- score.sas
- training.r (not required if you do not retrain your R model)
- training.sas (not required if you do not retrain your R model)

You create the modelinput.sas7bdat, modeloutput.sas7bdat, target.sas7bdat, inputvar.xml, outputvar.xml, and targetvar.xml files as you would for importing a SAS code file. For more information, see “Model Template Component Files” on page 362.

The remaining files, outmodel.rda, score.r, score.sas training.r, and training.sas require additional file preparation.

Create outmodel.rda

The outmodel.rda file contains the output parameter estimate. This file is used by SAS Decision Manager to register and score the model. You create outmodel.rda when you build an R model. See “Build an R Model” on page 394. The outmodel.rda file uses the R function save() to save the scoring results.

Here is the syntax of an outmodel.rda file:

```
save(model-name, file="path/outmodel.rda")
```

Supply the following values:

model-name
is the name of the R model.

path
is the system path to the location where outmodel.rda is stored.

Here is an example outmodel.rda file:

```
save(logiten, file="c:/temp/outmodel.rda")
```

Create score.r

The score.r script is an R script that is used to score data. You can use the following R script to create score.r:

```
attach(R-matrix-input)

# ----------------------------------------------
# LOAD THE OUTPUT PARAMETER ESTIMATE FROM FILE OUTMODEL.RDA
# ----------------------------------------------
load('&_mm_scorefilesfolder/outmodel.rda')

# ----------------------------------------------
# SCORE THE MODEL
# ----------------------------------------------
score<- predict(model-name, type="response", newdata=R-matrix-input)

# ----------------------------------------------
# MERGING PREDICTED VALUE WITH MODEL INPUT VARIABLES
# ----------------------------------------------
mm_outds <- cbind(R-matrix-input, score)
```

Supply the following values:

R-matrix-input
is the name of the input R matrix file that you specified in the ExportDatasetToR function in the IML procedure. See "Build an R Model" on page 394.

score
is the output variable. The value for *score* must match the output variable that is defined in modeloutput.sas7bdat and outputvar.xml.

model-name
is the name of the R model. The value of *model-name* must match the R save function *model-name* argument that is specified in the outmodel.rda file.

Here is an example score.r file:

```
attach(mm_inds)

# ----------------------------------------------
# LOAD THE OUTPUT PARAMETER ESTIMATE FROM FILE OUTMODEL.RDA
# ----------------------------------------------
load('&_mm_scorefilesfolder/outmodel.rda')

# ----------------------------------------------
# PREDICT
# ----------------------------------------------
score<- predict(logiten, type="response", newdata=mm_inds)

# ----------------------------------------------
```

```
# MERGE THE PREDICTED VALUE WITH MODEL INPUT VARIABLES
# ----------------------------------------------
mm_outds <- cbind(mm_inds, score)
```

Create score.sas

The score.sas program defines the score test information in a data set and calls the %mmbatch macro. When you submit the %mmbatch macro, the task mm_r_model_train_main completes the following tasks:

- transforms a scoring data set to an R data frame
- generates and submits R code for scoring
- transforms the scored output to a SAS data set for reporting in SAS Decision Manager

Here is the score.sas program:

```
filename tmp catalog "sashelp.modelmgr.mm_include.source";
%include tmp;
filename tmp;

data work.mm_score_task_information;
   length role $ 8;
   length name $ 80;
   length value $ 200;

   role = "input";
   name = "importedData";
   value = "&_mm_inputds";
   output;

   role = "input";
   name = "modelID";
   value = "&_mm_modelID";
   output;

   role = "output";
   name = "exportedData";
   value = "&_mm_outputds";
   output;

   role = "input";
   name = "dataRole";
   value = "output-variable-name";
   output;

   role = "input";
   name = "p_Target";
   value = "output-variable-name";
   output;
run;

/* mm_r_model_score_main is a SAS Decision Manager process flow that
is used to run */
```

```
/* R model scripts using PROC
IML.                                                    */

%mmbatch(task=mm_r_model_score_main, taskprops=
mm_score_task_information);
```

Supply the following value:

output-variable-name
is the output variable that is defined in modeloutput.sas7bdat or modeloutput.xml.

To print verbose SAS logs, add the following lines before the RUN statement in the previous DATA step:

```
role = "input";
   name = "_mm_trace";
   value = "ON";
   output;
```

Create training.r

The training.r script is an R script that is used to build a train model. Use the following script for the training.r file. In the R save function, the path in the file= argument must be &_MM_TrainResultFolder.

You can use the following script to create training.r:

```
attach(R-matrix-input)

# ----------------------------------------------
# FIT THE LOGISTIC MODEL
# ----------------------------------------------
model-name<- model-fitting-function

# ----------------------------------------------
# SAVE THE OUTPUT PARAMETER ESTIMATE TO LOCAL FILE OUTMODEL.RDA
# ----------------------------------------------
save(model-name, file="&_MM_TrainResultFolder/outmodel.rda")
```

Supply the following values:

R-matrix-input
is the name of the R matrix that is specified in the ExportMatrixToR function that is used to build a model using the IML procedure.

model-name
is the name of the R model.

model-fitting-function
is an R model fitting function, such as lm() or glm().

Here is an example training.r R script to build the HMEQ R train model:

```
attach(mm_inds)

# ----------------------------------------------
# FIT THE LOGISTIC MODEL
# ----------------------------------------------
```

```
logiten<- glm(BAD ~ VALUE + factor(REASON) + factor(JOB) + DEROG +
CLAGE +
              NINQ + CLNO , family=binomial)

# ----------------------------------------------
# SAVE THE OUTPUT PARAMETER ESTIMATE TO LOCAL FILE OUTMODEL.RDA
# ----------------------------------------------
save(logiten, file="&_MM_TrainResultFolder/outmodel.rda")
```

Create training.sas

If you do not need to retrain your R model in SAS Decision Manager, you do not need this file.

The training.sas program defines the train task information in a data set and calls the %mmbatch macro. When you submit the %mmbatch macro, the task mm_r_model_train_main completes the following tasks:

- transforms a training data set to an R data frame
- generates and submits R code for training
- registers the training output parameter estimate file in SAS Decision Manager

Here is the training.sas file:

```
filename tmp catalog "sashelp.modelmgr.mm_include.source";
%include tmp;
filename tmp;

data work.mm_train_task_information;
   length role $ 8;
   length name $ 80;
   length value $ 200;

   role = "input";
   name = "trainData";
   value = "&_mm_inputds";
   output;

   role = "input";
   name = "modelID";
   value = "&_mm_modelID";
   output;
run;

/* mm_r_model_train_main is a SAS Decision Manager process flow that
is used to run */
/* R model scripts using PROC
IML.                                                    */

%mmbatch(task=mm_r_model_train_main, taskprops=
mm_train_task_information);
```

To print verbose SAS logs, add the following lines before the RUN statement in the previous DATA step:

```
role = "input";
```

```
name = "_mm_trace";
value = "ON";
output;
```

Appendix 5

Statistical Measures Used in Basel III Reports

Overview of Statistical Measures Used for Basel III Reports

SAS Decision Manager Basel III reports use several statistical measures to validate the stability, performance, and calibration for the two key types of Basel III risk models: the Probability of Default (PD) model and the Loss Given Default (LGD) model.

The statistical measures for model validation are grouped into three categories:

Category	Description
Model Stability	Tracks the change in distribution of the modeling data and scoring data.
Model Performance	■ Measures the ability of a model to discriminate between customers with accounts that have defaulted, and customers with accounts that have not defaulted. The score difference between non-default and default accounts helps determine the required cutoff score. The cutoff score helps predict whether a credit exposure is a default account.

Category	Description
	■ Measures the relationship between the actual default probability and the predicted default probability. This helps you understand the performance of a model over a time period.
Model Calibration	Checks the accuracy of the PD and LGD models by comparing the correct quantification of the risk components with the available standards.

The sections that follow describe the measures, statistics, and tests that are used to create the PD and LGD reports.

Model Stability Measure

The following table describes the model stability measure that is used to create the PD report and the LGD reports.

Measure	Description	PD Report	LGD Report
System Stability Index (SSI)	SSI monitors the score distribution over a time period.	Yes	Yes

Model Performance Measures and Statistics

The following table describes the model performance measures that are used to create the PD and LGD reports.

Measure	Description	PD Report	LGD Report
Accuracy	Accuracy is the proportion of the total number of predictions that were correct.	Yes	No
Accuracy Ratio (AR)	AR is the summary index of Cumulative Accuracy Profile (CAP) and is also known as Gini coefficient. It shows the	Yes	Yes

Measure	Description	PD Report	LGD Report
	performance of the model that is being evaluated by depicting the percentage of defaulted accounts that are captured by the model across different scores.		
Area Under Curve (AUC)	AUC can be interpreted as the average ability of the rating model to accurately classify non-default accounts and default accounts. It represents the discrimination between the two populations. A higher area denotes higher discrimination. When AUC is 0.5, it means that non-default accounts and default accounts are randomly classified, and when AUC is 1, it means that the scoring model accurately classifies non-default accounts and default accounts. Thus, the AUC ranges between 0.5 and 1.	Yes	No
Bayesian Error Rate (BER)	BER is the proportion of the whole sample that is misclassified when the rating system is in optimal use. For a perfect rating model, the BER has a value of zero. A model's BER depends on the probability of default. The lower the BER, and the lower the classification error, the better the model.	Yes	No
D Statistic	The D Statistic is the mean difference of scores between default accounts and non-default accounts, weighted by the relative distribution of those scores.	Yes	No
Error Rate	The Error Rate is the proportion of the total number of incorrect predictions.	Yes	No
Information Statistic (I)	The Information Statistic value is a weighted sum of the difference between conditional default and conditional non-default rates. The higher the value, the more likely a model can predict a default account.	Yes	No
Kendall’s Tau-b	Kendall's tau-b is a nonparametric measure of association based on the number of concordances and discordances in paired observations. Kendall's tau values range between -1 and +1, with a positive correlation indicating that the ranks of both variables increase together. A negative association indicates	Yes	No

Measure	Description	PD Report	LGD Report
	that as the rank of one variable increases, the rank of the other variable decreases.		
Kullback-Leibler Statistic (KL)	KL is a non-symmetric measure of the difference between the distributions of default accounts and non-default accounts. This score has similar properties to the information value.	Yes	No
Kolmogorov-Smirnov Statistic (KS)	KS is the maximum distance between two population distributions. This statistic helps discriminate default accounts from non-default accounts. It is also used to determine the best cutoff in application scoring. The best cutoff maximizes KS, which becomes the best differentiator between the two populations. The KS value can range between 0 and 1, where 1 implies that the model is perfectly accurate in predicting default accounts or separating the two populations. A higher KS denotes a better model.	Yes	No
1–PH Statistic (1–PH)	1-PH is the percentage of cumulative non-default accounts for the cumulative 50% of the default accounts.	Yes	No
Mean Square Error (MSE), Mean Absolute Deviation (MAD), and Mean Absolute Percent Error (MAPE)	MSE, MAD, and MAPE are generated for LGD reports. These statistics measure the differences between the actual LGD and predicted LGD.	No	Yes
Pietra Index	The Pietra Index is a summary index of Receiver Operating Characteristic (ROC) statistics because the Pietra Index is defined as the maximum area of a triangle that can be inscribed between the ROC curve and the diagonal of the unit square. The Pietra Index can take values between 0 and 0.353. As a rating model's performance improves, the value is closer to 0.353. This expression is interpreted as the maximum difference between the cumulative frequency distributions of default accounts and non-default accounts.	Yes	No

Measure	Description	PD Report	LGD Report
Precision	Precision is the proportion of the actual default accounts among the predicted default accounts.	Yes	No
Sensitivity	Sensitivity is the ability to correctly classify default accounts that have actually defaulted.	Yes	No
Somers' D (p-value)	Somers' D is a nonparametric measure of association that is based on the number of concordances and discordances in paired observations. It is an asymmetric modification of Kendall's tau. Somers' D differs from Kendall's tau in that it uses a correction only for pairs that are tied on the independent variable. Values range between -1 and +1. A positive association indicates that the ranks for both variables increase together. A negative association indicates that as the rank of one variable increases, the rank of the other variable decreases.	Yes	No
Specificity	Specificity is the ability to correctly classify non-default accounts that have not defaulted.	Yes	No
Validation Score	The Validation Score is the average scaled value of seven distance measures, anchored to a scale of 1 to 13, lowest to highest. The seven measures are the mean difference (D), the percentage of cumulative non-default accounts for the cumulative 50% of the default accounts (1-PH), the maximum deviation (KS), the Gini coefficient (G), the Information Statistic (I), the Area Under the Curve (AUC), or Receiver Operating Characteristic (ROC) statistic, and the Kullback-Leibler statistic (KL).	Yes	No

Model Calibration Measures and Tests

The following table describes the model calibration measures and tests that are used to create the PD and LGD reports:

Measure	Description	PD Report	LGD Report
Binomial Test	The Binomial Test evaluates whether the PD of a pool is correctly estimated. It does not take into account correlated defaults, and it generally yields an overestimate of the significance of deviations in the realized default rate from the forecast rate. The Modified Binomial Test now addresses the overestimate. This test takes into account the correlated defaults. The default correlation coefficient in SAS Decision Manager is 0.04. By using past banking evaluations, you can use these rho values (Berlin: Springer, 2011)[1] rho=0.04 Qualifying revolving retail rho=0.15 Residential mortgage rho=0.16 Other retail rho=0.24 Corporations, sovereign, and banks If the number of default accounts per pool exceeds either the low limit (binomial test at 0.95 confidence) or high limit (binomial test at 0.99 confidence), the test suggests that the model is poorly calibrated. To change the default rho value, contact your application administrator. The value is a report option in SAS Management Console.	Yes	No
Brier Skill Score (BSS)	BSS measures the accuracy of probability assessments at the account level. It measures the average squared deviation between predicted probabilities for a set of events and their outcomes. Therefore, a lower score represents a higher accuracy.	Yes	No
Confidence Interval	The Confidence Interval indicates the confidence interval band of the actual PD or LGD for a pool. The Probability of Default (PD) report provides the PD that is estimated from the model and the actual PD with its confidence interval limits. If the PD that is estimated from the model is within the confidence interval limits of the actual PD, then the model outcomes are consistent with the actual outcomes. For the Loss Given Default (LGD) report, confidence intervals are based on the	Yes	Yes

Measure	Description	PD Report	LGD Report
	pool-level average of the estimated LGD, plus or minus the pool-level standard deviation, and multiplied by the 1-(alpha/2) quantile of the standard normal distribution.		
Correlation Analysis	The model validation report for LGD provides a correlation analysis of the estimated LGD with the actual LGD. This correlation analysis is an important measure for a model's usefulness. The Pearson correlation coefficients are provided at the pool and overall levels for each time period are examined.	No	Yes
Hosmer-Lemeshow Test (p-value)	The Hosmer-Lemeshow test is a statistical test for goodness-of-fit for classification models. The test assesses whether the observed event rates match the expected event rates in pools. Models for which expected and observed event rates in pools are similar are well calibrated. The p-value of this test is a measure of the accuracy of the estimated default probabilities. The closer the p-value is to zero, the poorer the calibration of the model.	Yes	No
Mean Absolute Deviation (MAD)	MAD is the distance between the account level estimated and the actual loss LGD, averaged at the pool level.	No	Yes
Mean Absolute Percent Error (MAPE)	MAPE is the absolute value of the account-level difference between the estimated and actual LGD, divided by the estimated LGD, and averaged at the pool level.	No	Yes
Mean Squared Error (MSE)	MSE is the squared distance between the account level estimated and actual LGD, averaged at the pool level.	No	Yes
Normal Test	The Normal Test compares the normalized difference of predicted and actual default rates per pool with two limits estimated over multiple observation periods. This test measures the pool stability over time. If a majority of the pools lie in the rejection region, to the right of the limits, then the pooling strategy should be revisited.	Yes	No

Measure	Description	PD Report	LGD Report
Observed versus Estimated Index	The observed versus estimated index is a measure of closeness of the observed and estimated default rates. It measures the model's ability to predict default rates. The closer the index is to zero, the better the model performs in predicting default rates.	Yes	No
Traffic Lights Test	The Traffic Lights Test evaluates whether the PD of a pool is underestimated, but unlike the binomial test, it does not assume that cross-pool performance is statistically independent. If the number of default accounts per pool exceeds either the low limit (Traffic Lights Test at 0.95 confidence) or high limit (Traffic Lights Test at 0.99 confidence), the test suggests the model is poorly calibrated.	Yes	No

1 Robert Rauhmeier, “PD-Validation: Experience from Banking Practice,” in *The Basel II Risk Parameters*, ed. Bernd Engelmann and Robert Rauhmeier (Berlin: Springer, 2011). https://doi.org/10.1007/3-540-33087-9_14

Appendix 6

Sample Data and Models

Overview

You can use the sample data and models in SAS Decision Manager to cover basic and advanced tasks that are related to model management within an enterprise computing environment. Sample data and model folders are created by extracting files from the samples ZIP file. You use these data and model files to become familiar with the following basic tasks that are involved in model management:

- create a library and add data tables

- create a project
- import models
- run model reports
- select a champion model and challenger models
- run model scoring code
- monitor performance of project champion and challenger models
- publish models
- retrain models

Configure Users

All users who perform tasks using the sample data must be configured to use SAS Decision Manager. A user must be in the Model Manager Administrator Users group to complete the setup for using the sample data.

Required for Task	Group	Description
Setting up sample data and models	Decision Manager Common Administrators	This group has administrative permissions. This includes administration of the Projects and Portfolios.
All tasks	Decision Manager Users	This group has permission to read, add, or delete table summary information in the Data category. Users or groups must be a member of this group in order to add or delete table summary information.
Setting up sample data and models	Model Manager Administrator Users	This group has administrative permissions in the Projects and Portfolio categories.
All tasks	Model Manager Advanced Users	This group has permission to read, write, and delete content in the Projects and Portfolios categories
Creating and managing portfolios	Factory Miner Users	This group has permission to register project segments and models from SAS Factory Miner to the SAS Decision Manager model repository. It is recommended that you also these users to the Model Manager Administrator Users group or Model Manager Advanced Users group.

It is recommended that you add the Model Manager Administrator Users group as a member of the Decision Manager Common Administrators group and the Decision Manager Users group. The Model Manager Advanced Users group should be added as a member of the Decision Manager Users group. For more information, see "Groups and Group Membership" in *SAS Decision Manager: Administrator's Guide*.

Make the Sample Data and Models Available

The ZIP file SMM143Samples.zip contains the sample data sets, models, workflow templates, and score code. It is available from the SAS Decision Manager Product Documentation page. Extract the tutorial files to a computer that is accessible to the SAS Metadata Server and to SAS Decision Manager users. If your SAS Metadata Server is separate from the SAS Application Server, the files must be placed on the SAS Application Server. Use WinZip to extract the files. If you are using a different extraction program, follow that program's instructions for extracting the files.

To download the files:

1. Create a folder on the server machine or a network drive to store the sample files. The instructions refer to this folder as `<drive>`.

   Note: Users must have Read, Write, and Execute permissions to this folder and subfolders. You can create a group and add the users to that group to grant the permissions. For more information, see "Creating Operating System Accounts for Product Administrators and Users" in *SAS Decision Manager: Administrator's Guide*.

2. Save the SMM143Samples.zip to `<drive>`.
3. Open Windows Explorer to `<drive>`. Right-click **SMM143Samples.zip** and select **Open**. Click **Open**.
4. Click the arrow on the **Unzip** button to open the Unzip from WinZip File Folder window.
5. Select `<drive>` from the Unzip to WinZip File Folder window.

The data sets in `<drive>\SMM143Samples\Data` must be registered in a library in the SAS Metadata Repository. You can define a data library and register the tables in the SAS Metadata Repository using SAS Management Console. Then you can use the Data category view in SAS Decision Manager to add the registered tables to the list of data sources. For more information, see "About Managing Data Tables" on page 15.

The model files and folders in `<drive>\SMM143Samples\Models` must be available on a local or network drive.

Sample Values for Basic Model Management Tasks

Project Sample Values

New Project Values

Note: You can choose any name for a project or use the suggested names below.

Project Name	Model Function
HMEQ	**Classification**
HMEQ-Interval	**Prediction**

For more information, see "Create a Project" on page 108.

Project Variables

Input Data Source	Output Data Source
HMEQ_PROJECT_INPUT	**HMEQ_PROJECT_OUTPUT**

For more information, see "Defining Project Input and Output Variables" on page 114.

Project Properties

Name	Value
Default test table	**HMEQ_TEST**

Name	Value
Default scoring input table	**HMEQ_SCORING_INPUT**
Default scoring output table	**HMEQ_SCORING_OUTPUT**
Default train table	**HMEQ_TRAIN**
Training target variable	For a classification project, enter *BAD*. For a prediction project, enter *DEBTINC*.
Target event value	*1*
Class target level	For a classification project, select **Binary**. For a prediction project, select **Interval**.
Output event probability variable **Note:** This is used for a classification project.	**score**
Output prediction variable **Note:** This is used for a prediction project.	**P_DEBTINC**

For more information, see "Project Properties" on page 109.

Sample Models for Importing

Navigate to `\SMM143Samples\Models` and select the corresponding model files listed below.

Import Type	Available Sample Models
SAS Metadata Repository **Note:** These files must be registered in the SAS Metadata Repository before importing from Model Manager.	`\Reg1\miningResult.spk` `\Tree1\miningResult.spk`

SAS Package File	`\Reg1\miningResult.spk`
	`\Tree1\miningResult.spk`
	`\HMEQ_STAT_Item\HMEQItem.spk`
	`\HPForest\HPForest.spk`
	`\Reg1_Interval\miningResult.spk`

Import Type	Available Sample Models
	Note: Import the `Reg1_Interval` with an interval target to run a prediction model.
PMML File You can use SAS Decision Manager to import PMML models that are produced by another software application, such as SAS Enterprise Miner.	`\Neural\Neural.xml`
SAS Analytic Store Models The HPFOREST and HPSVM procedures are used to create a SAS analytic store (SASAST) file. This file contains the model scoring files and model input and output variables. You can register SAS analytic store models from SAS Factory Miner, or you can register them by importing a model from a SAS analytical store file into SAS Decision Manager.	`\HPForest_ASTORE` `\hpforest.sasast`

For more information, see "Overview of Importing Models" on page 128.

Mappings for Sample Model Variables and Project Variables

Model	Project Variable	Model Variable
Reg1	score	EM_EVENTPROBABILITY
Tree1	score	EM_EVENTPROBABILITY
Neural	score	P_BAD1
HMEQ_STAT_Item	score	P_BAD1
HPForest	score	P_BAD1
HPForest_ASTORE	score	P_BAD1
Reg1_Interval	P_DEBTINC	P_DEBTINC

For more information, see "Map Model Variables to Project Variables" on page 151.

Scoring Test Sample Values

Name	Enter a name for the scoring test (for example, Tree1).
Description (Optional)	Enter a description of the scoring test.
Model	Tree1
Type	**Test** **Note:** Specify the number of observations to be read from the scoring input table or accept the default of 1000 rows.
Input Table	**HMEQ_SCORE_INPUT**
Output Table	**HMEQ_SCORE_OUTPUT**
Variable Mappings	The scoring output variables are mapped automatically if the names match those in the **Maps To** column.
SAS Application Server	**SASApp**

For more information, see "Create a Scoring Test" on page 187.

You can schedule the scoring test to run on a particular date and time. You can also schedule how often you want the scoring test to run. For more information, see "Schedule a Scoring Test" on page 189.

Champion and Challenger Model Settings

Champion Model	Challenger Model
Tree1	Reg1

For more information, see "Overview of Deploying Models" on page 299.

Publishing Model Settings

Publish Destination	Model
SAS Metadata Repository	Tree1

Publish Destination	Model	Publish Method	Validation table
Teradata	Tree1	**SAS Embedded Process**	**HMEQ_TRAIN**
Teradata	Reg1	**Scoring function**	**HMEQ_TRAIN**

For more information, see "Publishing Models to the SAS Metadata Repository" on page 307.

Monitoring Project Champion Model Performance Sample Values

Project	Select the project that you want to monitor (for example, HMEQ).
Model	For a classification project, select the **Tree1** champion model. For a prediction project, select the **Reg1_Interval** champion model.
SAS Application Server	SASApp
Select the data processing method	Standard configuration Select **Run model score code**.
Output variables	Select **All**
Input variables	Select **All**
Data source method	Static data sources Data sources: ■ **HMEQ_PERF_Q1** ■ **HMEQ_PERF_Q2** ■ **HMEQ_PERF_Q3**

- **HMEQ_PERF_Q4**

Collection dates:

- `March 31,2018`
- `June 30,2018`
- `September 30,2018`
- `December 31,2018`

Report labels:

- `Q1`
- `Q2`
- `Q3`
- `Q4`

For more information, see "Create and Run a Performance Definition" on page 261.

After you create a performance definition, you can create a schedule to execute the definition to run on a specific day and at a specific time. You can schedule the definition to run once, hourly, daily, weekly, or monthly. For more information, see "Schedule Performance Definitions" on page 269.

Report Sample Values

Model Comparison and Summary Report Sample Values

You can use the sample data to create several model comparison reports that are used in the selection and approval of a champion model. Of the reports, only the Model Profile report can be created for any type of model. By contrast, the Interval Target Variable report can be created only for a prediction model. After you create the reports, you view them on the **Reports** tab. Use the reports to evaluate candidate models in a version or across versions by assessing the structure, performance, and resilience of your models.

Note: Enter a name and description if you do not want to use the default values for your reports. You can also select a style for the reports. When the SAS default option is selected, the default style and themes are used in generating the report.

Report Type	Output Type	Models and Options
Delta	**HTML**	Reg1 Tree1

Report Type	Output Type	Models and Options
Dynamic lift	**HTML**	Reg1 Tree1 Enter *3* for the control group response rate. Enter *1* for the prior probability. Use the default test table **HMEQ_TEST**.
Interval target variable	**PDF**	Reg1_Interval Use the default input table of **HMEQ_TEST**.
Model profile	**PDF**	Tree1
Training summary data set	**HTML**	Reg1_Interval Use the default input table of **HMEQ_TRAIN**. Select all of the variables to include in the summary data set.

For more information, see "Overview of Model Comparison, Validation, and Summary Reports" on page 194.

Dashboard Report

Before you can create a dashboard definition, you must have at least one project that contains performance data. For more information, see "Create a Dashboard Report Definition" on page 275.

Before you can generate dashboard reports, ensure that at least one project contains performance data. At least one dashboard report indicator must also be defined in that project. For more information, see "Generate Dashboard Reports" on page 280.

Loss Given Default (LGD) Report

To run an LGD report with the sample data, you must create an LGD project and define both the variables and properties. You must also import the corresponding sample models.

Note: You can choose any name for a project or use the suggested names below.

Table A6.1 LGD Project Information

Project Name	Model Function
LGD_Interval	**Prediction**

Table A6.2 LGD Project Variables

Input Variable	Output Variable
LGD_PROJ_INPUT	**LGD_PROJ_OUTPUT**

Table A6.3 LGD Project Properties

Default scoring input table	**LGD_SCORE_INPUT**
Default scoring output table	**LGD_SCORE_OUTPUT**
Training target variable	*lgd*
Class target level	**Interval**
Output prediction variable **Note:** This is used for a prediction project.	**p_lgd** **Note:** This file is needed only if you want to retrain the model.

Navigate to `\SMM143Samples\Models\LG\` and select the corresponding model files to import.

- `lgd_score.sas`
- `lgd_model_input.sas7bdat`
- `lgd_model_output.sas7bdat`
- `lgd_model_target.sas7bdat`
- `lgd_model_est.sas7bdat`
- `lgd_training.sas`

Table A6.4 LGD Variables Mappings

Project Variables	Model Variables
p_lgd	**P_LGD**

Table A6.5 LGD Report Sample Values

Name and Description	Enter a name and description if you do not want to use the default values.

Model	Select **LGD**.
Input Table	**LGD_SCORE-INPUT**
Run score code	Select **yes**.
Time period variable	Accept default value of **period**.
Time Label	Enter a value of *timelabel* to include the appendix in the report.
More Options	**Actual variable** Accept the default value of **lgd**. **Predicted variable** Accept the default value of **p_lgd**. **Pool variable** Accept the default value of **pool_id**.

For more information, see "Loss Given Default Reports" on page 207.

Probability of Default Model Validation (PD) Report

To run a PD report with the sample data, you must create a PD project and define both the variables and properties. You must also import the corresponding sample models.

Note: You can choose any name or use the suggested name below.

Table A6.6 *PD Project Information*

Project Name	Model Function
PD	**Classification**

Table A6.7 *PD Project Variables*

Input Variable	Output Variable
HMEQ_PROJECT_INPUT	**HMEQ_PROJECT_OUTPUT**

Table A6.8 *PD Project Properties*

Default test table	**HMEQ_TEST**

Default scoring input table	**PD_SCORE_INPUT**
Default scoring output table	**PD_SCORE_OUTPUT**
Default train table	**HMEQ_TRAIN**
Training target variable	*BAD*.
Target event value	*1*.
Class target level	**Binary**
Output event probability variable **Note:** This is used for a classification project.	**score**

Navigate to `\SMM143Samples\Models\PD` and select the `hmeq_scorecard.spk` model file to import.

Table A6.9 *PD Model Variables Mappings*

Project Variables	Model Variables
score	**P_BAD1**

Table A6.10 *PD Report Sample Values*

Name and Description	Enter a name and description if you do not want to use the default values.
Model	Select `hmeq_scorecard.spk`.
Input Table	**PD_SCORE-INPUT**
Run score code	Select **yes**.
Time period variable	Accept the default value of **period**.
Time Label	Enter a value of *timelabel* to include the appendix in the report.
More Options	**Scorecard bin variable** Accept the default value of **scorecard_bin**. **Scorecard points variable** Accept the default value of **scorecard_points**. **Cut-off value** Accept the default value of **100**.

For more information, see "Probability of Default Model Validation Reports" on page 216.

User-defined Report

The model that is used in this sample task is based on the ARBORETUM procedure, which is a SAS Enterprise Miner procedure.

Template	**ProcArborModelTemplate**
Code	In the code in the text box, revise the name **ProcArborModelTemplate** to `ProcArborModelTemplateTutorial`.
Project	You can create a new classification project or use an existing classification project created from the sample data. For more information, see "New Project Values" on page 414.
Import Models	Navigate to `<drive>:\SMM143Samples\Models\model8` and select the corresponding model files listed below: ■ `score8.sas` ■ `modelinput8.sas7bdat` ■ `modeloutput8.sas7bdat` ■ *target8.sas7bdat* ■ `importance8.sas7bdat` ■ `path8.sas7bdat` ■ `rules8.sas7bdat` ■ `nodestat8.sas7bdat`
Map Model Output Variables	Click the **Value** column for score and select **P_BAD1**.

For more information, see "User-Defined Reports" on page 228.

Ad Hoc Report

Name and Description	Enter a name and description if you do not want to use the default values.
Model	**ProcArbor**
Code	Copy the code from `VarImportance.sas` in the `<drive>\SMM143Samples\Sample Code` folder in a text editor.

For more information, see "Ad Hoc Reports" on page 226.

Retraining Models

Model	Tree1
Data processing method	**Standard configuration**
SAS Application Server	**SASApp**
Training data source	**HMEQ_TRAIN**
Report folder	Select a location to store the report.
Register models that have been retrained	Select this option. Select a destination version for new models. Select **New version** from the drop-down menu to create a new version for the models.
Select model to compare	Reg1
Use training data source	Select this option.
Specify report options	Enter a report name. Select **HTML** for the report output. Select a style for the report.

For more information, see "Edit a Model Retrain Definition" on page 290.

Once you define the model retrain definition, you can run the definition, view results, and schedule the definition to execute on a specific day and at a specific time. For more information, see "Execute a Model Retrain Definition" on page 293.

Portfolio Sample Values

New Portfolio Values

Field Name	Value
Portfolio name	*Portfolio 1*
Description	*(Optional) Project portfolio.*

Field Name	Value
Location	Select a location to save the portfolio.
Control table	Select **CONTROL_TABLE** from the library folder where you registered the data sets.
Model source location	Select the location of the model SPK files that are specified in the control table (for example, `C:\SMM143Samples\Models\segmodels`).
Model function	**Classification**
Input table	**HMEQ_PROJECT_INPUT**
Output table	**HMEQ_PROJECT_OUTPUT**
Default test table	**HMEQ_TEST**
Training target variable	Enter *BAD*
Target event value	Enter *1*
Class target level	**Binary**
Output event probability variable	**score**
Champion model	**Tree1**
Challenger model	**Reg1**

For more information, see "Create a New Portfolio" on page 163.

You can publish models from a portfolio. For more information, see "Publishing Models from a Portfolio" on page 169.

Monitoring Performance of Project Champion Models within a Portfolio

Performance data source	Select **HMEQ_SEG_Q1** from the library folder where you registered the data sets. (Optional) Monitor performance of the champion models for multiple performance data sources. ■ **HMEQ_SEG_Q2** ■ **HMEQ_SEG_Q3**

	■ **HMEQ_SEG_Q4**
Collection date	*March 31, 2018* (Optional) Monitor performance of the champion models for multiple performance data sources. ■ *June 30, 2018* ■ *September 30, 2018* ■ *December 31,2018*
Report label	*Q1* (Optional) Monitor performance of the champion models for multiple performance data sources. ■ *Q2* ■ *Q3* ■ *Q4*
Run model score code	Select this option.
Output variables	Select **All**.
Input variables	Select **All**.
Training target variable	Enter *BAD*
Class target level	**Binary**
Target event value	Enter *1*
Output event probability variable	**score**
Alerts and Notifications (Optional)	(Optional) Specify values for the alert and warning conditions or accept the defaults. (Optional) Send the results by email.

For more information, see "Monitor Performance of Project Champion Models" on page 174.

Sample Values for Advanced Reporting Tasks

Overview

The ZIP file SMM143Samples.zip contains additional sample data sets, models, and score code that you can use for advanced reporting tasks. You must create a separate project to use this data and import three different models. The models are imported from local files. The SAS code for the first model is the LOGISTICS procedure, and the SAS code for the second and third models consists of DATA step fragments.

Project Sample Values

New Project Values

Note: You can choose any name or use the suggested name below.

Project Name	Model Function
Deliquency	**Classification**

For more information, see "Create a Project" on page 108.

Project Variables

Input Variable	Output Variable
DELINQUENCY_PROJECT_INPUT	**DELINQUENCY_PROJECT_OUTPUT**

For more information, see "Defining Project Input and Output Variables" on page 114.

Project Properties

Default test table	**DELINQUENCY_TEST**
Default scoring input table	**DELINQUENCY_SCORING_INPUT**
Default scoring output table	**DELINQUENCY_SCORING_OUTPUT**
Default train table	**DELINQUENCY_TRAIN**
Training target variable	*BAD*
Target event value	*1*
Class target level	**Binary**
Output event probability variable	**POSTERIOR**

For more information, see "Project Properties" on page 109.

Sample Models for Importing from Local Files

Table A6.11 *Model 1*

Import Type	From a local file.
Model name	*Model 1* **Note:** You can create your own name or use the suggested name above.
Model template	**Classification**
Files	Navigate to `\SMM143Samples\Models\model1\` and select the corresponding model files listed below: ■ `score1.sas` ■ `modelin1.sas7bdat` ■ `modelout1.sas7bdat` ■ `target1.sas7bdat` ■ `om.sas7bdat`

Table A6.12 Model 2

Import Type	From a local file.
Model name	*Model 2* **Note:** You can create your own name or use the suggested name above.
Model template	**Classification**
Files	Navigate to `\SMM143Samples\Models\model2\` and select the corresponding model files listed below: ■ `score2.sas` ■ `modelin2.sas7bdat` ■ `modelout2.sas7bdat` ■ `target2.sas7bdat` ■ `ot.sas7bdat`

Table A6.13 Model 3

Import Type	From a local file.
Model name	*Model 3* **Note:** You can create your own name or use the suggested name above.
Model template	**Classification**
Files	Navigate to `\SMM143Samples\Models\model3\` and select the corresponding model files listed below: ■ `score3.sas` ■ `modelin3.sas7bdat` ■ `modelout3.sas7bdat` ■ `target3.sas7bdat`

For more information, see "Overview of Importing Models" on page 128.

Mappings for Model Properties and Output Variables

Table A6.14 Model Properties

Model	Properties
Model 1	Select **General** and enter *first model* in the **Description** field.
Model 2	Select **Specific**, click the **Score code type** box, and select **DATA step**.
Model 3	Select **Specific**, click the **Score code type** box, and select **DATA step**.

For more information, see "Set Model Properties" on page 143.

Table A6.15 Output Variable Mappings

Model	Project Variables	Model Variables
Model 1	**POSTERIOR**	**P_1**
Model 1	**PREDICTION**	**I_BAD**
Model 2	**POSTERIOR**	**PROB**
Model 2	**PREDICTION**	**PREDICTION**
Model 3	**POSTERIOR**	**P_BAD1**
Model	**PREDICTION**	**PREDICTION**

For more information, see "Map Model Variables to Project Variables" on page 151.

Champion Model Settings

Champion Model	Model 1

For more information, see"Overview of Deploying Models" on page 299.

Report Sample Values

Simple Ad Hoc Report

Name and Description	Enter a name and description if you do not want to use the default values.
Model	**Model 1**
Code	Copy the code from **RptVars.sas** in the*<drive>***SMM143Samples\Sample Code** folder in a text editor. In the SAS Editor, paste the code that you copied. If you are configured to use single sign-on web authentication, edit the **RptVars.sas** code and change the FILENAME statement to the following: `filename Rptfile sasxbamw "&_MM_TaskDir./ReportVars.pdf" authdomain="_SASMeta_";`

For more information, see "Ad Hoc Reports" on page 226.

Ad Hoc Score Range Report

Name and Description	Enter a name and description if you do not want to use the default values.
Model	**Model 1**

Code	Copy the code from **ScoreRange.sas** in the*<drive>***SMM143Samples\Sample Code** folder in a text editor. In the SAS Editor, paste the code that you copied.
	Add the arguments reportFormat=html and reportStyle=Seaside to the %MM_ExportReportsBegin macro argument list.
	`%MM_ExportReportsBegin(reportFormat=html, reportStyle=Seaside, fileName=ScoreRange);`
	Add the argument reportFormat=html to the %MM_ExportReportsEnd macro argument list.
	`%MM_ExportReportsEnd(reportFormat=html);`

For more information, see "Ad Hoc Reports" on page 226.

User-defined Report

Template	Select **New Template**. Select **Type** ⇨ **Report** ⇨ **SAS Code**.
Code	Select the `ScoreRange.sas` in the `<drive>\SMM143Samples\Sample Code` .

Edit Code	Edit the ScoreRange.sas code to set the input data source. Add the following lines of code after %getModelInfo(0) and before %scoreRange():
	`libname TutLib 'C:\SMM142Tutorials\Data';`
	`%let _MM_InputDS=TutLib.DELINQUENCY_SCORING_INPUT;`

Select **Model 1** when you run the new user-defined report.

For more information, see "User-Defined Reports" on page 228.

Aggregated Reports

SAS Decision Manager administrators and advanced users can combine multiple reports from the **Reports** tab to create a single, aggregated report. The format of the report can be PDF, HTML, or RTF. Aggregated reports are stored on the **Reports** tab.

For more information, see "Create an Aggregated Report" on page 239.

Model Comparison and Summary Reports

You can use the sample data to create several model comparison reports that are used in the selection and approval of a champion model. After you create the reports, you view them on the **Reports** tab.

Note: Enter a name and description if you do not want to use the default values for your reports. You can also select a style for the reports. When the SAS default option is selected, the default style and themes are used in generating the report.

Report Type	Output Type	Models and Options
Delta Report	**HTML**	Model 1 Model 2

Report Type	Output Type	Models and Options
Dynamic Lift Report	**PDF**	Model 1 Model 3 Enter*3* for the control group response rate. Enter*1* for the prior probability. Use the default test table **DELINQUENCY_TEST**.
Model Profile Report	**PDF**	Model 1

For more information, see "Overview of Model Comparison, Validation, and Summary Reports" on page 194.