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Getting Started

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Introduction to SAS Business Rules 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.

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 Business Rules 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 Business Rules 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 Business Rules 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 Business Rules 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.

data management

You can manage your list of data tables from within the application. You can add and remove tables from a SAS library defined in a SAS Metadata server. You can 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, such as for rule discovery and rule flow testing.

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 Business Rules 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 Business Rules Manager displays rules sets as lists of rules with each entry defining conditions and actions for one rule. By using SAS Business Rules 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 Business Rules 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 Business Rules 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.

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**Sign In**

To sign in to SAS Business Rules Manager:

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

   **Note:** Contact your system administrator if you need the URL for SAS Business Rules 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.

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 Business Rules Manager provides the following types of Help and documentation:

**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.

**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 Business Rules Manager windows to view the associated tooltip.
This document provides detailed information about the concepts and tasks that are related to using SAS Business Rules Manager. This document is available at http://support.sas.com/documentation/onlinedoc/brm.

SAS Business Rules Manager: Administrator’s Guide
This document contains information about the administration tasks that are required to set up and configure the SAS Business Rules Manager and is available at http://support.sas.com/documentation/onlinedoc/brm.

Create and Publish Business Rules

To create and publish business rules using SAS Business Rules 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.
Managing Data Tables

About Managing Data Tables

The Data category enables you to manage your list of data tables from within SAS Business Rules 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, such as for importing terms, rule discovery, and rule flow testing.

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 8 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 8.

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 Business Rules Manager: Administrator’s Guide.

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

- SAS Business Rules 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.
Add Registered Tables From Metadata

Note: For information on registering tables in metadata, see “Register Tables” in SAS Business Rules Manager: Administrator’s Guide.

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, you 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.


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.
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 Business Rules 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 Business Rules Manager: Administrator’s Guide*. 

---

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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**.
Managing Business Rule Folders

About Managing Business Rules Folders

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.

You can use the Manage Folders window to create new folders, and rename or delete existing folders. This window is accessible from the Actions menu ( icon) in each category view except the My Tasks, Data, and Decisions 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 Business Rules 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.
In the New Folder window, enter the name of the new folder. Folder names are limited to 100 characters.

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

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.

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 Business Rules 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 ability to rename folders is limited to folder administrators. For more information, see “Enable Business Rules Folder Administration” in SAS Business Rules 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.
PART 2
Defining a Rules Database

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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.

<table>
<thead>
<tr>
<th>Object</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>Vocabularies contain one or more business entities. Vocabularies categorize and structure the entities and terms needed to create a rules database.</td>
</tr>
<tr>
<td>Entity</td>
<td>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.</td>
</tr>
</tbody>
</table>
Object | Description
---|---
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 probably 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 Business Rules 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.
   - To create a new top-level folder, see “Create New Top-Level Folders” on page 15.
   - 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 Business Rules 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 Business Rules 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 25 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 22.

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

3. Select the data source from which you want to import terms. SAS Business Rules 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 25.

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 23 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

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Domain Type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character</td>
<td>Discrete</td>
<td>high risk; low risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;d'oscaill&quot;; &quot;d'fhill&quot;</td>
</tr>
<tr>
<td>Integer</td>
<td>Discrete</td>
<td>0; 800; 3500</td>
</tr>
<tr>
<td></td>
<td>Continuous</td>
<td>&gt;100; &lt;=myterm</td>
</tr>
<tr>
<td>Decimal</td>
<td>Discrete</td>
<td>3.14; 12.98</td>
</tr>
<tr>
<td></td>
<td>Continuous</td>
<td>&gt;1.25; &lt;=N1</td>
</tr>
<tr>
<td>Date</td>
<td>Discrete</td>
<td>01jul2012; 31jul2012</td>
</tr>
<tr>
<td></td>
<td>Continuous</td>
<td>&gt;='01jan2013'd; &lt;='31dec2013'd</td>
</tr>
<tr>
<td>Datetime</td>
<td>Discrete</td>
<td>01jul2012:10:52:00; 31jul2012:23:00:00</td>
</tr>
<tr>
<td></td>
<td>Continuous</td>
<td>&lt;='01jul2012:00:00:00'dt; &gt;='31jul2012:23:00:00'dt</td>
</tr>
<tr>
<td>Boolean</td>
<td></td>
<td>By default, Boolean values are set to True and False and cannot be changed.</td>
</tr>
</tbody>
</table>

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.
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.
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.
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 Business Rules 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 
Duplicate, and select **Duplicate**. SAS Business Rules 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 
Duplicate, 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 
Duplicate, 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 23.

To duplicate multiple terms:

1. Open the vocabulary that contains the terms, and select the check boxes for the terms.
2. Click 
Duplicate, 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 Business Rules 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 
Search for Rule Sets to navigate to the Vocabularies category view, click 
Duplicate, 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 Business Rules 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 Business Rules 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.
Using Lookup Tables and Functions

Using Lookup Tables and Functions

CSV File Imported Into SAS Business Rules Manager

Create a New Lookup Table

Import or Refresh Lookup Table Entries

Delete Lookup Tables

Duplicate Lookup Tables

Move Lookup Tables

Rename a Lookup Table

LOOKUP Function

LOOKUPVALUE Function

Using Lookup Tables and Functions

SAS Business Rules 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 Business Rules Manager. You can re-import updated CSV files as needed to refresh the lookup tables.

Note: SAS Business Rules 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 Business Rules Manager interface. See Step 4 of “Review Application Properties in SAS Management Console” in SAS Business Rules Manager: Administrator’s Guide for more information.
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 Business Rules 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 Business Rules 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 15. To create a new folder inside an existing folder, see “Create New Folders” on page 16.
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” in SAS Business Rules 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 Business Rules 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 Business Rules Manager appends _copy to the name.
To duplicate multiple lookup tables, select the tables, click 

Duplicate.

SAS Business Rules 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 

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 

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.
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:

\[ Cntry\_Key = \text{LOOKUP('Country\_Codes')} \]

If the value of Cntry_Key exists as a lookup key, the LOOKUP function returns the value \text{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.

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:

\[ Cntry\_Key = \text{LOOKUP('Country\_Codes')} \]

If the value of Cntry_Key exists as a lookup key, the LOOKUP function returns the value \text{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.

<table>
<thead>
<tr>
<th>Key</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU</td>
<td>Australia</td>
</tr>
<tr>
<td>BR</td>
<td>Brazil</td>
</tr>
<tr>
<td>CA</td>
<td>Canada</td>
</tr>
<tr>
<td>CR</td>
<td>Costa Rica</td>
</tr>
</tbody>
</table>

**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**

\[ \text{LOOKUPVALUE('lookup\_table\_name', variable)} \]

- **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.
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:

\[ \text{LOOKUPVALUE}('\text{Country\_Codes}', \text{Cntry\_Key}) \]

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.

```plaintext
IF Cntry_Key THEN ASSIGN Country_Name LookupValue('Country\_Codes', Cntry_Key)
```
Managing Rules and Rule Sets

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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 Business Rules Manager:

SAS Business Rules Manager generates the following rule condition:

(Credit_Score > 700) AND (Homeowner = True)

It generates the following assignments:
Action expressions are always assignment statements.

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

\[
\text{IF Credit Score > 700 AND Homeowner = True THEN Approved = True AND Interest Rate = 4.5}
\]

**Create a New Rule Set**

1. Click \( \text{Category} \) 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 15.
   - To create a new folder inside an existing folder, highlight the folder and click \( \text{Add} \). 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 Business Rules 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 37 and “Defining New Rules in a Rule Set” on page 38.

**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 \( \Rightarrow \) 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 41 for more information.

4. (Optional) Move the assignment statement to a different position in the rule set. To move the statement, click \( \uparrow \) or \( \downarrow \).
Click to save the rule set. SAS Business Rules 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 rule**. SAS Business Rules 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 41.

   For examples of rules in the rule set editor, see “About Rules, Rule Sets, and Expressions” on page 36.

   **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 41.

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 41.

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 39 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 39), controls how rules are evaluated within the rule set.
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 50.

**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. See “How Rules Are Evaluated and When Rule-Fired Records Are Generated” on page 40 for more information.

11 Click to save the rule set. SAS Business Rules 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 49 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 Business Rules 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 39 for more information.

If a rule’s condition expression evaluates to True, SAS Business Rules 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 38.
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 41
- “Punctuation for Data Values” on page 43
- “Operators for Use in Expressions” on page 44
- “Using the LIKE Operator” on page 45
- “Using Functions in Expressions” on page 46
- “Working with Missing Values” on page 46
- “Terms and Operators Added by SAS Business Rules Manager” on page 47
- “Leading Plus and Minus Operators” on page 47
- “Examples of Expressions” on page 47
- “LOOKUP Function” on page 32
- “LOOKUPVALUE Function” on page 33

Using the Expression Editors
SAS Business Rules 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 43.)
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.*

![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 Business Rules Manager opens the editor and displays the **Lookup Tables** tab.

2. Double-click on the lookup table name to add it to the expression.
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.

(Optional) Click Validate to check the syntax of the expression.

Click Save.

For more information, see “LOOKUP Function” on page 32 and “LOOKUPVALUE Function” on page 33.

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

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Punctuation Needed</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character</td>
<td>Enclose character strings in either single or double quotation marks.</td>
<td>= 'Gold Account'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= &quot;Ineligible&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= &quot;d'oscail&quot;</td>
</tr>
<tr>
<td>Date</td>
<td>Enter Date values by using the format DDMMY YYYY. Enclose each value in quotation</td>
<td>= '01AUG2015'd</td>
</tr>
<tr>
<td></td>
<td>marks followed by \texttt{d}.</td>
<td>&gt;='31AUG2015'd</td>
</tr>
<tr>
<td>Datetime</td>
<td>Enter Datetime values by using the format DDMM YYYY:HH:MM:SS. Use 24-hour clock</td>
<td>= '01AUG2015:15:00:00'</td>
</tr>
<tr>
<td></td>
<td>notation. Enclose each value in quotation marks followed by \texttt{dt}.</td>
<td>&lt;='31AUG2015:15:00:00'</td>
</tr>
<tr>
<td>Boolean</td>
<td>Boolean values are not enclosed in quotation marks. Enter only \texttt{True} or</td>
<td>=True</td>
</tr>
<tr>
<td></td>
<td>\texttt{False}.</td>
<td>=False</td>
</tr>
</tbody>
</table>

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 $\leq$, $\geq$, or $\neq$. Some mnemonic equivalents for these operators cannot be used in SAS Business Rules Manager expressions. See "Operators in Expressions" in \textit{SAS DS2 Programmer’s Guide} for more information about the operators shown in the table.

Table 6.2  Operators

<table>
<thead>
<tr>
<th>Operator</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\times$</td>
<td>Multiply</td>
<td>$0.085 \times \text{sales}$</td>
</tr>
<tr>
<td>$\div$</td>
<td>Divide</td>
<td>$\text{amount} / 5$</td>
</tr>
<tr>
<td>+</td>
<td>Add</td>
<td>$\text{num} + 3$</td>
</tr>
<tr>
<td>-</td>
<td>Subtract</td>
<td>$\text{sale} - \text{discount}$</td>
</tr>
<tr>
<td>=</td>
<td>Equal to</td>
<td>$= \text{maxTriesAllowed}$</td>
</tr>
<tr>
<td>$+\text{value}$</td>
<td>Leading plus’</td>
<td>$+60$</td>
</tr>
<tr>
<td>$\neq$</td>
<td>Not equal to</td>
<td>$\text{insufficientFunds} \neq \text{True}$</td>
</tr>
<tr>
<td>$&gt;$</td>
<td>Greater than</td>
<td>$\text{daysLate} &gt; 5$</td>
</tr>
<tr>
<td>$&lt;$</td>
<td>Less than</td>
<td>$\text{num} &lt; 8$</td>
</tr>
<tr>
<td>$\geq$</td>
<td>Greater than or equal to</td>
<td>$\text{balance} \geq 1000$</td>
</tr>
<tr>
<td>Operator</td>
<td>Definition</td>
<td>Example</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal to</td>
<td>balance &lt;= 250</td>
</tr>
<tr>
<td>IN (value-list)</td>
<td>Equal to an item in value-list</td>
<td>in ('high', 'medium', 'low')</td>
</tr>
<tr>
<td>NOT IN (value-list)</td>
<td>Not equal to an item in value-list</td>
<td>not in (10, 20, 30)</td>
</tr>
<tr>
<td>LIKE 'pattern-matching-expression'</td>
<td>If the term’s value matches pattern-matching-expression, the result is true.</td>
<td>like 'HS%PP'</td>
</tr>
<tr>
<td>LIKE (‘pattern-matching-expression’, ‘pattern-matching-expression’)</td>
<td></td>
<td>like ('_976%', '_223%')</td>
</tr>
<tr>
<td>expression AND expression</td>
<td>If both expressions are true, the result is true.</td>
<td>dateExpired &gt;= '01AUG2015'd AND dateExpired &lt;= '31AUG2015'd</td>
</tr>
<tr>
<td>expression OR expression</td>
<td>If either expression is true, the result is true.</td>
<td>dateEnrolled &gt;= '01JAN2015' OR member = True</td>
</tr>
</tbody>
</table>

* 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 69 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**

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>underscore (_)</td>
<td>Matches any single character</td>
</tr>
<tr>
<td>percent sign (%)</td>
<td>Matches any sequence of zero or more characters</td>
</tr>
<tr>
<td><em>Note:</em> Be aware of the effect of trailing blanks. To match values, you might have to use the TRIM function to remove trailing blanks.</td>
<td></td>
</tr>
<tr>
<td>any other character</td>
<td>Matches that character</td>
</tr>
</tbody>
</table>

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 23.) 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>
<thead>
<tr>
<th>LIKE Expression Example</th>
<th>Matching Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>like 'Sm%'</td>
<td>Smith, Smooth, Smathers, Smart, Smuggle</td>
</tr>
<tr>
<td>like '%th'</td>
<td>Smith, Smooth</td>
</tr>
<tr>
<td>like 'S__gg%'</td>
<td>Smuggle</td>
</tr>
<tr>
<td>like 'S_o'</td>
<td>(no matches)</td>
</tr>
<tr>
<td>like 'S_o%'</td>
<td>Smooth, Smathers</td>
</tr>
<tr>
<td>like 'S%th'</td>
<td>Smith, Smooth</td>
</tr>
</tbody>
</table>

Using Functions in Expressions

SAS Business Rules 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 Business Rules Manager

As you enter expressions into each cell, SAS Business Rules 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 Business Rules 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 case SAS Business Rules 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 Business Rules 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 Business Rules 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

<table>
<thead>
<tr>
<th>Expression as Entered into the Decision Table for Term X</th>
<th>Resulting Expression</th>
<th>Valid as a Condition Expression</th>
<th>Valid as an Action Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>x=5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>=5</td>
<td>x=5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>+10</td>
<td>x=x+10</td>
<td>No</td>
<td>See Note 7.</td>
</tr>
<tr>
<td>-10</td>
<td>x=-10</td>
<td>Yes</td>
<td>See Note 7.</td>
</tr>
<tr>
<td>&quot;mystring&quot;</td>
<td>x=&quot;mystring&quot;</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>=term1</td>
<td>x=term1</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Expression as Entered into the Decision Table for Term X</td>
<td>Resulting Expression</td>
<td>Valid as a Condition Expression</td>
<td>Valid as an Action Expression</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>----------------------</td>
<td>---------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>5 or &gt;100</td>
<td>x=5 or x&gt;100</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>^=5 and x&lt;10</td>
<td>x ^=5 and x&lt;10</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>^=5 or &gt;=(100/4)</td>
<td>x ^=5 or x&gt;=(100/4)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>in (10,20,30)</td>
<td>x IN (10,20,30)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>not in ('med','high')</td>
<td>x NOT IN ('MED','HIGH')</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>rate in ('med','high')</td>
<td>x = rate in ('med','high')</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>like ('M77__LL%','MA89_LL%')</td>
<td>x LIKE ('M77__LL%','MA89_LL%')</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&lt;'10JUN2012'd</td>
<td>x&lt;'10JUN2015'd</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&gt;'10JUN2012:17:00:00'dt</td>
<td>x&gt;'10JUN2015:17:00:00'dt</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>=ABS(-10)</td>
<td>x=ABS(-10)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>=True</td>
<td>x=True</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>False</td>
<td>x=False</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>&amp;myMacroVar</td>
<td>x=&amp;myMacroVar</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>%EVAL(&amp;myMacroVar)</td>
<td>x=%EVAL(&amp;myMacroVar)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>term1=5</td>
<td>x=term1=5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>term1=3 or term2=5</td>
<td>x=term1=3 or term2=5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5 or (x&gt;10 and &lt;20)</td>
<td>This expression is invalid as both a condition expression and as an action expression. SAS Business Rules Manager does not add column names after nested AND or OR operators.</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Expression as Entered into the Decision Table for Term X</td>
<td>Resulting Expression</td>
<td>Valid as a Condition Expression</td>
<td>Valid as an Action Expression</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>----------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>&gt;&quot;mystring&quot;</td>
<td>This expression is invalid as both a condition expression and as an action expression. SAS Business Rules Manager checks whether literal types are compatible with the specified operators. Character strings are not compatible with numeric operators.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>=4.6927e-101</td>
<td>x=4.6927e-101</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Notes:**

1. Action expressions must be assignment expressions only.
2. SAS Business Rules 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 Business Rules 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 47 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 Business Rules Manager checks whether the syntax in the expressions is valid, and if so, saves the rule set.
SAS Business Rules 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 Business Rules 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 Business Rules 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 Business Rules 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 ``, 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 Business Rules 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 Business Rules 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 “Managing Vocabularies” on page 21.
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 Business Rules 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 Business Rules 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 Business Rules 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 Business Rules 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.
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 Business Rules 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.

   ![Comments Form]

   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 Business Rules 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 delete.

Validate and Save a Rule Set

To save changes to a rule set, click . SAS Business Rules Manager validates the syntax of the expressions and displays an error message if it finds any problems. If SAS Business Rules 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 49 for more information.
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<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
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<td>58</td>
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<tr>
<td>Simple Rule Flows, Complex Rule Flows, and BY Groups</td>
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<td>64</td>
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<td>64</td>
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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 58 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 Business Rules Manager sorts the input data by those terms.

If you specify BY-group terms, SAS Business Rules 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 71 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 15.
   - 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 Business Rules 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 Business Rules 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 58.

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 OK, and then click OK. SAS Business Rules 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 Business Rules 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 Business Rules Manager automatically locks the rule set version. For more information, see “Managing Versions of a Rule Flow” on page 64.

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 ‹ up or › down 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 MONTHw. and WEEKDAYw. 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 Business Rules 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 MONTHw. and WEEKDAYw. 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.
To create a rule flow by using the Discover New Rule Flow wizard, complete these steps:

1. Click \(\text{�}\) to navigate to the Rule Flows category view, click \(\text{�}\), 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 (lbrace), right brace (rbrace), 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 Business Rules 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= System Option” 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>
<thead>
<tr>
<th>Table 7.1</th>
<th>Setup Options and Terms for Discovery Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discovery Technique</strong></td>
<td><strong>Setup Variables</strong></td>
</tr>
<tr>
<td>Decision Tree</td>
<td><strong>Maximum number of rules:</strong> Select the maximum number of rules that you want to be generated by the discovery analysis.</td>
</tr>
</tbody>
</table>
### Discovery Technique

<table>
<thead>
<tr>
<th>Setup Variables</th>
<th>Action Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scorecard</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Minimum points</strong>: The scorecard points are</td>
<td><strong>Target variable</strong>: specifies the variable that you</td>
</tr>
<tr>
<td>scaled with this option as the minimum value.</td>
<td>are modeling. The variable must have exactly</td>
</tr>
<tr>
<td>You can specify any nonnegative integer.</td>
<td>two discrete values such as 0 and 1 or <strong>True</strong> and <strong>False</strong>.</td>
</tr>
<tr>
<td><strong>Maximum points</strong>: The scorecard points are</td>
<td><strong>Target category</strong>: specifies how the values of</td>
</tr>
<tr>
<td>scaled with this option as the maximum value.</td>
<td>the target variable are mapped. The scorecard</td>
</tr>
<tr>
<td>You can specify any positive integer that is</td>
<td>points are scaled to the likelihood of the two</td>
</tr>
<tr>
<td>greater than the <strong>Minimum points</strong> value.</td>
<td>target variable values based on the sort order. Select</td>
</tr>
<tr>
<td></td>
<td><strong>High</strong> to indicate that the highest lexical value of the</td>
</tr>
<tr>
<td></td>
<td>target variable is mapped to the <strong>Maximum points</strong> value.</td>
</tr>
</tbody>
</table>

| Recency Frequency Monetary |                                                               |
|----------------------------|                                                               |
| Select the binning method. |                                                               |
| **Independent**: Simple   | **Customer ID**: specifies a numeric or character              |
| ranks are assigned to     | term that uniquely identifies a customer.                      |
| recency, frequency, and    | **Transaction date**: specifies the transaction                |
| monetary values. The      | date.                                                          |
| three ranks are assigned   | **Transaction amount**: specifies the transaction               |
| independently.            | amount.                                                       |
| **Nested**: A simple rank |                                                               |
| is assigned to recency    |                                                               |
| values. Within each recency|                                                               |
| rank, customers are       |                                                               |
| assigned a frequency rank. |                                                               |
| Within each frequency rank,|                                                               |
| customer are assigned a   |                                                               |
| monetary rank.            |                                                               |

<table>
<thead>
<tr>
<th>Market Baskets</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum number of rules</strong>: Select the maximum number</td>
<td><strong>ID</strong>: specifies the customer ID.</td>
</tr>
<tr>
<td>of rules that you want to be generated from the</td>
<td></td>
</tr>
<tr>
<td>discovery analysis.</td>
<td></td>
</tr>
<tr>
<td><strong>Item</strong>: specifies the item that was purchased.</td>
<td></td>
</tr>
<tr>
<td>Each value for the item must comply with the rules</td>
<td></td>
</tr>
<tr>
<td>for valid names according to the VALIDVARNAME=V7</td>
<td></td>
</tr>
<tr>
<td>system option.</td>
<td></td>
</tr>
</tbody>
</table>

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 Business Rules 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 Business Rules 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 Business Rules 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 Business Rules Manager automatically locks any unlocked rule sets. See “Create a Rule Flow Using the Rule Flow Editor” on page 58 for 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 Business Rules 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 Business Rules 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 Business Rules 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

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 Business Rules Manager reports rule flow results and test data such as rule-fired data. SAS Business Rules Manager saves the test results from the last time a test was run.

Input Data for Rule Flow Tests

SAS Business Rules 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 7 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.


4. Enter a name for the new test. Test names are limited to 30 characters.

5. (Optional) Enter a description for the test.
Select the data source that contains the input data for the test, and click Save.

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 Business Rules 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.

(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 68 for more information.

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.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Gray circle]</td>
<td>The test is not ready to run. The test definition is not complete, or it might contain errors.</td>
</tr>
<tr>
<td>![Green circle]</td>
<td>The test is defined correctly and is ready to run.</td>
</tr>
<tr>
<td>![Green plus]</td>
<td>The test is running.</td>
</tr>
<tr>
<td>![Green checkmark]</td>
<td>The test completed successfully.</td>
</tr>
<tr>
<td>![Yellow exclamation]</td>
<td>The test completed, but warnings were issued in the SAS log.</td>
</tr>
<tr>
<td>![Red x]</td>
<td>The test did not run successfully. View the SAS log for information.</td>
</tr>
</tbody>
</table>

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 Business Rules Manager, and the SAS log that was generated by the test in addition to other information. See “View Rule Flow Test Results” on page 68 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 Business Rules Manager generates DS1 code for the rule flow test. See “Generating DATA Step Code for a Rule Flow” on page 69 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 70 for more information.

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 Statement” 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 Business Rules 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 71.

Code
displays the code that was generated and run by SAS Business Rules 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 Business Rules 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 Business Rules 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 Business Rules 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 Business Rules 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 calling 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 Business Rules Manager writes a note in the SAS log that states which version was selected.

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 64.

**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 Business Rules 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 ![warning] . You cannot publish a rule flow if it contains changes that have not been saved.

3 Click ![publish] 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 Business Rules 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 Business Rules 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 Business Rules 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 ![folder].

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 Business Rules 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 ![warning] . You cannot deploy a rule flow if it contains changes that have not been saved.

3 Click ![create_process] 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 Business Rules 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 ![folder].

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: User’s Guide.

The following image shows a diagram for a simple rule flow with one rule set.
Using SAS Workflow with SAS Business Rules Manager

Chapter 8
Starting a Workflow and Working with Tasks .............................................. 77

Chapter 9
Managing Workflows .................................................................................. 83
Overview of Using Workflows

SAS Business Rules 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 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 Business Rules 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 Business Rules Manager: Administrator’s Guide

Start a New Workflow

When you start a new workflow, it is associated with the selected version of a 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 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 (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 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.
Note: A rule flow task must be approved before a workflow can be completed. Select Approved in the Complete Workflow Tasks window.

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 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 88.

View Task Details

Click the task name. The Task window appears. Here you can view general task information, the workflow diagram, and the participants.
<table>
<thead>
<tr>
<th>General</th>
<th>Workflow Diagram</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task:</td>
<td>Approve version</td>
<td></td>
</tr>
<tr>
<td>Workflow:</td>
<td>Score_Loan 05-21-2019</td>
<td></td>
</tr>
<tr>
<td>Date started:</td>
<td>Jun 10, 2019 02:38 PM</td>
<td></td>
</tr>
<tr>
<td>Claimed by:</td>
<td>sasdemo</td>
<td></td>
</tr>
<tr>
<td>Associated object:</td>
<td>Score_Loan (Current)</td>
<td></td>
</tr>
<tr>
<td>Object type:</td>
<td>Business Ruleflow</td>
<td></td>
</tr>
<tr>
<td>Possible actions:</td>
<td>Approve</td>
<td></td>
</tr>
</tbody>
</table>

Close
Managing Workflows

Overview of Managing Workflows

SAS Business Rules 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 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 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 86.

Set Mappings

There are two different types of workflow templates that can be configured for use with SAS Business Rules 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 \( \cdot \) and select **Set Mappings**. The Set Mappings window appears.
2 Select the Rule Flows tab.

3 Select an object and then select one or more templates to map to the object.

4 Select a type for each template. The types of templates that are available are Approval and Standard.

5 Select the default template for the object from the drop-down menu.

6 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 a 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.

![Add Participant Window]

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 Remove. 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 **Edit** 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.
3. To save the changes to the properties, click **Save**.
   
   If you do not want to save the changes to the properties, click **Cancel**.

   **CAUTION!** Clicking **Reset** clears all property values in the Properties pane. If you click **Reset**, all of the property values are cleared. To restore the property values, click **Save**; 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 **View** 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.