SAS® Text Miner 14.1 Reference Help

SAS® Documentation

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SAS® Text Miner 14.1: Reference Help

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Contents

Chapter 1

Introduction to SAS Text Miner and Text Mining

What's New in SAS Text Miner 14.1

SAS Text Miner 14.1 includes the following new features and enhancements:

- A new HPBOOLRULE procedure replaces macros in the **Text Rule Builder** node. For more information about the benefits of running the **Text Rule Builder** node with the HPBOOLRULE procedure and how you can specify to run the **Text Rule Builder** node as it functioned prior to SAS Text Miner 14.1, see "Overview of the HPBOOLRULE Procedure in the Text Rule Builder Node" on page 103.

- Enhancements to the HPTMINE procedure enable you to select or ignore parts of speech, attributes, and entities, as well as to build a search index.

- The **HP Text Miner** node now uses PROC HPTMINE to perform topic rotation and to create the topic table.

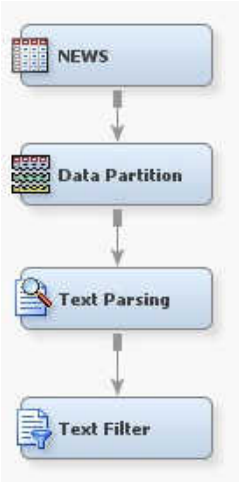
- Eleven parsing languages have been added to the **Language** property in the **HP Text Miner** node. The complete list of parsing languages includes: Chinese, Dutch, English, Finnish, French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, and Turkish.

- The new macro variable EM_TERM_LOC enables users to specify a location for SAS Text Miner nodes to write output data sets. These data sets are needed as input to SAS Text Miner score code. When this macro variable is set, it is recognized by the **Text Filter**, **Text Topic**, **Text Cluster**, **Text Profile**, and **Text Rule Builder** nodes as an output location. The score code generated by these nodes will use the data sets saved in the specified location as input. For more information about using the EM_TERM_LOC macro variable, see "Using Macro Variables to Store Prebuilt Scoring Data in Tables Instead of Prescore Code" on page 136. For an example that demonstrates how to create a stored process using the EM_TERM_LOC macro variable, see "Creating a Stored Process" on page 167.

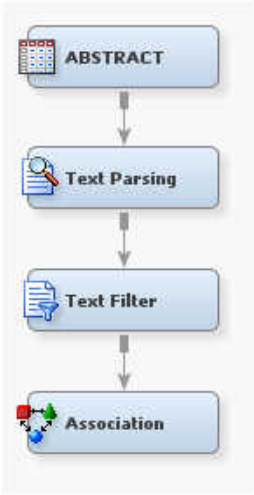
  Note: A SAS Text Miner license is still required to score with a SAS Text Miner model even with this new macro setting.

- The TGPARSE procedure has been replaced with the HPTMINE procedure in the **Text Parsing** node when the parsing language is Chinese, Dutch, English, Finnish, French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, or Turkish. For these languages, parsing is now multithreaded. The TGPARSE procedure will continue to be called when the parsing language is Arabic, Czech, Danish, Greek, Hebrew, Hungarian, Indonesian, Norwegian, Polish, Romanian, Slovak, Swedish, Thai, or Vietnamese.

- An **_item_** variable with term | role information has been added to the transaction output that is exported from the **Text Topic** node and the **Text Filter** node. This variable is added to the transaction tables **valid_trans** and **test_trans** when a **Data Partition** node is used in a process flow diagram, such as in the following:



  One benefit of having term | role information exported in the transaction table is that the **Association** node will show this information in the rules that it generates if used in a process flow diagram, such as in the following:



For more information, see http://support.sas.com/software/products/txtminer.

Replacing the Original Text Miner Node

The functionality that was available in the original **Text Miner** node has been moved to other nodes that are available with SAS Text Miner. This restructuring of functionality conforms more to the overall philosophy of SAS Enterprise Miner components. It also improves performance because you can make changes in nodes that follow the **Text Parsing** node without having to reparse the collection. The following table might be helpful to you in replacing the functionality that you are using in the original **Text Miner** node with the new nodes.

Controls and Functionality in the Original Text Miner Node	Replacement in New SAS Text Miner Nodes
Parsing	**Text Parsing** node
Term weightings	**Text Filter** node
Concept Linking Diagram	**Text Filter** node. The concept linking diagram is available in the Interactive Filter Viewer.
Creating and removing synonyms interactively	**Text Filter** node
Dynamically keeping and dropping terms	**Text Filter** node
Subsetting data for reclustering	**Text Filter** node
Clustering (Expectation Minimization and Hierarchical)	**Text Cluster** node
Generation of SVD values	**Text Cluster** node. Use this node output as input to your predictive models, for example.

Controls and Functionality in the Original Text Miner Node	Replacement in New SAS Text Miner Nodes
Roll-up Terms	**Text Topic** node. Set the number of single term topics to the number of Roll-up Terms that you desire.

Accessibility Features of SAS Text Miner 14.1

Overview of Accessibility Features

SAS Text Miner 14.1 includes accessibility and compatibility features that improve the usability of the product for users with disabilities, with exceptions noted below. These features are related to accessibility standards for electronic information technology that were adopted by the U.S. Government under Section 508 of the U.S. Rehabilitation Act of 1973, as amended. SAS Text Miner 14.1 conforms to accessibility standards for the Windows platform.

For specific information about Windows accessibility features, refer to your operating system's help. If you have questions or concerns about the accessibility of SAS products, send email to accessibility@sas.com.

For information about the accessibility features of SAS Enterprise Miner 14.1, see the Accessibility topic in the SAS Enterprise Miner 14.1 Help.

- "Additional Keyboard Controls for SAS Text Miner" on page 4
- "Exceptions to Accessibility Standards" on page 5

Additional Keyboard Controls for SAS Text Miner

In addition to standard keyboard controls, SAS Text Miner supports the following additional keyboard controls.

Table 1.1 *Keyboard Controls for Tables*

Keyboard Shortcut	Action
Shift + Page Up	selects all rows in the table from the first row that is visible in the scroll pane to the selected row
Shift + Page Down	selects all rows in the table from the selected row to the last row that is visible in the scroll pane
Ctrl + Shift + End	selects all rows in the table from the selected row to the last row
Ctrl + Shift + Home	selects all rows in the table from the first row to the selected row

Table 1.2 *Other Keyboard Controls*

Keyboard Shortcut	Action
F6	selects the Properties panel
Tab	navigates the Properties panel
F2+Spacebar	simulates the click action for ellipsis in the Properties panel
Ctrl + Shift + n	select a node in a process flow diagram
Ctrl + Shift + c	connect selected nodes in a process flow diagram

Exceptions to Accessibility Standards

Exceptions to the accessibility standards described in Section 508 of the U.S. Rehabilitation Act of 1973 include the following:

- On-screen indication of the current focus is not well-defined in some dialog boxes, in some menus, and in tables.
- High-contrast color schemes are not universally inherited.
- Many controls are not read by JAWS, and the accessible properties of many controls are not surfaced to the Java Accessibility API.

About SAS Text Miner

SAS Text Miner provides tools that enable you to extract information from a collection of text documents and uncover the themes and concepts that are revealed therein. In addition, because you can embed SAS Text Miner nodes in a SAS Enterprise Miner process flow diagram, you can combine quantitative variables with unstructured text in the mining process. This means that you are incorporating text mining with other traditional data mining techniques.

These languages are supported in SAS Text Miner: Arabic, Chinese (simplified and traditional), Czech, Danish, Dutch, English, Finnish, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Romanian, Russian, Slovak, Spanish, Swedish, Thai, Turkish, and Vietnamese. Each language must be licensed individually.

Note: Collections of text in some unsupported languages can still be processed in SAS Text Miner by choosing a supported language that uses the same or similar text encoding as the unsupported language.

SAS Text Miner includes the following SAS Enterprise Miner nodes:

- **Text Import Node** — enables you to create data sets that contain links to documents obtained with file crawl, web crawl, or web search. For more information, see "Overview of the Text Import Node" on page 13.

- **Text Parsing Node** — enables you to parse a document collection in order to quantify information about the terms that are contained therein. For more information, see "Overview of the Text Parsing Node" on page 22.
- **Text Filter Node** — enables you to reduce the total number of parsed terms or documents that are analyzed. For more information, see "Overview of the Text Filter Node" on page 44.
- **Text Topic Node** — enables you explore the document collection by clustering documents and summarizing the collection into a set of "topics." For more information, see "Overview of the Text Topic Node" on page 115.
- **Text Cluster Node** — enables you to cluster documents from the term-document frequency matrix that is created by the **Text Parsing** node and possibly refined by the **Text Filter** node. For more information, see "Overview of the Text Cluster Node" on page 65.
- **Text Rule Builder Node** — enables you to generate rules that are useful in describing and predicting a target variable. For more information, see "Overview of the Text Rule Builder Node" on page 95.
- **Text Profile Node** — enables you see how terms change over time. For more information, see "Overview of the Text Profile Node" on page 83.

You can use SMP mode in SAS 9.4 on a properly enabled SAS Server to deploy the **HP Text Miner** node in a process flow diagram, and use the HPTMINE procedure and the HPTMSCORE procedure. Using the **HP Text Miner** node in a process flow diagram can lead to multithreaded processing gains in many cases. For more information about the **HP Text Miner** node, see the HP Text Miner Node help page in the HPDM nodes help folder, or the HP Text Miner Node chapter of the *SAS Enterprise Miner High-Performance Data Mining Node Reference*.

In SAS Text Miner, the text mining process consists generally of the steps that are listed in the following table.

Step	Action	Description	Tools
1	File Preprocessing	Create a SAS data set from a document collection that is used as input for the **Text Parsing** node.	**Text Import** node, %TMFILTER macro, or SAS DATA step.

Step	Action	Description	Tools
2	Text Parsing	Decompose textual data, and generate a quantitative representation that is suitable for data mining purposes. Parsing might include the following: • stemming • automatic recognition of multi-word terms • normalization of various entities such as dates, currency, percent, and year • part-of-speech tagging • extraction of entities such as organization names, product names, and addresses • support for synonyms • language-specific analyses	**Text Parsing** node
3	Text Filtering	Transform the quantitative representation into a compact and informative format; reduce dimensions.	**Text Filter** node
4	Document Analysis	Cluster, classify, predict, or link concepts.	**Text Topic** node, **Text Cluster** node, **Text Rule Builder** node, **Text Profile** node, and SAS Enterprise Miner predictive modeling nodes

TIP A number of data sets are provided that might be useful for learning how to use SAS Text Miner.

For more information about each action and sample data sets, see the following.

- "File Preprocessing" on page 8
- "Text Parsing" on page 8

- "Text Filtering" on page 9
- "Document Analysis" on page 9
- "SAS Text Miner Sample Data Sets" on page 10

Note: SAS Text Miner 14.1 is not included with the base version of SAS Enterprise Miner 14.1. If your site has not licensed SAS Text Miner 14.1, then the SAS Text Miner nodes will not appear in your SAS Enterprise Miner 14.1 software.

File Preprocessing

The **Text Parsing** node requires an Input Data Source node to precede it in a process flow diagram. Input data for the **Text Parsing** node must be imported into a data source. Furthermore, because the **Text Parsing** node expects input data in a particular format, in most cases you will need to preprocess data before you can import it into a data source.

The **Text Import** node and the SAS %TMFILTER macro can be used to preprocess data.

The **Text Import** node can be used to extract text from many document formats or to retrieve text from websites by crawling the web.

The SAS **%TMFILTER** macro can be used in file preprocessing to extract text from many document formats. You can use this macro to create a SAS data set that can be used to create a data source to use as input for the **Text Parsing** node. The SAS **%TMFILTER** macro does not extract data from individual XML fields. However, you can still accomplish this task. The XML LIBNAME engine and the XML mapper in Base SAS enable you to read an XML file into a SAS data set where the fields of the XML document are the data set variables. This data set can then be used in SAS Text Miner for further preprocessing.

Documents are represented internally in SAS Text Miner by a vector that contains the frequency of how many times each term occurs in each document. This approach is very effective for short, paragraph-sized documents but can cause a harmful loss of information with longer documents. Consider preprocessing long documents in order to isolate content that is really of use in the model that you intend to build. For example, if you are analyzing journal papers, you might find that analyzing only the abstracts gives the best results.

For more information about the **Text Import** node, the **%TMFILTER** macro, or the **Text Parsing** node, see the following:

- "Overview of the Text Import Node" on page 13
- "%TMFILTER Macro" on page 143
- "Overview of the Text Parsing Node" on page 22

Text Parsing

In SAS Text Miner, text parsing is done with the **Text Parsing** node. Advanced techniques enable you to break documents into terms such as words, phrases, multi-word terms, entities, punctuation marks, and terms that are in foreign languages.

- You can process multi-word groups (for example, "off the shelf" or "because of") as single terms.

- You can identify each term's part of speech, based on its context.
- You can extract entities such as addresses, dates, phone numbers, and company names.
- You can choose to ignore all terms that are a particular part of speech.
- You can use a stop list to ignore a specific set of terms, such as a group of low-information words. Conversely, you can use a start list to restrict parsing to only a specific set of terms.
- You can return the root forms (called stems) of terms and treat all terms that have the same stem as equivalent. For example, “grinds”, “grinding”, and “ground” could all be viewed as the term “grind”.
- You can specify synonyms (such as “teach”, “instruct”, “educate”, “train”), and treat them as equivalent.

For more information about the **Text Parsing** node, see the following:

- “Overview of the Text Parsing Node” on page 22

Text Filtering

In SAS Text Miner, text filtering is done with the **Text Filter** node.

- You can explore a parsed document collection with the **Interactive Filter Viewer** of the **Text Filter** node. For more information about the **Interactive Filter Viewer**, see “Interactive Filter Viewer” on page 60.
- You can subset collections of documents based on the attributes of a document or the content of the document.
- You can interactively adjust the stop list and synonyms to focus on the aspects of the collection that are of interest to you.
- For more information about the **Text Filter** node, see “Overview of the Text Filter Node” on page 44.

Document Analysis

Exploration

SAS Text Miner offers visualization diagrams, topic creation, and clustering techniques that enable you to explore a parsed document collection. Applications include content discovery of large knowledge bases such as those that contain email, customer comments, abstracts, or survey data; unsupervised learning of categories; and taxonomy creation.

- You can generate data-driven topics and supply topics that you have defined in the **Text Topic** node for use in scoring new data.
- You can perform hierarchical clustering in the **Text Cluster** node. The node uses a Ward's minimum-variance method to generate hierarchical clusters, and results are presented in a tree diagram.

- You can perform expectation-maximization (EM) clustering in the **Text Cluster** node. EM clustering identifies primary clusters, which are the densest regions of data points, and secondary clusters, which are less dense groups of data points not included in the primary clusters. This is a spatial clustering technique that allows flexibility in the size and shape of clusters.
- You can use other SAS Enterprise Miner nodes for clustering, such as the Clustering and SOM/Kohonen nodes. For more information about these nodes, see the SAS Enterprise Miner Help.

Prediction

You can use SAS Enterprise Miner modeling capabilities to predict target variables, with applications that include the following:

- automatic email routing
- filtering spam
- matching resumes with open positions
- predicting the change in a stock price from contents of news announcements about companies
- predicting the cost of a service call based on the textual description of the problem
- predicting customer satisfaction from customer comments
- identifying authorship from a predetermined set of candidate authors

The **Text Rule Builder** node can be used for prediction.

See the SAS Enterprise Miner Help for information about how to use modeling nodes for target variable prediction.

SAS Text Miner Sample Data Sets

Sample Data

The following sample data sets are provided in the SAMPSIO library for use with SAS Text Miner 14.1.

Table 1.3 *Sample Data Sets*

Data Set	Description	Used In
Abstract	document collection of abstracts of conference papers	**Input Data** node

Data Set	Description	Used In
Afinn_sentiment	This data set is adapted from the AFINN sentiment publicly available English sentiment lexicon. It contains two topics, “Positive Tone” and “Negative Tone,” that can be used as User Topics in the **Text Topic** node. The Afinn_sentiment data set contains information from the AFINN sentiment database, which is made available under the Open Database License.	**Text Topic** node
News	document collection of brief news articles	Input Data node
Tm_abstract_topic	user-defined topics	**Text Topic** node

Default Data Sets

The following data sets are used in the SAS Text Miner 14.1 nodes as default inputs for node properties (for example, stop lists or multi-term lists). They are all in the SASHELP library.

Table 1.4 *Default Data Sets*

Data Set	Description	Used In
<language>_multi	(where <language> is: Eng, Frnch, Germ, Ital, Port, or Span) multi-term lists for various languages	**Text Parsing** node
<language>stop	(where <language> is: Eng, Frch, or Grmn) stop lists for various languages	**Text Parsing** node
Engsynms	synonym list for the English language	**Text Parsing** node

Chapter 2

The Text Import Node

Overview of the Text Import Node

The **Text Import** node serves as a replacement for an Input Data node by enabling you to create data sets dynamically from files that are contained in a directory or from the web. The **Text Import** node takes an import directory that contains text files in potentially proprietary formats such as MS Word and PDF files as input. The tool traverses this directory and filters or extracts the text from the files, places a copy of the text in a plain text file, and a snippet (or possibly even all) of the text in a SAS data set. If a URL is specified, the node will crawl websites and retrieve files from the web and move them to the import directory before doing this filtering process. The output of a **Text Import** node is a data set that can be imported into the **Text Parsing** node.

In addition to filtering the text, the **Text Import** node can also identify the language that the document is in and take care of transcoding documents to the session encoding. For

more on encoding and transcoding, see "SAS Text Miner and SAS Session Encoding" on page 180.

The **Text Import** node relies on the SAS Document Conversion server to extract plain text from various file formats so that the text can be analyzed by SAS Text Miner. The machine must be accessible from the SAS Enterprise Miner server via the host name and port number that were specified at install time.

Note:

- If you run the **Text Import** node in a UTF-8 SAS session, then the node attempts to transcode all filtered text to UTF-8 encoding so that the result data set can be used in a UTF-8 SAS session. In all other SAS session encodings, the **Text Import** node does not transcode the data. Instead, it assumes that the input data is in the same encoding as the SAS session. For more information, see "SAS Text Miner and SAS Session Encoding" on page 180.
- The **Text Import** node is not supported for use in group processing (Start Groups and End Groups nodes).

Text Import Node Input Data

The **Text Import** node does not require a predecessor node in a process flow diagram.

Text Import Node Properties

Contents

Text Import Node General Properties

These are the general properties that are available on the **Text Import** node:

- **Node ID** — displays the ID that is assigned to the node. Node IDs are especially useful for distinguishing between two or more nodes of the same type in a process

flow diagram. For example, the first **Text Import** node that is added to a diagram will have the Node ID **`TextImport`**, and the second Text Import node that is added will have the Node ID **`TextImport2`**.

- **Imported Data** — accesses a list of the data sets that are imported by the node and the ports that provide them. Click the ellipsis button to open the Imported Data window, which displays this list. If data exists for an imported data set, then you can select a row in the list and do any of the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set
- **Exported Data** — accesses a list of the data sets exported by the node and the ports to which they are provided. Click the ellipsis button to open the Exported Data window, which displays this list. If data exists for an exported data set, then you can select a row in the list and do any of the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set
- **Notes** — accesses a window that you can use to store notes of interest, such as data or configuration information. Click the ellipsis button to open the Notes window.

Text Import Node Train Properties

General Train Properties

These are the training properties that are available on the **Text Import** node:

- **Import File Directory** — specifies the path to the directory that contains files to be processed. Click the ellipsis for this property to select a directory accessible by the server for import.
- **Destination Directory** — specifies the path to the directory that will contain plain text files after processing. Click the ellipsis for this property to specify a destination directory that is accessible by the server.
- **Language** — Specifies the possible choices that the language identifier might choose from when assigning a language to each document. Click the ellipsis for this property to open the Language dialog box to specify one or more languages. Only languages that are licensed can be used.
- **Extensions** — restricts the **Text Import** node to filtering only files that satisfy the provided file type. All file types that the SAS Document Converter supports are filtered when the setting is not specified. See SAS Document Conversion for more information.
- **Text Size** — specifies the number of characters to use in the TEXT variable of the output data set. This variable can serve as a snippet when the size is small, or you can set the value to as large as 32000, so that as much text as possible is placed in the data set.
- "Web Crawl Properties" on page 16

Note: A user can potentially view the contents of the Import File and Destination directories from the Interactive Filter Viewer of the **Text Filter** node. If, however, the directories are not accessible from the client, such as with a UNIX server and a Windows client, the documents will not be viewable from the client. In order to use this feature in this case, the files would need to be moved to an accessible directory and the path updated in the data set.

Web Crawl Properties

- **URL** — specifies the URL of an initial web page to crawl.
- **Depth** — specifies the number of recursive levels of the URL to crawl. A depth of 1 means return all the files that are linked to from the initial page. A depth of 2 means return the files from a depth of 1 and also all the files that are linked to from that set, and so on. The number of files that are retrieved grows exponentially, so use caution when increasing the depth.
- **Domain** — specifies whether to process documents outside the domain of the initial web page.
- **User Name** — specifies the user name when the URL input refers to a secured website and requires a user name and password.
- **Password** — specifies the password when the URL input refers to a secured website and requires a user name and password.

Note:

- Web crawl properties are only available if SAS Text Miner uses a Windows server.
- When there is an issue with accessing a webpage, the document level HTTP status codes are reported in the output data set. The interpretation of the error code can be found at http://en.wikipedia.org/wiki/List_of_HTTP_status_codes.

Text Import Node Status Properties

These are the status properties that are displayed on the **Text Import** node:

- **Create Time** — time at which the node was created.
- **Run ID** — identifier of the run of the node. A new identifier is assigned every time the node is run.
- **Last Error** — error message, if any, from the last run.
- **Last status** — last reported status of the node.
- **Run time** — time at which the node was last run.
- **Run duration** — length of time required to complete the last node run.
- **Grid Host** — grid host, if any, that was used for computation.
- **User-Added Node** — denotes whether the node was created by a user as a SAS Enterprise Miner extension node. The value of this property is always `No` for the **Text Import** node.

Text Import Node Results

Contents

Results Window for the Text Import Node

After the **Text Import** node runs successfully, you can access the Results window in three ways:

- Click **Results** in the Run Status window that opens immediately after a successful run of the **Text Import** node.
- Click the **Results** icon on the main Toolbar.
- Right-click the **Text Import** node, and click **Results**.

The Results window for the **Text Import** node is similar to the Results window for other nodes in SAS Enterprise Miner. For general information about the Results window, see the SAS Enterprise Miner Help. The icons and main menus are the same as other nodes. However, the **View** menu does not include the selections **Assessment** or **Model**. Instead, it includes **Documents**, which access submenus that list the graphical results.

Note: You can access the SAS log from the **SAS Results** submenu of the **View** menu. This log can be a useful debugging tool.

Text Import Node Graphical Results

The following are the graphical results in the **Text Import** node Results window:

- The **Omitted/Truncated Documents** pie chart shows which documents were omitted or truncated. Position the mouse pointer over a sector to see the status of a sector, such as Truncated, and the frequency in a tooltip.
- The **Created/Accessed/Modified Dates by Frequency** scatter plot shows the frequency by which documents were created, modified, or accessed. Position the mouse pointer over a point to see the date and frequency of the action in a tooltip.
- The **Document Languages** pie chart shows the languages that are represented among imported documents. Position the mouse pointer over a sector to see frequency of each language in a tooltip.
- The **Document Lengths by Frequency** bar chart shows document size and frequency. Position the mouse pointer over a bar for a tooltip that contains this information.

- The **Document Types** pie chart shows the types of documents that are represented among imported documents by file extension, such as `.pdf`. Position the mouse pointer over a sector to see the frequency of each file extension in a tooltip.

Select a sector, point, or bar to highlight corresponding information in the other graphical results windows.

Text Import Node SAS Output Results

The SAS output from the **Text Import** node includes summary information about the input variables.

Text Import Node Output Data

For information about output data for the **Text Import** node, see "Output Data for SAS Text Miner Nodes" on page 131.

Using the Text Import Node

Contents

You can use the **Text Import** node to import documents from a directory or the web. See the following for examples of how to use the **Text Import** node.

Import Documents from a Directory

This example assumes that SAS Enterprise Miner is running, the SAS Document Conversion server is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

Perform the following steps to import documents from a directory:

1. Select the **Text Mining** tab, and drag a **Text Import** node to the diagram workspace.

2. Click the ellipsis button next to the **Import File Directory** property of the **Text Import** node.

   A Select Server Directory dialog box appears.

3. Navigate to a folder that contains documents that you want to create a data set from, select it, and then click **OK**.

   Note: To see the file types that you want to select, you might need to select `All Files` on the type drop-down menu.

4. Click the ellipsis button next to the **Language** property.

The Languages dialog box appears.

5. Select one or more licensed languages in which to require the language identifier to assign each document's language, and then click **OK**.

6. (Optional) Specify the file types to process for the **Extensions** property. For example, if you want to look at only documents with a .txt and a .pdf extension, specify `.txt .pdf` for the **Extensions** property, and click **Enter** on your keyboard.

   Note: If you do not specify file types to process, the **Text Import** node will process all file types in the specified import file directory.

7. Right-click the **Text Import** node, and click **Run**.

8. Click **Yes** in the Confirmation dialog box.

9. Click **Results** in the Run Status dialog box when the node has finished running.

10. Examine the results from the documents that you imported.

    You can now use the **Text Import** node as an input data source for your text mining analysis.

11. Select the **Text Mining** tab, and drag a **Text Parsing** node to the diagram workspace.

12. Connect the **Text Import** node to the **Text Parsing** node.

13. Right-click the **Text Parsing** node, and click **Run**.

14. Click **Yes** in the Confirmation dialog box.

15. Click **Results** in the Run Status dialog box when the node has finished running.

Import Documents from the Web

This example assumes that SAS Enterprise Miner is running, the SAS Document Conversion server is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

Note: Web crawling is supported only on Windows operating systems.

Perform the following steps to import documents from the web:

1. Select the **Text Mining** tab, and drag a **Text Import** node to the diagram workspace.

2. Click the ellipsis button for the **Import File Directory** property of the **Text Import** node.

   A Select Server Directory dialog box appears.

3. Navigate to a folder, select it, and then click **OK**.

   The documents are first written to the **Import File Directory** location. The files are processed from the **Import File Directory** location, and then are written to the **Destination Directory** location.

4. Enter the uniform resource locator (URL) of a web page that you want to crawl in the URL property of the **Text Import** node. For example, try *www.sas.com*.

5. Enter *1* as the number of levels to crawl in the Depth property.

6. Set the **Domain** property to **`Unrestricted`**.

   Note: If you want to crawl a password-protected website, set the **Domain** property to **Restricted**, and provide a user name for the **User Name** property, and a password for the **Password** property.

7. Right-click the **Text Import** node and click **Run**.

8. Click **Yes** in the Confirmation dialog box.

9. Click **Results** in the Run Status dialog box when the node has finished running.

Chapter 3

The Text Parsing Node

Overview of the Text Parsing Node

The **Text Parsing** node enables you to parse a document collection in order to quantify information about the terms that are contained therein. You can use the **Text Parsing** node with volumes of textual data such as e-mail messages, news articles, web pages, research papers, and surveys. See the following for more information about the **Text Parsing** node:

- "Text Parsing Node Input Data" on page 22
- "Text Parsing Node Properties" on page 23
- "Text Parsing Node Results" on page 27
- "Text Parsing Node Output Data" on page 29
- "Using the Text Parsing Node" on page 29

For related topics that you might find useful when using the **Text Parsing** node, see the following:

- "Start Lists and Stop Lists" on page 34
- "Term Stemming" on page 35
- "Term Roles and Attributes" on page 36
- "Synonym Lists" on page 39
- "Multi-Term Lists" on page 41

Note: The **Text Parsing** node is not supported for use in group processing (Start Groups and End Groups nodes).

Text Parsing Node Input Data

The **Text Parsing** node must be preceded by one or more Input Data Source nodes, where each data source contains a document collection to parse, or one or more **Text Import** nodes. At least one data source must have the role Train. Others can have roles of Train, Valid, Test, or Score.

Each observation from the input data source or **Text Import** node represents an individual document in the document collection. This data can have one of two structures. It can contain either the entire text of each document or the paths to plain text or HTML files that contain that text.

- If the data source contains the entire text of each document, then this text must be stored in a character variable that is assigned the role Text. Note that a SAS variable can hold only 32KB of text. If any document in the collection exceeds that limit, then you should not use this data source structure.

Note: There are sample data sets that you can use to create data sources with this structure. For more information, see "SAS Text Miner Sample Data Sets" on page 10.

- If the data source contains paths to files that contain the document text, then these paths must be stored in a character variable that is assigned the role Text Location. The paths must be relative to the SAS Text Miner server. This structure can be used either for collections that contain smaller documents or for documents that exceed the 32KB SAS variable limit.

  TIP

  - To help identify which link represents which document, you can include an additional character variable that contains truncated document text. Give this variable the role Text.
  - If there is a variable in the data set that contains the location of the unfiltered documents and if you assign this variable the role web Address, you will be able to access the original source of each document in the Interactive Results viewer.

The **Text Import** node creates the proper roles that are necessary for the **Text Parsing** node. The SAS **%TMFILTER** macro is an alternative to using the **Text Import** node to preprocess textual data. This macro creates a data source from the textual data that can be included with the Input Data Source node. For more information about these options to preprocess data for the **Text Parsing** node, see "File Preprocessing" on page 8.

A successful run of the **Text Parsing** node requires at least one variable with the role Text or Text Location. If you have more than one variable with either role (that has a use status of Yes), then the longest of these variables is used.

Text Parsing Node Properties

Contents

Text Parsing Node General Properties

These are the general properties that are available on the **Text Parsing** node:

- **Node ID** — displays the ID that is assigned to the node. Node IDs are especially useful for distinguishing between two or more nodes of the same type in a process flow diagram. For example, the first **Text Parsing** node that is added to a diagram will have the Node ID **`TextParsing`**. The second **Text Parsing** node that is added will have the Node ID **`TextParsing2`**.
- **Imported Data** — accesses a list of the data sets that are imported by the node and the ports that provide them. Click the ellipsis button to open the Imported Data window, which displays this list. If data exists for an imported data set, then you can select a row in the list and do any of the following:
  - browse the data set

  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set
- **Exported Data** — accesses a list of the data sets that are exported by the node and the ports to which they are provided. Click the ellipsis button to open the Exported Data window, which displays this list. If data exists for an exported data set, then you can select a row in the list and do any of the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set
- **Notes** — accesses a window that you can use to store notes of interest, such as data or configuration information. Click the ellipsis button to open the Notes window.

Text Parsing Node Train Properties

General Train Properties

These are the training properties that are available on the **Text Parsing** node:

- **Variables** — accesses a list of variables and associated properties in the data source. Click the ellipsis button to open the Variables window. For more information, see "Text Parsing Node Input Data" on page 22.
- "Parse Properties" on page 24
- "Detect Properties" on page 24
- "Ignore Properties" on page 25
- "Synonyms Properties" on page 26
- "Filter Properties" on page 26

Parse Properties

- **Parse Variable** — (value is populated after the node is run) displays the name of the variable in the input data source that was used for parsing. Depending on the structure of the data source, this variable contains either the entire text of each document in the document collection or the paths to plain text or HMTL files that contain that text.
- **Language** — accesses a window in which you can select the language to use when parsing. Click the ellipsis button to open the Languages window. Only supported languages that are licensed to you are available for selection. For a list of supported languages, see "About SAS Text Miner" on page 5.

Detect Properties

- **Different Parts of Speech** — specifies whether to identify the parts of speech of parsed terms. If the value of this property is Yes, then same terms with different parts of speech are treated as different terms. For more information, see "Parts of Speech in SAS Text Miner" on page 36.
- **Noun Groups** — specifies whether to identify noun groups. If stemming is turned on, then noun group elements are also stemmed. For more information, see "Noun Groups in SAS Text Miner" on page 37.

- **Multi-word Terms** — (for all languages except Chinese, Japanese, and Korean) specifies a SAS data set that contains multi-word terms. For more information, see "Multi-Term Lists" on page 41. Default data sets are provided for several languages. For more information, see "SAS Text Miner Sample Data Sets" on page 10. You can edit these data sets or create your own. Click the ellipsis button to open a window in which you can do the following:
  - Click **Replace Table** to replace the currently selected table.
  - Click **Add Table** to add to the currently selected table.
  - (If a multi-word term data set is selected) Add, delete, and edit terms in the multi-term list.
- **Find Entities** — specifies whether to identify the entities that are contained in the documents. Entity detection relies on linguistic rules and lists that are provided for many standard entity types. Custom entity types can be created by you by using SAS Concept Creation for SAS Text Miner software. For more information, see "Entities in SAS Text Miner" on page 37.
  - `None` identifies neither standard nor custom entities.
  - `Standard` identifies standard entities, but not custom entities.
  - `Custom` identifies custom entities, but not standard entities.
  - `All` identifies both standard and custom entities.
- **Custom Entities** — specifies the path (relative to the SAS Text Miner server) to a file that has been output from SAS Concept Creation for SAS Text Miner and contains compiled custom entities. Valid files have the extension `.li`. No custom entity should have the same name as a standard entity. For more information, see "Entities in SAS Text Miner" on page 37.

Ignore Properties

- **Ignore Parts of Speech** — accesses a window in which you can select one or more parts of speech. Terms that are assigned these parts of speech will be ignored when parsing. Click the ellipsis button to open the Ignore Parts of Speech dialog box. Use the SHIFT and Ctrl keys to make multiple selections. Terms with the selected parts of speech are not parsed and do not appear in node results.
- **Ignore Types of Entities** — (if the value of **Find Entities** is `Standard` or `All`) accesses a dialog box in which you can select one or more standard entities to ignore when parsing. For more information, see "Entities in SAS Text Miner" on page 37. Click the ellipsis button to open the Ignore Types of Entities window. Use the SHIFT and Ctrl keys to make multiple selections. Terms with the selected entity types are not parsed and do not appear in node results.
- **Ignore Types of Attributes** — accesses a window in which you can select one or more attributes to ignore when parsing. For more information, see "Attributes in SAS Text Miner " on page 38. Click the ellipsis button to open the Ignore Types of Attributes dialog box. Use the SHIFT and Ctrl keys to make multiple selections. Terms with the selected attribute types are not parsed and do not appear in node results.

Synonyms Properties

- **Stem Terms** — specifies whether to treat different terms with the same root as equivalent. For more information see "Term Stemming" on page 35.
- **Synonyms** — specifies a SAS data set that contains synonyms to be treated as equivalent. For more information, see "Synonym Lists" on page 39. Default data sets are provided for several languages. For more information, see "SAS Text Miner Sample Data Sets" on page 10. You can edit these data sets or create your own. Click the ellipsis button to open a window in which you can do the following:
  - Click **Replace Table** to replace the currently selected table.
  - Click **Add Table** to add to the currently selected table.
  - (If a synonym data set is selected) Add, delete, and edit terms in the synonym list.

Filter Properties

- **Start List** — specifies a SAS data set that contains the terms to parse. If you include a start list, then the terms that are not included in the start list appear in the results Term table with a Keep status of `N`. For more information, see "Start Lists and Stop Lists" on page 34. Click the ellipsis button to open a window in which you can do the following:
  - Click **Replace Table** to replace the currently selected table.
  - Click **Add Table** to add to the currently selected table.
  - (If a start list is selected) Add, delete, and edit terms in the start list.
- **Stop List** — specifies a SAS data set that contains terms to exclude from parsing. If you include a stop list, then the terms that are included in the stop list appear in the results Term table with a Keep status of `N`. For more information, see "Start Lists and Stop Lists" on page 34. Default data sets are provided for several languages. For more information, see "SAS Text Miner Sample Data Sets" on page 10. You can edit these data sets or create your own. Click the ellipsis button to open a window in which you can do the following:
  - Click **Replace Table** to replace the currently selected table.
  - Click **Add Table** to add to the currently selected table.
  - (If a stop list is selected) Add, delete, and edit terms in the stop list.
- **Select Languages** — specifies languages to keep in the document collection. If no languages are selected, all documents will be processed. To process documents with the selected languages, the input data set must include a Language variable.

Text Parsing Node Report Properties

This is the report property that is available on the **Text Parsing** node:

- **Number of Terms to Display** — indicates the maximum number of terms to be displayed in the Results viewer. Terms are first sorted by the number of documents in which they appear, and then the list is truncated to the maximum number. If the value of this property is **All**, then all terms are displayed.

Text Parsing Node Status Properties

These are the status properties that are displayed on the **Text Parsing** node:

- **Create Time** — time that the node was created.
- **Run ID** — identifier of the run of the node. A new identifier is assigned every time the node is run.
- **Last Error** — error message, if any, from the last run.
- **Last Status** — last reported status of the node.
- **Last Run Time** — time at which the node was last run.
- **Run Duration** — length of time required to complete the last node run.
- **Grid Host** — grid host, if any, that was used for computation.
- **User-Added Node** — denotes whether the node was created by a user as a SAS Enterprise Miner extension node. The value of this property is always **No** for the **Text Parsing** node.

Text Parsing Node Results

Contents

Results Window for the Text Parsing Node

After the **Text Parsing** node runs successfully, you can access the Results window in three ways:

- Click **Results** in the Run Status window that opens immediately after a successful run of the **Text Parsing** node.
- Click the Results icon on the main toolbar.
- Right-click the **Text Parsing** node, and select **Results**.

The Results window for the **Text Parsing** node is similar to the Results window for other nodes in SAS Enterprise Miner. For general information about the Results window, see the SAS Enterprise Miner Help. The icons and main menus are the same as other nodes. However, the **View** menu for the **Text Parsing** node Results window does not include the selections **Assessment** or **Model**. Instead, it includes **Terms**, which accesses a submenu that lists the graphical and tabular results.

Note: You can access the SAS log that was generated by the node processing from the **SAS Results** submenu of the **View** menu. This log can be a useful debugging tool.

Text Parsing Node Graphical and Tabular Results

The following are the graphical results in the **Text Parsing** node Results window:

- The **Number of Documents by Frequency** scatter plot displays the number of documents in which a term appears versus the frequency of occurrence of that term in the entire document collection. Each data point represents a parsed term. If you position the mouse pointer over a plotted point, then a tooltip indicates the term name, the number of documents in which that term appears, and the number of times that term appears in the entire document collection.
- The **Role by Freq** bar chart displays the total frequency of occurrence of parsed terms in the document collection, broken down by term role. Each bar represents a role. If you position the mouse pointer over a bar, then a tooltip indicates the role name and the number of times a parsed term with that role appears in the entire document collection.
- The **Attribute by Frequency** bar chart displays the total frequency of occurrence of parsed terms in the document collection, broken down by attribute. For more information, see "Attributes in SAS Text Miner " on page 38. If you position the mouse pointer over a bar, then a tooltip indicates the attribute name and the number of times a term with that attribute appears in the entire document collection.
- The **ZIPF Plot** displays a scatter plot of the number of documents for each term where each is sorted and plotted by rank. If you position the mouse pointer over a point, then a tooltip indicates the term name, rank, and number of documents.

The tabular result in the **Text Parsing** node Results window is the Terms table, which displays information about parsed top-level terms (that is, terms that have no parents above them). Note that if there are more terms than the setting of the property Number of Terms to Display, only that number of most frequent terms will be included. All graphical results in the **Text Parsing** node Results window are linked to this table. Therefore, you can select an observation in the Terms table, and the associated data points are highlighted in the graphics. Or you can select data points in the graphics, and the associated observations are highlighted in the Terms table.

Table 3.1 *Contents of the Terms Table*

Variable	Description
Term	top-level terms (in lowercase); terms that are parents are preceded by a plus (+) symbol.
Role	part of speech of the term, entity classification of the term, or the value Noun Group.
Attribute	attribute of the term.
Frequency	number of times the term appears in the document collection.
Number of Documents	number of documents in the collection in which the term appears.

Variable	Description
Keep	**Y** if the term is used in subsequent nodes of the text mining analysis; **N** otherwise.
Parent/Child Status	plus (+) symbol if the term is a parent; blank otherwise.
Parent ID	key value of the term's parent. *Note:* Note: Each SAS Text Miner node outputs a terms data set, which is stored with the project data. The names of these data sets follow the format "NodeID_terms" (for example, TextParsing_terms). You can determine which term corresponds to a particular key by looking at this data set. For more information about where to find project data, see the "Opening SAS Enterprise Miner 4.x and 5.3 projects in SAS Enterprise Miner 14.1" topic in the SAS Enterprise Miner Help.
Rank	rank that corresponds to the ZIPF Plot.

For more information see the following:

- "Term Roles and Attributes" on page 36

Text Parsing Node SAS Output Results

The SAS output from the **Text Parsing** node includes summary information about the input variables.

Text Parsing Node Output Data

For information about output data for the **Text Parsing** node, see "Output Data for SAS Text Miner Nodes" on page 131.

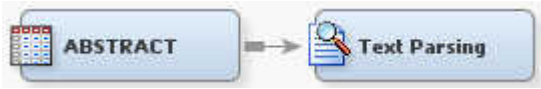
Using the Text Parsing Node

This example shows you how to identify terms and their instances in a data set that contains text using the **Text Parsing** node. This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*. Perform the following steps:

1. The SAS data set SAMPSIO.ABSTRACT contains the titles and text of abstracts from conferences. Create the ABSTRACT data source and add it to your diagram workspace. Set the Role value of the TEXT and TITLE variables to **Text**.

2. Select the **Text Mining** tab on the toolbar, and drag a **Text Parsing** node to the diagram workspace.

3. Connect the ABSTRACT data source to the **Text Parsing** node.



4. In the diagram workspace, right-click the **Text Parsing** node and select **Run**. Click **Yes** in the Confirmation dialog box that appears.

5. Click **Results** in the Run Status dialog box when the node finishes running. The Results window displays a variety of tabular and graphical output to help you analyze the terms and their instances in the ABSTRACT data source.

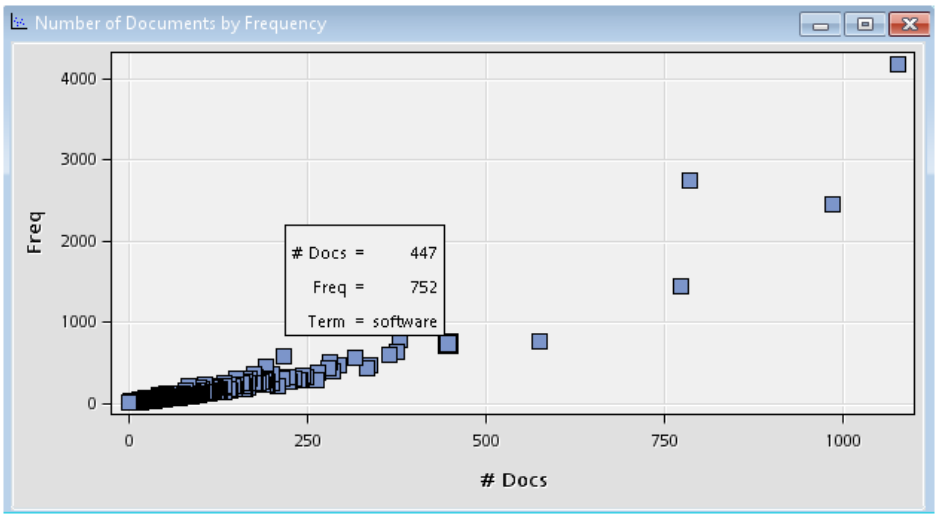
6. Sort the terms in the Terms table by frequency, and then select the term "software." As the Terms table illustrates, the term "software" is a noun that occurs in 447 documents in the ABSTRACT data source, and appears a total number of 752 times.

Terms

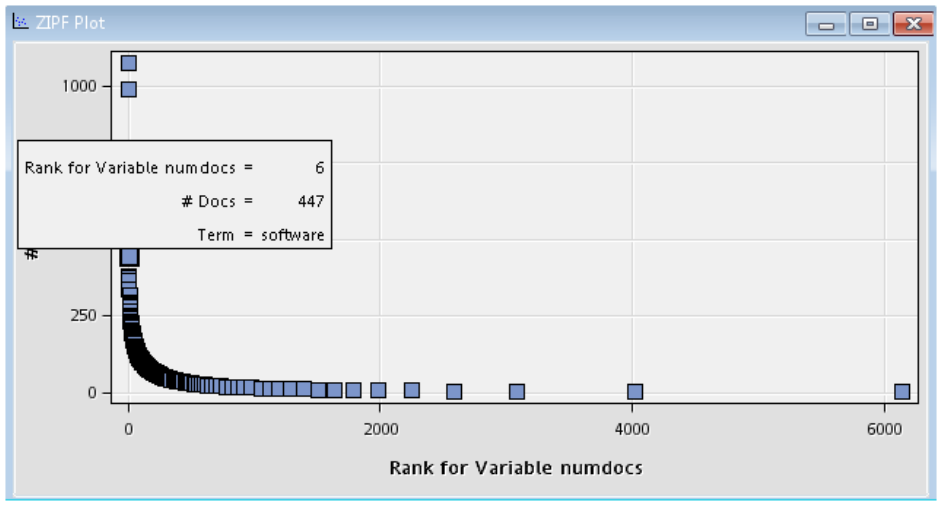
Term	Role	Attribute	Freq ▼	# Docs	Keep	Parent/Child Status	Parent ID	Rank for Variable numdocs
+ sas instit...	Company	Entity	4187	1077	Y	+	14168	1
data	Noun	Alpha	2747	786	Y		2030	3
+ be	Verb	Alpha	2448	987	N	+	23971	2
+ use	Verb	Alpha	1450	773	N	+	23834	4
+ applicatio...	Noun	Alpha	772	380	Y	+	4385	7
+ paper	Noun	Alpha	766	576	Y	+	11702	5
software	Noun	Alpha	752	447	Y		11833	6
+ user	Noun	Alpha	634	376	Y	+	5781	8
system	Prop	Alpha	593	365	Y		2813	9
proc	Prop	Alpha	580	218	Y		12420	27
+ system	Noun	Alpha	566	317	Y	+	11814	12
information	Noun	Alpha	501	283	Y		6050	15
+ provide	Verb	Alpha	471	338	N	+	23881	10
+ new	Adj	Alpha	463	295	N	+	24013	13
+ macro	Noun	Alpha	443	193	Y	+	15066	34
s	Noun	Alpha	435	280	N		23755	16
+ have	Verb	Alpha	433	335	N	+	23825	11

When you select a term in the Terms table, the point that corresponds to that term in the Text Parsing Results plots is highlighted.

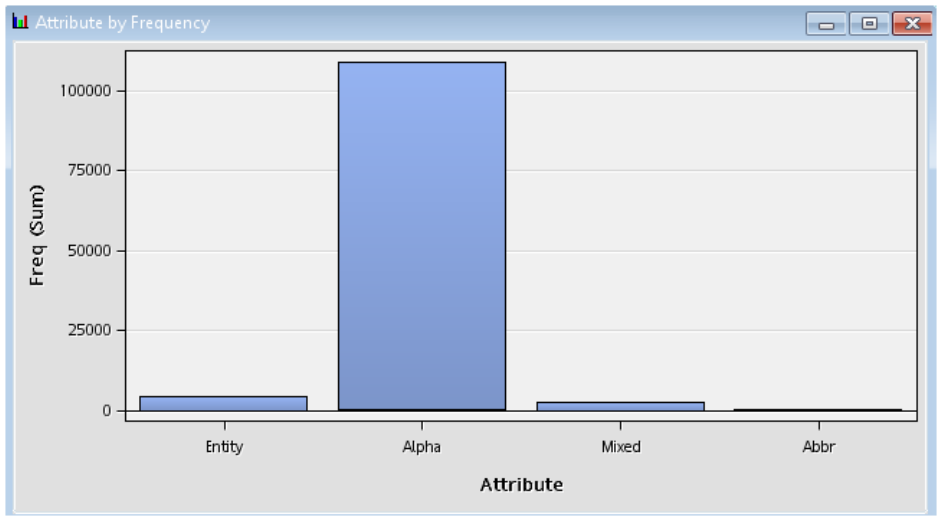
7. Select the Number of Documents by Frequency plot, and position the cursor over the highlighted point for information about the term "software."



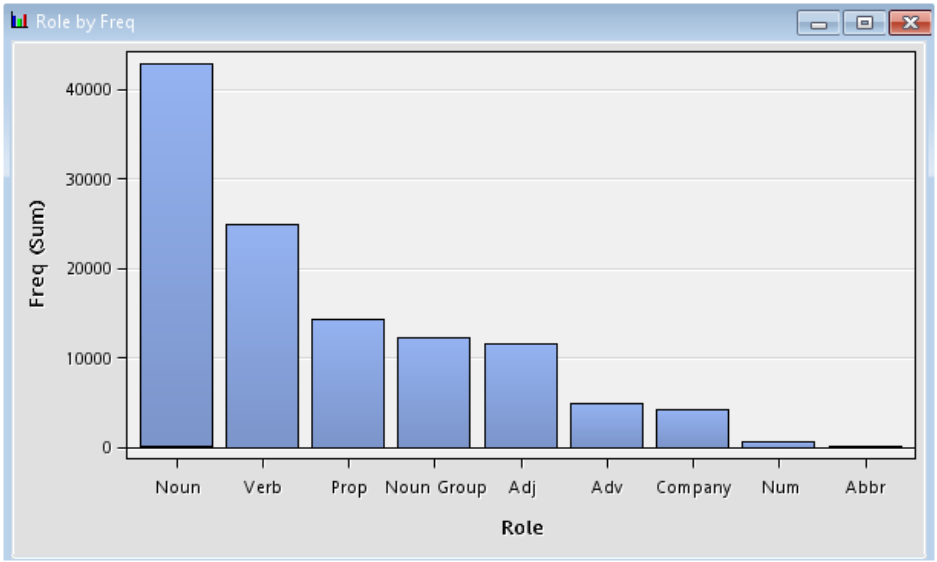
Similar information is also presented in a ZIPF plot.



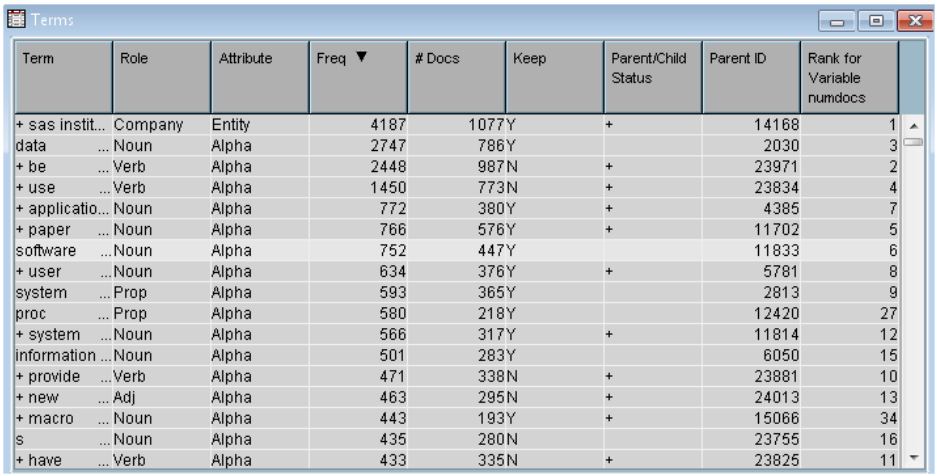
The Attribute by Frequency chart shows that **`Alpha`** has the highest frequency among attributes in the document collection.



The Role by Freq chart illustrates that **`Noun`** has the highest frequency among roles in the document collection.



8. Return to the Terms table, and notice that the term “software” is kept in the text parsing analysis. This is illustrated by the value of **`Y`** in the Keep column. Notice that not all terms are kept when you run the **Text Parsing** node with default settings.


Terms

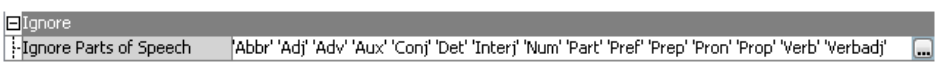
Term	Role	Attribute	Freq ▼	# Docs	Keep	Parent/Child Status	Parent ID	Rank for Variable numdocs
+ sas instit...	Company	Entity	4187	1077	Y	+	14168	1
data	Noun	Alpha	2747	786	Y		2030	3
+ be	Verb	Alpha	2448	987	N	+	23971	2
+ use	Verb	Alpha	1450	773	N	+	23834	4
+ applicatio...	Noun	Alpha	772	380	Y	+	4385	7
+ paper	Noun	Alpha	766	576	Y	+	11702	5
software	Noun	Alpha	752	447	Y		11833	6
+ user	Noun	Alpha	634	376	Y	+	5781	8
system	Prop	Alpha	593	365	Y		2813	9
proc	Prop	Alpha	580	218	Y		12420	27
+ system	Noun	Alpha	566	317	Y	+	11814	12
information	Noun	Alpha	501	283	Y		6050	15
+ provide	Verb	Alpha	471	338	N	+	23881	10
+ new	Adj	Alpha	463	295	N	+	24013	13
+ macro	Noun	Alpha	443	193	Y	+	15066	34
s	Noun	Alpha	435	280	N		23755	16
+ have	Verb	Alpha	433	335	N	+	23825	11

The **Text Parsing** node not only enables you to gather statistical data about the terms in a document collection. It also enables you to modify your output set of parsed terms by dropping terms that are a certain part of speech, type of entity, or attribute. Scroll down the list of terms in the Terms table. Notice that many of the terms with a role other than **`Noun`** are kept. Assume that you want to limit your text parsing results to terms with a role of **`Noun`**.

9. Close the Results window.

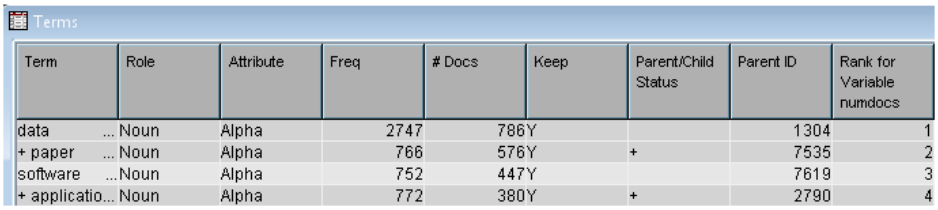
10. Select the **Text Parsing** node, and then select the ellipsis for the **Ignore Parts of Speech** property.

11. In the Ignore Parts of Speech dialog box, select all parts of speech except for **`Noun`** by holding down **Ctrl** on your keyboard and clicking each option. Click **OK**. Notice that the value for the **Ignore Parts of Speech** property is updated with your selection.



12. In addition to nouns, you also keep noun groups. Ensure that the **Noun Groups** property is set to its default value of **`Yes`**.

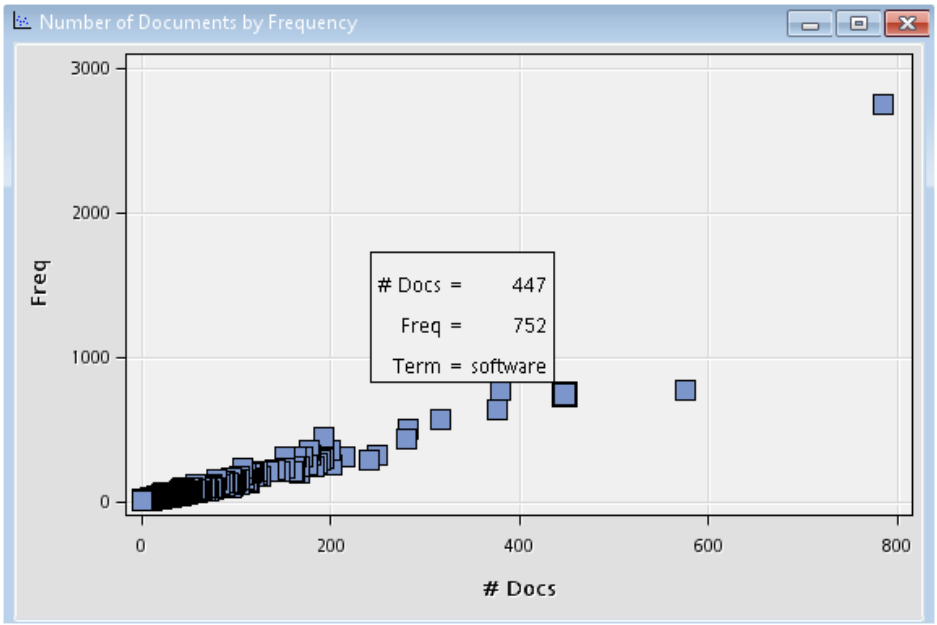
13. Right-click the **Text Parsing** node and select **Run**. Click **Yes** in the Confirmation dialog box that appears. Select **Results** in the Run Status dialog box when the node has finished running. Notice that the term "software" has a higher rank among terms with a role of just "noun" or "noun group" than it did when other roles were included. If you scroll down the Terms table, you can see that just terms with a **`Noun`** or **`Noun Group`** role are included.



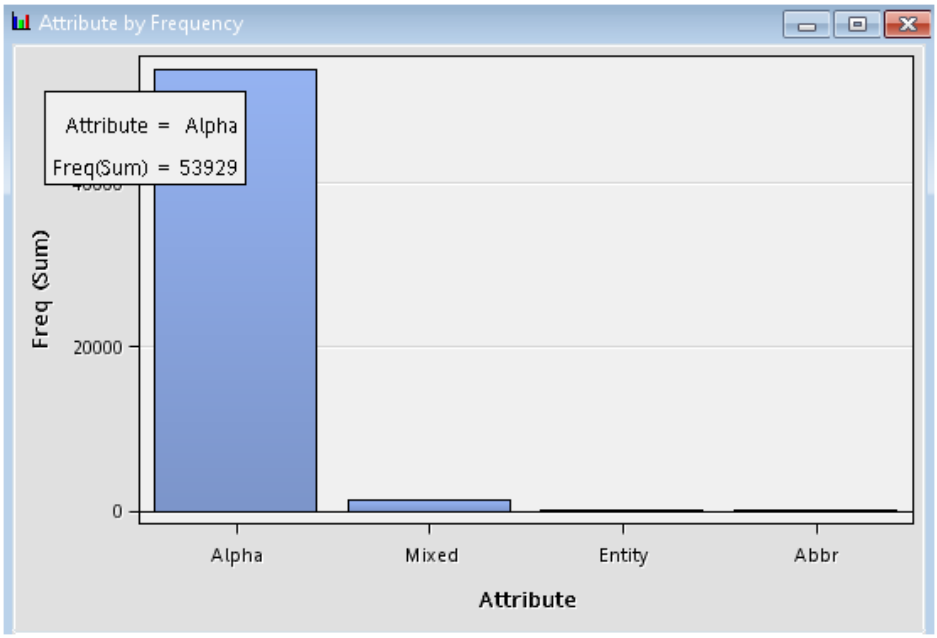
Terms

Term	Role	Attribute	Freq	# Docs	Keep	Parent/Child Status	Parent ID	Rank for Variable numdocs
data	Noun	Alpha	2747	786	Y		1304	1
+ paper	Noun	Alpha	766	576	Y	+	7535	2
software	Noun	Alpha	752	447	Y		7619	3
+ applicatio...	Noun	Alpha	772	380	Y	+	2790	4

As you would expect, there are fewer terms plotted in the Number of Documents by Frequency plot:



Similarly, the total number of terms in the output results with an attribute of **`Alpha`** has decreased, as can be seen in the Attribute by Frequency chart:



Start Lists and Stop Lists

You can use a start list or a stop list in the **Text Parsing** node. These lists enable you to control which terms are or are not used in a text mining analysis. A "start list" is a data set that contains a list of terms to include in the parsing results. If you use a start list, then only terms that are included in that list appear in parsing results. A "stop list," on the other hand, is a data set that contains a list of terms to exclude from the parsing results. Stop lists are often used to exclude terms that contain little information or that are extraneous to your text mining tasks. A default stop list is provided for each of several languages. For more information, see "SAS Text Miner Sample Data Sets" on page 10.

Start lists and stop lists have the same required format. You must include the variable "Term," which contains the terms to include or exclude, respectively. In addition, you can include the variable "Role," which contains an associated role. If you include "Role" and you have set the **Different Parts of Speech** property for the **Text Parsing** node to **`Yes`**, then terms are excluded or included based on the **`(Term, Role)`** pair.

Note:

- A role is either a part of speech, an entity classification, or the value **`Noun Group`**. For more information about roles, see "Term Roles and Attributes" on page 36.
- The "Term" variable must be a character variable.

For example, if you use the following stop list, then any instance of the terms "bank" and "list" are excluded from parsing results, regardless of their roles:

```
Term

bank
list
```

However, if you use the following stop list and the **Different Parts of Speech** property has the value **Yes**, then the terms “bank” and “list” are excluded from parsing results only if they are used as verbs:

```
Term    Role

bank    Verb
list    Verb
```

Term Stemming

Stemming is the process of finding the stem or root form of a term. SAS Text Miner uses dictionary-based stemming (also known as lemmatization), which unlike tail-chopping stemmers, produces only valid words as stems. When part-of-speech tagging is on, the stem selection process restricts the stem to be of the same part-of-speech as the original term.

Stem	Terms
aller (French)	vais, vas, va, allons, allez, vont
reach	reaches, reached, reaching
big	bigger, biggest
balloon	balloons
go	goes

Stemming can be very important for text mining because text mining is based on the co-occurrence relationships of terms throughout the collection. By treating the variations of a term as the term itself, document relationships can be clarified. For example, if “grinds”, “grinding”, and “ground” each occur independently in three separate documents, the individual terms do not contribute to the similarity of these three documents. However, if the terms are all stemmed to “grind” and the documents are treated as if they contain “grind” rather than the original variants, the documents will be related by this common stem.

Because SAS Text Miner uses the same equivalent term concept to manage stems as it does to manage synonyms, you can customize the stem by editing the synonym list.

Furthermore, SAS Text Miner supports compound words for German. Compound words are decomposed only when stemming is performed. When they are detected, a parent

form is generated. This parent form separates the compound into its parts by delimiting the parts with the # symbol. The individual components of the compound word are also added as terms. For example, the compound word “eckkonsole” is assigned the parent term “eck#konsole” and this parent as well as “eck” and “konsole” are added to the Terms table.

Other examples of compound words include “levensecht,” “kinderloos,” “naisjuoksija,” “Obstanbaugebiet,” and “hellgelb.”

Term Roles and Attributes

Contents

Parts of Speech in SAS Text Miner

SAS Text Miner can identify the part of speech for each term in a document based on the context of that term. Terms are identified as one of the following parts of speech:

- Abbr (abbreviation)
- Adj (adjective)
- Adv (adverb)
- Aux (auxiliary or modal)
- Conj (conjunction)
- Det (determiner)
- Interj (interjection)
- Noun (noun)
- Num (number or numeric expression)
- Part (infinitive marker, negative participle, or possessive marker)
- Pref (prefix)
- Prep (preposition)
- Pron (pronoun)
- Prop (proper noun)

- Verb (verb)
- VerbAdj (verb adjective)

Noun Groups in SAS Text Miner

SAS Text Miner can identify noun groups, such as “clinical trial” and “data set”, in a document collection. Noun groups are identified based on linguistic relationships that exist within sentences. Syntactically, these noun groups act as single units. Therefore, you can choose to parse them as single terms.

- If stemming is on, noun groups are stemmed. For example, the text “amount of defects” is parsed as “amount of defect”.
- Frequently, shorter noun groups are contained within larger noun groups. Both the shorter and larger noun groups appear in parsing results.

Entities in SAS Text Miner

An “entity” is any of several types of information that SAS Text Miner can distinguish from general text. If you enable SAS Text Miner to identify them, entities are analyzed as a unit, and they are sometimes normalized. When SAS Text Miner extracts entities that consist of two or more words, the individual words of the entity are also used in the analysis.

By default, SAS Text Miner identifies the following standard entities:

- ADDRESS (postal address or number and street name)
- COMPANY (company name)
- CURRENCY (currency or currency expression)
- DATE (date, day, month, or year)
- INTERNET (e-mail address or URL)
- LOCATION (city, country, state, geographical place or region, or political place or region)
- MEASURE (measurement or measurement expression)
- ORGANIZATION (government, legal, or service agency)
- PERCENT (percentage or percentage expression)
- PERSON (person's name)
- PHONE (phone number)
- PRODUCT
- PROP_MISC (proper noun with an ambiguous classification)

- SSN (Social Security number)
- TIME (time or time expression)
- TIME_PERIOD (measure of time expressions)
- TITLE (person's title or position)
- VEHICLE (motor vehicle including color, year, make, and model)

You can also use SAS Contextual Analysis, SAS Concept Creation for SAS Text Miner, or SAS Content Categorization Studio to define custom entities and import these for use in a **Text Parsing** node. Also note that any custom entity rules that use the SEQUENCE or PREDICATE_RULE operators are NOT supported; as these are set up to denote "Facts", which SAS Text Miner does not currently have any facilities to handle.

Entities are normalized in these situations:

- SAS Text Miner uses a fixed dictionary of company and organization names in order to identify these entity types. These entity types will frequently be associated with a parent. For example, if "IBM" appears in the text, it is returned with the predefined parent "International Business Machines". Typically, the longest and most precise version of a name is used as the parent form.
- SAS Text Miner normalizes entities that have an ISO (International Standards Organization) standard (dates or years, currencies, and percentages). Rather than return the normalization as a parent of the original term, these normalizations actually replace the original term.
- You can alter any parent forms that are returned by editing the synonym list. Place terms that you want to identify as an entity in the "Term" variable, place the parent to associate with it in the "Parent" variable, and place the entity category in the "Category" variable. Then rerun the node.

Attributes in SAS Text Miner

When a document collection is parsed, SAS Text Miner categorizes each term as one of the following attributes, which gives an indication of the characters that compose that term:

- Abbr, if the term is an abbreviation
- Alpha, if characters are all letters
- Mixed, if term characters include a mix of letters, punctuation, and white space
- Num, if term characters include a number
- Punct, if the term is a punctuation character

Synonym Lists

Contents

Overview of Synonym Lists

You can use a synonym list in the **Text Parsing** node. A synonym list enables you to specify different words that should be processed equivalently, as the same representative parent term. A default synonym list is provided for the English language. For more information, see "SAS Text Miner Sample Data Sets" on page 10.

Synonym data sets have a required format. If your synonyms data set does not contain the variables listed below, then the **Text Parsing** node will return an error.

You must include the following variables:

- "Term" contains a term to treat as a synonym of "Parent."
- "Parent" contains the representative term to which "Term" should be assigned.

Note: If a synonym list includes multiple entries that assign the same terms to different parents, then the parsing results will reflect only the first entry.

In addition to the required "term" and "parent" variables, you might also use "termrole" and "parentrole" variables in the synonyms data set. These optional variables enable you to specify that a term with a particular role is mapped to a parent term with a particular role. For example, you can specify that the term "drink," when tagged as a noun, is mapped to the noun "beverage" as the parent term. You can also specify that when "drink" is tagged as a verb, it is mapped to the verb "sip" as the parent term. To use the "role" variables, the **Noun Groups** and **Different Parts of Speech** properties in the **Text Parsing** must be set to **`Yes`**. If you are using entity roles in the synonym list, the **Find Entities** property in the **Text Parsing** node must not be set to **`None`**.

You can use the following format, which enables you to change a part of speech tag.

Term	Term Role	Parent	Parent Role
car	Noun	vehicle	Noun

Note: Term and parent values should be in lowercase form.

In the **Text Parsing** node, the following format maps all forms of "sas" to "sas institute:Company" regardless of the part of speech tag that is assigned to it. In the **Text Filter** node, the following format maps only "sas:Company" to "sas institute:Company".

Term	Parent	Term Role	Parent Role
sas	sas institute		Company

Note: If you need to map “sas:Noun”, you must add the following information:

Term	Parent	Term Role	Parent Role
sas	sas institute		Company
sas	sas institute	Noun	Company

You can also use the following format. For example, use of the following synonym list causes any instance of “sas,” when identified as a company, to be processed as “sas institute.” Also, any instance of “employees” is processed as “employees.” In fact, if part-of-speech tagging is on, then this entry disables stemming for only the term “employees.”

Term	Parent	Category
sas	sas institute	Company
employees	employees	

Note: The format that uses a term, parent, and a category is still accepted, but it is interpreted as a term, parent, and a parent role.

Synonyms and Part-of-Speech Tagging

The following examples demonstrate how synonym lists are handled when part-of-speech tagging is on.

Term	Parent	Term Role	Parent Role
well	water		

In this example, a term and parent (but not a parent role) are defined. When part-of-speech tagging is either on or off, every occurrence of “well,” regardless of part of speech, is assigned to the parent “water.”

Term	Parent	Term Role	Parent Role
well			Noun
data mining			Noun

In this example, a term and parent role (but not a parent) are defined. When part-of-speech tagging is either on or off, the entry for the single word term, “well,” has no effect on the parsing results. However, when part-of-speech tagging is on, the multi-word term, “data mining” is treated as a single term only when identified as a noun. When part-of-speech tagging is off, any instance of “data mining” is treated as a single term.

Term	Parent	Term Role	Parent Role
well	water		Noun

In this example, a term, parent, and parent role are defined. When part-of-speech tagging is on, “well” is assigned to the parent “water” only when it is identified as a noun. When part-of-speech tagging is off, all instances of “well” are assigned to the parent “water.”

Defining Multi-Word Terms Using a Synonym List

You can use a synonym to specify groups of words that should be processed together as single terms. To define a multi-word term, include it as a “Term” in a synonym list; do not assign it to a “Parent.” For more information, see “Multi-Term Lists” on page 41.

Unlike other entries in a synonym list, multi-word terms are case sensitive. Appearances of the multi-word term that have the following casings are identified and treated as a single term:

- same casing as the multi-word term entry in the synonym list
- all uppercase version of the multi-word term
- all lowercase version of the multi-word term
- a version that capitalizes the first letter of each term in the multi-word term and lowercases the remaining characters

Multi-Term Lists

You can use a multi-term list in the **Text Parsing** node. These lists enable you to specify groups of words that should be processed together, as single terms. A default multi-term list is provided for each of several languages. For more information, see “SAS Text Miner Sample Data Sets” on page 10.

Multi-word term data sets have a required format. You must include the variables “Term,” which contains a multi-word term, and “Role,” which contains an associated role.

Note: A role is either a part of speech, an entity classification, or the value **Noun Group**. For more information about roles, see “Term Roles and Attributes” on page 36.

For example, if you use the following multi-term list, then any instance of the words “as far as” is processed as one term, a preposition. Any instance of the words “clinical trial” is processed as one term, a noun:

Term	Role
as far as	Prep
clinical trial	Noun

You can similarly define multi-word terms using a synonym list. In this case, the groups of words that you specify will be processed together as single terms. For more information, see “Defining Multi-Word Terms Using a Synonym List” on page 41.

Chapter 4

The Text Filter Node

Overview of the Text Filter Node

You can use the **Text Filter** node to reduce the total number of parsed terms or documents that are analyzed. Therefore, you can eliminate extraneous information so that only the most valuable and relevant information is considered. For example, the **Text Filter** node can be used to remove unwanted terms and to keep only documents that discuss a particular issue. This reduced data set can be orders of magnitude smaller than the one that represents the original collection. The data set that represents the original collection might contain hundreds of thousands of documents and hundreds of thousands of distinct terms. See the following for more information about the **Text Filter** node.

- "Text Filter Node Input Data" on page 44
- "Text Filter Node Properties" on page 45
- "Text Filter Node Results" on page 48
- "Text Filter Node Output Data" on page 51
- "Using the Text Filter Node" on page 51

For related topics that you might find useful when using the **Text Filter** node, see the following:

- "How to Create a Dictionary Data Set" on page 56
- "Term Weighting" on page 57
- "Text Filter Node Search Expressions" on page 59
- "Interactive Filter Viewer" on page 60
- "Strength of Association for Concept Linking" on page 63

Note: The **Text Filter** node is not supported for use in group processing (Start Groups and End Groups nodes).

Text Filter Node Input Data

The **Text Filter** node must be preceded by a **Text Parsing** node in a process flow diagram. The **Text Filter** node directly imports the document table from the **Text Parsing** node. But it also relies on several data sets that the **Text Parsing** node places in its workspace directory.

Text Filter Node Properties

Contents

Text Filter Node General Properties

These are the general properties that are available on the **Text Filter** node:

- **Node ID** — displays the ID that is assigned to the node. Node IDs are especially useful for distinguishing between two or more nodes of the same type in a process flow diagram. For example, the first **Text Filter** node that is added to a diagram will have the Node ID **`TextFilter`**. The second **Text Filter** node that is added will have the Node ID **`TextFilter2`**.

- **Imported Data** — accesses a list of the data sets that are imported by the node and the ports that provide them. Click the ellipsis button to open the Imported Data window, which displays this list. If data exists for an imported data set, then you can select a row in the list and do the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set

- **Exported Data** — accesses a list of the data sets that are exported by the node and the ports to which they are provided. Click the ellipsis button to open the Exported Data window, which displays this list. If data exists for an exported data set, then you can select a row in the list and do the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set

- **Notes** — accesses a window that you can use to store notes of interest, such as data or configuration information. Click the ellipsis button to open the Notes window.

Text Filter Node Train Properties

General Train Properties

These are the training properties that are available on the **Text Filter** node:

- **Variables** — accesses a list of variables and associated properties in the data source. Click the ellipsis button to open the Variables window.
- "Spelling Properties" on page 46
- "Weightings Properties" on page 46
- "Term Filters Properties" on page 46
- "Document Filters Properties" on page 47
- "Results Properties" on page 47

Spelling Properties

- **Check Spelling** — specifies whether to check spelling and create synonyms for misspelled words.
- **Dictionary** — specifies a data set of correctly spelled terms. Click the ellipsis button to open the Select a SAS Table window, and select a dictionary data set to use when you use spell checking. For more information about how to create a dictionary data set, see "How to Create a Dictionary Data Set" on page 56.

  Note: The **Check Spelling** property value must be set to `Yes` to use the dictionary data set.

Weightings Properties

- **Frequency Weighting** — specifies the frequency weighting method to use. For more information, see "Frequency Weighting Methods" on page 58.
- **Term Weight** — specifies the term weighting method to use. For more information, see "Term Weighting Methods" on page 58.

Term Filters Properties

- **Minimum Number of Documents** — excludes terms that occur in fewer than this number of documents.
- **Maximum Number of Terms** — specifies the maximum number of terms to keep.
- **Import Synonyms** — specifies a synonym data set. Click the ellipsis button to navigate to a data set. Click **Replace Table** to replace the currently selected table. Click **Add Table** to add to the currently selected table. Synonym data sets must have the variables term and parent. The variables term role and parent role are optional variables that give you control of changing term role assignments (part-of-speech tag or entity category), if desired.

Document Filters Properties

- **Search Expression** — specifies a search expression to use to filter documents. For more information, see "Text Filter Node Search Expressions" on page 59.
- **Subset Documents** — accesses a window in which you can build a WHERE clause to use to filter documents. Only documents that satisfy this WHERE clause are kept. For more information about WHERE clauses and WHERE-expression processing, see *SAS Language Reference: Concepts* at http://support.sas.com/documentation/onlinedoc/base/index.html. Click the ellipsis button to open the Build Where Clause dialog box, in which you can do the following:
  - Select from the drop-down menus to build a WHERE clause.
  - Enter the full text of a custom WHERE clause.

Results Properties

- **Filter Viewer** — (after the node has run) accesses the "Interactive Filter Viewer" on page 60, in which you can interactively refine the parsed and filtered data. Click the ellipsis button to open the Interactive Filter Viewer.
- **Spell-Checking Results** — (after the node has run and if the value of **Check Spelling** is **`Yes`**) accesses a window in which you can view the data set that contains spelling corrections that are generated during spell checking. Click the ellipsis button to view the data set.

  In the spell checking results data set, the variable **`Term`** contains the proposed misspelled terms, and the variable **`Parent`** contains the associated proposed correct spellings of these terms. If you want to edit this file, you can do so using SAS code.
- **Exported Synonyms** — opens a data set that contains synonyms that are exported from the Interactive Filter Viewer. For more information about how to create a synonym data set from the Interactive Filter Viewer, see "Create Synonym Data Sets" on page 62.

Text Filter Node Report Properties

These are the report properties that are available on the **Text Filter** node:

- **Terms to View** — specifies which terms to display in the Results window.
  - **Selected** displays all terms that were kept after filtering.
  - **Filtered** displays all terms that were dropped after filtering.
  - **All** displays all terms both kept and dropped after filtering.
- **Number of Terms to Display** — indicates the maximum number of terms to be displayed in the Results viewer. Terms are first sorted by the number of documents in which they appear, and then the list is truncated to the maximum number. If the value of this property is **`All`**, then all terms are displayed.

Text Filter Node Status Properties

These are the status properties that are displayed on the **Text Filter** node:

- **Create Time** — time that the node was created.
- **Run ID** — identifier of the run of the node. A new identifier is assigned every time the node is run.
- **Last Error** — error message, if any, from the last run.
- **Last Status** — last reported status of the node.
- **Last Run Time** — time at which the node was last run.
- **Run Duration** — length of time required to complete the last node run.
- **Grid Host** — grid host, if any, that was used for computation.
- **User-Added Node** — denotes whether the node was created by a user as a SAS Enterprise Miner Extension node. The value of this property is always `No` for the **Text Filter** node.

Text Filter Node Results

Contents

Results Window for the Text Filter Node

After the Text Filter node runs successfully, you can access the Results window in three ways:

- Click **Results** in the Run Status window that opens immediately after a successful run of the **Text Filter** node.
- Click the Results icon on the main Toolbar.
- Right-click the **Text Filter** node, and select **Results**.

The Results window for the **Text Filter** node is similar to the Results window for other nodes in SAS Enterprise Miner. For general information about the Results window, see the SAS Enterprise Miner Help. The icons and main menus are the same as other nodes. However, the **View** menu does not include the selections **Assessment** or **Model**. Instead,

it includes **Terms** and **Filtering**, which access submenus that list the graphical and tabular results.

Note: You can access the SAS log from the **SAS Results** submenu of the **View** menu. This log can be a useful debugging tool.

Text Filter Node Graphical and Tabular Results

The following are the graphical results in the **Text Filter** node Results window:

- The **Number of Documents** scatter plot displays the imported number of documents in which a term appears versus the number of documents. Each data point represents a term. If you position the mouse pointer over a plotted point, then a tooltip indicates the term name, the imported number of documents for a term, the number of documents in which that term appears, and the weight of the term.

  Note: The **Number of Documents** scatter plot is available in the **Text Filter** node results if the value for the number of documents in which a term appears changes from before the **Text Filter** node runs to after the node runs. This might occur when you are using the **Check Spelling**, **Subset Documents**, or **Search Expression** properties in the **Text Filter** node, or when you are making changes in the **Interactive Filter Viewer**. In the Results Window, select **View** ⇨ **Filtering** ⇨ **Number of Documents** to open the **Number of Documents** scatter plot.

- The **Number of Documents by Weight** scatter plot displays the number of documents in which a term appears versus the weight of the term. Each data point represents a term. If you position the mouse pointer over a plotted point, then a tooltip indicates the term name, the number of documents in which that term appears, and the weight of the term. For more information, see "Term Weighting" on page 57.

- The **Number of Documents by Frequency** scatter plot displays the number of documents in which a term appears versus the frequency of occurrence of that term in the entire document collection. Each data point represents a term. If you position the mouse pointer over a plotted point, then a tooltip indicates the term name, the number of documents in which that term appears, and the number of times that term appears in the entire document collection.

- The **Role by Freq** bar chart displays the total frequency of occurrence of terms in the document collection, broken down by term role and keep status. Each bar represents a role. If you position the mouse pointer over a bar, then a tooltip indicates the role name, the number of times a term with that role appears in the entire document collection, and the keep status of the associated terms.

- The **Attribute by Frequency** bar chart displays the total frequency of occurrence of terms in the document collection, broken down by attribute and keep status. If you position the mouse pointer over a bar, then a tooltip indicates the attribute name, the number of times a term with that attribute appears in the entire document collection, and the keep status of the associated terms.

- The **ZIPF Plot** displays a scatter plot of the number of documents for each term, where each is sorted and plotted by rank. If you position the mouse pointer over a point, then a tooltip indicates the term name, rank, and number of documents.

There are three tabular results in the **Text Filter** node Results window:

- The **Terms** table displays information about top-level terms (in other words, terms that have no parents above them). All graphical results in the **Text Filter** node Results window are linked to this table. Therefore, you can select an observation in the Terms table, and the associated data points are highlighted in the graphics. Or, you can select data points in the graphics, and the associated observations are highlighted in the Terms table.

- The **Excluded Terms** table (accessible via the **Filtering** submenu of the **View** menu) displays information about all dropped terms.

- The **New Parent Terms** table (accessible via the **Filtering** submenu of the **View** menu) displays information about all terms that were newly classified as parent terms in the **Text Filter** node.

Table 4.1 *Contents of the Terms Table*

Variable	Description
Term	top-level terms (in lowercase); terms that are parents are preceded by a plus (+) symbol.
Role	part of speech of the term, entity classification of the term, or the value **`Noun Group`**.
Attribute	attribute of the term.
Status	**`Keep`** if the term is used in subsequent nodes of the text mining analysis; **`Drop`** otherwise.
Weight	weight of the term
Imported Frequency	number of times the term appears in the document collection. This variable reflects the frequency passed from the previous node.
Frequency	number of times the term appears in the document collection. This variable reflects the frequency after filtering.
Number of Imported Documents	number of documents in the collection in which the term appears. This variable reflects the number passed from the previous node.
Number of Documents	number of documents in the collection in which the term appears. This variable reflects the number after filtering.
Rank	rank that corresponds to the ZIPF Plot.
Parent/Child Status	plus (+) symbol if the term is a parent; blank otherwise.

Variable	Description
Parent ID	key value of the term's parent. *Note:* Each SAS Text Miner node outputs a terms data set, which is stored with the project data. The names of these data sets follow the format "NodeID_terms" (for example, TextFilter_terms). You can determine which term corresponds to a particular key by looking at this data set. For more information about where to find project data, see the "Opening SAS Enterprise Miner 4.x and 5.3 projects in SAS Enterprise Miner 14.1" topic in the SAS Enterprise Miner Help.

For more information, see:

- "Term Roles and Attributes" on page 36
- "Term Weighting" on page 57

Text Filter Node SAS Output Results

The SAS output from the **Text Filter** node includes summary information about the input variables.

Text Filter Node Output Data

For information about output data for the **Text Filter** node, see "Output Data for SAS Text Miner Nodes" on page 131.

Using the Text Filter Node

This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

The **Text Filter** node enables you to reduce the total number of terms in your text mining analysis. For example, common or infrequent words might not be useful to analyze, and can be filtered out. This example shows you how to filter out terms using the **Text Filter** node. This example assumes that you have performed "Using the Text Parsing Node" on page 29. It builds off the process flow diagram created there.

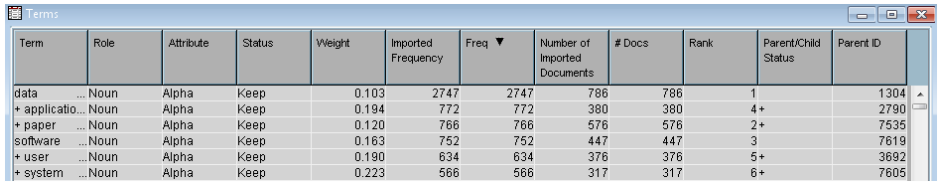
1. Select the **Text Mining** tab on the toolbar, and drag a **Text Filter** node to the diagram workspace.

2. Connect the **Text Parsing** node to the **Text Filter** node.

3. In the diagram workspace, right-click the **Text Filter** node and select **Run**. Click **Yes** in the Confirmation dialog box.

4. Click **Results** in the Run Status dialog box when the node finishes running.

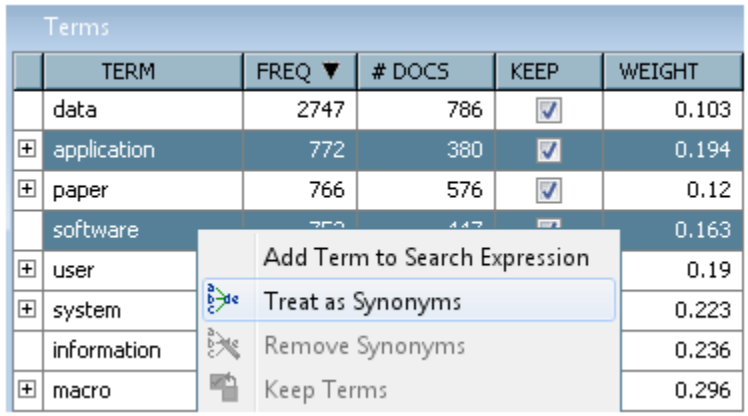
5. Select the Terms table. Sort the terms by frequency by clicking the Freq column heading.



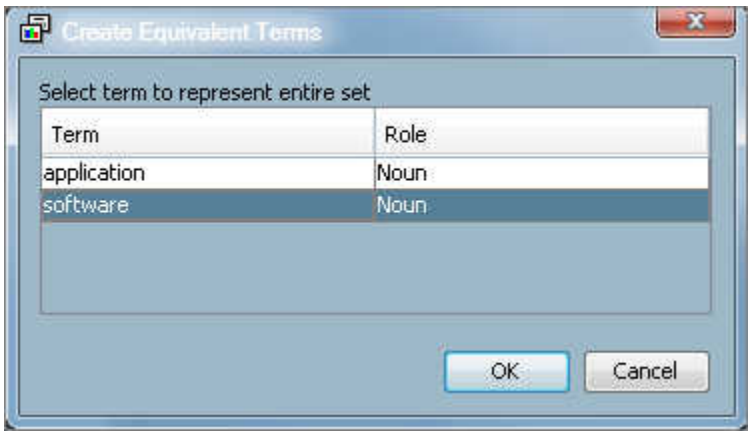
Assume that for purposes of your text mining analysis, you know that “software” and “application” are really used as synonyms in the documents that you want to analyze, and you want to treat them as the same term.

6. Close the Results window. Select the **Text Filter** node, and then click the ellipsis button for the **Filter Viewer** property.

7. In the Interactive Filter Viewer sort the terms in the Terms table by frequency. Hold down **Ctrl** on your keyboard, select “software” and “application”, and then right-click “software” and select **Treat as Synonyms** from the drop-down menu.



8. In the Create Equivalent Terms dialog box, select **software** as the term to represent both terms in the Terms table.



9. Click **OK** in the Create Equivalent Terms dialog box. Notice that the term "software" now represents both terms in the Terms table. Expand the term "software".

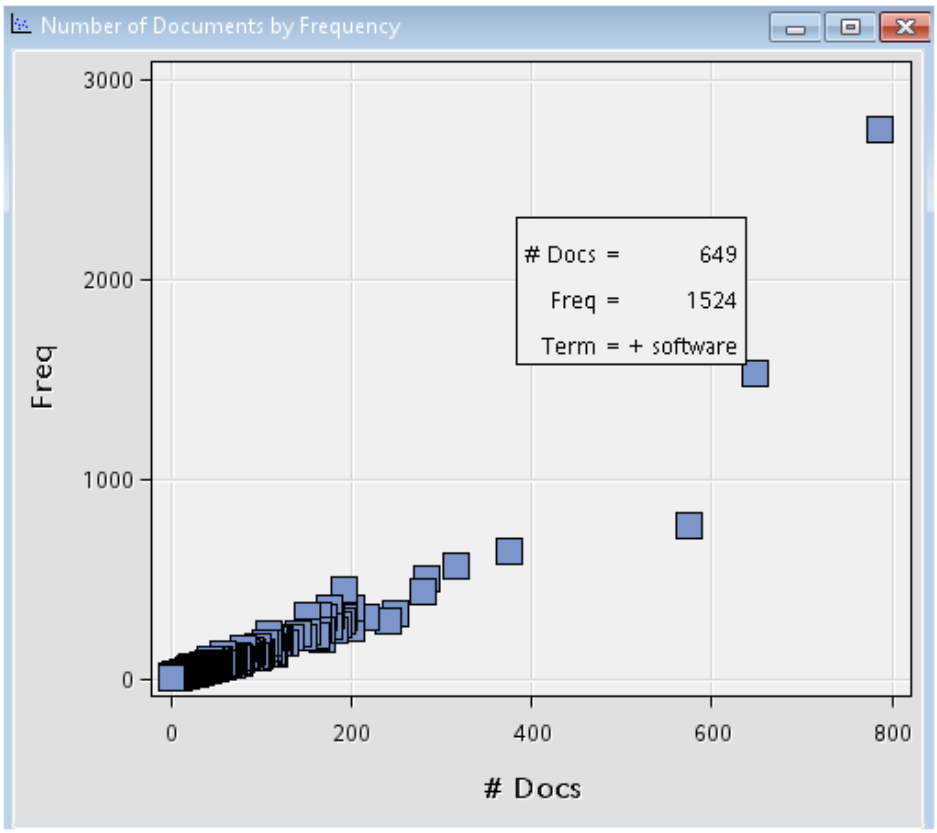
Terms

	TERM	FREQ ▼	# DOCS	KEEP	WEIGHT
⊟	software	1524	649	☑	0.122
	applications	340	218		
	software	752	447		
	application	432	242		
⊞	paper	766	576	☑	0.12
⊞	user	634	376	☑	0.19

10. Close the Interactive Filter Viewer. When prompted whether you would like to save your changes, select **Yes**.

11. Right-click the **Text Filter** node, and select **Run**. Select **Yes** in the Confirmation dialog box. Select **Results** in the Run Status dialog box when the node has finished running.

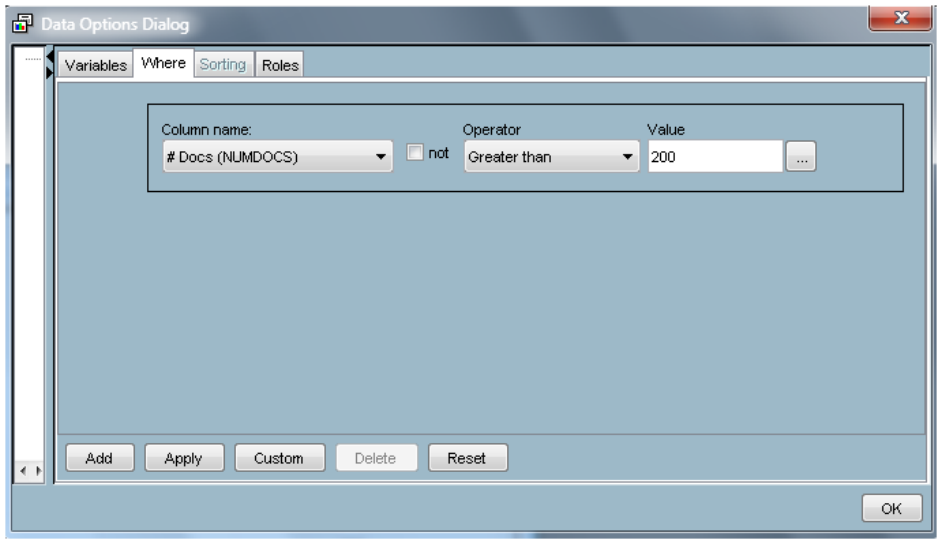
12. Select the Number of Documents by Frequency plot to see how both terms are now treated as the same.



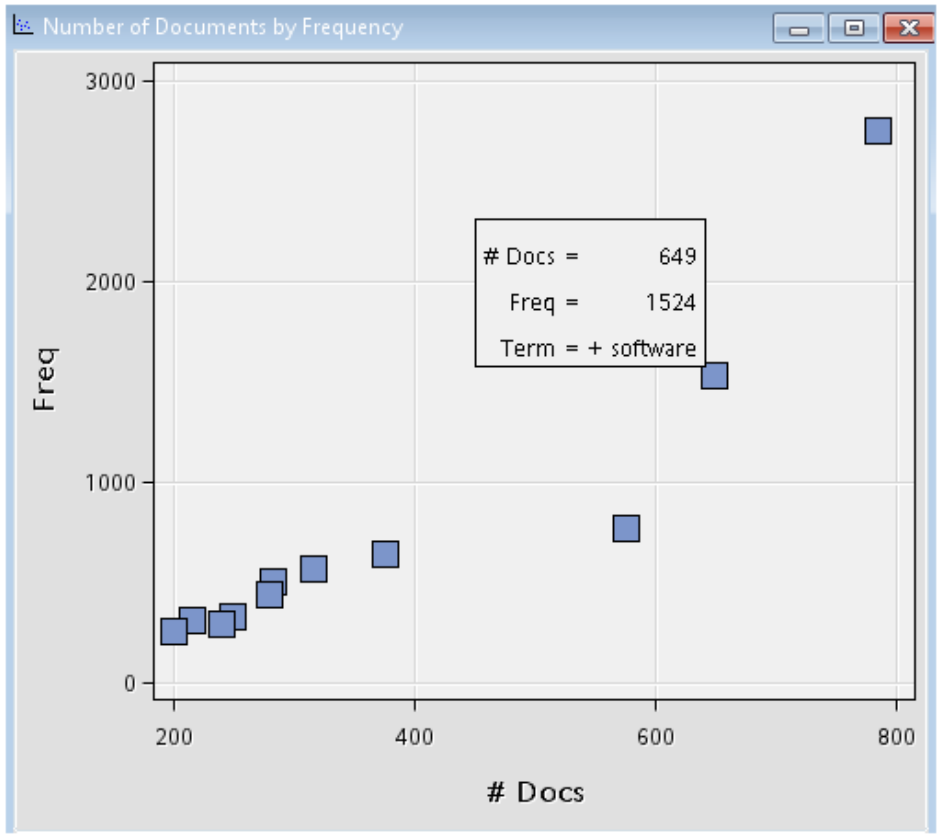
You can also use options to change your view or specify a subset of results to appear in a plot. For example, consider that you want to refine this plot to only show terms that appear in more than 200 documents.

13. Right-click the Number of Documents by Frequency plot, and select **Data Options**.

14. Select the **Where** tab in the Data Options Dialog box. Select **`# Docs`** from the **Column name** drop-down menu. Select **`Greater than`** from the **Operator** drop-down menu. Type *200* in the **Value** text box.

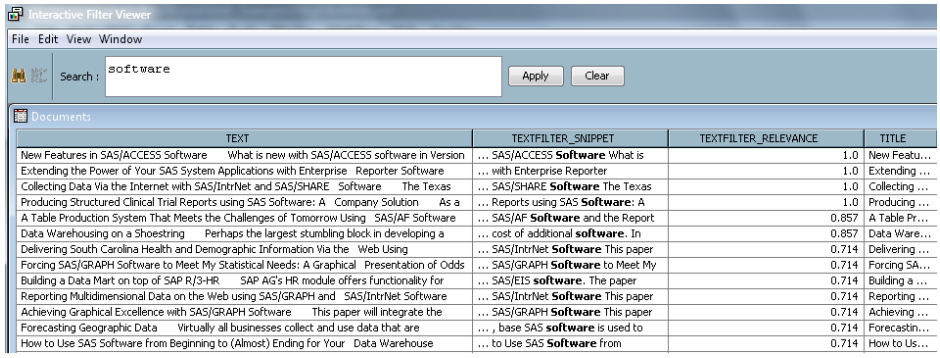


15. Click **Apply**, and then click **OK**. The Number of Documents by Frequency plot resizes and includes only terms that occur in more than 200 documents.



16. Close the Results window. In addition to resizing or subsetting a plot to help focus your analysis, you can also directly search for terms using the Interactive Filter Viewer.

17. Select the **Text Filter** node, and then click the ellipsis button for the **Filter Viewer** property. In the Interactive Filter Viewer, type *software* in the **Search** text box, and click **Apply**.



TEXT	TEXTFILTER_SNIPPET	TEXTFILTER_RELEVANCE	TITLE
New Features in SAS/ACCESS Software What is new with SAS/ACCESS software in Version	... SAS/ACCESS **Software** What is	1.0	New Featu...
Extending the Power of Your SAS System Applications with Enterprise Reporter Software	... with Enterprise Reporter	1.0	Extending ...
Collecting Data Via the Internet with SAS/IntrNet and SAS/SHARE Software The Texas	... SAS/SHARE **Software** The Texas	1.0	Collecting ...
Producing Structured Clinical Trial Reports using SAS Software: A Company Solution As a	... Reports using SAS **Software**: A	1.0	Producing ...
A Table Production System That Meets the Challenges of Tomorrow Using SAS/AF Software	... SAS/AF **Software** and the Report	0.857	A Table Pr...
Data Warehousing on a Shoestring Perhaps the largest stumbling block in developing a	... cost of additional **software**. In	0.857	Data Ware...
Delivering South Carolina Health and Demographic Information Via the Web Using	... SAS/IntrNet **Software** This paper	0.714	Delivering ...
Forcing SAS/GRAPH Software to Meet My Statistical Needs: A Graphical Presentation of Odds	... SAS/GRAPH **Software** to Meet My	0.714	Forcing SA...
Building a Data Mart on top of SAP R/3-HR SAP AG's HR module offers functionality for	... SAS/EIS **software**. The paper	0.714	Building a ...
Reporting Multidimensional Data on the Web using SAS/GRAPH and SAS/IntrNet Software	... SAS/IntrNet **Software** This paper	0.714	Reporting ...
Achieving Graphical Excellence with SAS/GRAPH Software This paper will integrate the	... SAS/GRAPH **Software** This paper	0.714	Achieving ...
Forecasting Geographic Data Virtually all businesses collect and use data that are	... , base SAS **software** is used to	0.714	Forecastin...
How to Use SAS Software from Beginning to (Almost) Ending for Your Data Warehouse	... to Use SAS **Software** from	0.714	How to Us...

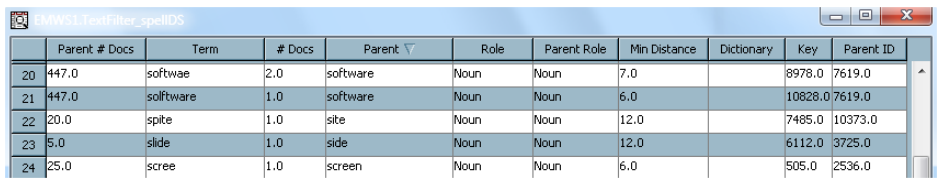
The Documents table provides a snippet of text that includes the term that you are searching for. You can use information in the Documents table to help you understand the context in which a term is being used by examining the snippet result in addition to the full text and title of the document. For more information about the Interactive Filter Viewer, see "Interactive Filter Viewer" on page 60.

Searching for a term in the Interactive Filter Viewer raises an interesting problem. As shown above, a search for "software" is case insensitive. However, what if there are instances of a term that you want to find that are misspelled in the document collection? You can also check for spelling when filtering terms using a dictionary data set.

18. Close the Interactive Filter Viewer, and select **No** when prompted for whether you want to save changes.

19. (Optional) Select the **Text Filter** node, and set the **Check Spelling** property to **`Yes`**. When you rerun the **Text Filter** node, terms will be checked for misspellings. You can also specify a data set to use in spell-checking by clicking the ellipsis button for the **Dictionary** property and selecting a data set. For information about creating a dictionary data set, see "How to Create a Dictionary Data Set" on page 56.

Right-click the **Text Filter** node, and select **Run**. Select **Yes** in the Confirmation dialog box. When the node finishes running, select **OK** in the Run Status dialog box. Click the ellipsis button for the **Spell-Checking Results** property to access a window in which you can view the data set that contains spelling corrections generated during spell-checking. To see misspellings for the term "software," click in the Parent column to sort the column in ascending order. Click again to sort the Parent column in descending order. Scroll through the table to see that the terms "software" and "solftware" are identified as misspellings of "software."



	Parent # Docs	Term	# Docs	Parent	Role	Parent Role	Min Distance	Dictionary	Key	Parent ID
20	447.0	softwae	2.0	software	Noun	Noun	7.0		8978.0	7619.0
21	447.0	solftware	1.0	software	Noun	Noun	6.0		10828.0	7619.0
22	20.0	spite	1.0	site	Noun	Noun	12.0		7485.0	10373.0
23	5.0	slide	1.0	side	Noun	Noun	12.0		6112.0	3725.0
24	25.0	scree	1.0	screen	Noun	Noun	6.0		505.0	2536.0

You can see this relationship in the Terms table in the Interactive Filter Viewer. Click the ellipsis button for the **Filter Viewer** property. Expand the term "software" in the Terms table to view its synonyms. The synonyms include "softwae," which was identified as a misspelled term during spell-checking.

Terms

	TERM	FREQ ▼	# DOCS	KEEP	WEIGHT	ROLE	ATTRIBUTE
	data	2747	786	☑	0.103	Noun	Alpha
⊟	software	1528	650	☑	0.121	Noun	Alpha
	software	752	447			Noun	Alpha
	applications	340	218			Noun	Alpha
	softwae	2	2			Noun	Alpha
	solftware	1	1			Noun	Alpha
	applicaion	1	1			Noun	Alpha
	application	432	242			Noun	Alpha
⊞	paper	766	576	☑	0.12	Noun	Alpha

Notice that the synonyms also include "application," which was created in steps 7-10 of this example, and "applicaion," which was identified during spell-checking as a misspelling of "application."

How to Create a Dictionary Data Set

You can use a “dictionary data set” as input to the **Text Filter** node or the %TEXTSYN macro for any language that is supported by SAS Text Miner.

Typically, if you specify to use spell checking during filtering, the words in a document collection are checked against each other and candidate misspellings are proposed. Including a dictionary data set for spell checking can reduce the number of misspellings that are falsely identified by this process. All words in the dictionary data set are viewed as correctly spelled, regardless of how they compare to other words in the collection.

There are several free dictionary sources that you can use with a DATA step to create a dictionary data set for use with SAS Text Miner. For example, OpenOffice.org has links to dictionaries for many languages that are available for free download at http://extensions.services.openoffice.org/dictionary.

To create an English dictionary data set that you can use with the **Text Filter** node or the %TEXTSYN macro, do the following:

1. Go to http://extensions.services.openoffice.org/en/project/en_US-dict to download the ZIP files for OpenOffice US English spelling dictionary.

2. Click **Download** to download the file en_US.oxt to your local machine. You might need to rename this file to en_US.zip in order to extract the dictionary files. The dictionary file is en_US.dic. You must extract this file to a location on your local machine.

3. In SAS Enterprise Miner, select **View** ⇨ **Program Editor**.

4. In the Program Editor that opens, enter and run the following SAS code. This code removes extraneous characters from the OpenOffice dictionary, assigns the proper noun part of speech to any term that is capitalized in the file, and creates an English dictionary data set with the required format.

   Note: Be sure to change `<fileLocation>` to the path to the ZIP files for the dictionary. Also, note that the following code uses a library called tmlib. You will need to create this library with a LIBNAME statement before running this code, or change tmlib to another library that you have already created.

```
data tmlib.engdict (keep=term pos);
   length inputterm term $32;
   infile '<fileLocation>en_US.dic'
      truncover;
   input linetxt $80.;
   i=1;
   do until (inputterm = ' ');
      inputterm = scan(linetxt, i, ' ');
      if inputterm ne ' ' then do;
          location=index(inputterm,'/');
        if location gt 0 then
        term = substr(inputterm,1,location-1);
        if location eq 0 then
        term = inputterm;
         if lowcase(term) ne term then pos = 'Prop';
         term = lowcase(term);
         output;
         end;
      i=i+1;
      end;
   run;
```

Term Weighting

Contents

Overview of Term Weights

The term weighting options in the **Text Filter** node enable you to vary the importance of terms based on how frequently the terms occur in individual documents and how the terms are distributed throughout the document collection. A weighted, term-by-document frequency matrix is created for a text mining analysis by first assigning child frequencies to their parent terms. Next, a weighting function is applied to the frequency of occurrence of each term in each document. Finally, the entry for each term is scaled by multiplying it by its term weight. This weighted, term-by-document frequency matrix becomes the underlying representation for the collection. Formally, term and frequency weights are applied as follows.

Let f_{ij} be the ijth frequency in the unweighted term-by-document matrix, the frequencies of terms be weighted using the function g(.), and the weight of the ith term be denoted by w_i. Then the weighted frequency of element f_{ij} in the term-by-document frequency matrix is: $w_i * g(f_{ij})$.

Frequency Weighting Methods

The following frequency weighting functions, g(.), are available in the **Text Filter** node.

- **Default**

  The default frequency weighting method is Log with one exception. In a process flow that has multiple **Text Filter** nodes, the default frequency weighting method that is used in a node is determined by the setting that was specified in the previous **Text Filter** node.

- **Binary**

  an indicator function, where $g(f_{ij})= 1$ if a term appears in the document, and $g(f_{ij})= 0$ if it does not. This function removes the effect of terms that occur repeatedly in the same document.

- **Log**

  $g(f_{ij})= \log_2(f_{ij}+1)$. This function dampens the effect of terms that occur many times in a document.

- **None**

  $g(f_{ij})= 1$. In other words, no change is applied to the raw frequency for the term.

Term Weighting Methods

Term weights are useful for distinguishing important terms from others. In general, the assumption is that terms that are useful for categorizing documents are those that occur in only a few documents but many times in those few documents. SAS Text Miner implements several methods that, at a high level, have the same goals. However, because the functions vary, you should try different weighting techniques to see which method works best for a particular analysis.

In the **Text Filter** node, the following term weights, w_i, are available.

- **Default**

  The default term weighting method is Entropy (if the data source does not have a categorical target) and Mutual Information (if the data source has a categorical target) with one exception. In a process flow that has multiple **Text Filter** nodes, the default term weighting method used in a node is controlled by the setting that was specified in the previous **Text Filter** node.

- **Entropy**

$$w_i = 1 + \sum_j \frac{(f_{ij}/g_i)\cdot\log_2(f_{ij}/g_i)}{\log_2(n)}$$

  Here, g_i is the number of times that term i appears in the document collection, and n is the number of documents in the collection. Log(.) is taken to be 0 if $f_{ij}=0$. This method gives greater weight to terms that occur infrequently in the document collection by using a derivative of the entropy measure found in information theory.

- **Inverse Document Frequency**

$$w_i = \log_2\left(\frac{1}{P(t_i)}\right) + 1$$

Here, $P(t_i)$ is the proportion of documents that contain term t_i. This method gives greater weight to terms that occur infrequently in the document collection by placing the number of documents that contain the term in the numerator of the formula.

Note: $1/P(t_i) = N/N(t_i)$.

- **Mutual Information**

$$w_i = \max_{C_k}\left[\log\left(\frac{P(t_i, C_k)}{P(t_i)\,P(C_k)}\right)\right]$$

Here, $P(t_i)$ is the proportion of documents that contain term t_i. $P(C_k)$ is the proportion of documents that belong to category C_k. And $P(t_i, C_k)$ is the proportion of documents that contain term t_i and belong to category C_k. Log(.) is taken to be 0 if $P(t_i, C_k)=0$ or $P(C_k)=0$.

This weight is valid only if the data source includes a categorical target variable. The weight is proportional to the similarity of the distribution of documents that contain the term to the distribution of documents that are contained in the respective category.

- **None**

$w_i = 1$. In other words, no term weight is applied.

Text Filter Node Search Expressions

The **Text Filter** node and the **Interactive Filter Viewer** enable you to use a search expression to filter documents. A subset of documents that match your query is returned. A query consists of a list of terms, and the search results show a set of documents that contain at least one of the query terms. A relevance score indicates how well each document matches the query. A relevance of 1 indicates which document was the best match in the collection for that query. You can use the following special characters to enhance a search:

- **`+term`** returns only documents that include **`term`**.
- **`-term`** returns only documents that do not include **`term`**.

  Note: A query cannot consist entirely of -term. Use of this special character must be in combination with additional query terms. Positive terms locate the documents, and then negative terms are applied to filter those.
- **`"text string"`** returns only documents that include the quoted text.
- **`string1*string2`** returns only documents that include a term that begins with **`string1`**, ends with **`string2`**, and has text in between.

- `>#term` returns only documents that include `term` or any of the synonyms that have been assigned to the `term`.

Note: The Interactive Filter Viewer does not support use of the `+` operator with the `>#` operator in a search. Query length is limited to 100 bytes on the Solaris for 64 and Solaris for x64 platforms.

Interactive Filter Viewer

Contents

Overview of the Interactive Filter Viewer

The Interactive Filter Viewer enables you to refine the parsed and filtered data that exists after the **Text Filter** node has run. You can save any changes that you make to the data when you close the Interactive Filter Viewer. The edited data is used in subsequent nodes of the analysis. To access the Interactive Filter Viewer, click the ellipsis button that corresponds to the **Filter Viewer** property in the Properties panel of the **Text Filter** node.

Searching in the Interactive Filter Viewer

Search Box Functionality

The **Search** box enables you to filter documents based on the results of a search expression. If you enter a search expression in the **Search Expression** property before you run the **Text Filter** node, then the **Search** box is populated with that expression when you open the Interactive Filter Viewer. You can edit the expression or enter a new expression in the Interactive Filter Viewer and click **Apply** to refine the filter. Search expressions can also be added to the **Search** box by right-clicking on a term in the Terms table and selecting **Add Term to Search Expression**. For more information about search expressions, see "Text Filter Node Search Expressions" on page 59.

Note: The number of search results for a given term might differ from the number of documents that are assigned to that term in the Terms table because the search is over the original text and not over the entries in the table.

Find Functionality

To access the Find Text window, select the Documents window or the Terms window and select **Edit** ⇨ **Find**. Enter text that you want to find, and click **OK**. You will be advanced to the next matching observation in the **TEXT** column of the Documents

window, or the **TERM** column of the Terms window. This behavior is different from that of the **Search** box.

Documents Window of the Interactive Filter Viewer

The Documents window of the Interactive Filter Viewer displays all of the variables in the input data source. The first variable that is displayed is the variable that was used for text parsing. To wrap or unwrap the full contents of this variable in the column cells, select **Edit** ⇨ **Toggle Show Full Text**. You cannot wrap the contents of the other columns.

If the input data source in the process flow diagram contains paths to files that contain the document text (rather than containing the full text, itself) and if these files are accessible from the client, then you can use the **Edit** menu to view the full document text. Select **Edit** ⇨ **View Input File** to view the file stored in the location that is specified by the variable with the role **`Web Address`** (if such a variable exists in the data source). Select **Edit** ⇨ **View Original** to view the file that is stored in the location specified by the variable with the role **`Text Location`**.

You can right-click the column title and select **Label** or **Name** to switch between labels and variable names.

Terms Window of the Interactive Filter Viewer

The Terms window of the Interactive Filter Viewer displays a table that is similar to the Terms table that is displayed in the **Text Filter** node results window. However, fewer variables are displayed. And, instead of displaying only top-level terms, the Terms window of the Interactive Filter Viewer displays all terms. If stemming or synonym lists are used in the node, then parent terms appear as the root of a tree in the table. Children appear as branches. Click the plus (+) symbol at the left of a parent term to view or hide its children.

The following functions in the Terms window enable you to refine your filtered data:

- Select two or more terms, and then select **Edit** ⇨ **Treat as Synonyms** to define new synonyms. You are prompted to specify which of the selected terms to treat as the parent in the Create Equivalent Terms window. The other selected terms are treated as children.

- Select one or more child terms, and then select **Edit** ⇨ **Remove Synonyms** to disassociate one or more child terms from a parent.

- Select one or more terms, and then select **Edit** ⇨ **Toggle KEEP** to toggle the keep status of one or more terms. For a single term, you can also accomplish this task by selecting the check box in the **KEEP** column for that term.

Note: You can use the SHIFT and Ctrl keys to make multiple selections in the table.

The Terms window is equipped with a quick-find functionality that enables you to scroll quickly to a specific row in a sorted column. To use quick-find, sort the table by a particular column, select any row, and enter the first letter or number of any row to which you want to scroll. The cursor advances to the first item under the sorted column that starts with that letter or number. Quick-find is available for all columns except for **KEEP**. Quick-find complements the find functionality.

Concept Linking Window of the Interactive Filter Viewer

The Concept Linking window enables you to interactively view terms that are associated with a particular term in a hyperbolic tree display. To view the Concept Linking window, select a term in the Terms window and select **Edit ⇨ View Concept Links**. The Concept Linking window is available for only a single term at a time, and for only kept terms (not for dropped terms).

In the Concept Linking window, the selected term appears in the center of the tree, surrounded by the terms that are most highly associated with that term. The width of the lines in the display represents the strength of association between terms. A thicker line indicates a closer association. For more information, see "Strength of Association for Concept Linking" on page 63. Furthermore, you can double-click a term in the display to expand the tree and include terms that are associated with that term.

If you position the mouse pointer over a term, then a tooltip shows two numbers, separated by a forward slash (/). The first number is the number of documents in which the term appears with its immediate predecessor in the display. The second number represents the total number of documents in which the term occurs in the document collection.

A pop-up menu enables you to perform these actions in the Concept Linking window:

- **Copy** — Right-click in the Concept Linking window and click **Copy** to copy the diagram into the clipboard.
- **Expand Links** — Right-click a selected node, and select **Expand Links** to expand the links associated with the node. The node will not expand if there are no further links associated with that node.
- **Add Term to Search Expression** — Right-click a selected node, and select **Add Term to Search Expression** to add the term to the **Search** box.

Create Synonym Data Sets

Perform the following steps to create a synonym data set that consists of synonym changes that you have made in the Interactive Filter Viewer.

1. Click the ellipsis button for the **Filter Viewer** property of the **Text Filter** node.

   Note: The Interactive Filter Viewer can be opened only after the **Text Filter** node has been successfully run.

2. Select terms in the **Terms** table that you want to treat as synonyms.

3. Right-click the selected terms, and then click **Treat as Synonyms** on the pop-up menu.

4. Select the term in the Create Equivalent Terms dialog box that you want to use as the parent term, and then click **OK**.

5. Select **File ⇨ Export Synonyms**.

   The Export Synonyms dialog box appears.

6. Select a library on the **Library** drop-down menu for the data set that you want to create.

   Note: If you do not see a library that you want to store a synonym data set, you can create a library in SAS Enterprise Miner before opening the Interactive Filter Viewer.

7. Provide a name for your synonym data set.

8. Click **OK**.

Strength of Association for Concept Linking

For a given pair of terms, their "strength of association" with one another is computed using the binomial distribution. This strength measure is used to produce concept linking diagrams in the **Interactive Filter Viewer** of the **Text Filter** node.

The following assumptions obtain:

- **`n`** is the number of documents that contain term **`B`**.
- **`k`** is the number of documents containing both term **`A`** and term **`B`**.
- **`p = k/n`** is the probability that term **`A`** occurs when term **`B`** occurs, assuming that they are independent of each other.

Then the strength of association between the terms **`A`** and **`B`**, for a given **`r`** documents, is as follows:

$$Strength = \log_e(1/Prob_k)$$

The sum of probabilities is as follows:

$$Prob_k = \sum_{r=k}^{r=n} Prob(r).$$

$$Prob(r) = [n! / [r!(n - r)!]] \; p^r(1-p)^{(n-r)}$$

Chapter 5

The Text Cluster Node

Overview of the Text Cluster Node

The **Text Cluster** node clusters documents into disjoint sets of documents and reports on the descriptive terms for those clusters. Two algorithms are available. The Expectation Maximization algorithm clusters documents with a flat representation, and the Hierarchical clustering algorithm groups clusters into a tree hierarchy. Both approaches rely on the singular value decomposition (SVD) to transform the original weighted, term-document frequency matrix into a dense but low dimensional representation.

The most memory-intensive task of the text clustering process is computing the SVD of the weighted term-by-document frequency matrix. For more information, see "Singular Value Decomposition" on page 74. When in-memory resources are limited, the node might use, instead of the full collection, a simple random sample of the documents in an attempt to run the node successfully. Sampling occurs only if the node encounters a memory failure during an attempt to compute the SVD without sampling. Furthermore, because sampling generally occurs when the document collection is extremely large, there is typically not an adverse effect on modeling results. Exactly when sampling occurs depends on a number of parameters including the size of your collection, the platform on which your system is running, and the available RAM.

For related topics that you might find useful when using the **Text Cluster** node, see the following:

Note: The **Text Cluster** node is not supported for use in group processing (Start Groups and End Groups nodes).

Text Cluster Node Input Data

The **Text Cluster** node requires the following predecessor nodes:

- a data source
- a **Text Parsing** node
- a **Text Filter** node

Text Cluster Node Properties

Contents

Text Cluster Node General Properties

These are the general properties that are available on the **Text Cluster** node:

- **Node ID** — displays the ID that is assigned to the node. Node IDs are especially useful for distinguishing between two or more nodes of the same type in a process flow diagram. For example, the first **Text Cluster** node that is added to a diagram will have the Node ID `TextCluster`. The second **Text Cluster** node that is added will have the Node ID `TextCluster2`.

- **Imported Data** — accesses a list of the data sets that are imported by the node and the ports that provide them. Click the ellipsis button to open the Imported Data window, which displays this list. If data exists for an imported data set, then you can select a row in the list and do any of the following:

  - browse the data set

  - explore (sample and plot) the data in a data set

  - view the table and variable properties of a data set

- **Exported Data** — accesses a list of the data sets that are exported by the node and the ports to which they are provided. Click the ellipsis button to open the Exported Data window, which displays this list. If data exists for an exported data set, then you can select a row in the list and do any of the following:

  - browse the data set

  - explore (sample and plot) the data in a data set

  - view the table and variable properties of a data set

- **Notes** — accesses a window that you can use to store notes of interest, such as data or configuration information. Click the ellipsis button to open the Notes window.

Text Cluster Node Train Properties

General Train Properties

These are the training properties that are available on the **Text Cluster** node:

- **Variables** — accesses a list of variables and associated properties in the data source. Click the ellipsis button to open the Variables window.
- "Transform Properties" on page 67
- "Cluster Properties" on page 68

Transform Properties

- **SVD Resolution** — specifies the resolution to use to generate the singular-value decomposition (SVD) dimensions. For more information about SVD, see "Singular Value Decomposition" on page 74.
- **Max SVD Dimensions** — specifies the maximum number of SVD dimensions to generate. The minimum value that you can specify is `2`, and the maximum value that you can specify is `500`.

Cluster Properties

- **Exact or Maximum Number** — specifies whether to find an exact number of clusters or any number less than or equal to a maximum number of clusters.
- **Number of Clusters** — specifies the number of clusters to create. This is the exact number if the value of **Exact or Maximum Number** is `Exact`, and it is the maximum number if the value of **Exact or Maximum Number** is `Maximum`.
- **Cluster Algorithm** — specifies the clustering algorithm to use. For more information about clustering, see "Clustering Techniques" on page 79.
- **Descriptive Terms** — specifies the number of descriptive terms to display for each cluster. The default value is `15`. For more information, see "Descriptive Terms" on page 81.

Text Cluster Node Status Properties

These are the status properties that are displayed on the **Text Cluster** node:

- **Create Time** — time that the node was created.
- **Run ID** — identifier of the run of the node. A new identifier is assigned every time the node is run.
- **Last Error** — error message, if any, from the last run.
- **Last Status** — last reported status of the node.
- **Last Run Time** — time at which the node was last run.
- **Run Duration** — length of time that is required to complete the last node run.
- **Grid Host** — grid host, if any, that was used for computation.
- **User-Added Node** — denotes whether the node was created by a user as a SAS Enterprise Miner extension node. The value of this property is always `No` for the **Text Cluster** node.

Text Cluster Node Results

Contents

Results Window for the Text Cluster Node

After the **Text Cluster** node runs successfully, you can access the Results window in three ways:

- Click **Results** in the Run Status dialog box that opens immediately after a successful run of the **Text Cluster** node.
- Click the Results icon on the main Toolbar.
- Right-click the **Text Cluster** node, and click **Results**.

The Results window for the **Text Cluster** node is similar to the Results window for other nodes in SAS Enterprise Miner. For general information about the Results window, see the SAS Enterprise Miner Help. The icons and main menus are the same as other nodes. However, the **View** menu does not include the options **Assessment** or **Model**. Instead, it includes the **Clusters** option, which accesses submenus that list the graphical and tabular results.

Note: You can access the SAS log from the **SAS Results** submenu of the **View** menu. This log can be a useful debugging tool.

Text Cluster Node Graphical and Tabular Results

The following are the graphical results in the **Text Cluster** node Results window.

- The **Cluster Frequencies** pie chart shows the frequency of each cluster. Position the mouse pointer over a sector to see the cluster ID and frequency in a tooltip. Select a sector to highlight the cluster in the other graphical results windows and the **Clusters** table.
- The **Cluster Frequency by RMS** scatter plot shows the root mean squared (RMS) standard deviation by frequency. Position the mouse pointer over a point to see the frequency, RMS standard deviation, and descriptive terms in the cluster in a tooltip. Select a point to highlight the cluster in the other graphical results windows and the **Clusters** table.
- The **Distance Between Clusters** scatter plot shows the distance between clusters using a Cartesian coordinate system. Position the mouse pointer over a point to see the x-coordinate, y-coordinate, cluster ID, and descriptive terms in the cluster in a tooltip. Select a point to highlight the cluster in the other graphical results windows and the **Clusters** table.
- The **Cluster Hierarchy** plot shows a hierarchical relationship among clusters when the **Cluster Algorithm** property is set to **`HIERARCHICAL`**. Select a point to highlight corresponding information in the **Hierarchy Data** table.

The **Clusters** table displays information about each cluster.

The **Hierarchy Data** table displays hierarchical and statistical information about each cluster in the Clusters table when the **Cluster Algorithm** property is set to **`HIERARCHICAL`**.

Text Cluster Node SAS Output Results

The SAS output from the **Text Cluster** node includes summary information about the input variables.

Text Cluster Node Output Data

For information about output data for the **Text Cluster** node, see "Output Data for SAS Text Miner Nodes" on page 131.

Using the Text Cluster Node

This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

This example uses the **Text Cluster** node to cluster SAS Users Group International (SUGI) abstracts.

Note: SAS Users Group International is now SAS Global Forum.

Perform the following steps:

1. Create a data source for SAMPSIO.ABSTRACT. Change the Role of the variable TITLE to **`ID`**.

   Note: The SAMPSIO.ABSTRACT data set contains information about 1,238 papers prepared for meetings of SUGI from 1998 through 2001 (SUGI 23 through 26). The variable TITLE is the title of the SUGI paper. The variable TEXT contains the abstract of the SUGI paper.

2. Add the SAMPSIO.ABSTRACT data source to the diagram workspace.

3. Select the **Text Mining** tab on the Toolbar, and drag a **Text Parsing** node to the diagram workspace.

4. Connect the **Input Data** node to the **Text Parsing** node.

5. Select the **Text Parsing** node, and then click the ellipsis for the **Stop List** property.

6. Click **Replace Table** , browse to select SAMPSIO.SUGISTOP as the stop list, and then click **OK**. Click **Yes** in the confirmation dialog box. Click **OK** to exit the dialog box for the **Stop List** property.

7. Set the **Find Entities** property to **Standard**.

8. Click the ellipsis button for the **Ignore Types of Entities** property to open the Ignore Types of Entities dialog box.

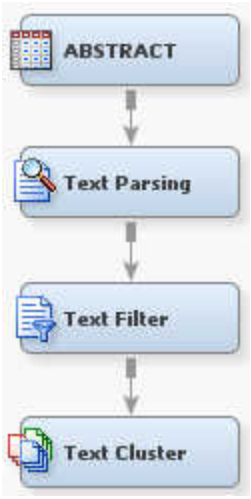
9. Select all entity types except for **`Location`**, **`Organization`**, **`Person`**, and **`Product`**. Click **OK**.

10. Select the **Text Mining** tab, and drag a **Text Filter** node into the diagram workspace.

11. Connect the **Text Parsing** node to the **Text Filter** node.

12. Select the **Text Mining** tab, and drag a **Text Cluster** node into the diagram workspace.

13. Connect the **Text Filter** node to the **Text Cluster** node. Your process flow diagram should resemble the following:



14. Right-click the **Text Cluster** node and select **Run**. Click **Yes** in the Confirmation dialog box.

15. Click **Results** in the Run Status dialog box when the node has finished running.

16. Select the Clusters table.

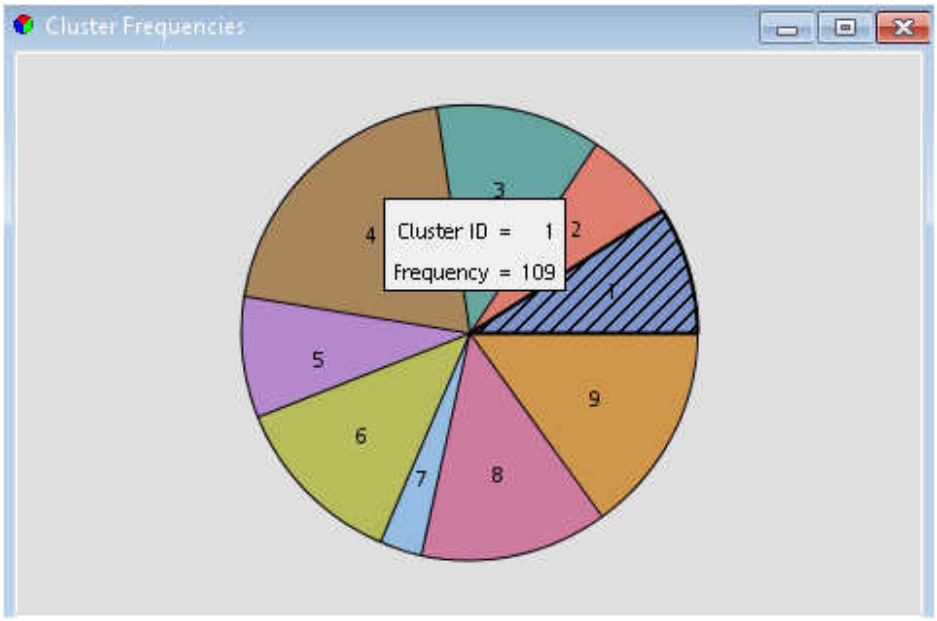
    The Clusters table contains an ID for each cluster, the descriptive terms that make up that cluster, and statistics for each cluster.

Clusters

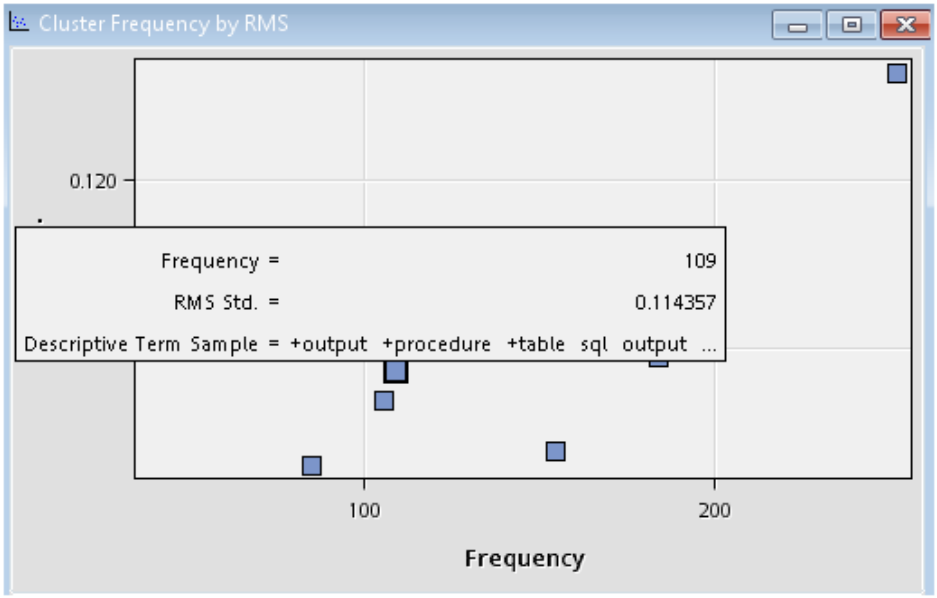
Cluster ID	Descriptive Terms	Frequency	Percentage
1	+output +procedure +table ...	109	9%
2	af +object +frame +entry +...	85	7%
3	+warehouse +'data wareho...	142	11%
4	+model +analysis statistic...	252	20%
5	+server +performance nt s...	106	9%
6	+set +variable +macro +'d...	155	13%
7	'sas institute' institute +gro...	39	3%
8	+program +programmer +r...	166	13%
9	web +graph intrnet +page ...	184	15%

17. Select the first cluster in the Clusters table.

18. Select the Cluster Frequencies window to see a pie chart of the clusters by frequency. Position the mouse pointer over a section to see the frequency for that cluster in a tooltip.

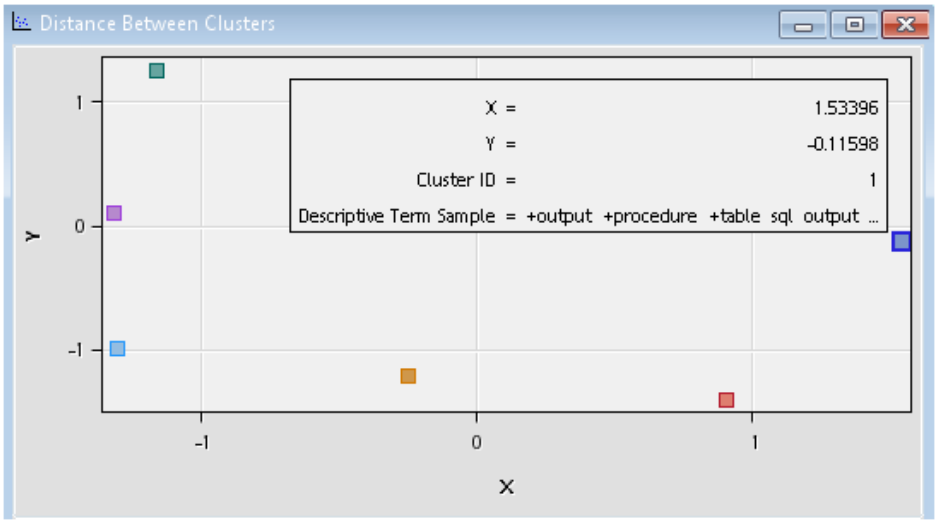


19. Select the Cluster Frequency by RMS window, and then position the mouse pointer over the highlighted cluster.



How does the first cluster compare to the other clusters in terms of distance?

20. Select the Distance Between Clusters window. Then position the mouse pointer over the highlighted cluster to see the position of the first cluster in an X and Y coordinate grid.



Position the mouse pointer over other clusters to compare distances.

21. Close the Results window.

    Now compare the clustering results obtained with the Expectation-Maximization clustering algorithm by using a Hierarchical clustering algorithm.

22. Select the **Text Cluster** node.

23. Select **`Exact`** for the **Exact or Maximum Number** property.

24. Specify *10* for the **Number of Clusters** property.

25. Select **`Hierarchical`** for the **Cluster Algorithm** property.

26. Right-click the **Text Cluster** node and select **Run**. Click **Yes** in the Confirmation dialog box.

27. Click **Results** in the Run Status dialog box when the node has finished running.

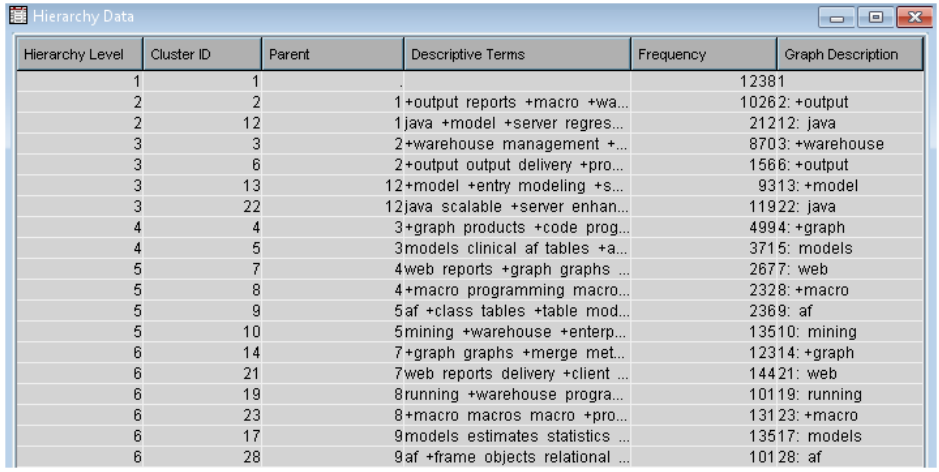
28. Select the Clusters table.

Clusters

Cluster ID	Descriptive Terms	Frequency	Percentage
6	+output output delivery ...	156	13%
10	mining +warehouse +e...	135	11%
13	+model +entry modelin...	93	8%
14	+graph graphs +merge ...	123	10%
17	models estimates stati...	135	11%
19	running +warehouse pr...	101	8%
21	web reports delivery +c...	144	12%
22	java scalable +server e...	119	10%
23	+macro macros macro ...	131	11%
28	af +frame objects relati...	101	8%

Notice that while there are 10 clusters in the table, the Cluster IDs do not range from 1 to 10.

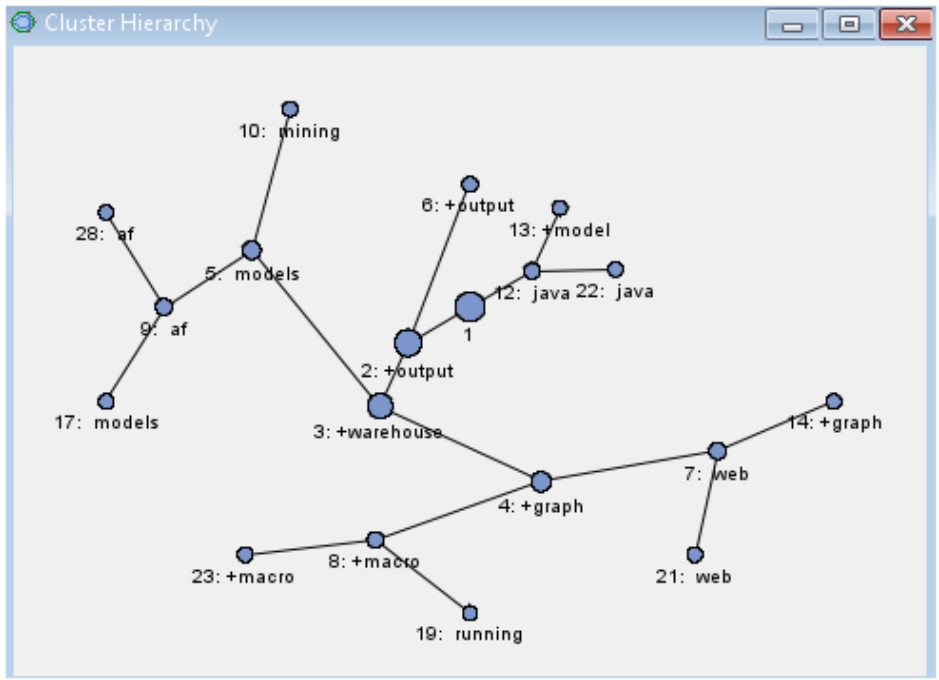
29. Select the Hierarchy Data table for more information about the clusters that appear in the Clusters table.



Hierarchy Data

Hierarchy Level	Cluster ID	Parent	Descriptive Terms	Frequency	Graph Description
1	1	.		12381	
2	2	1	+output reports +macro +wa...	10262	+output
2	12	1	java +model +server regres...	2121	2: java
3	3	2	+warehouse management +...	8703	+warehouse
3	6	2	+output output delivery +pro...	1566	+output
3	13	12	+model +entry modeling +s...	931	3: +model
3	22	12	java scalable +server enhan...	1192	2: java
4	4	3	+graph products +code prog...	4994	+graph
4	5	3	models clinical af tables +a...	3715	5: models
5	7	4	web reports +graph graphs ...	2677	7: web
5	8	4	+macro programming macro...	2328	+macro
5	9	5	af +class tables +table mod...	2369	9: af
5	10	5	mining +warehouse +enterp...	1351	0: mining
6	14	7	+graph graphs +merge met...	1231	4: +graph
6	21	7	web reports delivery +client ...	1442	1: web
6	19	8	running +warehouse progra...	1011	9: running
6	23	8	+macro macros macro +pro...	1312	3: +macro
6	17	9	models estimates statistics ...	1351	7: models
6	28	9	af +frame objects relational ...	1012	8: af

30. Select the Cluster Hierarchy graph for a hierarchical graphical representation of the clusters.



31. Close the Results window.

Singular Value Decomposition

Parsing the document collection generates a term-document frequency matrix. Each entry of the matrix represents the number of times that a term appears in a document. For a collection of several thousand documents, the term-document frequency matrix can contain hundreds of thousands of words. It requires too much computing time and space

to analyze this matrix effectively. Also, dealing with high dimensional data is inherently difficult for modeling. To improve the performance, singular value decomposition (SVD) can be implemented to reduce the dimensions of the term-document frequency matrix. SVD transforms the matrix into a lower dimensional, more compact, and informative form.

A high number of SVD dimensions usually summarize the data better. But the higher the number, the more computing resources are required. The **Text Cluster** node determines the number of SVD dimensions based on the values of the **SVD Resolution** and **Max SVD Dimensions** properties. The value of the **SVD Resolution** property can be set to **`Low`** (default), **`Medium`**, or **`High`**. High resolution yields more SVD dimensions. The default value of the **Max SVD Dimensions** property is 100, and the value must be between 2 and 500. Suppose that the maximum number of SVD dimensions that you specify for the **Max SVD Dimensions** property is maxdim and these maxdim SVD dimensions account for p% of the total variance. High resolution always generates the maximum number of SVD dimensions, maxdim. For medium resolution, the recommended number of SVD dimensions account for 5/6*(p% of the total variance). For low resolution, the recommended number of SVD dimensions account for 2/3*(p% of the total variance).

The computation of the SVD is itself a memory-intensive task. For extremely large problems, the SVD might automatically perform a random sample of the documents in an attempt to avoid running out of memory. When this occurs, a note indicating that sampling has occurred will be written to the SAS log.

The SVD approximates the original weighted frequency matrix. It is the best least squares fit to that matrix. In other words, for any given k, the transformation output will be the factorization of the matrix with k dimensions that best approximates the original matrix. A higher value of k gives a better approximation to the matrix A. However, choosing too large a value for k might result in too high a dimension for the modeling process. Generally, the value of k must be large enough to preserve the meaning of the document collection, but not so large that it captures the noise. Values between 10 and 200 are appropriate unless the document collection is small. In SAS Text Miner, you can specify the number of dimensions (k). That is, you can specify the first k singular values to be calculated. The algorithm for computing the singular values is designed to give only the leading singular values. The value for k can be at most 4 fewer than the minimum of the number of rows and number of columns of A. In some cases, the algorithm might not be able to calculate that many singular values, so you must reduce the number of dimensions. As you carry out text mining, this problem does not usually occur. For your specific text mining application, you might want to compare the results for several values of k. As a general rule, smaller values of k (2 to 50) are useful for clustering, and larger values (30 to 200) are useful for prediction or classification.

SVD factors the large, sparse term-by-document frequency matrix by calculating a truncated SVD of the matrix. Then, it projects the rows or columns of the sparse matrix onto the columns of a dense matrix.

Suppose **`A`** is the large, sparse term-by-document frequency matrix with weighted entries. The SVD of a matrix **`A`** is a factorization of **`A`** into three new matrices **`U`**, **`D`**, and **`V`**, such that $\mathbf{A} = \mathbf{UDV}^{\mathbf{T}}$, where matrices **`U`** and **`V`** have orthonormal columns, and **`D`** is a diagonal matrix of singular values. SVD calculates only the first **`k`** columns of these matrices (**`U`**, **`D`**, and **`V`**). This is called the truncated decomposition of the original matrix.

After the SVD is computed, each column (or document) in the term-by-document frequency matrix can be projected onto the first k columns of U. Mathematically, this projection forms a k-dimensional subspace that is a best fit to describe the data set. Column projection (document projection) of the term-by-document matrix is a method to represent each document by k distinct concepts.

In other words, the collection of documents is mapped into a k-dimensional space in which one dimension is reserved for each concept. Similarly, each row (or term) in the term-by-document matrix can be projected onto the first k columns of **V**.

The following description shows the benefits of the SVD. Suppose that you have a document collection as given below. Documents 1, 3, and 6 are about banking at a financial institution. To be more specific, documents 3 and 6 are about borrowing from a financial institution. Documents 2, 4, 5, and 7 are about the bank of a river. Finally, documents 8 and 9 are about a parade. Some of these documents share the same words. A bank can relate to a financial institution or to the shore of a river. “Check” can serve as a noun in document 1 or in an entirely different role as a verb in document 8. “Floats” is used as both a verb in document 4 and as an object that appears in a parade in document 8.

- Document 1 — deposit the cash and check in the bank
- Document 2 — the river boat is on the bank
- Document 3 — borrow based on credit
- Document 4 — river boat floats up the river
- Document 5 — boat is by the dock near the bank
- Document 6 — with credit, I can borrow cash from the bank
- Document 7 — boat floats by dock near the river bank
- Document 8 — check the parade route to see the floats
- Document 9 — along the parade route

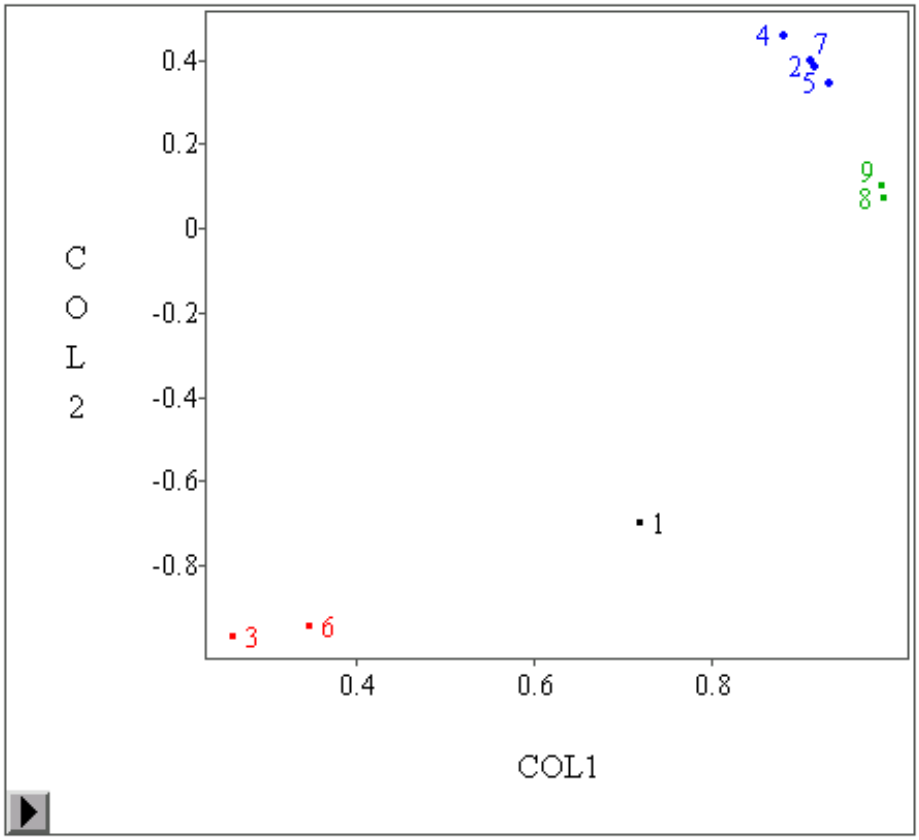
Parsing this document collection generates the following term-by-document frequency matrix:

	d1	d2	d3	d4	d5	d6	d7	d8	d9
the	2	2	0	1	2	1	1	2	1
cash	1	0	0	0	0	1	0	0	0
check	1	0	0	0	0	0	0	1	0
bank	1	1	0	0	1	1	1	0	0
river	0	1	0	2	0	0	1	0	0
boat	0	1	0	1	1	0	1	0	0
+ be	0	1	0	0	1	0	0	0	0
on	0	1	1	0	0	0	0	0	0
borro w	0	0	1	0	0	1	0	0	0
credit	0	0	1	0	0	1	0	0	0
+ floats	0	0	0	1	0	0	1	1	0
by	0	0	0	0	1	0	1	0	0

	d1	d2	d3	d4	d5	d6	d7	d8	d9
dock	0	0	0	0	1	0	1	0	0
near	0	0	0	0	1	0	1	0	0
parade	0	0	0	0	0	0	0	1	1
route	0	0	0	0	0	0	0	1	1

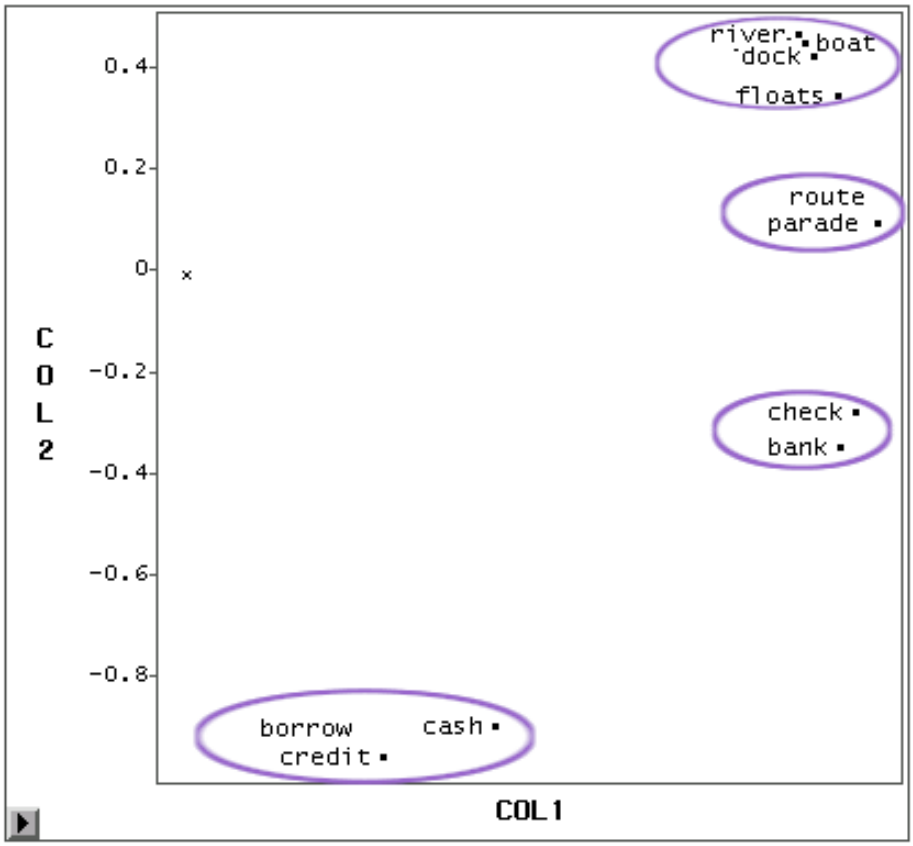
By using the co-occurrence of items from the matrix as a measure of similarity, you can see that documents 1 and 2 are more similar than documents 1 and 3. This is because documents 1 and 2 share the same word **bank**, but documents 1 and 3 have no words in common. However, in fact, documents 1 and 2 are not related at all, but documents 1 and 3 are similar. The SVD helps overcome this difficulty.

The SVD is then applied to approximate the above matrix, and documents are projected into a reduced dimensional space. The generated SVD dimensions are those that fit the subspace the best in terms of least-square best fit. The following displays show the two-dimensional scatter plot of documents.

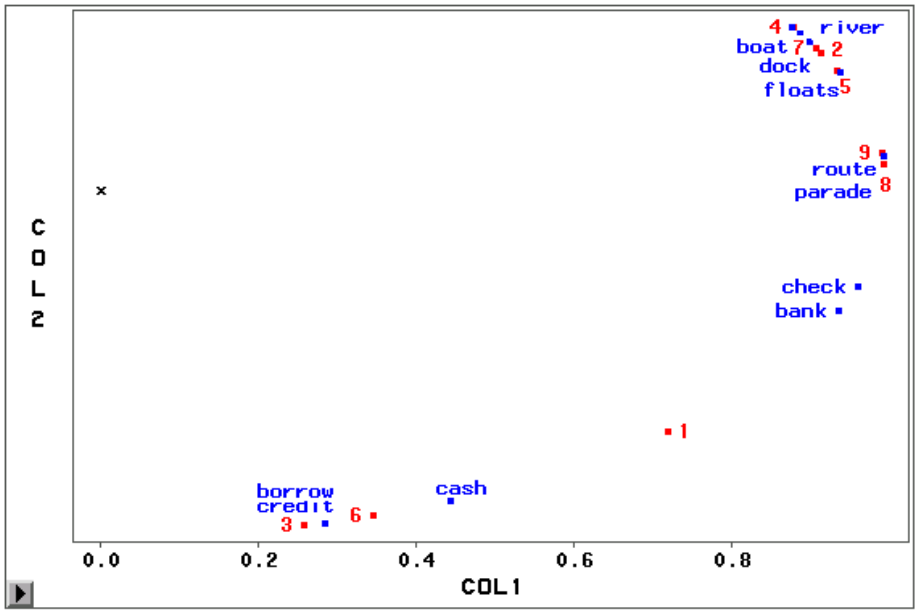


Document 1 is closer to document 3 than it is to document 2. This is true even though documents 1 and 3 do not share any of the same words. On the other hand, document 5 is directly related to documents 2, 4, and 7. That is, projections tend to place similar documents—even if they share few common words—close to one another in the reduced space. The SVD represents terms with 2 dimensions rather than the original 16 dimensions (1 dimension for each word).

The following display shows the two-dimensional scatter plot of terms. The terms form four groups:



The following display shows the scatter plot of documents and terms all together:



Clustering Techniques

Contents

Hierarchical Clustering

When the **Text Cluster** node performs hierarchical clustering on document vectors, it obtains an initial set of seeds. Then, the node generates a result tree. In this tree, parent clusters always contain at least two children, and children are either leaves or have subtrees, themselves.

In hierarchical clustering, the Ward minimum variance method is used. In this method, the distance between two clusters is as follows:

$$\frac{(u_1 - u_2)'(u_1 - u_2)}{1/n_1 + 1/n_2}$$

Here, u_1 and u_2 are the cluster means, and n_1 and n_2 are the cluster frequencies.

Expectation-Maximization Clustering

The expectation-maximization (EM) algorithm assumes that a mixture model approximates the data distribution by fitting k cluster density functions, f_h (h=1, ..., k) to a data set with d variables. The mixture model probability density function that is evaluated at point x is as follows:

$$p(x) = \sum_{h=1}^{k} w_h f_h(x \mid \mu_h, \Sigma_h)$$

Here, w_h is the proportion of data that belongs to primary cluster h. Each cluster is modeled by a d-dimensional Gaussian probability distribution as follows:

$$f_h(x \mid \mu_h, \Sigma_h) = \frac{1}{\sqrt{(2\pi)^d |\Sigma_h|}} \exp\left(-\frac{1}{2}(x - \mu_h)^T (\Sigma_h)^{-1}(x - \mu_h)\right)$$

Here, μ_h and D_h are the mean vector and covariance matrix for each cluster h.

In the **Text Cluster** node, EM clustering is an iterative process:

1. Obtain initial parameter estimates.

2. Apply the standard or scaled version of the EM algorithm to find primary clusters and to update parameter estimates. The standard EM algorithm uses the entire input data set at each iteration to estimate the model parameters. The scaled EM algorithm, on the other hand, uses a portion of the input data set at each iteration.

   If the data set is small enough and less memory is needed, the standard EM algorithm is used. Otherwise, the scaled EM algorithm is used. The algorithm terminates when two successive log-likelihood values differ by a particular amount or when a maximum of five iterations has been reached.

3. (For the scaled EM algorithm) Summarize data in the primary summarization phase. Observations that are near each of the primary cluster means are summarized. If a primary cluster contains fewer observations than the minimum requirement, this cluster becomes inactive. Inactive clusters are not used for updating the parameter estimates in the EM algorithm.

4. (For the scaled EM algorithm) Summarize data in the secondary summarization phase. Secondary clusters are identified as subsets of observations that result from a k-means clustering algorithm, where the sample standard deviation for each variable does not exceed the specified amount. Then, a hierarchical agglomerative clustering algorithm is used to combine similar secondary clusters. A secondary cluster is disjoint from all other secondary clusters and from all primary clusters.

For each observation x in the data set at iteration j, the parameter estimates of a standard EM algorithm are computed as follows:

1. Compute the membership probability of x in each cluster h = 1,...,k.

$$w_h^j(x) = \frac{w_h^j f_h\left(x \mid \mu_h^j, \Sigma_h^j\right)}{\sum w_i^j f_i\left(x \mid \mu_i^j, \Sigma_i^j\right)}$$

2. Update the mixture model parameters for each cluster h = 1,...,k.

$$w_h^{j+1} = \sum_x w_h^j(x)$$

$$\mu_h^{j+1} = \frac{\sum_x w_h^j(x)\, x}{\sum_x w_h^j(x)} \qquad \Sigma_h^{j+1} = \frac{\sum_x w_h^j(x)(x - \mu_h^{j+1})(x - \mu_h^{j+1})^T}{\sum_x w_h^j(x)}$$

The iterative computation stops if $\left| L(\Phi^j) - L(\Phi^{j+1}) \le \varepsilon \right|$, where ε > 0, and

$$L(\Phi) = \sum_x \log\left[\sum_{h=1}^{k} w_h f_h(x \mid \mu_h, \Sigma_h)\right]$$

For EM clustering, the distance between a document and a cluster is the Mahalanobis distance, sqrt((x-u)'S(x-u)). Here, u is the cluster mean, and S is the inverse of the cluster covariance matrix.

Descriptive Terms

The **Text Cluster** node uses a descriptive terms algorithm to describe the contents of both EM clusters and hierarchical clusters. If you specify to display m descriptive terms for each cluster, then the top 2*m most frequently occurring terms in each cluster are used to compute the descriptive terms.

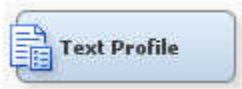
For each of the 2*m terms, a binomial probability for each cluster is computed. The probability of assigning a term to cluster j is prob=F(k|N, p). Here, F is the binomial cumulative distribution function. k is the number of times that the term appears in cluster j. N is the number of documents in cluster j. p is equal to (sum-k)/(total-N), sum is the total number of times that the term appears in all the clusters, and total is the total number of documents. The m descriptive terms are those that have the highest binomial probabilities.

Descriptive terms must have a keep status of Y and must occur at least twice (by default) in a cluster. You can use the macro variable TM_MINDESCTERMS to change the minimum frequency that a descriptive term must have. If a cluster consists of blank documents or documents that contain only the dropped terms, or if the terms do not meet the minimum required frequency, then no descriptive term will be displayed. For more information about macro variables, see "Using Macro Variables to Set Additional Properties" on page 135.

Chapter 6

The Text Profile Node

Overview of the Text Profile Node



The **Text Profile** node enables you to profile a target variable using terms found in the documents. For each level of a target variable, the node outputs a list of terms from the collection that characterize or describe that level.

The approach uses a hierarchical Bayesian model using PROC TMBELIEF to predict which terms are the most likely to describe the level. In order to avoid merely selecting the most common terms, prior probabilities are used to down-weight terms that are common in more than one level of the target variable. For binary target variables, a two-way comparison is used to enhance the selection of terms. For nominal variables, an n-way comparison is used. Finally, for ordinal and time variables (which are converted to ordinal internally), a sequential, two-way comparison is done. This means that the reported terms for level n are compared to those at level n-1. The exception for this is the first level, which is compared to level 2 since there is no preceding level to compare it to.

In all cases of variable types, a corpus-level profile output is also provided. This can be interpreted as the best descriptive terms for the entire collection itself.

See the following for more information about the **Text Profile** node:

Note: The **Text Profile** node is not supported for use in group processing (Start Groups and End Groups nodes).

Text Profile Node Input Data

The **Text Profile** node requires the following:

- one **Text Parsing** node and at least one **Text Filter** node that precedes it in the diagram.
- at least one target variable with a measurement level of either **`Binary`**, **`Ordinal`**, or **`Nominal`**, or a format type of **`DATE`** or **`DATETIME`.** The **Use** column value must be set to **`Default`** or **`Yes`**.

  Note: The **Text Profile** node can profile multiple binary targets. If the node has more than one of any other target type, then only the first one in the target list will be profiled. The type of an ordinal target variable must be numeric.

Text Profile Node Properties

Contents

Text Profile Node General Properties

These are the general properties that are available on the **Text Profile** node:

- **Node ID** — displays the ID that is assigned to the node. Node IDs are especially useful for distinguishing between two or more nodes of the same type in a process flow diagram. For example, the first **Text Profile** node that is added to a diagram will have the Node ID **`TextProfile`**, and the second **Text Profile** node that is added will have the Node ID **`TextProfile2`**.

- **Imported Data** — accesses a list of the data sets that are imported by the node and the ports that provide them. Click the ellipsis button to open the Imported Data window, which displays this list. If data exists for an imported data set, then you can select a row in the list and do any of the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set
- **Exported Data** — accesses a list of the data sets that are exported by the node and the ports to which they are provided. Click the ellipsis button to open the Exported Data window, which displays this list. If data exists for an exported data set, then you can select a row in the list and do any of the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set
- **Notes** — accesses a window that you can use to store notes of interest, such as data or configuration information. Click the ellipsis button to open the Notes window.

Text Profile Node Train Properties

These are the training properties that are available on the **Text Profile** node:

- **Variables** — accesses a list of variables and associated properties in the data source. Click the ellipsis button to open the Variables window.
- **Maximum Number of Terms** — specifies the maximum number of terms to use to describe each variable level.
- **Date Binning Interval** — specifies the time interval to bin date target variables.

  Note: This setting is applied only for date targets in the data source.

Text Profile Node Status Properties

These are the status properties that are displayed on the **Text Profile** node:

- **Create Time** — time at which the node was created.
- **Run ID** — identifier of the run of the node. A new identifier is assigned every time the node is run.
- **Last Error** — error message, if any, from the last run.
- **Last Status** — last reported status of the node.

- **Last Run Time** — time at which the node was last run.
- **Run Duration** — length of time that is required to complete the last node run.
- **Grid Host** — grid host, if any, that was used for computation.
- **User-Added Node** — denotes whether the node was created by a user as a SAS Enterprise Miner extension node. The value of this property is always `No` for the **Text Profile** node.

Text Profile Node Results

Contents

Results Window for the Text Profile Node

After the **Text Profile** node runs successfully, you can access the Results window in three ways:

- Click **Results** in the Run Status window that opens immediately after a successful run of the **Text Profile** node.
- Click the Results icon on the main toolbar.
- Right-click the **Text Profile** node, and click **Results**.

The Results window for the **Text Profile** node is similar to the Results window for other nodes in SAS Enterprise Miner. For general information about the Results window, see the SAS Enterprise Miner Help. The icons and main menus are the same as other nodes. However, the **View** menu for the **Text Profile** node Results window does not include the options **Assessment** or **Model**. Instead, it includes **Targets**, which accesses a submenu that lists the graphical and tabular results.

Note: You can access the SAS log that was generated by the node processing from the **SAS Results** submenu of the **View** menu. This log can be a useful debugging tool.

Text Profile Node Graphical and Tabular Results

The tabular result in the **Text Profile** node Results window is the Profiled Variables table. This table displays the value of each target variable and its associated highest-belief terms. Each observation has at most the specified maximum number of terms associated with it, but it can have fewer. The **Target Similarities** constellation plot and the **Target Distribution** pie chart are linked to this table. Therefore, you can select an observation in the Profiled Variables table to highlight the associated data points in these

graphics. Or, you can select data points in these graphics to highlight the associated observations in the Profiled Variables table.

Table 6.1 *Contents of the Profiled Variables Table*

Variable	Description
Name	name of the target variable or corpus
Value	values of the target variable
Term 1 to Term n	terms that describe each variable level
Freq	frequency of each target value
Target variable name	contains values of the target variable
Date/Time Interval	When you run a **Text Profile** node with a time target in the data source, the Profiled Variables table in the node results includes **Date/Time Interval** variable. This variable numbers the time intervals from 0 to the number of intervals. *Note:* The first row (Corpus) in the Profiled Variables table is all of the data combined, and therefore isn't a time interval.
Var/Var Level ID	the variable or variable level ID
Terms	all the terms that describe each variable level

The following are the graphical results in the **Text Profile** node Results window:

- The **Target Distribution** pie chart shows the frequencies of the target values. It is linked to the Profiled Variables table.

  Note: The **Target Distribution** pie chart becomes a lattice of pie charts when you run the **Text Profile** node with multiple binary variables (one chart for each variable).

- The **Beliefs by Value** graph shows belief values for term and role pairs for various target values. If you position the mouse pointer over a cell, then a tooltip indicates the target value, term and role pair, and belief value.

  Note: The **Beliefs by Value** graph is displayed for nominal targets.

- Either the **Term Time Series** or the **Term Ordinal Series** line plot is displayed when a target variable has the format type DATE or DATETIME or when the target variable is ordinal, respectively. The chart contains a multiple line plot that shows how the rate of occurrence of each selected term changes over the values of the target variable. When you select a target value, at most the top 16 terms for that target value are displayed in the line plot. So some terms might appear in the Profiled Variables table that are not displayed in this plot.

  Note: The line plot is available only for time targets.

- The **Target Similarities** constellation plot shows similarities between the sets of documents characterized by the different target values. The similarities are calculated using PROC DISTANCE on the term beliefs of the chosen terms. The constellation plot is linked to the Profiled Variables table.

  Note: The **Target Similarities** constellation plot is available for nominal and ordinal targets.

Text Profile Node SAS Output Results

The SAS output from the **Text Profile** node includes summary information about the input variables. In addition, it shows the variable analysis type that was performed (NOM = nominal, ORD = ordinal, or BIN = binary).

Text Profile Node Output Data

For information about output data for the **Text Profile** node, see "Output Data for SAS Text Miner Nodes" on page 131.

Using the Text Profile Node

This example uses the SAMPSIO.NEWS data set to profile terms using the **Text Profile** node. This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

The **Text Profile** node must be preceded by one **Text Parsing** node and at least one **Text Filter** node in the diagram. For more information about the input requirements for the **Text Profile** node, see "Text Profile Node Input Data" on page 84.

The SAMPSIO.NEWS data set consists of 600 brief news articles. Most of the news articles fall into one of these categories: computer graphics, hockey, and medical issues.

The SAMPSIO.NEWS data set contains 600 observations and the following variables:

- **TEXT** is a nominal variable that contains the text of the news article.
- **graphics** is a binary variable that indicates whether the document belongs to the computer graphics category (1-yes, 0-no).
- **hockey** is a binary variable that indicates whether the document belongs to the hockey category (1-yes, 0-no).
- **medical** is a binary variable that indicates whether the document is related to medical issues (1-yes, 0-no).
- **newsgroup** is a nominal variable that contains the group that a news article fits into.

1. Use the Data Source Wizard to define a data source for the data set SAMPSIO.NEWS.

   a. Set the measurement levels of the variables **graphics**, **hockey**, and **medical** to **`Binary`**.

b. Set the model role of the variable **hockey** to `Target` and leave the roles of **newsgroup**, **graphics**, and **medical** as `Input`.

c. Set the variable **TEXT** to have a role of `Text`.

d. Select `No` in the Data Source Wizard — Decision Configuration dialog box.

e. Use the default target profile for the target **hockey**.

2. After you create the **NEWS** data source, drag it to the diagram workspace.

3. Select the **Text Mining** tab on the toolbar, and drag a **Text Parsing** node to the diagram workspace.

4. Connect the **NEWS** data source to the **Text Parsing** node.

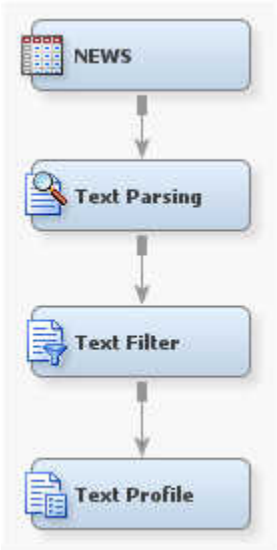
5. Select the **Text Mining** tab on the toolbar, and drag a **Text Filter** node to the diagram workspace.

6. Connect the **Text Parsing** node to the **Text Filter** node.

7. Select the **Text Mining** tab on the toolbar, and drag a **Text Profile** node to the diagram workspace.

8. Connect the **Text Filter** node to the **Text Profile** node.

   Your process flow diagram should resemble the following:

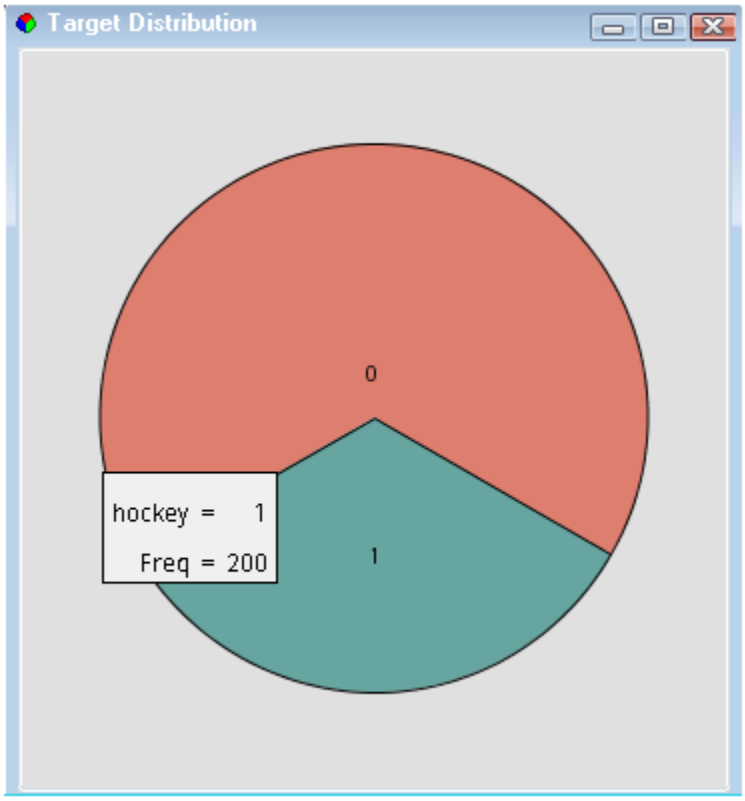


9. Select the **Text Profile** node in the process flow diagram.

10. In the diagram workspace, right-click the **Text Profile** node and select **Run**. Click **Yes** in the Confirmation dialog box that appears.

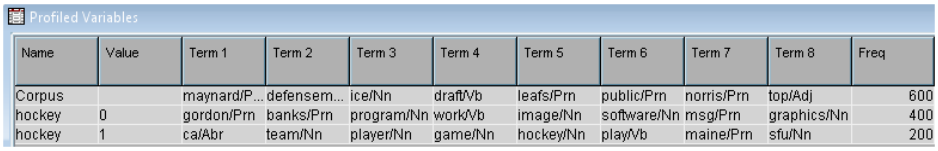
11. Click **Results** in the Run Status dialog box when the node finishes running.

12. Select the **Target Distribution** pie chart.



The **Target Distribution** pie chart shows the frequencies of the target values. It is grouped by hierarchy level and is linked to the Profiled Variables table.

13. Select the **Profiled Variables** table.



Name	Value	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6	Term 7	Term 8	Freq
Corpus		maynard/P...	defensem...	ice/Nn	draft/Vb	leafs/Prn	public/Prn	norris/Prn	top/Adj	600
hockey	0	gordon/Prn	banks/Prn	program/Nn	work/Vb	image/Nn	software/Nn	msg/Prn	graphics/Nn	400
hockey	1	ca/Abr	team/Nn	player/Nn	game/Nn	hockey/Nn	play/Vb	maine/Prn	sfu/Nn	200

The **Profiled Variables** table displays each combination of values of the target variables and their associated highest-belief terms. Each observation has at most the specified maximum number of terms associated it, but it can have less. All graphical results in the **Text Profile** node Results window are linked to this table. Therefore, you can select an observation in the Profiled Variables table, and the associated data points are highlighted in the graphics. Or, you can select data points in the graphics to highlight associated observations in the Profiled Variables table.

14. Close the Results window.

15. Select the **News** data source.

16. Click the ellipsis button for the **`Variables`** property.

    The Variables dialog box appears.

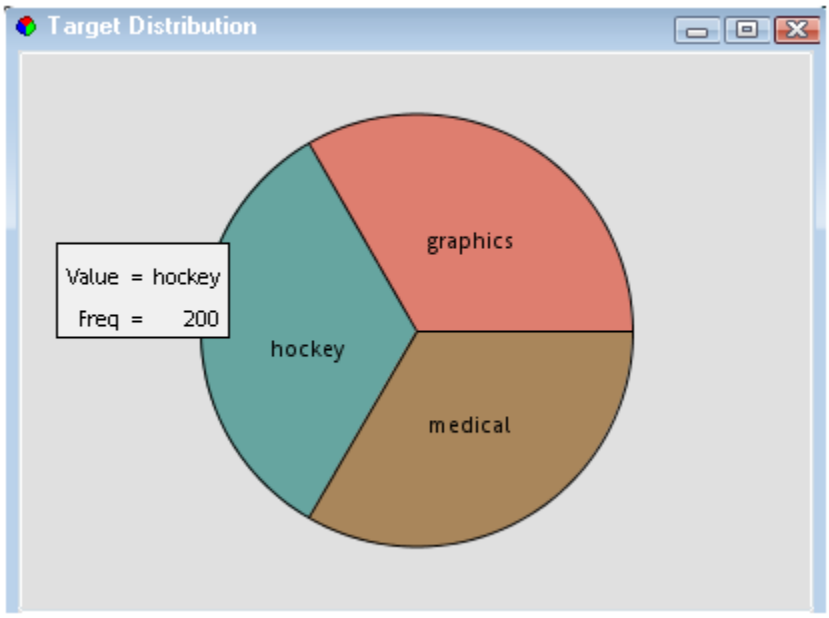
17. Set the role of the **newsgroup** variable to **`Target`**, and set the role of the **hockey** variable to **Input**.

18. Click **OK**.

19. In the diagram workspace, right-click the **Text Profile** node and click **Run**. Click **Yes** in the Confirmation dialog box that appears.

20. Click **Results** in the Run Status dialog box when the node finishes running.

21. Select the **Target Distribution** pie chart.



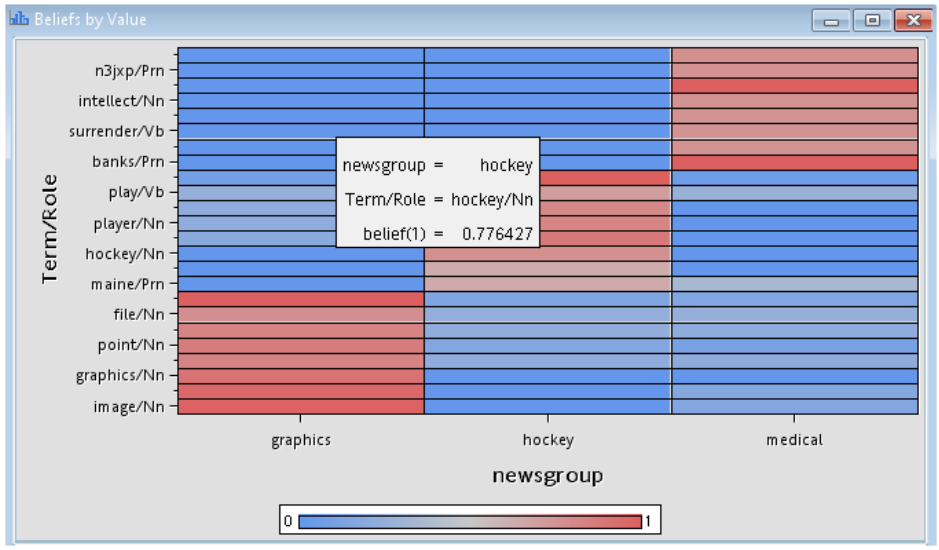
Since you changed the value of the Target from the binary hockey variable to the nominal newsgroup variable, you can now see the distribution of the three possible newsgroup values (hockey, medical, and graphics).

22. Select the **Target Similarities** constellation plot.

The **Target Similarities** constellation plot shows similarities among different target values. The similarities are measured using PROC DISTANCE on the term beliefs. Links are shown only between those target values on the same level of the hierarchy. The constellation plot is linked to the Profiled Variables table.

Note: The **Target Similarities** constellation plot is available for nominal and ordinal targets.

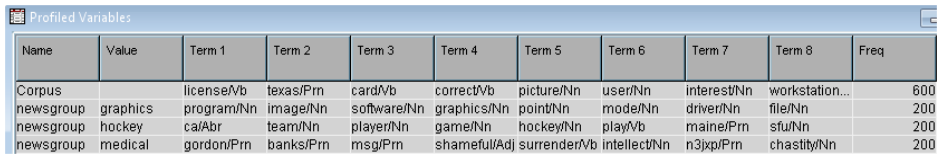
23. Select the **Beliefs by Value** graph.



The **Beliefs by Value** graph shows belief values for term and role pairs for various target values. If you position the mouse pointer over a cell, then a tooltip indicates the target value, term and role pair, and belief value.

Note: The **Beliefs by Value** graph is displayed for nominal and ordinal targets.

24. Select the **Profiled Variables** table.



Name	Value	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6	Term 7	Term 8	Freq
Corpus		license/Vb	texas/Prn	card/Vb	correct/Vb	picture/Nn	user/Nn	interest/Nn	workstation...	600
newsgroup	graphics	program/Nn	image/Nn	software/Nn	graphics/Nn	point/Nn	mode/Nn	driver/Nn	file/Nn	200
newsgroup	hockey	ca/Abr	team/Nn	player/Nn	game/Nn	hockey/Nn	play/Vb	maine/Prn	sfu/Nn	200
newsgroup	medical	gordon/Prn	banks/Prn	msg/Prn	shameful/Adj	surrender/Vb	intellect/Nn	n3jxp/Prn	chastity/Nn	200

25. Close the Results window.

26. Select the **Text Profile** node.

27. Click the value for the **Maximum Number of Terms** property, and enter `16`.

    Click **Enter** on your keyboard.

28. In the diagram workspace, right-click the **Text Profile** node and click **Run**. Click **Yes** in the Confirmation dialog box that appears.

29. Click **Results** in the Run Status dialog box when the node finishes running.

30. Select the **Profiled Variables** table. Notice that there are now 16 term and role pairs for each target value.

31. Close the Results window.

32. (Optional) Run the **Text Profile** node with a target variable that has the format type DATE or DATETIME. This will produce a Term Time Series line plot in the results.

a. Create the data source **VRTEXT** from the **Sampsio** library. Set the role value of the **VAX_DATE** variable to `Target`.

   This data source contains adverse event reactions to vaccinations. For example, some side effects reported might include soreness, redness, fever, and so on.

b. Add the **VRTEXT** node to the diagram workspace.

c. Select the **Text Mining** tab on the toolbar, and drag a **Text Parsing** node to the diagram workspace.

d. Connect the **VRTEXT** data source to the **Text Parsing** node.

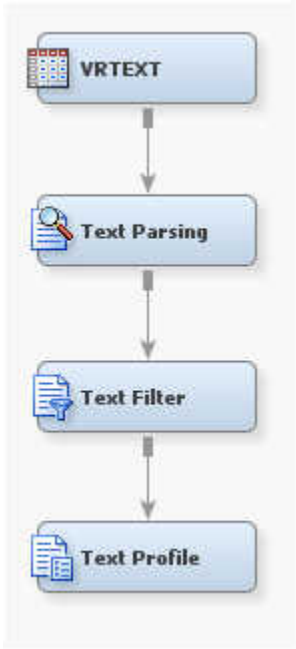
e. Select the **Text Mining** tab on the toolbar, and drag a **Text Filter** node to the diagram workspace.

f. Connect the **Text Parsing** node to the **Text Filter** node.

g. Select the **Text Mining** tab on the toolbar, and drag a **Text Profile** node to the diagram workspace.

h. Connect the **Text Filter** node to the **Text Profile** node.

   Your process flow diagram should resemble the following:

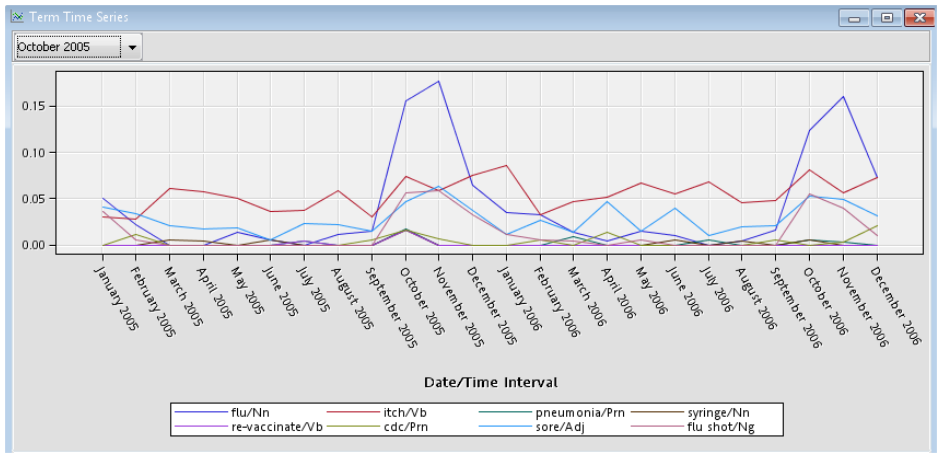


i. Select the **Text Profile** node, and select `Monthly` as the value for the **Date Binning Interval** property.

j. In the diagram workspace, right-click the **Text Profile** node and click **Run**. Click **Yes** in the Confirmation dialog box that appears.

k. Click **Results** in the Run Status dialog box when the node finishes running.

l. Select the Term Time Series line plot, and then select `October 2005` from the menu.



In this example, you can see that the flu starts climbing and stays prominent for several months.

For more information about the Term Time Series line plot, see "Text Profile Node Graphical and Tabular Results" on page 86.

33. (Optional) Run the **Text Profile** node with a target variable that is ordinal. This will produce a Term Ordinal Series line plot in the results. For more information about the Term Ordinal Series line plot, see "Text Profile Node Graphical and Tabular Results" on page 86.

Chapter 7

The Text Rule Builder Node

Overview of the Text Rule Builder Node

The **Text Rule Builder** node generates an ordered set of rules that together are useful in describing and predicting a target variable. Each rule in the set is associated with a specific target category. This specific target category consists of a conjunction that indicates the presence or absence of one or a small subset of terms (for example, “term1” AND “term2” AND (NOT “term3”)). A particular document matches this rule if and only if it contains at least one occurrence of term1 and of term2 but no occurrences of term3.

This set of derived rules creates a model that is both descriptive and predictive. The rules are provided in the syntax that can be used within SAS Content Categorization Studio, and can be deployed there.

The **Text Rule Builder** node is a standard SAS Enterprise Miner modeling tool, complete with the standard reporting features. You can view which predicted target values are most likely to be wrong based on the generated model. You have the option to change the target that is assigned to some of these observations and rerun the results. Thus, the **Text Rule Builder** node facilitates "active learning" in which a user can dynamically interact with an algorithm to iteratively build a predictive model.

See the following for more information about the **Text Rule Builder** node:

- "Text Rule Builder Node Input Data" on page 96
- "Text Rule Builder Node Properties" on page 96
- "Text Rule Builder Node Results" on page 100
- "Text Rule Builder Node Output Data" on page 99
- "Using the Text Rule Builder Node with the HPBOOLRULE Procedure" on page 103
- "Using the Text Rule Builder Node" on page 104

Text Rule Builder Node Input Data

The training data that is provided to the **Text Rule Builder** node must be preceded by at least one **Text Parsing** and one **Text Filter** node. The node must have at least one target variable with a measurement level of binary, ordinal, or nominal. The **Drop** property for the target variable in the input data node in the process flow diagram must be set to **No**. In the **Text Rule Builder** node, the target variable should have a **Use** property value of **Default** or **Yes**. If any of these conditions are not met, the **Text Rule Builder** node will generate an error.

If you plan on using validation or test data, those data sets must contain the same target variables that are in the training data.

Text Rule Builder Node Properties

Contents

Text Rule Builder Node General Properties

These are the general properties that are available on the **Text Rule Builder** node:

- **Node ID** — displays the ID that is assigned to the node. Node IDs are especially useful for distinguishing between two or more nodes of the same type in a process flow diagram. For example, the first **Text Rule Builder** node that is added to a diagram has the Node ID **`TextRule`**, and the second **Text Rule Builder** node that is added has the Node ID **`TextRule2`**.

- **Imported Data** — accesses a list of the data sets that are imported by the node and the ports that provide them. Click the ellipsis button to open the Imported Data window, which displays this list. If data exists for an imported data set, then you can select a row in the list and do any of the following:

  - browse the data set

  - explore (sample and plot) the data in a data set

  - view the table and variable properties of a data set

- **Exported Data** — accesses a list of the data sets that are exported by the node and the ports to which they are provided. Click the ellipsis button to open the Exported Data window, which displays this list. If data exists for an exported data set, then you can select a row in the list and do any of the following:

  - browse the data set

  - explore (sample and plot) the data in a data set

  - view the table and variable properties of a data set

- **Notes** — accesses a window that you can use to store notes of interest, such as data or configuration information. Click the ellipsis button to open the Notes window.

Text Rule Builder Node Train Properties

These are the training properties that are available on the **Text Rule Builder** node:

- **Variables** — choose which categorical target to use in this node (note that only one target can be analyzed). Click the ellipsis button to open the Variables window.

- **Generalization Error** — determines the predicted probability for rules that use an untrained data set. This is to prevent overtraining. Higher values do a better job of preventing overtraining at a cost of not finding potentially useful rules. Valid values are **Very Low**, **Low**, **Medium** (default), **High**, and **Very High**.

- **Purity of Rules** — determines how selective each rule is by controlling the maximum p-value necessary to add a term to a rule. Selecting **Very High** results in the fewest, purest rules. Selecting **Very Low** results in the most rules that handle the most terms. Valid values are **Very Low** (p<.17), **Low** (p<.05), **Medium** (default, p<.005), **High** (p<.0005), and **Very High** (p<.00005).

- **Exhaustiveness** — determines the exhaustiveness of the rule search process, or how many potential rules are considered at each step. As you increase the exhaustiveness, you increase the amount of time that the **Text Rule Builder** node requires and increase the probability of overtraining the model. Valid values are **Very Low**, **Low**, **Medium** (default), **High**, and **Very High**.

Text Rule Builder Node Score Properties

These are the score properties that are available on the **Text Rule Builder** node:

- **Content Categorization Code** — Click the ellipsis button to the right of the **Content Categorization Code** property to view the Content Categorization Code window. The code that is provided in this window can be copied and pasted into SAS Content Categorization Studio. The **Text Rule Builder** node must be run before you can open the Content Categorization Code window.

- **Change Target Values** — Click the ellipsis button to the right of the **Change Target Values** property to view the Change Target Values window. The Change Target Values window enables you to view and reassign target values. As a result, you can rerun the **Text Rule Builder** node and iteratively refine your model.

  The observations in the Change Target Values window contain all observations in the training, validation, or test data set that meet any of the following conditions:

  - contains a rule that predicted a target value other than the target assigned to this document in the imported data. This includes observations for which the target contains a missing value.

  - an observation for which you have previously changed the imported target value to a different target value.

The observations in the Change Target Values window are ordered by the model's determined "posterior probability" in descending order from 1 to 0. Therefore, the values that the model is most certain are incorrect are at the very beginning.

The data set that is shown in the Change Target Values window is not created until you run the node. The node will generate an error if you try to view the Change Target Values window before running the node. Any changes to the assigned target value are retained and used when the node is rerun, as long as the target variable has not been changed. When you rerun the node, your changes are applied to the data before the rule creation algorithm is run.

If you copy a **Text Rule Builder** node, then the **Change Target Values** data set is copied to the new node.

Text Rule Builder Node Status Properties

These are the status properties that are displayed on the **Text Rule Builder** node:

- **Create Time** — time at which the node was created.

- **Run ID** — identifier of the run of the node. A new identifier is assigned every time the node is run.

- **Last Error** — error message, if any, from the last run.

- **Last Status** — last reported status of the node.

- **Last Run Time** — time at which the node was last run.

- **Run Duration** — length of time that is required to complete the last node run.
- **Grid Host** — grid host, if any, that was used for computation.
- **User-Added Node** — denotes whether the node was created by a user as a SAS Enterprise Miner extension node. The value of this property is always `No` for the **Text Rule Builder** node.

Text Rule Builder Node Output Data

The **Text Rule Builder** node exports the following:

- **Train Role** — contains the imported training data set to be imported to an assessment tool with the following additional columns:

Role	Form	Type	Source	Example Name	Purpose
CLASSIFICATION	F_<target>	$32	Decmeta, Type=FROM	F_c_target	Formatted target value normalized to a length of 32.
CLASSIFICATION	I_<target>	$32	Decmeta, Type=INTO	I_c_target	Formatted predicted target value normalized to a length of 32.
PREDICTED	P_<target> <target-value>	8	Decmeta, Type=PREDICTED,level=formatted normalized target value	P_c_targethockey	There is one of these for every target value. This contains the posterior probability generated by the model that the observation belongs to for that target. The sum of these should equal one for every observation.

Role	Form	Type	Source	Example Name	Purpose
ASSESSMENT	W_<target>	8		W_c_target	Why the observation was assigned the INTO value that it was. This contains the number of the rule that triggered the classification, or missing if no rule matched and it was assigned by default to the most common remaining value.

- **Validate, Test Role** — contains any imported validation or test data set to be imported to an assessment tool with the same additional columns as listed above.
- **EMINFO** — contains the following:
  - key=LastTmNode, Value=&EM_NODEID
  - key=LastTMNodeType, Value=TextBoolCat
  - key=LastTextBoolCat, value=&EM_NODEID
  - key=PRESCORECODE, value=&EM_NODEID

See "Output Data for SAS Text Miner Nodes" on page 131 for more information.

Text Rule Builder Node Results

Contents

Results Window for the Text Rule Builder Node

After the **Text Rule Builder** node runs successfully, you can access the Results window in three ways:

- Click **Results** in the Run Status window that opens immediately after a successful run of the **Text Rule Builder** node.
- Click the Results icon on the main toolbar.
- Right-click the **Text Rule Builder** node, and click **Results**.

The Results window for the **Text Rule Builder** node is similar to the Results window for other nodes in SAS Enterprise Miner. For general information about the Results window, see the SAS Enterprise Miner Help. The icons and main menus are the same as other nodes. However, the **View** menu for the **Text Rule Builder** node Results window does not include the selection **Model**. Instead, it includes **Rules**, which accesses a submenu that lists the generated rules in tabular form.

Note: You can access the SAS log that was generated by the node processing from the **SAS Results** submenu of the **View** menu. This log can be a useful debugging tool.

Text Rule Builder Node Graphical and Tabular Results

The following are the graphical results in the **Text Rule Builder** node Results window:

- **Score Rankings Overlay** — The Score Rankings Overlay chart displays assessment statistics. To change the graphed statistic, click one of the following items on the drop-down menu:

  - **Cumulative Lift**
  - **Lift**
  - **Gain**
  - **% Response**
  - **Cumulative % Response**
  - **% Captured Response**
  - **Cumulative % Captured Response**

  For more graphical options, right-click the Score Rankings Overlay chart, and click **Data Options**.

- **Fit Statistics** — The Fit Statistics table displays the following statistics for the target variable:

  - Average Squared Error
  - Divisor for ASE
  - Maximum Absolute Error
  - Sum of Frequencies
  - Root Average Squared Error
  - Sum of Squared Errors
  - Frequency of Classified Cases
  - Misclassification Rate
  - Number of Wrong Classifications

- **Rules Obtained** — The Rules Obtained table displays rules for predicting the target variable.

  The Rule column contains the rules that are extracted from the text. These rules are presented as the conjunction of terms and their negations. For example, the Rule "dividend&~acquire&~sell" says that for a document to satisfy this rule, it must contain the term “dividend” and should not contain either of the terms “acquire” or

"sell". Note that the '~' character is the negation operation on a term. If a document satisfies a rule, the document is covered by that rule. Otherwise, it is uncovered.

The "Target Value" column indicates the target value that corresponds to the rule. The order of the rules for each category in the table is important. The rule in the first row for each category is discovered by considering all the documents and is the first rule that is added into the rule set. The rule in the second row of the table for each category is learned by analyzing all documents that were not covered by the first rule, and so on.

The "Precision" column indicates the precision (True Positive/Total category N) for training data for all rules up to this point in the table for this target value for matching documents that were actually assigned to that target value.

The "Recall" column indicates the recall (True Positive/Total matching) for training data for all rules up to this point in the table for this target value matching documents that were actually assigned to that target value.

The "F1 Score" column indicates the harmonic mean of precision and recall.

Let r_i be the i^{th} rule that is added into the rule set. The True Positive/Total column of r_i indicates the number of correctly matching documents in the training data for that rule. The number of matching documents is followed by a slash and then by the total number of documents that match that rule.

The precision column and recall column of r_i contain the precision and recall of the rule set $r_1 \ldots , r_i$, which is computed using the training data.

If there is validation data, the last four columns will have an additional "Valid" in their labels to indicate that they apply to the validation data.

- **Rule Success** — The Rule Success graph shows the success per generated rule using training and validation data. Position the pointer over a bar for a tooltip that contains information about the bar. The categorical variable is a concatenation of the rule ID (Why Into variable) and the partition (train or valid). The Assigned Target variable is used to group the data by the original assigned target values. Therefore, there are up to X different colors displayed in one bar. X is the number of different target values. The values and their associated colors are identified in the legend. For more information about the rules in this graph, see the Document Rules table. The Document Rules table can be opened by navigating to **View** ⇨ **Rules** ⇨ **Document Rules**.

- **Document Rules** — The Document Rules table contains additional information about the bars that appear in the Rule Success graph. The Document Rules table can be viewed by navigating to **View** ⇨ **Rules** ⇨ **Document Rules**. Select a row in the Document Rules table to highlight the corresponding bar in the Rule Success graph.

Two additional charts are available by navigating to **View** ⇨ **Assessment**:

- Select **Classification Chart** to display a stacked bar chart of the classification results for a categorical variable. The horizontal axis displays the target levels that observations actually belong to. The color of the stacked bars identifies the target levels that observations are classified into. The height of the stacked bars represents the percentage of total observations.

- Select **Score Distribution** to display a chart that plots the proportion of events (by default), nonevents, and other values on the vertical axis. The values on the horizontal axis represent the model score of a bin. The model score depends on the prediction of the target. For categorical targets, observations are grouped into bins,

based on the posterior probabilities of the event level and the number of buckets. The Score Distribution chart of a useful model shows a higher percentage of events for higher model scores and a higher percentage of nonevents for lower model scores. The chart choices are as follows:

- **Percentage of Events** — for categorical targets.
- **Number of Events** — for categorical targets.
- **Cumulative Percentage of Events** — for categorical targets.

If you use a target profile in your data source, the following additional graphs are available in the results by navigating to **View** ⇨ **Assessment**:

- Select **Adjusted Classification Chart** to display an adjusted classification chart. The adjusted classification chart is the same as the classification chart except that the percentage of total observations has been adjusted such that the adjusted percentage = unadjusted percentage * (prior/data prior). This chart is available only if you have a target profile with adjusted prior probabilities in the data source.

- Select **Score Rankings Matrix** to display a score rankings matrix plot. The score rankings matrix plot overlays the selected statistics for standard, baseline and best models in a lattice that is defined by the training and validation data sets. This chart is available only if you have a target profile in the data source.

For more information about graphical and tabular results in SAS Enterprise Miner, see the Predictive Modeling Help topic in the SAS Enterprise Miner help.

Text Rule Builder Node SAS Output Results

The SAS output from the **Text Rule Builder** node includes summary information about the input variables, targets, predicted and decision variables, training results, and validation results (if a **Data Partition** node was used). The Classification Table contains precision (as Target Percentage) and recall (as Outcome Percentage), for both the training and validation data.

Using the Text Rule Builder Node with the HPBOOLRULE Procedure

Overview of the HPBOOLRULE Procedure in the Text Rule Builder Node

In SAS Text Miner 14.1, a new HPBOOLRULE procedure replaces macros in the **Text Rule Builder** node. This section contains information about the benefits of using the **Text Rule Builder** node with the HPBOOLRULE procedure, and how you can run the **Text Rule Builder** node as it existed prior to SAS Text Miner 14.1 in case you prefer the previous way this node worked.

Benefits of Using the HPBOOLRULE Procedure in the Text Rule Builder Node

This section outlines some benefits from using the HPBOOLRULE procedure instead of the macros that were used in the **Text Rule Builder** node in releases prior to SAS Text Miner 14.1:

- All category values are processed in parallel to obtain rules. This means that processing happens much faster, particularly when there are many target values.
- The **Text Rule Builder** node prior to SAS Text Miner 14.1 assigned the first matching rule as a predicted value. The new **Text Rule Builder** node uses posterior probability* sqrt(1/prior), meaning that all matching rules are considered for categorization.
- In the Rules Obtained window in the results, The **Text Rule Builder** node prior to SAS Text Miner 14.1 only showed the true positive/total for the one rule that determined categorization. In the **Text Rule Builder** in SAS Text Miner 14.1, the Rules Obtained window shows the true positive/total for all matching rules.
- A new column (rule_<target>) has been added to the output training, validation, and test data that contains the numbers of all matching rules for that document.
- The **Text Rule Builder** node will now use a **target profile** for a target variable if one is set up. This is similar to most other predictive modeling nodes in SAS Enterprise Miner.

Using the Text Rule Builder Node as It Existed Prior to SAS Text Miner 14.1

As mentioned there are several advantages with the new approach of creating rules for all target levels simultaneously. However, it does result in some different rules being generated than previous releases of SAS Text Miner. If, for compatibility reasons, you want to use the "old-style" approach to building rules, there is an easy way to enable this. Please contact Technical Support for this information.

Using the Text Rule Builder Node

This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

The **Text Rule Builder** node creates Boolean rules from small subsets of terms to predict a categorical target variable. The node must be preceded by **Text Parsing** and **Text Filter** nodes.

This example uses the SAMPSIO.NEWS data set to show you how to predict a categorical target variable with the **Text Rule Builder** node. The results will also show that the model is highly interpretable and useful for explanatory and summary purposes as well.

The SAMPSIO.NEWS data set consists of 600 brief news articles. Most of the news articles fall into one of these categories: computer graphics, hockey, and medical issues.

The SAMPSIO.NEWS data set contains 600 observations and the following variables:

- **TEXT** is a nominal variable that contains the text of the news article.
- **graphics** is a binary variable that indicates whether the document belongs to the computer graphics category (1-yes, 0-no).
- **hockey** is a binary variable that indicates whether the document belongs to the hockey category (1-yes, 0-no).
- **medical** is a binary variable that indicates whether the document is related to medical issues (1-yes, 0-no).
- **newsgroup** is a nominal variable that contains the group that a news article fits into.

To use the **Text Rule Builder** node to predict the categorical target variable, **newsgroup**, in the SAMPSIO.NEWS data set:

1. Use the Data Source Wizard to define a data source for the data set SAMPSIO.NEWS.

   a. Set the measurement levels of the variables **graphics**, **hockey**, and **medical** to **`Binary`**.

   b. Set the model role of the variable **newsgroup** to **`Target`** and leave the roles of **graphics**, **hockey**, and **medical** as **`Input`**.

   c. Set the variable **TEXT** to have a role of **`Text`**.

   d. Select **`No`** in the Data Source Wizard — Decision Configuration dialog box.

   e. Use the default target profile for the target **newsgroup**.

2. After you create the **NEWS** data source, drag it to the diagram workspace.

3. Select the **Text Mining** tab on the toolbar, and drag a **Text Parsing** node to the diagram workspace.

4. Connect the **NEWS** data source to the **Text Parsing** node.

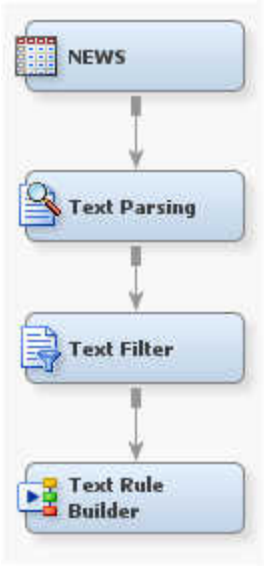
5. Select the **Text Mining** tab on the toolbar, and drag a **Text Filter** node to the diagram workspace.

6. Connect the **Text Parsing** node to the **Text Filter** node.

7. Select the **Text Mining** tab on the toolbar, and drag a **Text Rule Builder** node to the diagram workspace.

8. Connect the **Text Filter** node to the **Text Rule Builder** node.

   Your process flow diagram should resemble the following:



9. Select the **Text Rule Builder** node in the process flow diagram.
10. Click the value for the **Generalization Error** property, and select **`Very Low`**.
11. Click the value for the **Purity of Rules** property, and select **`Very Low`**.
12. Click the value for the **Exhaustiveness** property, and select **`Very Low`**.
13. In the diagram workspace, right-click the **Text Rule Builder** node and select **Run**. Click **Yes** in the Confirmation dialog box that appears.
14. Click **Results** in the Run Status dialog box when the node finishes running.
15. Select the Rules Obtained table to see information about the rules that were obtained.

    The words in the Rule column have the corresponding precision at implying the target, **newsgroup**.

Rules Obtained

Target Value	Rule #	Rule	Precision	Recall	F1 score	True Positive/Total
GRAPHICS	1	graphics	100.0%	18.00%	30.51%	36/36
GRAPHICS	2	image	98.41%	31.00%	47.15%	30/31
GRAPHICS	3	algorithm	98.68%	37.50%	54.35%	16/17
GRAPHICS	4	sphere	98.78%	40.50%	57.45%	9/9
GRAPHICS	5	vesa	98.86%	43.50%	60.42%	8/8
GRAPHICS	6	define	98.94%	46.50%	63.27%	13/13
GRAPHICS	7	animation	98.99%	49.00%	65.55%	10/10
GRAPHICS	8	software & ~play	98.20%	54.50%	70.10%	22/24
GRAPHICS	9	graphics	98.31%	58.00%	72.96%	20/21
GRAPHICS	10	program & ~gordon & ~year	98.45%	63.50%	77.20%	28/30
GRAPHICS	11	fractal	98.48%	65.00%	78.31%	7/7
GRAPHICS	12	polygon	98.51%	66.00%	79.04%	14/14
GRAPHICS	13	vga	98.53%	67.00%	79.76%	14/14
GRAPHICS	14	bit	98.55%	68.00%	80.47%	12/13
GRAPHICS	15	file	96.60%	71.00%	81.84%	25/31
GRAPHICS	16	email	96.75%	74.50%	84.18%	20/27
GRAPHICS	17	mode	96.82%	76.00%	85.15%	15/18
GRAPHICS	18	create & ~team	96.89%	78.00%	86.43%	18/21
GRAPHICS	19	phone & ~doctor	96.99%	80.50%	87.98%	16/21
GRAPHICS	20	image	97.01%	81.00%	88.28%	7/7
GRAPHICS	21	technique	97.02%	81.50%	88.59%	7/7
GRAPHICS	22	help & ~ca	97.08%	83.00%	89.49%	16/21
GRAPHICS	23	fax	97.11%	84.00%	90.08%	21/29

In the seventh column above, the True Positive (the first number) is the number of documents that matched the rule. The Total (the second number) is the total positive.

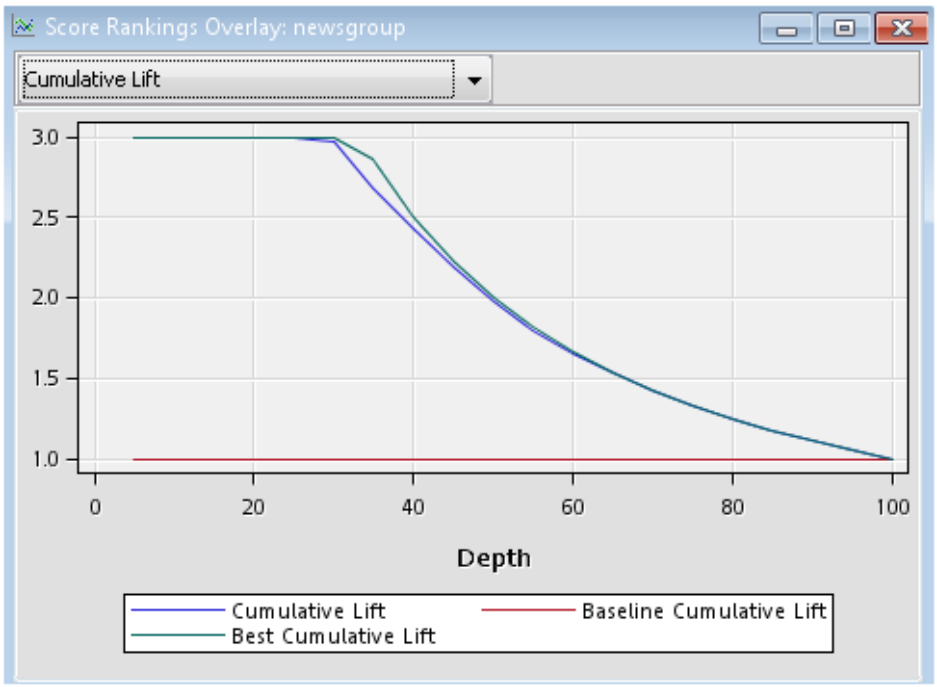
In the above example, in the first row, 36 of the documents matched the rule "graphics". All 36 of these documents were actually in the GRAPHICS category. In the next row, 30 out of 31 documents correctly matched the rule "image". This means that in the training data, 31 documents contain the term "image". 30 of these documents were an example of the GRAPHICS category, and one was not.

Most of the rules are single term rules because the NEWS data set is limited in size. However, there are several multiple term rules above. In the 18th row, the rule "create & ~team" means that 18 out of the 21 documents that contain the word "create" and do not contain the word "team" are an example of the GRAPHICS category.

Note: ~ means logical not.

16. Select the Score Rankings Overlay graph to view the following types of information about the target variable:
    - Cumulative Lift
    - Lift
    - Gain
    - % Response
    - Cumulative % Response
    - % Captured Response
    - Cumulative % Captured Response

    Note: To change the statistic, select one of the above options from the drop-down menu.

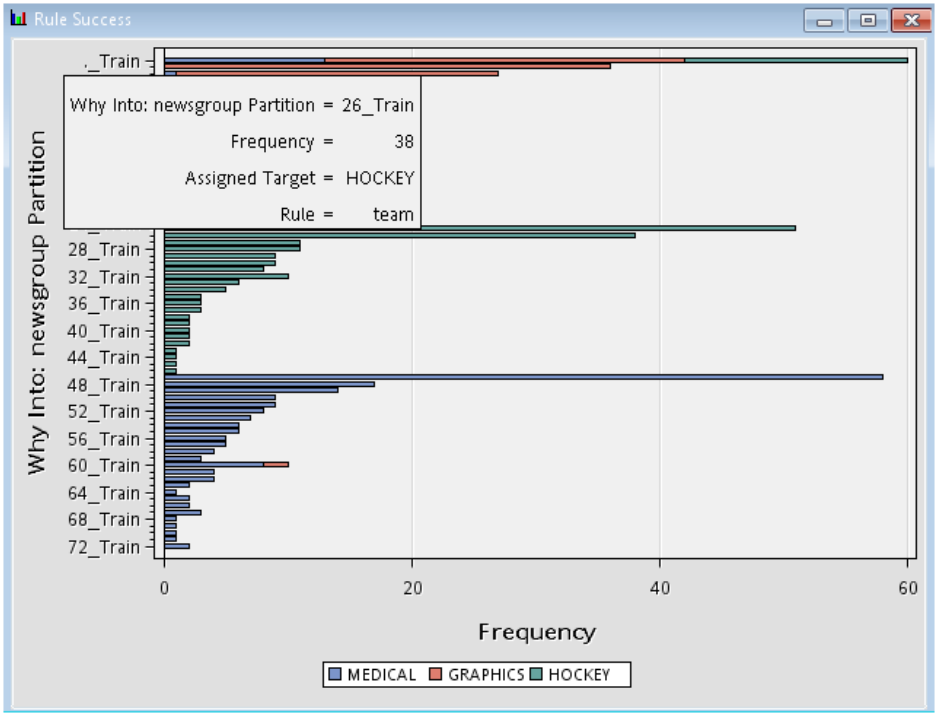


17. Select the Fit Statistics window for statistical information about the target variable, **newsgroup**.

Fit Statistics

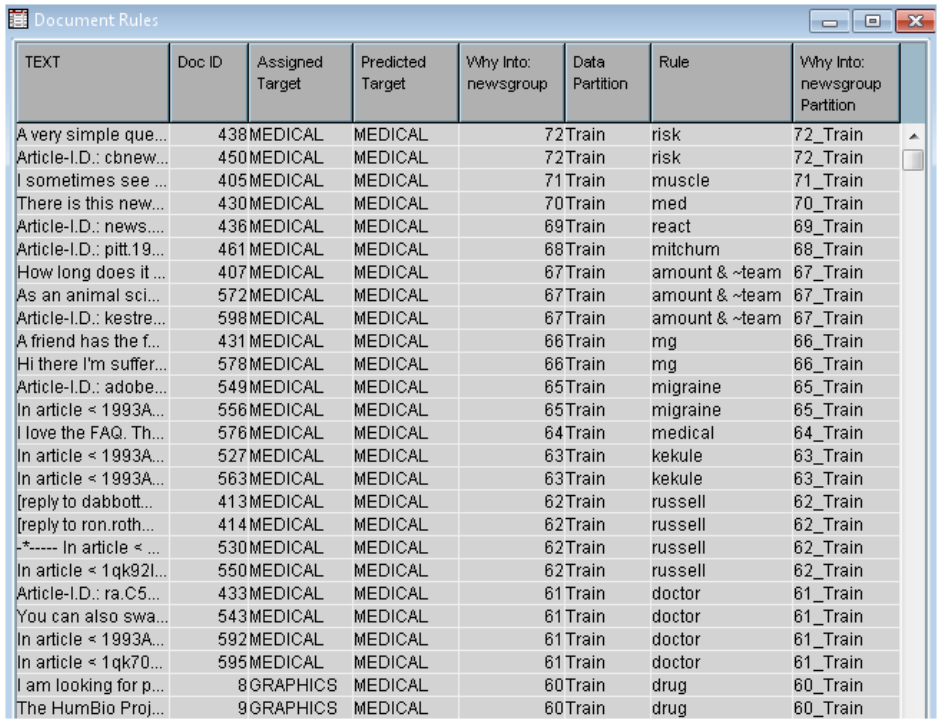
Target	Target Label	Fit Statistics	Statistics Label	Train
newsgroup		_ASE_	Average Squa...	0.018283
newsgroup		_DIV_	Divisor for ASE	1800
newsgroup		_MAX_	Maximum Abs...	0.502025
newsgroup		_NOBS_	Sum of Frequ...	600
newsgroup		_RASE_	Root Average ...	0.135216
newsgroup		_SSE_	Sum of Squar...	32.9101
newsgroup		_DISF_	Frequency of ...	600
newsgroup		_MISC_	Misclassificati...	0.063333
newsgroup		_WRONG_	Number of Wr...	38

18. Select the Rule Success graph, and position the cursor over a bar for more information.



19. Select **View** ⇨ **Rules** ⇨ **Document Rules** from the menu.

    The Document Rules table appears with more information about the rules in the Rule Success graph.



Document Rules

TEXT	Doc ID	Assigned Target	Predicted Target	Why Into: newsgroup	Data Partition	Rule	Why Into: newsgroup Partition
A very simple que...	438	MEDICAL	MEDICAL	72	Train	risk	72_Train
Article-I.D.: cbnew...	450	MEDICAL	MEDICAL	72	Train	risk	72_Train
I sometimes see ...	405	MEDICAL	MEDICAL	71	Train	muscle	71_Train
There is this new...	430	MEDICAL	MEDICAL	70	Train	med	70_Train
Article-I.D.: news....	436	MEDICAL	MEDICAL	69	Train	react	69_Train
Article-I.D.: pitt.19...	461	MEDICAL	MEDICAL	68	Train	mitchum	68_Train
How long does it ...	407	MEDICAL	MEDICAL	67	Train	amount & ~team	67_Train
As an animal sci...	572	MEDICAL	MEDICAL	67	Train	amount & ~team	67_Train
Article-I.D.: kestre...	598	MEDICAL	MEDICAL	67	Train	amount & ~team	67_Train
A friend has the f...	431	MEDICAL	MEDICAL	66	Train	mg	66_Train
Hi there I'm suffer...	578	MEDICAL	MEDICAL	66	Train	mg	66_Train
Article-I.D.: adobe...	549	MEDICAL	MEDICAL	65	Train	migraine	65_Train
In article < 1993A...	556	MEDICAL	MEDICAL	65	Train	migraine	65_Train
I love the FAQ. Th...	576	MEDICAL	MEDICAL	64	Train	medical	64_Train
In article < 1993A...	527	MEDICAL	MEDICAL	63	Train	kekule	63_Train
In article < 1993A...	563	MEDICAL	MEDICAL	63	Train	kekule	63_Train
[reply to dabbott...	413	MEDICAL	MEDICAL	62	Train	russell	62_Train
[reply to ron.roth...	414	MEDICAL	MEDICAL	62	Train	russell	62_Train
-*----- In article < ...	530	MEDICAL	MEDICAL	62	Train	russell	62_Train
In article < 1qk92l...	550	MEDICAL	MEDICAL	62	Train	russell	62_Train
Article-I.D.: ra.C5...	433	MEDICAL	MEDICAL	61	Train	doctor	61_Train
You can also swa...	543	MEDICAL	MEDICAL	61	Train	doctor	61_Train
In article < 1993A...	592	MEDICAL	MEDICAL	61	Train	doctor	61_Train
In article < 1qk70...	595	MEDICAL	MEDICAL	61	Train	doctor	61_Train
I am looking for p...	8	GRAPHICS	MEDICAL	60	Train	drug	60_Train
The HumBio Proj...	9	GRAPHICS	MEDICAL	60	Train	drug	60_Train

20. Close the Results window.

21. Click the value for the **Generalization Error** property, and select **`Medium`**.

22. Click the value for the **Purity of Rules** property, and select **`Medium`**.

23. Click the value for the **Exhaustiveness** property, and select **`Medium`**.

24. Select the **NEWS** data source.

25. Click the ellipsis button for the **Variables** property.

26. Change the role of the HOCKEY variable to **`Target`**, and change the role of the NEWSGROUP variable to **`Input`**.

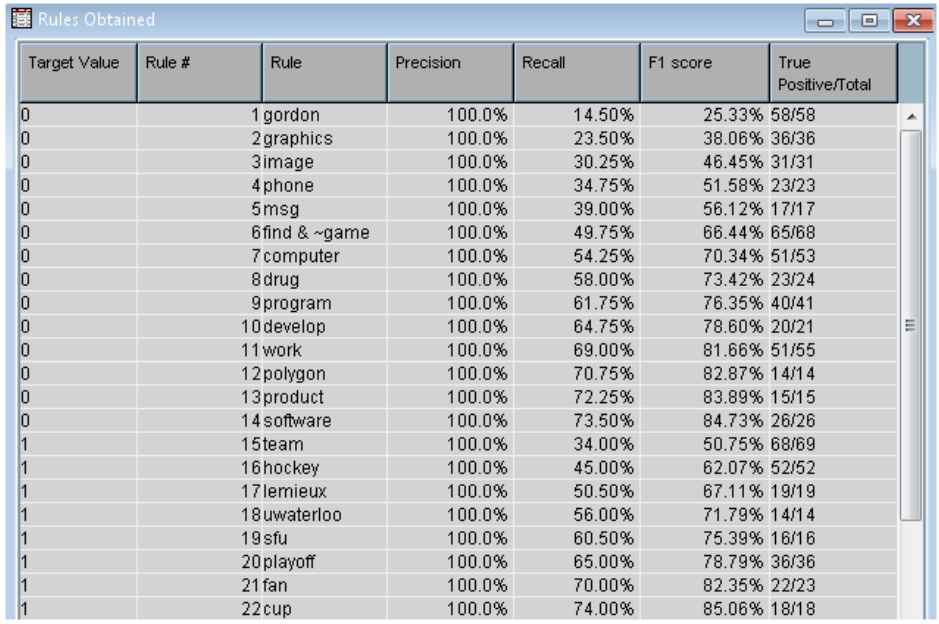
27. Click **OK**.

28. In the diagram workspace, right-click the **Text Rule Builder** node and select **Run**. Click **Yes** in the Confirmation dialog box that appears.

29. Click **Results** in the Run Status dialog box when the node finishes running.

30. Select the Rules Obtained table to see information about the rules that predicted the hockey target.

    The words in the Rule column have the corresponding precision at implying the hockey target.


Rules Obtained

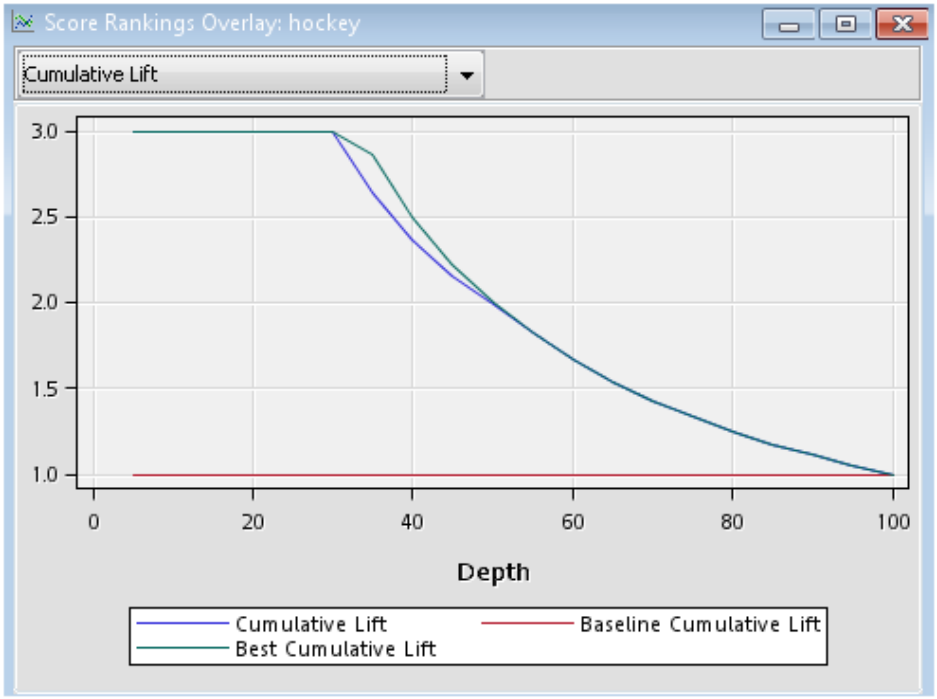
Target Value	Rule #	Rule	Precision	Recall	F1 score	True Positive/Total
0	1	gordon	100.0%	14.50%	25.33%	58/58
0	2	graphics	100.0%	23.50%	38.06%	36/36
0	3	image	100.0%	30.25%	46.45%	31/31
0	4	phone	100.0%	34.75%	51.58%	23/23
0	5	msg	100.0%	39.00%	56.12%	17/17
0	6	find & ~game	100.0%	49.75%	66.44%	65/68
0	7	computer	100.0%	54.25%	70.34%	51/53
0	8	drug	100.0%	58.00%	73.42%	23/24
0	9	program	100.0%	61.75%	76.35%	40/41
0	10	develop	100.0%	64.75%	78.60%	20/21
0	11	work	100.0%	69.00%	81.66%	51/55
0	12	polygon	100.0%	70.75%	82.87%	14/14
0	13	product	100.0%	72.25%	83.89%	15/15
0	14	software	100.0%	73.50%	84.73%	26/26
1	15	team	100.0%	34.00%	50.75%	68/69
1	16	hockey	100.0%	45.00%	62.07%	52/52
1	17	lemieux	100.0%	50.50%	67.11%	19/19
1	18	uwaterloo	100.0%	56.00%	71.79%	14/14
1	19	sfu	100.0%	60.50%	75.39%	16/16
1	20	playoff	100.0%	65.00%	78.79%	36/36
1	21	fan	100.0%	70.00%	82.35%	22/23
1	22	cup	100.0%	74.00%	85.06%	18/18

In the above example, the target value is 0 or 1, instead of “HOCKEY,” because you set the hockey variable to be the target instead of the newsgroup variable. Thus, you are most interested in the rules that begin with rule #15 because those correspond to the hockey documents. 68 out of 69 documents that match the rule “team” (68 were correctly assigned) were in the HOCKEY newsgroup.

Note that the rule matches discussed above are not, in themselves, definitive evidence for the rule builder algorithm to assign a category based on a single rule match. Instead, the algorithm determines all the rule matches for a document, and then decides, based on the combination of the rule matches, which category to assign. So, for example, suppose that a document contains the word “hockey”, matching rule 16 associated with hockey documents and also contains the word “work” matching rule 11 associated with non-hockey documents. In this case, it would generally decide to assign the document to hockey=1 (because rule 16 is true in training data 52/52 times but rule 11 is true only 51/55 times). At the same time, it would not be very confident about its prediction. On the other hand, if a document matched rules 15, 16, and 17, the model would be very confident about its prediction. This confidence is reflected in the posterior probabilities that are assigned for each of the categories to each document. These posterior probabilities show up in the output tables, and can also be seen in the **Change Target Values** property. The thresholds for determining the decisions, based on posterior probabilities, can also be changed using a target profile.

31. Select the Score Rankings Overlay graph to view the following types of information about the target variable:
    - Cumulative Lift
    - Lift
    - Gain
    - % Response
    - Cumulative % Response
    - % Captured Response
    - Cumulative % Captured Response

Note: To change the statistic, select one of the above options from the drop-down menu.

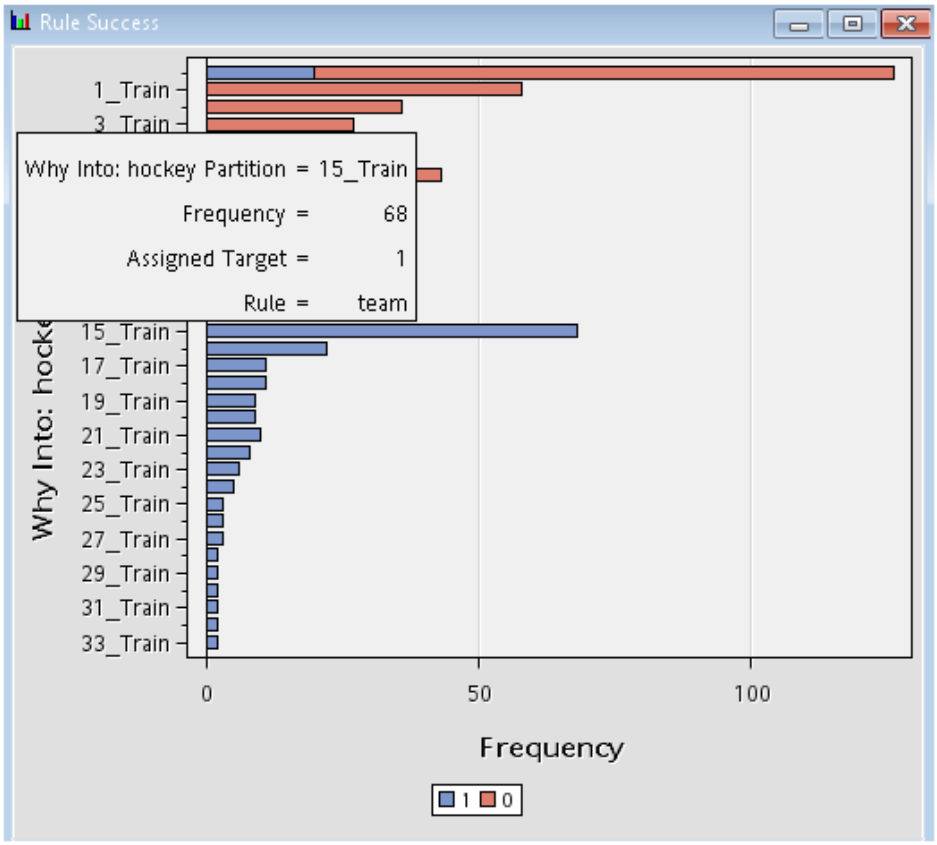


32. Select the Fit Statistics table for statistical information about the hockey target variable.

Fit Statistics

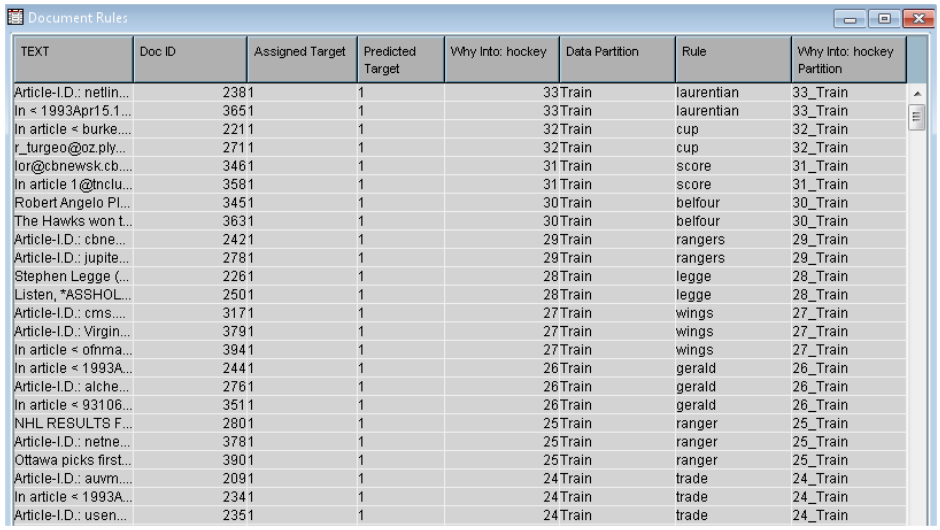
Target	Target Label	Fit Statistics	Statistics Label	Train
hockey		_ASE_	Average Sq...	0.005403
hockey		_DIV_	Divisor for A...	1200
hockey		_MAX_	Maximum A...	0.526749
hockey		_NOBS_	Sum of Fre...	600
hockey		_RASE_	Root Averag...	0.073504
hockey		_SSE_	Sum of Squ...	6.483351
hockey		_DISF_	Frequency ...	600
hockey		_MISC_	Misclassific...	0.033333
hockey		_WRONG_	Number of ...	20

33. Select the Rule Success graph, and position the cursor over a bar for more information.



34. Select **View** ⇨ **Rules** ⇨ **Document Rules** from the menu.

    The Document Rules table appears with more information about the rules in the Rule Success graph.



TEXT	Doc ID	Assigned Target	Predicted Target	Why Into: hockey	Data Partition	Rule	Why Into: hockey Partition
Article-I.D.: netlin...	2381		1	33	Train	laurentian	33_Train
In < 1993Apr15.1...	3651		1	33	Train	laurentian	33_Train
In article < burke....	2211		1	32	Train	cup	32_Train
r_turgeo@oz.ply...	2711		1	32	Train	cup	32_Train
lor@cbnewsk.cb....	3461		1	31	Train	score	31_Train
In article 1@tnclu...	3581		1	31	Train	score	31_Train
Robert Angelo Pl...	3451		1	30	Train	belfour	30_Train
The Hawks won t...	3631		1	30	Train	belfour	30_Train
Article-I.D.: cbne...	2421		1	29	Train	rangers	29_Train
Article-I.D.: jupite...	2781		1	29	Train	rangers	29_Train
Stephen Legge (...	2261		1	28	Train	legge	28_Train
Listen, *ASSHOL...	2501		1	28	Train	legge	28_Train
Article-I.D.: cms....	3171		1	27	Train	wings	27_Train
Article-I.D.: Virgin...	3791		1	27	Train	wings	27_Train
In article < ofnma...	3941		1	27	Train	wings	27_Train
In article < 1993A...	2441		1	26	Train	gerald	26_Train
Article-I.D.: alche...	2761		1	26	Train	gerald	26_Train
In article < 93106...	3511		1	26	Train	gerald	26_Train
NHL RESULTS F...	2801		1	25	Train	ranger	25_Train
Article-I.D.: netne...	3781		1	25	Train	ranger	25_Train
Ottawa picks first...	3901		1	25	Train	ranger	25_Train
Article-I.D.: auvm....	2091		1	24	Train	trade	24_Train
In article < 1993A...	2341		1	24	Train	trade	24_Train
Article-I.D.: usen...	2351		1	24	Train	trade	24_Train

35. Close the Results window.

36. Click the ellipsis button for the **Content Categorization Code** property.

    The Content Categorization Code window appears. The code provided in this window is the code that is generated for SAS Content Categorization and is ready for compilation.

37. Click **Cancel**.

38. Click the ellipsis button for the **Change Target Values** property.

    The Change Target Values window appears.

    You can use the Change Target Values window to improve the model.

39. Select one or more cells in the **Assigned Target** column, and select a new target value.

40. Click **OK**.

41. Rerun the **Text Rule Builder** node, and then check whether your model has been improved.

Chapter 8

The Text Topic Node

Overview of the Text Topic Node

The **Text Topic** node enables you to explore the document collection by automatically associating terms and documents according to both discovered and user-defined topics. Topics are collections of terms that describe and characterize a main theme or idea. The approach is different from clustering because clustering assigns each document to a unique group. But the **Text Topic** node assigns a score for each document and term to

each topic. Then thresholds are used to determine whether the association is strong enough to consider that the document or term belongs to the topic. As a result, documents and terms can belong to more than one topic or to none at all. The number of topics that you request should be directly related to the size of the document collection (for example, a large number for a large collection).

The most memory-intensive task is computing the singular value decomposition (SVD) of the term-by-document frequency matrix. For more information, see "Singular Value Decomposition" on page 74. When in-memory resources are limited, the **Text Topic** node might use, instead of the full collection, a simple random sample of the documents. The **Text Topic** node does this in an attempt to run the node successfully. Sampling occurs only if the node encounters a memory failure during an attempt to compute the SVD without sampling. Furthermore, because sampling generally occurs when the document collection is extremely large, there is typically not an adverse effect on modeling results. Exactly when sampling occurs depends on a number of parameters including the size of your collection, the platform on which your system is running, and the available RAM.

See the following for more information about the **Text Topic** node.

- "Text Topic Node Input Data" on page 116
- "Text Topic Node Properties" on page 116
- "Text Topic Node Results" on page 119
- "Text Topic Node Output Data" on page 121
- "Using the Text Topic Node" on page 121

For related topics that you might find useful when using the **Text Topic** node, see the following:

- "User-Defined Topic Lists" on page 128
- "Interactive Topic Viewer" on page 129

Note: The **Text Topic** node is not supported for use in group processing (Start Groups and End Groups nodes).

Text Topic Node Input Data

The **Text Topic** node must be preceded by a **Text Parsing** node. If it is not also preceded by a **Text Filter** node, then the **Text Topic** node weights terms using the Log frequency weighting and a term weighting of Mutual Information if there is a categorical target, or Entropy otherwise. For more information, see "Term Weighting" on page 57.

Text Topic Node Properties

Contents

Text Topic Node General Properties

These are the general properties that are available on the **Text Topic** node:

- **Node ID** — displays the ID that is assigned to the node. Node IDs are especially useful for distinguishing between two or more nodes of the same type in a process flow diagram. For example, the first **Text Topic** node that is added to a diagram will have the Node ID **`TextTopic`**, and the second **Text Topic** node that is added will have the Node ID **`TextTopic2`**.
- **Imported Data** — accesses a list of the data sets that are imported by the node and the ports that provide them. Click the ellipsis button to open the Imported Data window, which displays this list. If data exists for an imported data set, then you can select a row in the list and do any of the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set
- **Exported Data** — accesses a list of the data sets exported by the node and the ports to which they are provided. Click the ellipsis button to open the Exported Data window, which displays this list. If data exists for an exported data set, then you can select a row in the list and do any of the following:
  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set
- **Notes** — accesses a window that you can use to store notes of interest, such as data or configuration information. Click the ellipsis button to open the Notes window.

Text Topic Node Train Properties

General Train Properties

These are the training properties that are available on the **Text Topic** node:

- **Variables** — accesses a list of variables and associated properties in the data source. Here you can select the text variable and target variable that you want to use for Mutual Information weighting. Click the ellipsis button to open the Variables window.
- **User Topics** — specifies a SAS data set that contains user-defined topics. For more information, see "User-Defined Topic Lists" on page 128. A sample data set is provided for use with the SAMPSIO.abstract sample input data set. For more information, see "SAS Text Miner Sample Data Sets" on page 10. Click the ellipsis button to open a window in which you can do the following:
  - Click **Replace Table** to replace the currently selected table.
  - Click **Add Table** to add to the currently selected table.
  - (If a user-defined topic data set is selected) Add, delete, and edit user-defined topics.

Two sample data sets are provided. One is for use with the SAMPSIO.ABSTRACT sample input data set, and the other is for detecting positive and negative tone in any English document set. For more information, see "SAS Text Miner Sample Data Sets" on page 10.

Term Topics Properties

- **Number of Single-term Topics** — specifies the maximum number of single-term topics to create from top-weighted terms. This number should be less than or equal to the smaller of 1000 or the number of terms that are imported into the **Text Topic** node. When the node is run, the number of single-term topics actually created is equal to the number that is specified here plus the number of user topics, u. Then the u single-term topics that are most closely related to user topics are eliminated.

Learned Topics Properties

- **Number of Multi-term Topics** — specifies the maximum number of multi-term topics to create from a rotated singular-value decomposition (SVD) of the weighted term-by-document matrix. For more information, see "Singular Value Decomposition" on page 74. This number should be less than or equal to the smaller of 1000, the number of documents less 6, and the number of terms that are imported into the **Text Topic** node less 6. When the node is run, the number of multi-term topics actually that are created is equal to the number specified here plus the number of user topics, u. Then the u multi-term topics that are most closely related to user topics are eliminated. See *Getting Started with SAS Text Miner* for how that makes it possible to discover new topics that come up at new time periods.

  Note: Convergence problems can arise if you specify a number that is too close to the smaller of the number of documents and the number of terms that are imported into the **Text Topic** node. In this case, choosing a smaller number of multi-term topics can lead to convergence.

- **Correlated Topics** — specifies whether learned topics must be orthogonal (uncorrelated) or if they can be correlated. The topics can align more closely with the individual terms if the correlated topics option is set to `Yes`. But then the results should not be fed into a Memory Based Reasoning (MBR) modeling tool that requires orthogonal inputs.

Results Properties

- **Topic Viewer** — (after the node has run) opens the Interactive Topic Viewer in which you can interactively adjust the results of the topic creation. Click the ellipsis button to open the Interactive Topic Viewer. For more information, see "Interactive Topic Viewer" on page 129.

Text Topic Node Status Properties

These are the status properties that are displayed on the **Text Topic** node:

- **Create Time** — time at which the node was created.
- **Run ID** — identifier of the run of the node. A new identifier is assigned every time the node is run.
- **Last Error** — error message, if any, from the last run.
- **Last Status** — last reported status of the node.
- **Last Run Time** — time at which the node was last run.

- **Run Duration** — length of time that is required to complete the last node run.
- **Grid Host** — grid host, if any, that was used for computation.
- **User-Added Node** — denotes whether the node was created by a user as a SAS Enterprise Miner Extension node. The value of this property is always **No** for the **Text Topic** node.

Text Topic Node Results

Contents

Results Window for the Text Topic Node

After the **Text Topic** node runs successfully, you can access the Results window in three ways:

- Click **Results** in the Run Status window that opens immediately after a successful run of the **Text Topic** node.
- Click the **Results** icon on the main toolbar.
- Right-click the **Text Topic** node, and click **Results**.

The Results window for the **Text Topic** node is similar to the Results window for other nodes in SAS Enterprise Miner. For general information about the Results window, see the SAS Enterprise Miner Help. The icons and main menus are the same as other nodes. However, the **View** menu for the **Text Topic** node Results window does not include the selections **Assessment** or **Model**. Instead, it includes **Custom Reports**, which accesses a submenu that lists the graphical and tabular results.

Note: You can access the SAS log that was generated by the node processing from the SAS Results submenu of the **View** menu. This log can be a useful debugging tool.

Text Topic Node Graphical and Tabular Results

The following are the graphical results in the **Text Topic** node Results window:

- The **Number of Documents by Topics** bar chart displays the number of documents that are assigned to each topic. Each bar corresponds to a topic. If you position the mouse pointer over a bar, then a tooltip indicates the topic, the number of documents included in that topic, the category, and the topic ID.
- The **Number of Terms by Topics** bar chart displays the number of terms that define each topic. Each bar corresponds to a topic. If you position the mouse pointer over a bar, then a tooltip indicates the topic, the number of terms included in that topic, the category, and the topic ID.

- The **Topic Terms** matrix graph shows the interaction between each pair of topics by examining terms that describe the topics. The terms are plotted in each scatterplot with the two topic scores that are associated with the lattice entry. If you position the mouse pointer over a point, then a tooltip indicates the term that you have selected, its topic scores for the two topics, and how frequent the term is with a RANK (where RANK=1 means the term is the most frequent term in the collection).

The tabular result in the **Text Topic** node Results window is the **Terms** table and the **Topics** table. The **Terms** table shows terms and their weights for each topic. The **Topics** table displays information about identified topics.

The **Topic Terms** matrix graph is linked to the **Terms** table. Therefore, you can select observations in the **Terms** table to highlight the associated data points in the **Topic Terms** matrix graph. Or, you can select data points in the **Topic Terms** matrix graph to highlight the associated observations in the **Terms** table.

The **Number of Documents by Topics** bar chart and the **Number of Terms by Topics** bar chart are linked to the **Topics** table. Therefore, you can select observations in the **Topics** table to highlight the associated data points in these graphics. Or, you can select data points in these graphics to highlight the associated observations in the **Topics** table.

Table 8.1 *Contents of the Topics Table*

Variable	Description
Category	**`User`** if the topic is user-defined, **`Single`** if the topic is a single-term topic, and **`Multiple`** if the topic is a multi-term topic.
Topic ID	key value of the topic.
Document Cutoff	minimum topic membership that a document must have to be included in this topic.
Term Cutoff	minimum topic weight that a term must have to be used as a term for this topic. The weight of any term that has an absolute value weight less than this is effectively set to zero.
Topic	terms that describe the topic.
Number of Terms	number of terms in the topic
# Docs	number of documents that contain the topic

Table 8.2 *Contents of the Terms Table*

Variable	Description
Term	a row for each term.
Role	role value for the term.
Attribute	attribute value for the term.

Variable	Description
Weight	weight for each term.
Freq	frequency of the term.
# Docs	number of documents that contain the term.
Keep	whether the term was kept (Y) or dropped (N).
Rank	rank for the variable NUMDOCS.
Topics 1 to n	a column for each topic in the Topics table.
_termid	ID value for each term.

Text Topic Node SAS Output Results

The SAS output from the **Text Topic** node includes summary information about the input variables.

Text Topic Node Output Data

For information about output data for the **Text Topic** node, see "Output Data for SAS Text Miner Nodes" on page 131.

Using the Text Topic Node

This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

The **Text Topic** node enables you to create topics of interest from a list of terms. The goal in creating a list of topics is to establish combinations of words that you are interested in analyzing. For example, you might be interested in mining articles that discuss the activities of a "company president." One way to approach this task is to look at all articles that have the term "company," and all articles that have the term "president." The **Text Topic** node enables you to combine the terms "company" and "president" into the topic "company president."

The ability to combine individual terms into topics can improve your text mining analysis. Through combining, you can narrow the amount of text that is subject to analysis to specific groupings of words that you are interested in. This example shows you how to create topics using the **Text Topic** node.

1. The SAS data set SAMPSIO.ABSTRACT contains the titles and text of abstracts from conferences. Create the ABSTRACT data source and add it to your diagram workspace. Set the Role value of the TEXT and TITLE variables to **`Text`**.

2. Select the **Text Mining** tab on the toolbar, and drag a **Text Parsing** node to the diagram workspace.

3. Connect the ABSTRACT data source to the **Text Parsing** node.

4. Select the **Text Parsing** node, and then select the ellipsis for the **Ignore Parts of Speech** property.

5. In the Ignore Parts of Speech dialog box, select all parts of speech except for **`Noun`** by holding down **Ctrl** on your keyboard and clicking each option. Click **OK**.

6. Set the **Noun Groups** property to **`Yes`**.

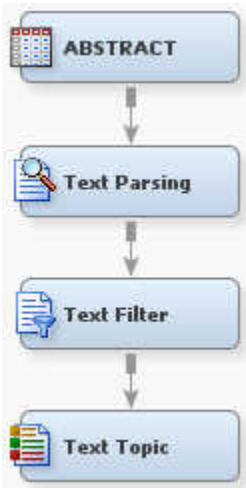
7. Select the **Text Mining** tab on the toolbar, and drag a **Text Filter** node to the diagram workspace.

8. Connect the **Text Parsing** node to the **Text Filter** node.

9. Select the **Text Mining** tab on the toolbar, and drag a **Text Topic** node to the diagram workspace.

10. Connect the **Text Filter** node to the **Text Topic** node.

    Your process flow diagram should resemble the following:



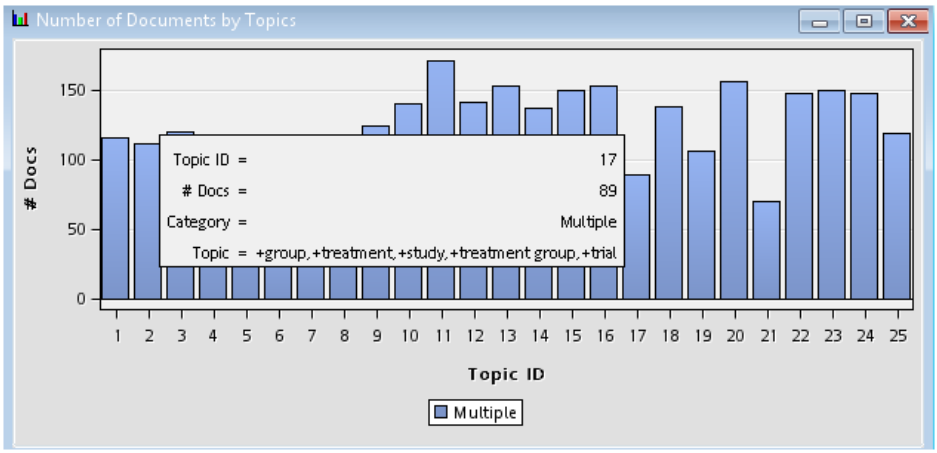
11. In the diagram workspace, right-click the **Text Topic** node and select **Run**. Click **Yes** in the Confirmation dialog box that appears. Click **Results** in the Run Status dialog box when the node finishes running.

12. Select the Topics table to view the topics that have been created with a default run of the **Text Topic** node.

Topics

Category	Topic ID	Document Cutoff	Term Cutoff	Topic	Number of Terms	# Docs
Multiple	1	0.101	0.037	+output,+tem...	76	116
Multiple	2	0.100	0.037	+customer,+b...	94	112
Multiple	3	0.100	0.038	+test,+metho...	111	120
Multiple	4	0.103	0.036	+graph,graph...	60	111
Multiple	5	0.124	0.036	+macro,+mac...	44	111
Multiple	6	0.094	0.037	+entry,+catalo...	82	67
Multiple	7	0.113	0.036	+select state...	58	67
Multiple	8	0.115	0.036	+data wareho...	54	111
Multiple	9	0.105	0.037	+report,print,+...	81	124
Multiple	10	0.103	0.038	+performanc...	83	140
Multiple	11	0.098	0.038	+programmer...	110	172
Multiple	12	0.106	0.037	web,+page,+...	79	142
Multiple	13	0.119	0.037	+variable,+val...	78	153
Multiple	14	0.100	0.037	+client,+serve...	84	137
Multiple	15	0.112	0.038	+analysis,+pr...	106	150
Multiple	16	0.109	0.038	+mainframe,...	81	153
Multiple	17	0.089	0.038	+group,+treat...	92	89
Multiple	18	0.106	0.038	+application,...	90	138
Multiple	19	0.086	0.038	+decision,su...	107	106
Multiple	20	0.096	0.038	+table,+datab...	102	156
Multiple	21	0.081	0.038	+workshop,+t...	106	70
Multiple	22	0.089	0.038	+program,+ti...	105	148
Multiple	23	0.096	0.038	+version,+fea...	96	150
Multiple	24	0.105	0.038	information,+t...	86	148
Multiple	25	0.093	0.038	+model,+vari...	104	119

13. Select the Number of Documents by Topics chart to see a topic by the number of documents that it contains.



Note: You might need to resize the default graph to see the topic ID values.

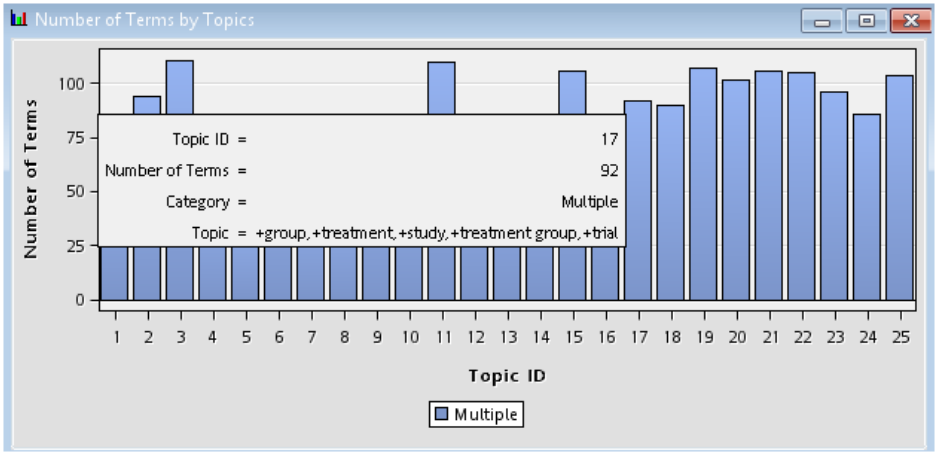
14. Select the **Terms** table. Select the first entry in the table.

Terms

Term	Role	Attribute	WEIGHT	Freq	# Docs	Keep
data	Noun	Alpha	0.102578	2747	786	Y
+ paper	Noun	Alpha	0.11954	766	576	Y
software	Noun	Alpha	0.163427	752	447	Y
+ applicatio...	Noun	Alpha	0.194299	772	380	Y
+ user	Noun	Alpha	0.189986	634	376	Y
+ system	Noun	Alpha	0.223114	566	317	Y
information	Noun	Alpha	0.236117	501	283	Y
+ tool	Noun	Alpha	0.261338	306	216	Y
+ presentati...	Noun	Alpha	0.270126	249	201	Y
+ analysis	Noun	Alpha	0.284412	357	200	Y
+ macro	Noun	Alpha	0.295543	443	193	Y
+ procedur...	Noun	Alpha	0.279307	303	193	Y
+ method	Noun	Alpha	0.284915	286	190	Y
+ technique...	Noun	Alpha	0.290022	269	187	Y
+ environm...	Noun	Alpha	0.283273	244	183	Y

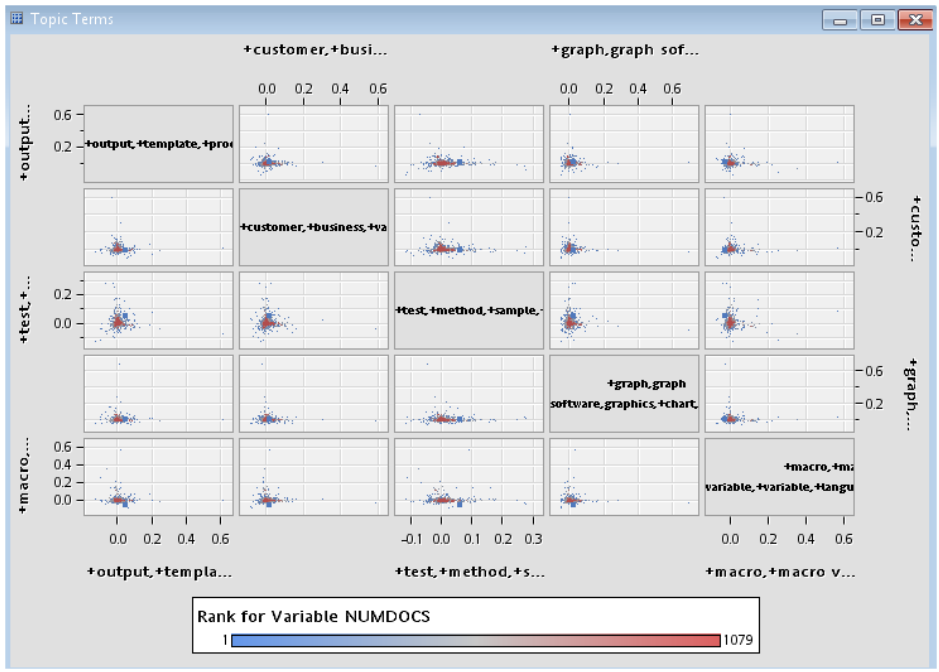
The **Terms** table shows terms and their weights for each topic. Notice that all kept terms have a role of **`Noun`** or **`Noun Group`**.

15. Select the **Number of Terms by Topics** bar chart.



If you position the mouse pointer over a bar, then a tooltip indicates the topic ID, the number of terms included in that topic, the category, and the topic.

16. Select the **Topic Terms** matrix graph.



The **Topic Terms** matrix graph shows the topic values across terms.

Note: You might need to expand this matrix to see the points more clearly.

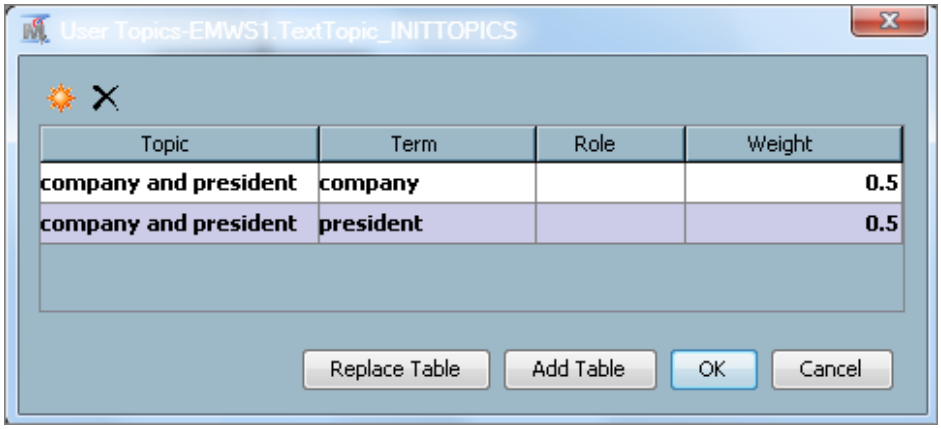
In addition to multi-term topics, you can use the **Text Topic** node to create single-term topics or to create your own topics.

17. Close the Results window, and select the **Text Topic** node.

18. Select the **Number of Single-term Topics** property, type *10*, and press **Enter** on your keyboard.

19. Click the ellipsis button for the **User Topics** property.

20. In the User Topics dialog box, click  to add a row. Enter the term *company*, give it a weight of *0.5*, and specify the topic *company and president*. Click  again to add a second row. Enter the term *president*, give it a weight of *0.5*, and specify the topic *company and president*.



21. Click **OK**.

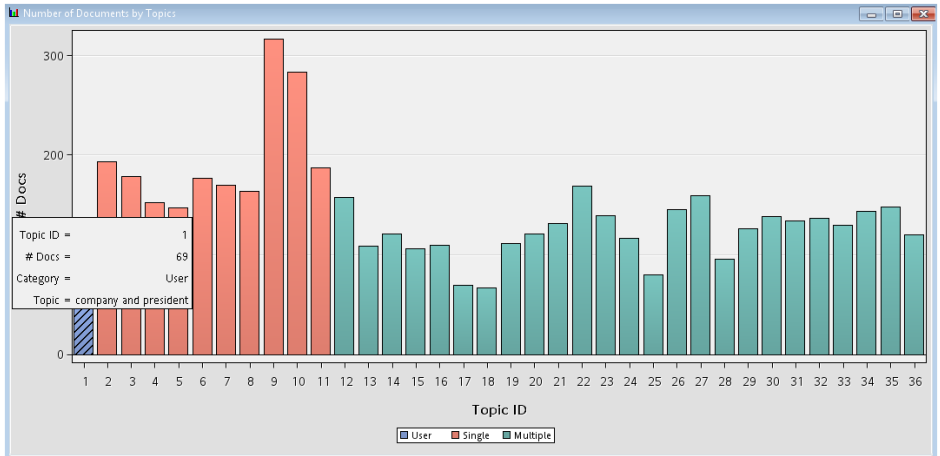
22. Right-click the **Text Topic** node and select **Run**. Select **Yes** in the Confirmation dialog box, and then **Results** in the Run Status dialog box when the node finishes running.

23. Select the Topics table. Notice that 10 new single-term topics have been created along with the topic that you specified in the User Topics dialog box.

Topics

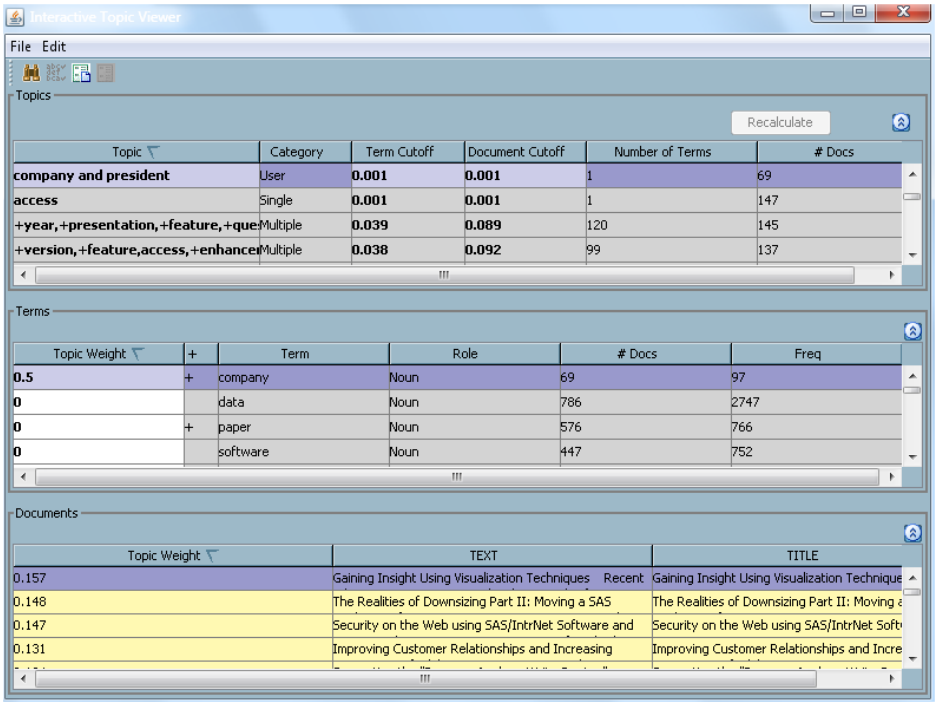
Category	Topic ID	Document Cutoff	Term Cutoff	Topic	Number of Terms	# Docs
User	1	0.001	0.001	company and ...	1	69
Single	2	0.001	0.001	+macro	1	193
Single	3	0.001	0.001	+data set	1	179
Single	4	0.001	0.001	+report	1	152
Single	5	0.001	0.001	access	1	147
Single	6	0.001	0.001	+variable	1	177
Single	7	0.001	0.001	+program	1	170
Single	8	0.001	0.001	web	1	164
Single	9	0.001	0.001	+system	1	317
Single	10	0.001	0.001	information	1	283
Single	11	0.001	0.001	+technique	1	187
Multiple	12	0.117	0.037	+variable,+val...	89	158
Multiple	13	0.099	0.037	+customer,+b...	91	109
Multiple	14	0.100	0.038	+test,+method...	107	121
Multiple	15	0.101	0.037	+graph,graph ...	57	106
Multiple	16	0.123	0.036	+macro,+mac...	45	110
Multiple	17	0.094	0.037	+entry,+catalo...	89	69
Multiple	18	0.112	0.036	+select state...	60	67
Multiple	19	0.114	0.036	+data wareho...	55	111
Multiple	20	0.101	0.037	+report,print,+t...	76	121
Multiple	21	0.103	0.038	+performance...	86	131
Multiple	22	0.102	0.038	+statement,+p...	106	169
Multiple	23	0.105	0.037	web,+page,+b...	76	139
Multiple	24	0.102	0.037	+output,+temp...	73	117
Multiple	25	0.104	0.037	java,+applet,+...	78	80
Multiple	26	0.089	0.039	+year,+presen...	120	145
Multiple	27	0.112	0.038	+mainframe,+...	84	159
Multiple	28	0.091	0.038	+group,+treat...	82	96
Multiple	29	0.091	0.038	+client,+serve...	90	126
Multiple	30	0.088	0.038	+program,+ti...	108	138
Multiple	31	0.096	0.038	+table,+datab...	93	134
Multiple	32	0.092	0.038	+version,+feat...	99	137
Multiple	33	0.097	0.038	+application,+...	81	130
Multiple	34	0.105	0.038	information,+t...	86	144
Multiple	35	0.094	0.038	+data set,+set...	107	148
Multiple	36	0.092	0.038	+model,regre...	105	120

24. Select the Number of Documents by Topics window to see the multi-term, single-term, and user-created topics by the number of documents that they contain.



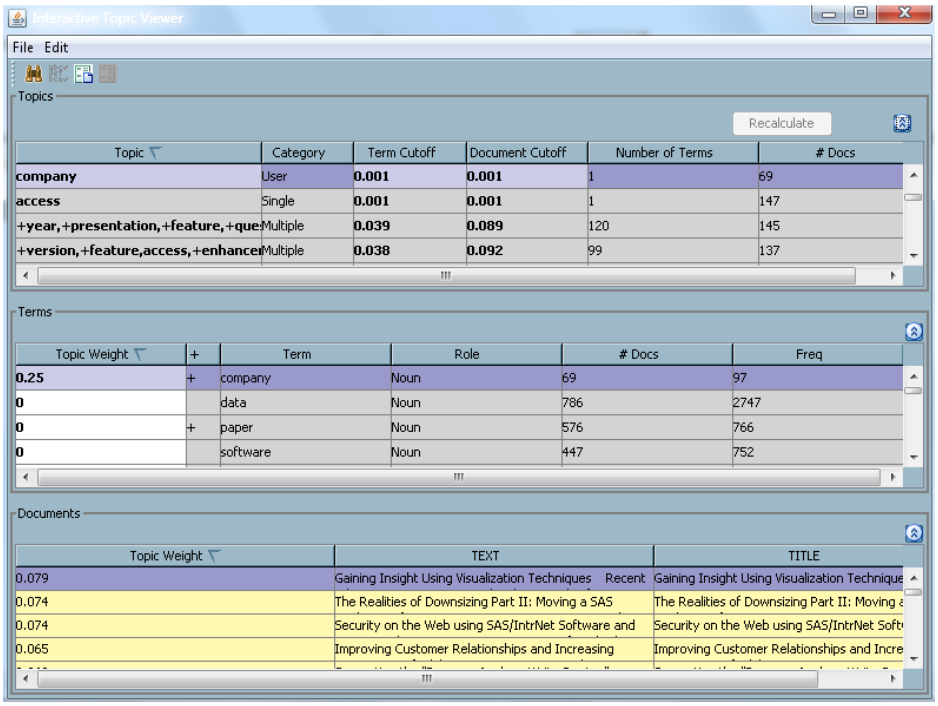
You can use the Interactive Topic Viewer to view and modify topic properties.

25. Close the Results window, and select the **Text Topic** node. Click the ellipsis button for the **Topic Viewer** property. When the Interactive Topic Viewer window appears, sort by the **Topic** column in the **Topics** pane.



In the Interactive Topic Viewer, you can change the topic name, term and document cutoff values, and the topic weight.

26. Select the topic value “company and president” in the Topics table and rename the topic *company*. Select the topic weight for the term “company” in the Terms table, and change it to *0.25*. Click **Recalculate**.



27. Close the Interactive Topic Viewer, and select **No** when prompted for whether you want to save your changes. For more information about the Interactive Topic Viewer, see "Interactive Topic Viewer" on page 129.

User-Defined Topic Lists

You can use a user-defined topic list in the **Text Topic** node. User-defined topic lists enable you to define your own topics of interest. A sample user topic list is provided for use when analyzing the SAMPSIO.abstract sample data set.

User-defined topic data sets have a required format. You must include the variables **_topic_**, **_term_**, **_role_**, and **_weight_**. The variables **_topic_** and **_weight_** must have nonmissing values for all observations in the data set. Also, no observations can have blank values for both **_term_** and **_role_**.

- **_topic_** contains a unique identifier for each topic.
- **_term_** contains a term that is used in the topic identified by the value of **_topic_**. If this value is blank, then all terms that match the given role are assigned to the topic. For example, you could have a "People" topic that has one row with **_term_** blank, and **_role_** set to "PERSON". The values in **_term_** are not case sensitive.
- **_role_** contains the role of **_term_**. A role is either a part of speech, an entity classification, or the value Noun Group. If this value is blank, then any time the **_term_** occurs with any role, it is considered to be in the topic. The values in **_role_** are not case sensitive. For more information about roles, see "Term Roles and Attributes" on page 36.
- **_weight_** contains the weight of term and role pair. Weights are relative. Give most important term and role pairs a weight of **1**. Give less important term and role pairs positive weights less than one in order to reflect their relative importance. Note that terms with a **_weight_** of **0** are omitted.

Several terms can be used in the same topic. To define topics with several terms, include multiple observations that all have the same value of **_topic_**. Each observation corresponds to a different term.

For example, the following user-defined topic list defines two topics ("davis" and "nouns"). The nouns topic would include all terms with a role of Noun:

topic	_term_	_role_	_weight_
davis	Betty Davis	person	1.0
davis	eyes	noun	0.8
davis	film		0.2
nouns		noun	1.0

Interactive Topic Viewer

Contents

Overview of the Interactive Topic Viewer

The Interactive Topic Viewer enables you to refine the topics that were generated (either automatically or from user-defined topics) when the **Text Topic** node was run. You can edit values that appear in bold in the tables of the viewer. You can save any changes that you make to the topics when you close the Interactive Topic Viewer. Any change to a topic name, cutoff, or any topic weights will cause that topic to be a User topic and to be stored in the data set in the User Topics property. To access the Interactive Topic Viewer, click the ellipsis button that corresponds to the **Topic Viewer** property in the Properties panel of the **Text Topic** node.

The Interactive Topic Viewer initially opens as a window that is split three ways. At the top is the Topics table, which contains a list of all user, single, and multi-term topics. One of these topics is always selected as the active topic. When the viewer is first opened, this is the first topic in the topic table. Next is the Terms table, which contains the weights for the selected topic for each term sorted by descending weight. Last is the Documents table, which contains topic weights for the selected topic, also sorted by descending weight. For easier viewing, you can hide any one of these tables by clicking on the arrow icon at the top right of any of the tables. Clicking that icon a second time opens that tableClicking to hide any other table causes the new table to be hidden and the old one to reappear. Any of the columns in any of the tables can be resized or dragged to move, and any column can be sorted by clicking on it. Clicking the same column again causes it to be sorted in the opposite order.

Topics Table of the Interactive Topic Viewer

The Topics table displays summary information about the generated topics. You can edit the following properties of a topic:

- topic name
- term cutoff value
- document cutoff value

Note: The topic name, by default, consists of those five terms that have the highest topic weights in the Terms table. However, you can create a more succinct heading if preferred.

The Terms table and Documents table are linked to the Topics table. You can select a different topic either by double-clicking an observation in the Topics table or right-

clicking on a topic and selecting **Select Current Topic**. Then the Terms and Document tables will update to display values that are related to the selected topic. Furthermore, if you edit values in the Topics table, then you must click **Recalculate** to repopulate these two tables with the new information that results from the edit.

Terms Table of the Interactive Topic Viewer

The Terms table displays summary information about the terms that formulate the topic selected in the Topics table. Terms with weights that are higher in absolute value than the term cutoff contribute to the particular topic. Those that are lower do not contribute to the topic. You can edit the topic weight for any term. If you edit the topic weight for a term, then the topic is automatically reclassified as a user-specified topic, if it was not classified as such already.

Documents Table of the Interactive Topic Viewer

The Documents table displays the relation of each document to the selected topic. If the topic weight for the document is greater than the document cutoff for the topic, the document is considered to contain the topic. This information includes, in addition to the topic weight for a document, all of the variables in the input data source. The second variable that is displayed is the variable that was used for text parsing. To wrap or unwrap the full contents of this variable in the column cells, right-click the value for an observation and click **Toggle Show Full Text** on the resulting menu.

The Interactive Topic Viewer enables you to examine each document on a term-by-term basis. In the Documents table, right-click the document that you want to investigate and click **Show Document Terms**. Or click the **Show Document Terms** icon at the top left. This refreshes the Terms table so that it contains only the terms in the document that you selected. Selecting a new document in the Documents table updates the Terms table to include only the terms from that document. To go back to showing all terms, right-click and click **Show All Terms** or click the **Show All Terms** icon at the top left.

Merging Topics

To merge multiple topics into one, enter the same topic name for all topics to be merged. The topics will initially still show up as distinct topics, but when you rerun the node, they will be combined into one, with all terms included from all topics. For all terms in common between the topics, the weight will be the average for each of the topics.

Chapter 9

Output Data

Output Data for SAS Text Miner Nodes

You can access the output data from a SAS Text Miner node by using data sets that are referenced by the macro variables &EM_DATA_EMINFO and &EM_IMPORT_DATA_EMINFO. When you run a process flow diagram in SAS Enterprise Miner, a data set is created and passed on in the flow. This data set, when exported by a node, is referenced by the macro variable &EM_DATA_EMINFO. When imported by a node (from a previous node), this data set is referenced by the macro variable &EM_IMPORT_DATA_EMINFO.

The EMINFO data sets keep track of which node produced the most recent output. After training is performed, this data set is edited as follows:

- Observations are added (if not already present) for the variable **`key`** and given the following values, which are discussed in detail below:
  - **`LastTMNode`**
  - **`PRESCORECODE`**
  - (if Text Parsing node) **`LastTextParsing`**
  - (if Text Filter node) **`LastTextFilter`**
  - (if Text Topic node) **`LastTopic`**
  - (if Text Cluster node) **`LastCluster`**
  - (if Text Rule Builder node) **`LastTextRule`**
  - (if Text Profile node) **`LastTextProfile`**
- For each observation, the variable **`data`** is the assigned value of the node ID of a particular node in the process flow.
- The variable **`target`** is in the data set, but is not used by the SAS Text Miner nodes.

The value of data that corresponds to LastTextParsing, LastTextFilter, LastTopic, and LastCluster is the node ID of the most recently run node of each node type in the flow. You could use this value, for example, to access output data sets from the most recently run node of a particular type. For example, the following code would obtain the ID of the most recently run Text Topic node run and print the TERMS output data from that node.

```
%let last_topic_node = ;
proc sql noprint;
  select data into :last_topic_node
  from &EM_IMPORT_DATA_EMINFO
  where key="LastTopic";
quit;

proc print data=&last_topic_node._TERMS
run;
```

Note: SAS Text Miner nodes use the naming convention "nodeID._TERMS" for the Terms data set.

The EMINFO data set also includes a key for PRESCORECODE. Its data value is the node ID of the last SAS Text Miner node in the process flow. SAS Enterprise Miner looks for a file called PRESCORECODE.sas in the workspace directory for the referenced node (&EM_NODEDIR.&EM_DSEP.PRESCORECODE.sas). This file contains SAS code that is appended to a score flow before it runs.

Or, if you wanted to create a SAS code node that mimicked a Text Filter node, you could add the following code to the end of your code:

```
data &EM_DATA_EMINFO;
  length TARGET KEY $32 DATA $43;

  key="LastTMNode";
  data="&EM_NODEID";
  output;

  key="LastTextFilter";
  data="&EM_NODEID";
  output;
run;
```

Chapter 10

Overview of Scoring with Text Miner

Overview of Scoring with SAS Text Miner

This chapter explains notable changes and options in the scoring process for SAS Text Miner.

The Scoring Process

SAS Text Miner models, whether they are supervised or unsupervised, can also be used in a scoring process. However, unlike most of the other SAS Enterprise Miner models, many data sets from the SAS Text Miner training run must be accessible at score time. The data sets that are needed include the terms data set that is generated from the **Text Filter** node (or, in some cases, the **Text Topic** node), the tmconfig data set (contains the parsing options), and the multiword term data set. These last two data sets are both generated from the **Text Parsing** node. In addition, most of the other SAS Text Miner nodes also produce supplementary data sets that will be referenced by the score code.

In previous versions of SAS Text Miner, these data sets have been embedded in the prescore code that is generated from the nodes. This means that the score code was extremely large because the necessary data sets were then generated by the score code. Starting with SAS Text Miner 14.1, all of these data sets are kept in an accessible directory, and the score code references the data sets from that directory.

The default location for the data sets is the workspace directory of your project. This folder is prefixed with **EMWS**. Since that directory might not be accessible from the location from which you want to run your score code, you can also override the location by setting the macro variable EM_TERM_LOC in your start-up code and rerunning your training flow. When the macro is set to a valid path, the data sets that are needed at scoring time (but generated at training time) will reside there. If you use a network drive that is accessible from both the training run and your deployment location, then you will not have to relocate these input data sets. For more information about the EM_TERM_LOC macro variable see, "Using Macro Variables to Store Prebuilt Scoring Data in Tables Instead of Prescore Code" on page 136. For an example that

demonstrates how to create a stored process using the EM_TERM_LOC macro variable, see "Creating a Stored Process" on page 167.

As always, SAS Text Miner models still need to be run in SAS where a SAS Enterprise Miner and a SAS Text Miner installation is available. This is because score code from many SAS Text Miner nodes relies on SAS procedures and not just DATA step code.

Chapter 11

Macro Variables, Macros, and Functions

Using Macro Variables to Set Additional Properties

Contents

Overview of SAS Text Miner Macro Variables

Some advanced properties can be set using the value of macro variables (rather than in the node properties) for the **Text Filter** node, the **Text Topic** node, and the **Text Rule Builder** node. You can set the values of these macro variables in the start-up code. If you specify an invalid value for a macro variable, then the default value is used. You can also use macro variables to store prebuilt scoring data in tables instead of prescore code.

Using Macro Variables to Store Prebuilt Scoring Data in Tables Instead of Prescore Code

You can use the EM_TERM_LOC macro variable that is listed in the following table to store prebuilt scoring data in tables instead of prescore code. This affects data sets that are used by the **Text Filter**, **Text Topic**, **Text Cluster**, **Text Profile** and **Text Rule Builder** nodes. The EM_TERM_LOC macro variable enables you to deploy scoring results where a SAS Text Miner install is available. The EM_TERM_LOC macro variable also reduces the size of prescore code.

Table 11.1 *Macro Variables to Store Prebuilt Scoring Data in Tables*

Macro Variable	Description
EM_TERM_LOC	You can use the EM_TERM_LOC macro variable to specify where to store scoring tables that are prebuilt. SAS Text Miner score code uses those scoring tables for scoring.

When you use the EM_TERM_LOC macro variable, SAS Text Miner uses scoring tables that are stored prebuilt, rather than built within score code for the SAS Text Miner nodes. You can specify the EM_TERM_LOC macro variable by navigating to the **Project Start Code** in SAS Enterprise Miner, and indicating the location of the scoring tables. So, when you specify the EM_TERM_LOC macro variable in the **Project Start Code**, scoring tables are written to the specified location, which is used for scoring. When you do not specify the EM_TERM_LOC macro variable in the **Project Start Code**, scoring tables in your project's **EMWS** folder are used for scoring.

The following is an example of how to use the EM_TERM_LOC macro variable in the SAS Enterprise Miner **Project Start Code** to specify a location to write scoring tables to, which is used for scoring:

```
%let em_term_loc=\\myMachine\folder\SAS_Text_Miner\Term_Location;
```

Note: The above path is hypothetical, and should be replaced with the actual path that you want to use on your system that contains a destination folder that you have Write access to before running the **Project Start Code**.

Text Filter Node Macro Variables

You can use the macro variables listed in the following table to set additional properties for the **Text Filter** node. These properties all relate to spell-checking. Note the following:

- To reduce the number of falsely identified misspellings (Type I error rate), set larger values for TMM_DICTPEN, TMM_MINPARENT, and TMM_MULTIPEN and smaller values for TMM_MAXCHILD and TMM_MAXSPEDIS.
- To reduce the number of non-identified misspellings (Type II error rate), set larger values for TMM_MAXCHILD and TMM_MAXSPEDIS and smaller values for TMM_DICTPEN, TMM_MINPARENT, and TMM_MULTIPEN.

Table 11.2 *Macro Variables for the Text Filter Node*

Macro Variable	Default Value	Description
TMM_DICTPEN	2	penalty to apply to the SPEDIS() value if a dictionary data set is specified and a potential misspelling exists in the dictionary
TMM_MAXCHILD	log10(numdocs)+1	maximum number of documents in which a term can occur and also be considered a misspelling
TMM_MAXSPEDIS	15	maximum SPEDIS() for a misspelling and its parent to have and also evaluate as a misspelling
TMM_MINPARENT	log10(numdocs)+4	minimum number of documents in which a term must occur to be considered a possible parent
TMM_MULTIPEN	2	penalty to apply to the SPEDIS() value if one of the terms is a multi-word term

Text Topic Node Macro Variables

You can use the macro variables listed in the following table to set additional properties for the **Text Topic** node.

Table 11.3 *Macro Variables for the Text Topic Node*

Macro Variable	Default Value	Description
TMM_DOCCUTOFF	0.001	document cutoff value is for any user-created topic. It is used to determine the default document cutoff for user topics (excluding those that are modified multi-term or single-term topics) in the Topic table. Higher values decrease the number of documents assigned to a topic.
TMM_NORM_PIVOT	0.7	value (between 0 and 1) used for the pivot normalization of document length. If you want longer documents to contain many more topics than short documents, set this value closer to 1. If you want short documents and long documents to contain about the same number of topics, set this value closer to 0.
TMM_TERM_CUTOFF		cutoff value is for any user-created or multi-term topic. It is used to determine the default term cutoff for user topics (excluding those that are modified multi-term or single-term topics) and for multi-term in the Topic table. Higher values decrease the number of documents assigned to a topic. If this macro variable is set to blank or not set, then the mean topic weight + 1 standard deviation is set for topic cutoff for each topic.

Text Rule Builder Node Macro Variables

You can use the macro variable that is listed in the following table to set additional properties for the **Text Rule Builder** node.

Table 11.4 Macro Variables for the Text Rule Builder Node

Macro Variable	Default Value	Description
TMB_MAXTEXTLEN	200 bytes	identifies the length of the text variable in the Change Target Values table. Any text variable that matches on the first &tmb_maxtextlen bytes in that table is assumed to be the same document.

Using Special Characters

If you use special characters, such as ' and " in a path, you need to mask the pathname by using %nrbquote.

For example, consider that you want to use the following path to specify a location for variable em_term_loc in the project start code:

```
\\myComp\public\MyFolder\tm\user's termloc folder
```

You can use %nrbquote as shown below for a path with this quotation mark character:

```
%let em_term_loc=%nrbquote(\\myComp\public\MyFolder\tm\user's termloc folder);
```

For more information, see http://support.sas.com/documentation/cdl/en/mcrolref/61885/HTML/default/viewer.htm#tw3514-overvwqt.htm.

Overview of Macros and Functions

You can use the following SAS Text Miner macros and functions to create a synonym data set, filter a collection of documents, generate a compressed, term-by-document frequency summary data set, and other tasks:

- "%TEXTSYN Macro" on page 139
- "%TMFILTER Macro" on page 143
- "TGSCORE Function" on page 153

%TEXTSYN Macro

Contents

%TEXTSYN Macro Syntax

The %TEXTSYN macro is provided with SAS Text Miner. You can use this macro after a **Text Parsing** node has been successfully run to find and correct misspellings that appear in the input data source. It is not supported for use with the Chinese language.

The macro creates a synonym data set, which you can use in SAS Text Miner, that contains misspelled terms and candidate parents (correctly spelled terms). The data set includes the variables "term", "parent", "termrole", and "parentrole." Using optional arguments, you can also specify that the synonym data set include example usages (from up to two documents) of the misspelled terms.

Terms are selected as follows:

1. Candidate child terms that occur in a specified maximum number of documents are selected from all terms. Likewise, candidate parent terms that occur in a specified minimum number of documents are selected from all terms.

2. All combinations of the candidate parent and child terms are found where the first alphabetic character is the same for a parent and a child. The SPEDIS function (a Base SAS function) is used to calculate a distance measure in both directions for each parent-child combination. The minimum of the two distances is divided by the length of the shorter term, which defines a new distance measure. For multi-word terms and terms that do not appear in a dictionary, this distance measure is multiplied by a penalty constant.

3. Parent-child combinations with the lowest final distance measures (below a specified threshold) are output to the synonym data set.

```
%TEXTSYN (TERMDS=<libref.>SAS-data-set, SYNDS=<libref.>output-data-set,
          <, DOCDS=<libref.>SAS-data-set, OUTDS=<libref.>SAS-data-set,
          TEXTVAR=text-variable, DICT=<libref.>SAS-data-set, MNPARDOC=n,
          MXCHDDOC=n, MAXSPED=n, MULTIPEN=n, DICTPEN=n, CONTEXT=n >)
```

Required Arguments:

- **TERMDS=**<libref.>SAS-data-set

  specifies the name of the Terms data set that was output from any **Text Parsing** node.

  Note: Each **Text Parsing** node outputs a terms data set, which is stored with the project data. The name of these data sets follows the format NodeID_TERMS (for example, TEXTparsing_TERMS).

- **SYNDS=**<libref.>SAS-data-set

  specifies the name to give the output synonym data set. It is recommended that you save this data set in a permanent library. For more information, see "%TEXTSYN Macro Output Data Set" on page 141.

Optional arguments:

- **DOCDS=**<libref.>SAS-data-set

  specifies the name of the Documents data set that was output. This argument is required to include example usages of the misspelled terms.

- **OUTDS=**<libref.>SAS-data-set

specifies the name of the OUT data set that was output from a **Text Parsing** node. This argument is required to include example usages of the misspelled terms.

- **TEXTVAR=**variable-name

  specifies the name of the character variable in the input data set that contains the text (or a path to a file that contains the text) to score. This argument is required to include example usages of the misspelled terms.

- **DICT=**<libref.>SAS-data-set

  specifies the name of a dictionary data set. Using a dictionary data set can reduce the number of false positives that are in the output synonym data set. For more information, see "How to Create a Dictionary Data Set" on page 56.

- **MNPARDOC=**n

  specifies the minimum number of documents in which a term must appear in order to be considered a parent term. The default value is 3.

- **MXCHDDOC=**n

  specifies the maximum number of documents in which a term must appear in order to be considered a child term. The default value is 6.

- **MAXSPED=**n

  specifies the SPEDIS() cutoff value for acceptance that a parent-child combination is valid. The default value is 15.

- **MULTIPEN=**n

  specifies the number by which to multiply the value of MAXSPED= when the parent or child term is a multi-word term. The default value is 2.

- **DICTPEN=**n

  specifies the number by which to multiply the value of MAXSPED= when the child term is found in the dictionary table. The default value is 2.

- **CONTEXT=**n

  specifies the number of words to include before and after the target term in examples. The default value is 4.

%TEXTSYN Macro Output Data Set

The synonym output data set contains the following variables:

Column Name	Description
<Example1>	(if DOCDS=, OUTDS=, and TEXTVAR= arguments are specified) example from a document that includes the TERM.
<Example2>	(if DOCDS=, OUTDS=, and TEXTVAR= arguments are specified) example from a document that includes the TERM.

Column Name	Description
TERM	child term from the KEY data set. This is typically a misspelled word.
TERMROLE	the part of speech or entity of TERM
PARENT	parent term for the misspelled word.
PARENTROLE	the part of speech or entity of PARENT
CHILDNDOCS	number of documents that contain TERM
NUMDOCS	number of documents that contain PARENT
MINSPED	minimum spelling distance between terms. The smaller the number, the closer the terms.
DICT	(if DICT= argument is specified) **Y** if TERM is found in the dictionary data set, and **N** otherwise.

%TEXTSYN Macro Example

This example assumes that you have already created a diagram in a SAS Enterprise Miner project and that you have created an input data source using the SAMPSIO.ABSTRACT sample data set.

1. Drag the input data source that you have created using the SAMPSIO.ABSTRACT data set into the diagram workspace.
2. Select the **Text Mining** tab on the Toolbar.
3. Drag a **Text Parsing** node to the diagram workspace.
4. Connect the input data source node to the **Text Parsing** node.
5. Select the **Text Parsing** node to view its properties.
   - Set **Different Parts of Speech** to **No**.
   - Set **Noun Groups** to **No**.
6. In the diagram workspace, right-click the **Text Parsing** node and click **Run**. Click **Yes** in the Confirmation dialog box.
7. Click **OK** in the Run Status dialog box.
8. Drag a **SAS Code** node to the diagram workspace from the **Utility** tab on the toolbar.
9. Connect the **Text Parsing** node to the **SAS Code** node.

10. Select the **SAS Code** node, and then click the ellipsis button for the **Code Editor** property.

11. Enter the following code into the code window. Be sure to change <libref> to the actual libref for your diagram.

    TIP To determine the libref of a diagram, select the diagram name in the Project panel and view the value of the **ID** property. This value is the libref.

    Note: The following code assumes that the **Mylib** libref has been assigned to a SAS library. If you have not already created a **Mylib** libref, change **Mylib** in the following code to another libref to store your output:

```
%textsyn(docds=<libref>.TEXTparsing_train,
         termds= <libref>.TEXTparsing_TERMS,
         outds=<libref>.TEXTparsing_tmOUT,
         synds=Mylib.textsyn,
         textvar=text);
```

12. Right-click the **SAS Code** node and click **Run**. Click **Yes** in the Confirmation dialog box, and **OK** in the Run Status dialog box when the node has finished running.

13. Click the **Explorer** toolbar shortcut to open the Explorer window. In the SAS Libraries tree, navigate to the library where you stored your output results. Highlight this directory. Then double-click the file in the right panel of the Explorer window. A preview of the data set opens.

    Note: If you do not see the data set, you might need to refresh your Explorer window.

    The example1 and example2 variables provide example usages of the candidate misspelled terms from the input data set. Misspelled terms in the examples are enclosed in exclamation marks. Proposed correctly spelled terms are contained in the parent variable.

    Note: After you run the %TEXTSYN macro, you should always examine the output data set and delete any proposed misspelled terms that should remain spelled as they are in the input data set.

%TMFILTER Macro

Contents

%TMFILTER Macro Syntax

The %TMFILTER macro is provided with SAS Text Miner. It is supported in all operating systems for filtering and on Windows for crawling. See documentation for the SAS Document Conversion server for more information.

You can use this macro to do the following:

- filter a collection of documents that are saved in any supported file format and output a SAS data set that can be used to create a SAS Text Miner data source.

- web crawl and output a SAS data set that can be used to create a SAS Text Miner data source. Web crawling retrieves the text of a starting web page, extracts the URL links within that page, and then repeats the process within the linked pages recursively. You can restrict a crawl to the domain of the starting URL. Or you can let a crawl process any linked pages that are not in the domain of the starting URL. The crawl continues until a specified number of levels of drill-down is reached or until all the web pages that satisfy the domain constraint are found. Web crawling is supported only in Windows operating systems.

- identify the languages of all documents in a collection.

```
%TMFILTER (DIR=path, URL=path <,DATASET=<libref.>output-data-set
          <,DEPTH=n,  DESTDIR=path, EXT=extension1 <extension2 extension3...>,
          FORCE=anything, HOST=name | IP address, LANGUAGE=ALL | language1
          <language2 language3...>, NORESTRICT=anything,  NUMCHARS=n,
          PASSWORD=password, USERNAME=username>)
```

Note:

- If you run %TMFILTER in a UTF-8 SAS session, then the macro attempts to transcode all filtered text to UTF-8 encoding so that the resulting data set can be used in a UTF-8 SAS session. In all other SAS session encodings, %TMFILTER does not transcode the data. Instead, it assumes that the input data is in the same encoding as the SAS session. For more information, see "SAS Text Miner and SAS Session Encoding" on page 180.

- The %TMFILTER macro sets the macro variable EMEXCEPTIONSTRING to `1` if an error occurs. You can use the value of this variable to debug programs (for example, in extension nodes or SAS Code nodes).

- If you run the web crawling aspect of %TMFILTER macro within a SAS Enterprise Miner client installation that is connected to a Windows server, then you must issue the XCMD SAS system option on the server. For details, see the post-installation instructions that are generated during the installation of SAS Enterprise Miner and SAS Text Miner.

  When there is an issue with accessing a web page, the document level HTTP status codes are reported in the output data set. The interpretation of the error code can be found at http://en.wikipedia.org/wiki/List_of_HTTP_status_codes.

Required arguments:

- **DIR**=path

  specifies the path to the directory that contains the documents to process. Any subfolders in this directory are processed recursively. The path might be a UNC (Universal Naming Convention) formatted network path.

- **URL**=URL

  (web crawling only) specifies the URL—fewer than or equal to 255 characters in length—of the starting web page. The value can be either in the form **`http://www.sas.com`** or **`www.sas.com`**. Web pages that are retrieved are placed in the directory that is specified by the DIR= argument. Web crawling is supported only in Windows operating systems.

  Note:

  - If the URL contains an ampersand (&), then the ampersand will be misinterpreted as a macro trigger. In this case, you must use the %NRSTR function when you specify the URL.

  - Be aware of the terms and service policies of the web pages that you want to crawl. Some policies might restrict automatic access, and some might restrict how you use any retrieved content. Furthermore, be aware that when you are crawling web pages, the %TMFILTER macro might place a high demand on a web host.

Optional arguments:

- **DATASET**=<libref.>output-data-set

  specifies the name to give the output data set. For more information, see "%TMFILTER Macro Output Data Set" on page 146. It is recommended that you save this data set in a permanent library. If you do not specify this argument, then the name of the output data set is Work.Data.

- **DEPTH**=n

  (for web crawling only) specifies the number of levels for web crawling. If you do not specify this argument, then the macro visits all links on the starting web page and all links on the linked pages (in other words, **`DEPTH=2)`**.

- **DESTDIR**=path

  specifies the path to the directory in which to save the output plain text files. Do not make the value of DESTDIR= a subdirectory of the DIR= directory. If you do not specify this argument, then filtered plain text files that correspond to the files in DIR= directory are not produced.

  Note: If you specify a network path, then the folders in the path must already exist on the network machine. Otherwise, the macro will fail. If you specify a local path, then it is not necessary for the folders to exist. The %TMFILTER macro creates them automatically if they do not already exist.

- **EXT**=extension1 <extension2 extension3...>

  specifies one or more file types to process. Only files (with a listed extension) that are in the directory specified by the DIR= argument are processed. To specify documents with no extension, use a single period (**`EXT= .`**). If you do not specify this argument, then all applicable file types are processed.

- **FORCE**=anything

  specifies not to terminate the %TMFILTER macro if the directory specified by the DESTDIR= argument is not empty when the macro begins processing. Any value (for example, **`1`** or **`'y'`**) keeps the macro from terminating if the destination

directory is not empty. Otherwise, if you do not specify this option or if you do not specify a value for it, the macro terminates if the destination directory is not empty.

- **HOST=**name | IP address

  specifies the name or IP address of the machine on which to run the %TMFILTER macro. If you do not specify this argument, then the macro assumes that the SAS Document Conversion Server will use its own defaults.

- **LANGUAGE=**ALL | language1 <language2 language3...>

  specifies one or more licensed languages in which the input documents are written. If a list is supplied, then the %TMFILTER macro automatically detects the language (from those in the list) of each document. To search all supported languages, specify **`LANGUAGE=ALL`**. Automatic detection is not accurate in documents that contain fewer than 256 characters.

  If you do not specify this argument, then it is assumed that input files are written in English.

- **NORESTRICT=**anything

  (for web crawling only) specifies to allow the processing of websites outside the domain of the starting URL. Any value (for example, **`1`** or **`'y'`**) lets the macro process websites outside of the starting domain. Otherwise, if you do not specify this option or if you do not specify a value for it, only web pages that are in the same domain as the starting URL are processed.

- **NUMCHARS=**n

  specifies the length of the TEXT variable in the output data set. If you do not specify this argument, then the TEXT variable is restricted to 100 characters. For more information, see "%TMFILTER Macro Output Data Set" on page 146.

- **PASSWORD=**password

  (for web crawling only) specifies the password to use when the URL input refers to a secured website that requires a password.

- **PORT=**port-number

  specifies the number of the port on which the SAS Document Conversion Server resides. If it is not set, it is assumed that the conversion server will use its own defaults.

- **USERNAME=**user name

  (for web crawling only) specifies the user name to use when the URL input refers to a secured website that requires a user name.

%TMFILTER Macro Output Data Set

The output data set contains the following variables:

Column Name	Description
TEXT	text of each document, truncated to the length specified by the NUMCHARS= argument.

Column Name	Description
URI	path to the input files that reside in the directory specified by the DIR= option.
NAME	name of the input file
FILTERED	path to the directory that contains the HTML file. This path corresponds to the value of the DESTDIR= argument.
LANGUAGE	most likely source language of the document, as determined by the LANGUAGE= option.
CREATED	date and time that the input document was created.
ACCESSED	date and time that the input document was last accessed.
MODIFIED	date and time that the input document was last modified.
TRUNCATED	`1` if TEXT contains truncated text; `0` otherwise.
OMITTED	`1` if the document was skipped (because of an unsupported input file type or some filtering error). `0` otherwise.
EXTENSION	file extension of the input document.
SIZE	size of the input document, in bytes.
FILTEREDSIZE	size of the input document after filtering, in bytes.

%TMFILTER Macro Details

Contents

Starting the cfs.exe Process Manually

By default, the cfs.exe process is automatically started by the %TMFILTER macro. However, if the socket connection mechanism is unable to function properly, you might need to start the process manually. To manually start cfs.exe:

1. Ensure that the log file (cfs.log) is created in a writable system location by editing the _cfsoptions.txt file. This file is located in the !SASROOT/tmine/sasmisc directory, where !SASROOT is the actual path to your SAS installation. Edit the

following line, ensuring that what you specify for **<path>** is a writable directory, and save the file:

```
<cat name="CatLogFileManager.FilePath" value="<path>\_cfsLog.txt" />
```

2. Open a Command Prompt window and navigate to the !SASROOT/tmine/sasmisc directory.

3. In the Command Prompt window, submit the following code. Replace <portnumber> with a four-digit port number and !SASROOT with the actual path to your SAS installation. (if this path has spaces, enclose the entire path in quotation marks.)

```
cfs.exe -optionfile !SASROOT/tmine/sasmisc/_cfsoptions.txt -port <portnumber>
```

At this point, the cfs.exe process is running. The command window should no longer contain a command prompt. When you run the %TMFILTER macro, you must use the MANUAL= and PORT= options. When the macro finishes, you can either terminate the cfs.exe process (by closing the command window), or you can call the macro again without restarting the process.

Supported Document Formats

The following four tables list the proprietary-encoded file formats supported by the %TMFILTER macro.

Table 11.5 *Text, Markup, and Word Processing Formats*

Document Format	Version
ASCII text	All
ANSI text	All
HTML/XML	
Microsoft Rich Text Format (RTF)	All
Microsoft Word for Macintosh (DOC)	All
Microsoft Word for PC (DOC)	4, 5, 5.5, 6
Microsoft Word for Windows (DOC)	All
Microsoft Word for Windows (DCX)	
Microsoft WordPad	All
Microsoft Works (WPS)	1 — 4
Office Writer	4.0 — 6.0
OpenOffice (SXW)	1, 1.1

Table 11.6 *Spreadsheets*

Document Format	Version
Comma-Separated Values (CSV)	All
Microsoft Excel for Macintosh	All
Microsoft Excel for Windows (XLS)	All
Microsoft Excel for Windows (XLSX)	
Microsoft Multiplan	4
Microsoft Works Spreadsheet (S30, S40)	1 — 4
OpenOffice Spreadsheets (SXI, SXP)	1.1

Table 11.7 *Presentation Formats*

Document Format	Version
Adobe Portable Document Format (PDF)	2.0 — 6.0, Japanese
Microsoft PowerPoint for Windows (PPT)	All
Microsoft PowerPoint for Macintosh (PPT)	All
Microsoft PowerPoint (PPTX)	
OpenOffice (SXI, SXP)	1.1

Table 11.8 *Database Formats*

Document Format	Version
Access	Through 2.0
dBASE	Through 5.0
Microsoft Works for Windows	Through 4.0
Microsoft Works for DOS	Through 2.0
Microsoft Works for Macintosh	Through 2.0

%TMFILTER Macro Examples

Contents

Filter Documents of Different File Types

When you use the %TMFILTER macro to create a SAS data set that contains the text of documents of various formats, you must decide whether you want to store all the text in the variable in the SAS data set, or whether you want to reference the files by path and then place only a portion of text into the Text variable. In this example, all the text is placed in the SAS data set because the files are short. If the files were longer, the DESTDIR parameter would have been used in addition to the DIR and NUMCHARS parameters.

```
%tmfilter(dataset=tmlib.txtinput, dir=c:\public\example, numchars=32000);
```

Note: In the above example, you must first specify a libref (such as "tmlib") to a location that you can access, and you must specify a directory of files that you would like to process with the %TMFILTER macro.

You use the DATASET parameter to specify a name for the generated SAS data set. The DIR parameter specifies a directory that contains documents of various formats. The %TMFILTER macro extracts text of all the supported file formats in the directory and its subdirectories. In this example, the C:\public\example directory contains four files and a folder named "more" that contains three additional files.

After the SAS data set is generated, you can create a data source from this SAS data set and explore its contents. For information about how to explore the SAS data set, see the SAS Enterprise Miner Help.

The following table shows examples of the values of the TRUNCATED and OMITTED variables:

Table 11.9 *Example Variable Values*

EXPLANATION	TRUNCATED	OMITTED
The document cannot be processed.	1	1
The document is larger than 32 KB and the text must be truncated.	1	0
The document has been processed.	0	0

If the %TMFILTER macro fails, consult the log file. The log file contains information that can help you diagnose problems that might occur during this process. Sometimes the macro skips a file because the file cannot be extracted. In this case, the filename is listed

in the corresponding log file. The log file can be found by selecting the **Log** tab in the SAS Enterprise Miner Program Editor.

When you use the %TMFILTER macro to retrieve web pages, you must specify values for the URL, DIR, and DESTDIR parameters. The %TMFILTER macro extracts text from the web pages and transforms textual data of different formats into a SAS data set. That data set is then used as input for the **Text Parsing** node. Notice that non-text components such as figures and graphics are ignored in the process. The following example code shows how to use the %TMFILTER macro to process documents on a web page:

```
%tmfilter(url=http://www.sas.com/technologies/analytics/datamining,
          depth=1,
          dir=c:\macro\dir,
          destdir=c:\macro\destdir,
          norestrict=1,
          dataset=tmlib.macrooutput);
```

In this example, the following web page contains links to HTML files:

```
http://www.sas.com/technologies/analytics/datamining
```

View the SAS data set Tmlib.Macrooutput in SAS. The data set consists of the variables TEXT, URI, NAME, FILTERED, LANGUAGE, CREATED, ACCESSED, MODIFIIED, TRUNCATED, OMITTED, EXTENSION, SIZE, and FILTEREDSIZE.

When the SAS data set Tmlib.Macrooutput is used as an input to a **Text Parsing** node, the variables TEXT, FILTERED, and URI should be assigned the roles of Text, Text Location, and Web Address, respectively.

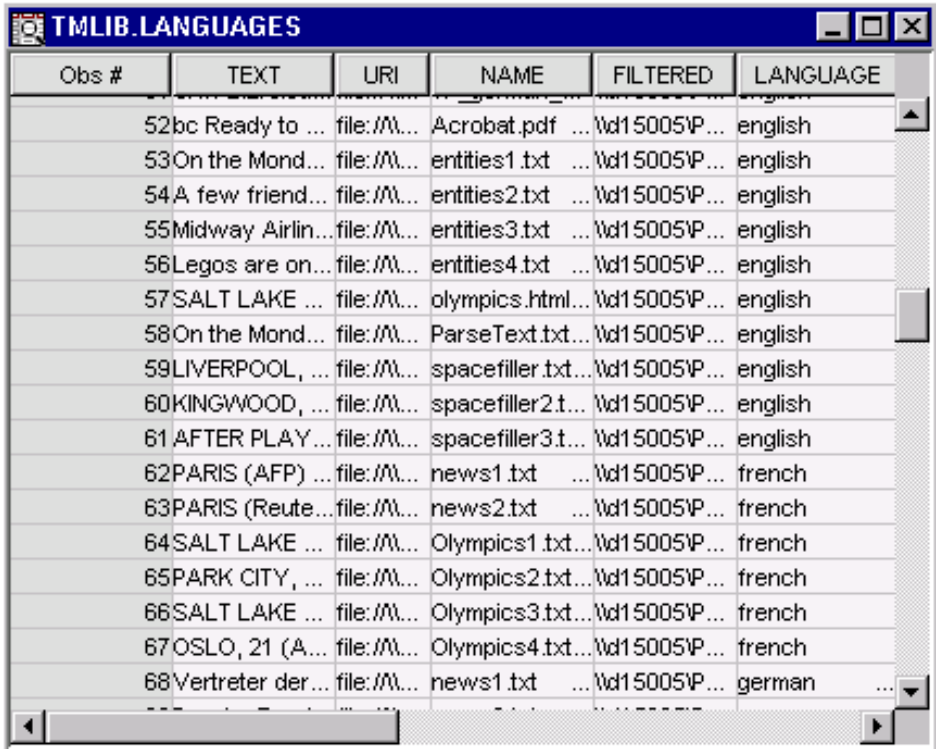
Language Detection

Suppose you store a collection of documents in various languages in the mydoc folder. You use the following %TMFILTER macro statement with the LANGUAGE parameter to create a SAS data set. The LANGUAGE parameter uses language identification technology to detect the language of each document. The value of the LANGUAGE parameter is a list of licensed languages that are separated by spaces.

```
%tmfilter(dir=c:\mydoc,
          dataset=tmlib.languages,
          language=arabic chinese czech danish
                   dutch english finnish french
                   german greek hebrew hungarian
                   indonesian italian japanese
                   korean norwegian polish portuguese
                   romanian russian slovak spanish
                   swedish thai turkish vietnamese);
```

Use any of the following parameter values: **arabic, chinese, czech, danish, dutch, english, finnish, french, german, greek, hebrew, hungarian, indonesian, italian, japanese, korean, norwegian, polish, portuguese, romanian, russian, slovak, spanish, swedish, thai, turkish,** and **vietnamese**.

The following is a display of the contents of the resulting Tmlib.Languages data set. The LANGUAGE column represents the language that SAS Text Miner detects.



TMLIB.LANGUAGES

Obs #	TEXT	URI	NAME	FILTERED	LANGUAGE
52	bc Ready to ...	file://\\...	Acrobat.pdf ...	\\d15005\P...	english
53	On the Mond...	file://\\...	entities1.txt ...	\\d15005\P...	english
54	A few friend...	file://\\...	entities2.txt ...	\\d15005\P...	english
55	Midway Airlin...	file://\\...	entities3.txt ...	\\d15005\P...	english
56	Legos are on...	file://\\...	entities4.txt ...	\\d15005\P...	english
57	SALT LAKE ...	file://\\...	olympics.html...	\\d15005\P...	english
58	On the Mond...	file://\\...	ParseText.txt...	\\d15005\P...	english
59	LIVERPOOL, ...	file://\\...	spacefiller.txt...	\\d15005\P...	english
60	KINGWOOD, ...	file://\\...	spacefiller2.t...	\\d15005\P...	english
61	AFTER PLAY...	file://\\...	spacefiller3.t...	\\d15005\P...	english
62	PARIS (AFP) ...	file://\\...	news1.txt ...	\\d15005\P...	french
63	PARIS (Reute...	file://\\...	news2.txt ...	\\d15005\P...	french
64	SALT LAKE ...	file://\\...	Olympics1.txt...	\\d15005\P...	french
65	PARK CITY, ...	file://\\...	Olympics2.txt...	\\d15005\P...	french
66	SALT LAKE ...	file://\\...	Olympics3.txt...	\\d15005\P...	french
67	OSLO, 21 (A...	file://\\...	Olympics4.txt...	\\d15005\P...	french
68	Vertreter der...	file://\\...	news1.txt ...	\\d15005\P...	german

The accuracy of language identification increases significantly if all the documents in the DIR directory are in the languages that SAS Text Miner supports.

Convert Files

You can use the %TMFILTER macro to convert files into a SAS data set that can then be used as an input data source for the **Text Parsing** node. The %TMFILTER macro supports web crawling only in Windows operating environments, but you can run the %TMFILTER macro on files on either Windows or UNIX. The following example specifies some %TMFILTER macro parameters.

1. Create a new project and define the following LIBNAME statement in the start-up code:

   ```
   libname mylib '<path-to-your-library>';
   ```

   Note: The value **`mylib`** is the first-level SAS name that identifies the library name. You must replace <path-to-your-library> with the path specification that points to your SAS library.

2. Run the following code in the Program Editor:

   ```
   %tmfilter (dataset=mylib.tmoutds,
              dir=\\aclientmachine\Public\TM\Examples,
              destdir=\\aclientmachine\Public\TM\mydatasets,
              ext=doc txt html pdf,
              language=english spanish,
              numchars=20);
   ```

   - The value **`mylib`** is the library name, and the value tmoutds is the name of the generated SAS data set.

   - The value **`\\aclientmachine\Public\TM\Examples`** is the path to the directory that contains the files to be processed.

- The value **\\aclientmachine\Public\TM\mydatasets** is the path to the directory that will contain the filtered files.
- The file extensions .doc, .txt, .html, and .pdf are processed by the %TMFILTER macro.
- The languages **english** and **spanish** are by the %TMFILTER macro.
- The length in bytes of the TEXT variable is 20.

TGSCORE Function

Contents

TGSCORE Function Syntax

The TGSCORE function is called inside a SAS DATA step and is used in SAS Text Miner for document scoring. It takes a textual variable and data sets from a SAS Text Miner training run and generates a compressed, term-by-document frequency summary data set. Child term frequencies are mapped to the parent terms. The TGSCORE function can also build a Teragram search index. A zero is returned if the function runs successfully, and a nonzero value is returned otherwise.

```
TGSCORE (text-variable, "<libref.>CONFIG-data-set", "<libref.>KEY-data-set",
         "<libref.>output-data-set", "multiterm-file-path"|0, 0|1)
```

Table 11.10 *Arguments of the TGSCORE Function*

Argument	Description
text-variable	name of character variable in the input data set that contains the text (or a path to a file that contains the text) to score.
CONFIG-data-set	name of the CONFIG data set. This data set contains the parsing settings that are used for scoring.

Argument	Description
KEY-data-set	name of the KEY output data set, which contains summary information about the terms from the training data at the document collection level. The data set must contain the variables “term” and “key.” It must also contain “role” if part-of-speech tagging is used, and “parent” can be included to map child terms to parent terms. • You must sort the data set by the variable “term” and also create an index on this variable if part-of-speech tagging is used. • You must sort the data set by the variables “term” and “role” and also create an index on these variables if part-of-speech tagging is not used.
output-data-set	name to give the output data set.
multiterm-file-path	file path of the XML file that contains the list of multi-word terms. The SAS Text Miner parser ensures that the multi-word terms that are on this list are treated as a single term. If you are not using a multiterm file, then you must enter a `0` (with no quotation marks) for this argument.
0|1	`1` builds a Teragram search index. `0` does not. If an index is created, then multiple index files (with different extensions) are saved to the Work directory with the name **`stgindex`**. These files can be used to perform queries against the data that is being scored.

TGSCORE Function Example

1. Using SAS Text Miner, build and run a model to produce a KEY output data set and a CONFIG data set. You can determine the names of these data sets by looking at the SAS log. In this example, the data sets that were produced are named EMWS.TEXT_TERMS and EMWS.TEXT_OUT_T_CFG, respectively.
2. Sort and index the KEY data set. In this example, the training run has used part-of-speech tagging. Therefore, you can create a composite index on the term and role variables. The following code accomplishes the sorting and indexing.

```
proc sort data=EMWS.TEXT_TERMS out=work.sortKey;
   by key;
run;

proc datasets lib=work nolist;
   modify sortKey;
   index create both=(term role);
run;
```

3. Use the TGSCORE function to produce an output data set and Teragram search index files in the Work directory:

```
data _NULL_;
   set sampsio.svdtutor;
```

```
   rc=tgscore(text,"EMWS.TEXT_OUT_T_CFG","WORK.sortKey","WORK.OUT",0,1);
run;
```

Note: You can use a **Score** node after a **Text Parsing** node in a process flow diagram and examine the generated code for more examples.

Chapter 12

Additional Examples

Classifying News Articles

Contents

Description of the Input Data Set

This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

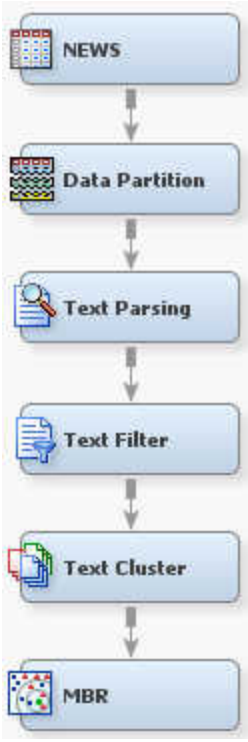
The SAMPSIO.NEWS data set consists of 600 brief news articles. Most of the news articles fall into one of these categories: computer graphics, hockey, and medical issues.

The SAMPSIO.NEWS data set contains 600 observations and the following variables:

- **TEXT** is a nominal variable that contains the text of the news article.
- **graphics** is a binary variable that indicates whether the document belongs to the computer graphics category (1-yes, 0-no).
- **hockey** is a binary variable that indicates whether the document belongs to the hockey category (1-yes, 0-no).
- **medical** is a binary variable that indicates whether the document is related to medical issues (1-yes, 0-no).
- **newsgroup** is a nominal variable that contains the group that a news article fits into.

Creating the Process Flow Diagram

Follow these steps to create the Process Flow Diagram:



Input Data Source

1. Use the Data Source Wizard to define a data source for the data set SAMPSIO.NEWS.
2. Set the measurement levels of the variables graphics, hockey, and medical to **`Binary`**.

3. Set the model role of the variable hockey to **`Target`** and leave the roles of graphics, medical, and newsgroup as **`Input`**. The variable TEXT has a role of **`Text`**.

4. Select **`No`** in the Data Source Wizard — Decision Configuration dialog box. Use the default target profile for the target hockey.

5. After you create the data source, drag it to the diagram workspace.

Data Partition Node

1. Add a **Data Partition** node to the diagram workspace and connect the **Input Data** node to it.

2. Set the **Partitioning Method** property to **`Simple Random`**.

3. In the Properties panel of the **Data Partition** node, change the data set percentages for training, validation, and test to 60.0, 20.0, and 20.0, respectively.

Text Parsing Node

1. Add a **Text Parsing** node to the diagram workspace and connect the **Data Partition** node to it.

2. Ensure that the **Stem Terms**, **Different Parts of Speech**, and **Noun Groups** properties are set to **`Yes`**. Use the default settings for other parsing properties.

Text Filter Node

1. Add a **Text Filter** node to the diagram workspace.

2. Connect the **Text Parsing** node to the **Text Filter** node.

Text Cluster Node

1. Add a **Text Cluster** node to the diagram workspace.

   Note: For process flow diagrams where you want to use the **Decision Tree** node in your predictive model, it is recommended that you use the **Text Topic** node instead of the **Text Cluster** node.

2. Connect the **Text Filter** node to the **Text Cluster** node.

MBR Node (Memory-Based Reasoning Node)

1. Add an **MBR** node to the diagram workspace.

2. Connect the **Text Cluster** node to the **MBR** node.

3. Right-click the **MBR** node, and select **Run**.

4. Click **Yes** in the Confirmation dialog box.

5. Click **Results** in the Run Status dialog box after the node has finished running.

Viewing Results

In the MBR Results window, select **View** ⇨ **Assessment** ⇨ **Classification Chart: hockey**.

The classification chart displays the agreement between the predicted and actual target values. By default, the chart displays the percentage on the vertical axis. To create a plot based on frequency counts, right-click in the chart and select **Data Options**. In the Data Options dialog box, set the Role for the variable COUNT to **`Response`**.

Using SAS Code Node to Generate a Precision and Recall ROC Chart

Follow these steps to generate a precision and recall ROC chart:

1. Add a **SAS Code** node to the diagram workspace and connect the **MBR** node to it.

2. Select the **SAS Code** node and click the ellipsis button next to the **Code Editor** property to open the Code window.

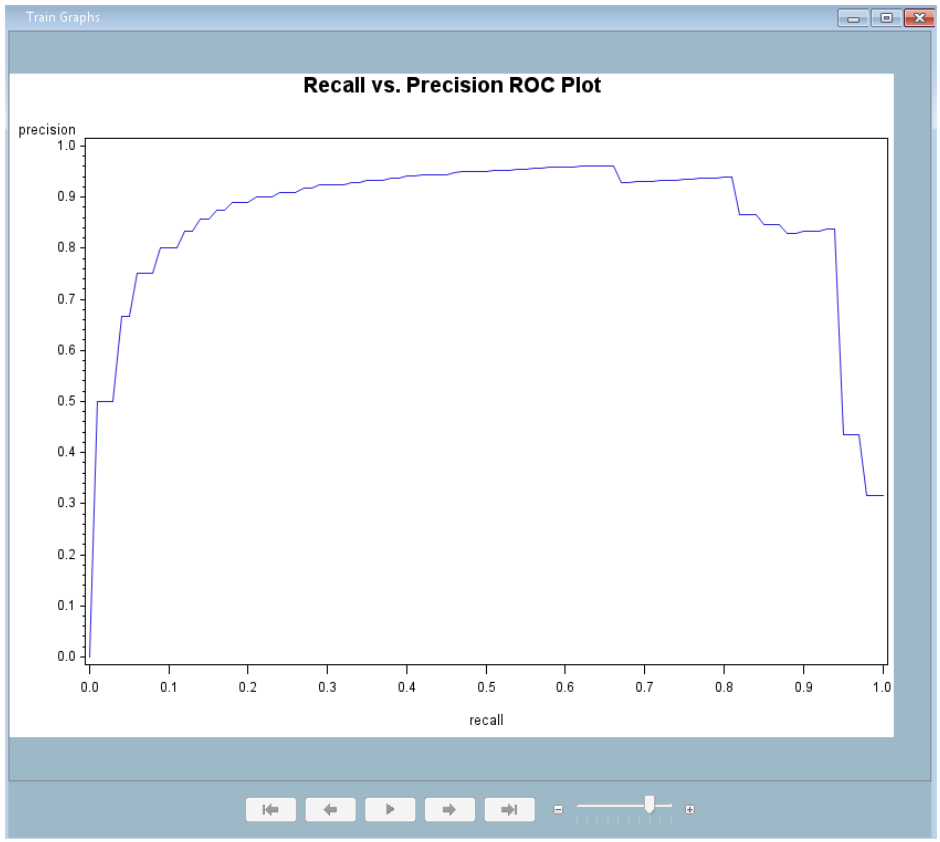
3. Enter the following SAS code in the Training Code editor:

```
%prcrcroc(hockey, P_hockey1, &EM_IMPORT_TEST);
%prerec(hockey, I_hockey, &EM_IMPORT_TEST);
run;
```

   The macro PRCRCROC creates a precision and recall ROC plot. The macro PREREC prints a confusion matrix of the scored test data set. For more information about these macros, see "PRCRCROC and PREREC Macros" on page 163.

4. Close the SAS Code window. Run the **SAS Code** node and view the results.

5. On the main menu in the SAS Code Results window, select **View** ⇨ **SAS Results** ⇨ **Train Graphs** to display the precision and recall ROC chart. The following display shows the precision and recall ROC chart:



For more information, see the Precision and Recall ROC Chart topic in the SAS Enterprise Miner help.

6. The Output window in the SAS Code Results window displays the confusion matrix (with a threshold value of 50%) of the scored training data set. The scored test data set has 120 observations, which is 20% of the original input data set (600 observations). The following display shows the resulting confusion matrix.

```
Recall vs. Precision ROC Plot

The FREQ Procedure

Table of hockey by I_hockey

hockey     I_hockey(Into: hockey)

Frequency|
Percent  |
Row Pct  |
Col Pct  |0       |1       |  Total
---------+--------+--------+
       0 |     76 |      6 |     82
         |  63.33 |   5.00 |  68.33
         |  92.68 |   7.32 |
         |  95.00 |  15.00 |
---------+--------+--------+
       1 |      4 |     34 |     38
         |   3.33 |  28.33 |  31.67
         |  10.53 |  89.47 |
         |   5.00 |  85.00 |
---------+--------+--------+
Total          80       40      120
            66.67    33.33   100.00



Recall vs. Precision ROC Plot

Obs    clasrate    misclass    precision     recall    breakeven

 1      91.6667     8.33333       0.85      0.89474     0.87237
```

Interpretation of the matrix shows the following:

- 76 articles are correctly predicted as 0.
- 34 articles are correctly classified into the hockey category.
- 6 articles that actually belong in the hockey category are misclassified.
- 4 articles that do not belong in the hockey category are misclassified.
- The overall correct classification rate is 91.6667%.
- Precision and recall are 0.85 and 0.89474, respectively. The break-even point is 0.87237, which is the average of these values.

Precision and Recall ROC Chart

Precision and recall are measures that describe the effectiveness of a binary text classifier to predict documents that are relevant to the category. A relevant document is one that actually belongs to the category. A classifier has a high precision if it assigns a

low percentage of non-relevant documents to the category. Recall indicates how well the classifier can find relevant documents and assign them to the correct category. Precision and recall can be calculated from a two-way contingency table:

		Predicted Values	
		1	0
Actual Values	1	A	C
	0	B	D

Suppose that the target value 1 is of interest, that A is the number of documents that are predicted into category 1 and actually belong to that category, that A+C is the number of documents that actually belong to category 1, and that A+B is the number of documents that are predicted into category 1. Then, precision = A/(A+B) and recall = A/(A+C). High precision and high recall are generally mutually conflicting goals. To obtain high precision, the classifier assigns to the category only the documents that are definitely in the category. High precision is achieved at the expense of missing some documents that might also belong to the category, and it therefore lowers the recall.

The precision and recall ROC chart enables you to make a decision about a cutoff probability to categorize the documents. Charts that push upward and to the right represent good precision and recall, which means a good prediction model. The precision and recall ROC chart emphasizes the trade-off between precision and recall. The precision and recall ROC chart is relevant to the sensitivity and specificity ROC chart in the **Assessment** node, but it is not exactly the same.

PRCRCROC and PREREC Macros

Two macros, PRCRCROC and PREREC, are used in this example to explore the results from the **MBR** node.

The macro PRCRCROC computes and plots a precision and recall curve for the scored data set. Here is an example of PRCRCROC:

```
%prcrcroc(hockey, P_hockey1, &EM_IMPORT_TEST);
```

In the example, hockey is the target variable, P_hockey1 is the posterior probability for an observation that the predicted value of hockey is 1, and &EM_IMPORT_TEST is the macro variable name of the scored test data set.

The macro PREREC is used to generate a tabular view of classification results. The following code shows an example:

```
%prerec(hockey, I_hockey, &EM_IMPORT_TEST);
```

In the example, hockey is the target variable, I_hockey is the label of the predicted category of an observation, and &EM_IMPORT_TEST is the scored test data set.

Scoring New Documents

This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

When the model for the document collection is generated, you can use it to predict new documents. Scoring can be done either at the same time as training or after the training is complete.

Suppose you have created a model as described in "Classifying News Articles" on page 157, and you want to score new documents with the model. In this case, you must use the **Score** node in your process flow diagram. In this example, a sample from the SAMPSIO.NEWS data set is used as the score data set. Follow these steps to score new documents.

1. Create the process flow diagram in the Classification of News Articles example through the **MBR** node.

2. Drag the SAMPSIO.NEWS data source to the diagram workspace, and rename it NEWS (2).

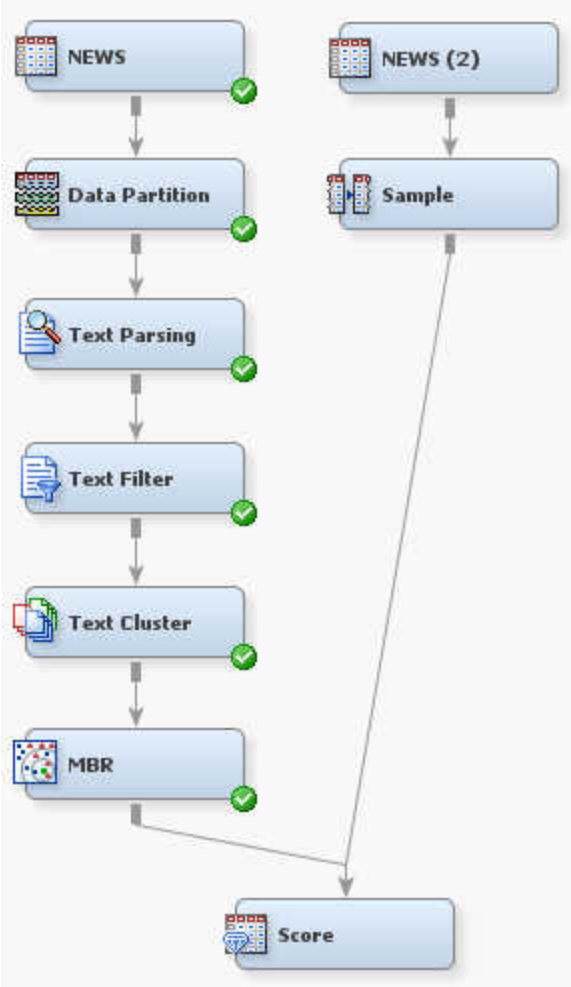
3. Select the NEWS (2) input data node in the diagram workspace, and change the value of the Role property to `Score`.

4. Select the **Sample** tab on the toolbar, and drag a **Sample** node to the diagram workspace.

5. Connect the NEWS (2) input data node to the **Sample** node.

6. Select the **Assess** tab on the toolbar, and drag a **Score** node to the diagram workspace.

7. Connect the **MBR** node to the **Score** node, and connect the **Sample** node to the **Score** node. Your process flow diagram should resemble the following:



8. Right-click the **Score** node and click **Run**. Click **Yes** in the Confirmation window that appears.

9. Click **Results** in the **Run Status** dialog box when the node finishes running. The Output window in the Results window displays the summary statistics for the score class variable, such as I_hockey.

10. Close the Results window.

Using the Association Node with SAS Text Miner Nodes

This example assumes that SAS Enterprise Miner is running, and a diagram workspace has been opened in a project. For information about creating a project and a diagram, see *Getting Started with SAS Enterprise Miner*.

You can use topic output as input to an **Association** node to help you perform association discovery and sequence discovery of topics.

Association discovery is the identification of items that occur together in a given event or record. Association discovery rules are based on frequency counts of the number of

times items occur alone and in combination. An association discovery rule can be expressed as "if item A is part of an event, then item B is also part of the event X percent of the time." Associations can be written using the form A ==> B, where A (or the left hand side) is called the antecedent and B (the right hand side) is called the consequent.

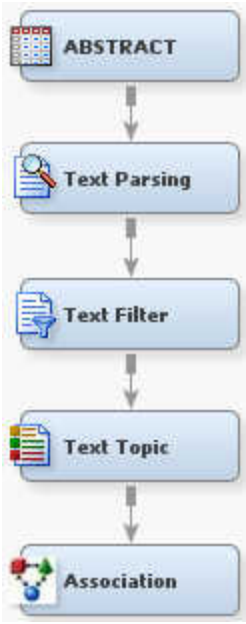
Both sides of an association rule can contain more than one item. An example of an association rule might be, "If shoppers buy a jar of salsa, then they buy a bag of tortilla chips." In this example, the antecedent is "buy a jar of salsa," and the consequent is "buy a bag of tortilla chips." Association rules should not be interpreted as a direct causation. Association rules define some affinity between two or more items.

Sequence discovery takes into account the ordering of the relationships among items. For example, rule A ==> B implies that event B occurs after event A occurs. Here are two hypothetical sequence rules:

- Of those customers who currently hold an equity index fund in their portfolio, 15% of them will open an international fund in the next year.
- Of those customers who purchase a new computer, 25% of them will purchase a laser printer in the next month.

You can use the **Text Topic** node as input to an **Association** node. This example illustrates a process flow diagram that generates topic output as input for an **Association** node in SAS Enterprise Miner. Perform the following steps to use a **Text Topic** node as input to an **Association** node:

1. The SAS data set SAMPSIO.ABSTRACT contains the titles of abstracts and abstracts from conferences. Create the ABSTRACT data source and add it to your diagram workspace. Set the Role value of the TEXT and TITLE variables to **`Text`**.
2. Select the **Text Mining** tab on the toolbar, and drag a **Text Parsing** node to the diagram workspace. Connect the ABSTRACT data source to the **Text Parsing** node.
3. Drag a **Text Filter** node from the **Text Mining** tab to the diagram workspace. Connect the **Text Parsing** node to the **Text Filter** node.
4. Drag a **Text Topic** node from the **Text Mining** tab to the diagram workspace. Connect the **Text Filter** node to the **Text Topic** node.
5. Select the **Explore** tab on the toolbar, and drag an **Association** node to the diagram workspace. Connect the **Text Topic** node to the **Association** node. Your final diagram should resemble the following:



6. In the diagram workspace, right-click the **Association** node and click **Run**. Click **Yes** in the Confirmation dialog box that appears.

Note: Other process flow diagrams are possible. However, a **Text Topic** node should precede the **Association** node in your process flow diagram.

For more information about the **Association** node, see the SAS Enterprise Miner help.

Creating a Stored Process

Overview of Creating a Stored Process

Often, you want to deploy your scoring process outside the SAS environment, through another SAS product, through a web application, or even via Microsoft Office (for example, as a spreadsheet). Fortunately, you can easily deploy the score code via a stored process that is registered in SAS Metadata.

This example explains how to create a stored process. See *SAS 9.4 Stored Processes: Developer's Guide* for more information about stored processes. See *SAS Add-In 7.1 for Microsoft Office: Getting Started in Microsoft Excel, Microsoft Word, and Microsoft PowerPoint* for information about deploying stored processes in Microsoft Office.

How to Create a Stored Process

The following is a step-by-step guide that takes you through two examples of how you can build a stored process. The first example that is presented in this section builds a stored process that you can use in SAS Enterprise Guide, or that can be called by a web application. The second example in "Modifying the Stored Process to Be Run from Microsoft Excel" on page 173 builds off the example in this section, and illustrates how you can modify the stored process to be run from Microsoft Excel.

Perform the following steps to build a stored process that you can use in SAS Enterprise Guide, or that can be called by a web application:

1. Create a SAS Text Miner process flow diagram in SAS Enterprise Miner.

   a. Create the **NEWS** data source from the `SAMPSIO` library by setting the **newsgroup** variable to be the target, and add the **NEWS** data source to your diagram workspace.

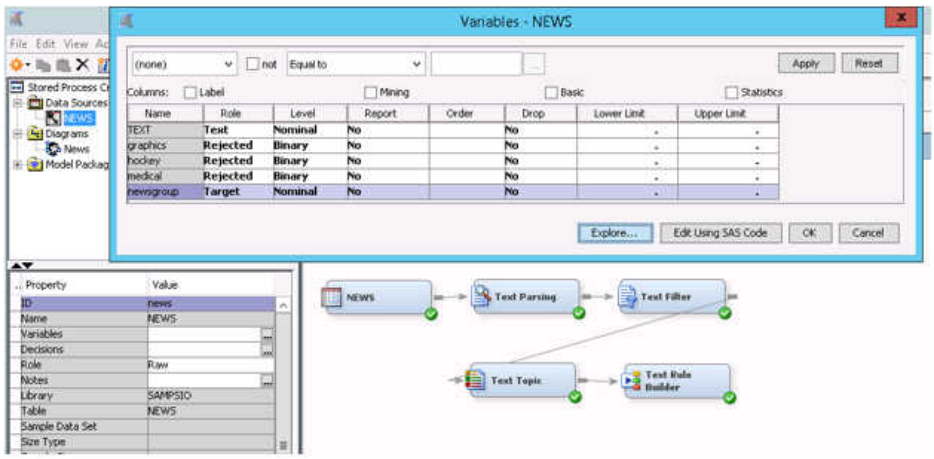
   b. Add the following nodes to your diagram workspace from the **Text Mining** tab.

      - **Text Parsing**
      - **Text Filter**
      - **Text Topic**
      - **Text Rule Builder**

   c. Connect the **NEWS** data source to the **Text Parsing** node. Connect the **Text Parsing** node to the **Text Filter** node. Connect the **Text Filter** node to the **Text Topic** node. Finally, connect the **Text Topic** node to the **Text Rule Builder** node.

      Your process flow diagram should resemble the following:

      Note: In your process flow diagram, your nodes will not have a green check mark because you have not run them yet.

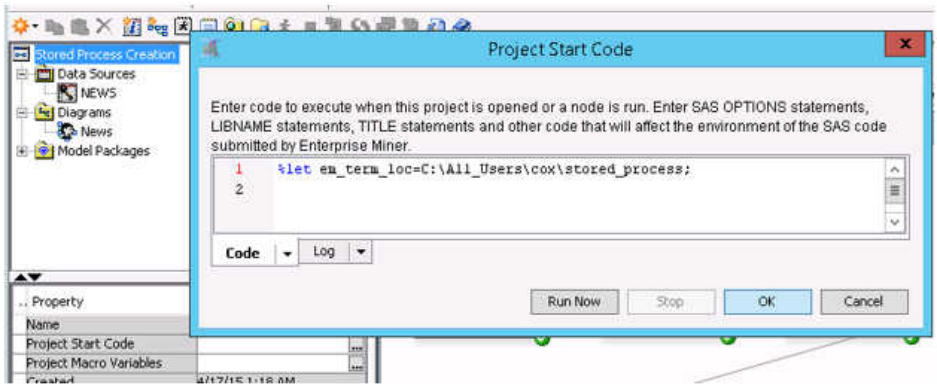


2. Set the value of the **Number of Multi-term Topics** property of the **Text Topic** node to be **5**.

3. Modify the project start code.

   a. Click the project name.

      Note: In the following example, the project is called **Stored Process Creation**, but your project name will be whatever you specified for it when you created your SAS Enterprise Miner project.



b. Click the ellipses for the **Project Start Code** property.

   The Project Start Code dialog box appears.

c. Specify a path for the **em_term_loc** macro variable.

```
%let em_term_loc=C:\All_Users\myUserID\stored_process;
```

   Note: The above path is just an example. The path that you specify should be appropriate for your system. It is important that the path that you specify is available to anyone who wants to use the stored process; so often a location available across your network is a good choice.

   This project start code uses the **em_term_loc** SAS macro variable to set up an external folder to store data sets that will be used with your stored process. For more information about the **em_term_loc** SAS macro variable, see "Using Macro Variables to Store Prebuilt Scoring Data in Tables Instead of Prescore Code" on page 136.

d. Click **OK**.

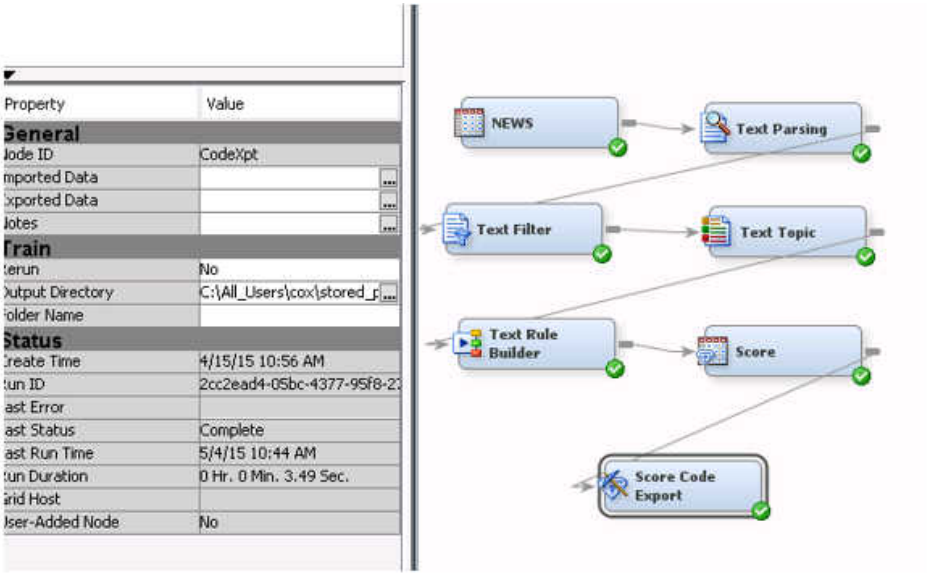
4. Add additional nodes.

   a. Add a **Score** node to your process flow diagram from the **Assess** tab.

   b. Add a **Score Code Export** node to your process flow diagram from the **Utility** tab.

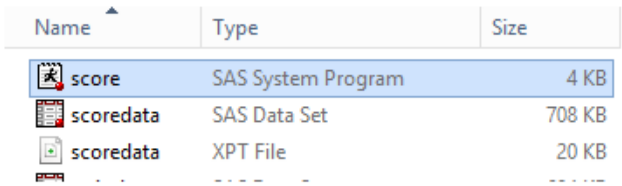
   c. Connect the **Text Rule Builder** node to the **Score** node. Connect the **Score** node to the **Score Code Export** node. Your process flow diagram should resemble the following:

      Note: In your process flow diagram, your nodes will not have a green check mark because you have not run them yet.



d. Set the value for the **Output Directory** property of the **Score Code Export** node to be the same location that you specified for the `em_term_loc` macro variable in your **Project Start Code**.

5. In the diagram workspace, right-click the **Score Code Export** node and select **Run**. Click **Yes** in the Confirmation dialog box that appears. After a successful run, a SAS program with the name **score** has been stored by the **Score Code Export** node where you told it to store it.



6. Configure stored process information in SAS Enterprise Guide.

a. Launch SAS Enterprise Guide, and create a new project.

b. Create a new stored process.

i. Select **File** ⇨ **New** ⇨ **Stored Process** from the menu.

A wizard to create a stored process appears.

ii. Provide a name for the stored process.

Note: This example uses the name *TM Stored Process*.

iii. Click **Next**.

iv. Provide SAS code by clicking the **Replace with code from** ⇨ **My Computer** and navigate to that location.

Note: This code has been stored by the **Score Code Export** node where you told it to store it. It should show a SAS program with the name **score**.

v. Select **score**, and then click **Open**.

You will see the code being embedded in this window.

vi. Modify the following code so that you are not actually modifying the data that you are scoring from

```
Data &em_score_output; set &em_score_output;
```

to

```
Data &em_score_output; set &em_score_input;
```

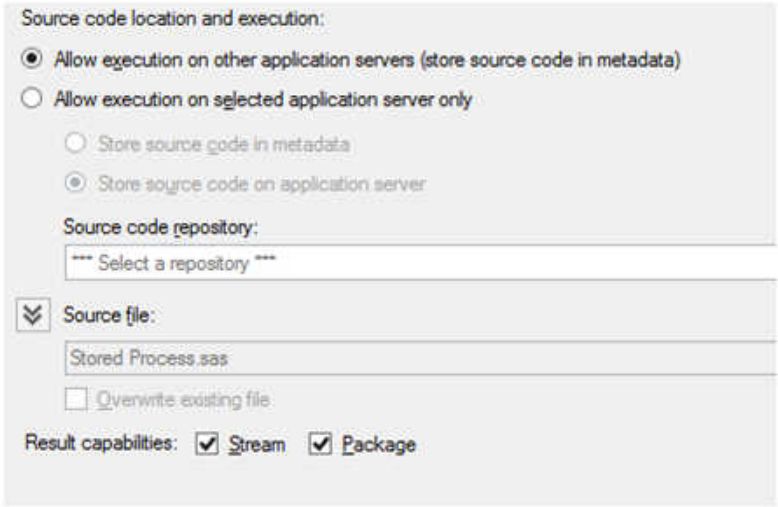
.

vii. Add the following code to print the contents of the scored data, which just keeps the variables that you care about:

```
Proc print label;
   Id text;
   Var I_Newsgroup TextTopic_raw1-TextTopic_raw5;
Run;
```

viii. Click **Next** to go to the third screen in the wizard.

ix. Specify that you want to allow execution on other application servers so that it is not tied to this particular server. Make sure that both **Stream** and **Package** result capabilities are checked.

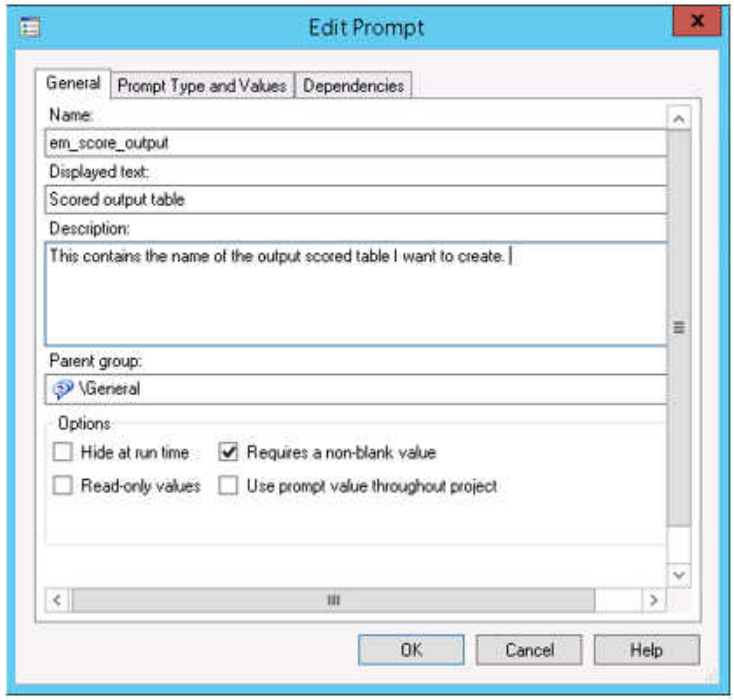


x. Click **Next** to navigate to the fourth screen.

xi. Click **New**.

xii. Choose **Prompt from SAS code for**.

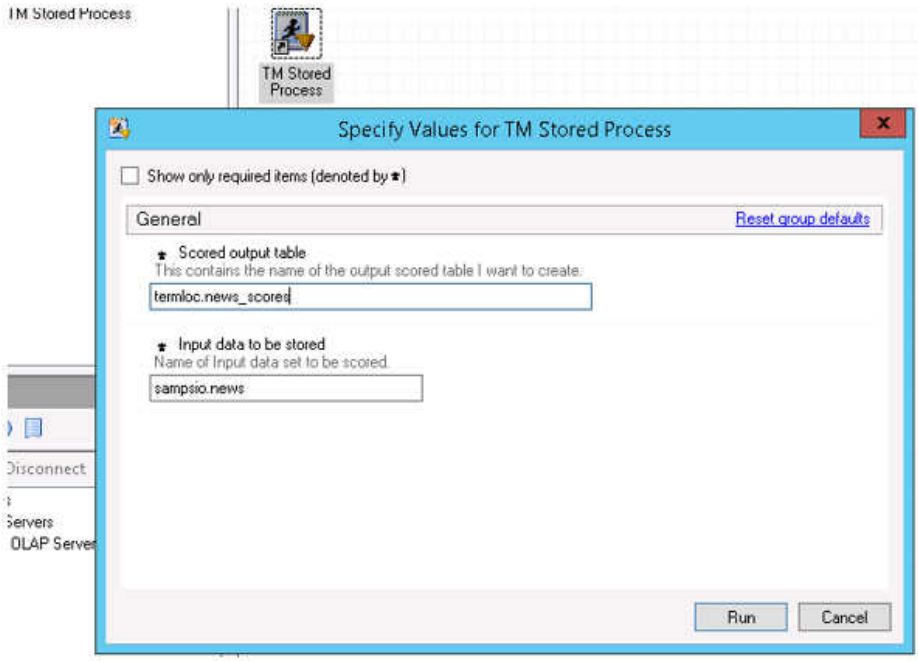
The **`em_score_output`** and **`em_score_input`** are both given to you as choices. Create a prompt for each of these, and enter appropriate displayed text where it is shown. Both prompts are required, or the code would not run. So also be sure to enable the check box that requires a non-blank value. The following is an example for the **`em_score_output`** results data set:



xiii. Click **OK** to save your changes for both prompts.

xiv. Click **Finish**. (At this point, you do not need to do anything on the fifth or sixth screen.)

c. Right-click the **TM Stored Process** icon and run it. You will then see a screen like the following with input fields for the input and output data. Since the only SAS libraries the stored process knows about are **sampsio**, **termloc**, and **work**, you can use something like the following:



d. Click **Run**.

If everything works correctly, you should see a report like the following in the **Results** tab:

If you have a syntax error, correct it and rerun it, until you get something like the above. At this point, the stored process can be deployed within a web application. With a few modifications, the stored process can even be deployed from a Microsoft Office application, such as Microsoft Excel, which is discussed in the following section.

Modifying the Stored Process to Be Run from Microsoft Excel

This section explains how to modify the stored process so that it can be run from Microsoft Excel.

Note: You can modify the stored process so that it can be run from Microsoft Excel only if the SAS Add-in for Microsoft Office is installed and activated. To verify whether the SAS Add-in for Microsoft Office is installed and activated, open Microsoft Excel, and check whether there is a **SAS** tab in the menu.

The example in this section involves selecting some documents in Microsoft Excel and using SAS Text Miner score code to automatically score them.

This involves using SAS code to stream the input data from Microsoft Excel, and saving the resulting data in a temporary place. Then you need to remove the prompts that you created in the previous section. Finally, the data stream needs to be identified as a Data Source and Target.

To modify a stored process to be run from Microsoft Excel:

1. Modify the code in SAS Enterprise Guide.

   Note: The steps in this section begin where the steps in the last section ended.

   a. Select the option **Modify Stored Process** at the top of the **Results** tab.

      Each of the six screens that were configured in the previous section are displayed to the left.

   b. Click **SAS Code**.

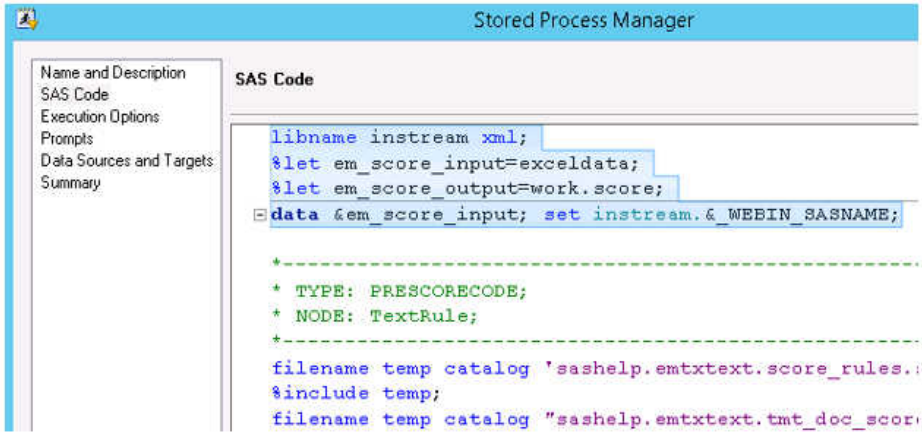
      In this view, you can modify the SAS code to take advantage of the information that is coming from Microsoft Excel.

   c. Type (or copy) the next four lines:

```
libname instream xml;
%let em_score_input=exceldata;
%let em_score_output=work.score;
data &em_score_input; set instream.&_WEBIN_SASNAME;
```

This code assigns a library and data source that represents the selected cells from Microsoft Excel.

Your window should look something like the following:



d. Modify prompts.

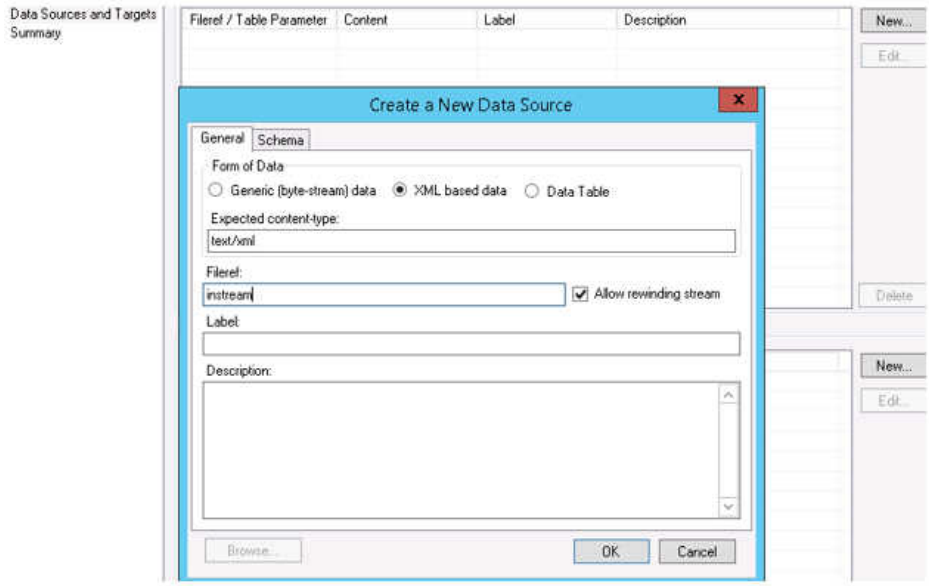
   i. Click the **Prompts** option in the left panel.

   ii. Choose each of the prompts that you created earlier, and then click **Delete** to remove each one.

e. Click **Data Sources and Targets** on the left panel.

f. Click **New**.

g. Specify that the data source uses XML-based data, that the **Fileref** is *instream*, and that the **Allow rewinding stream** check box is enabled.



h. Click **OK**.

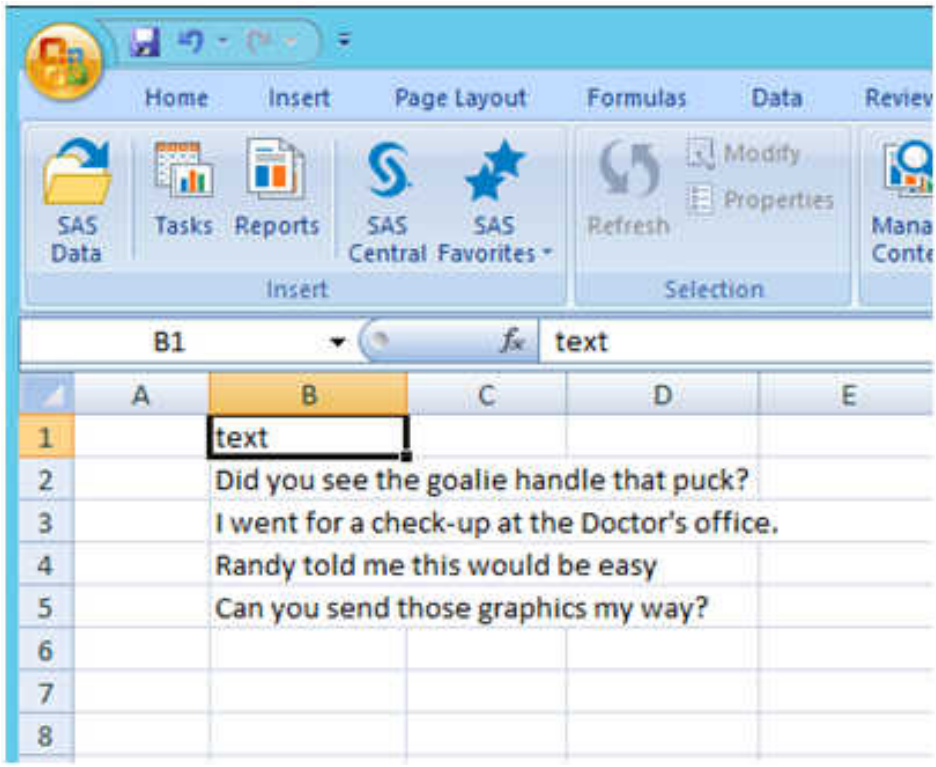
i. Click **Save**.

You are now ready to do scoring from Microsoft Excel.

2. Open Microsoft Excel.

3. Enter a series of texts in a column, and make sure that the column is labeled with the word *text*.

Note: This is because *text* is the parse variable.

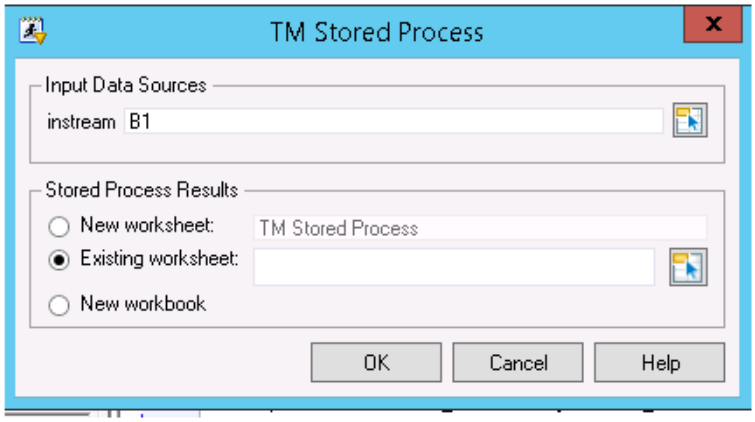


4. Click the **SAS** tab in the menu if it is not already selected.

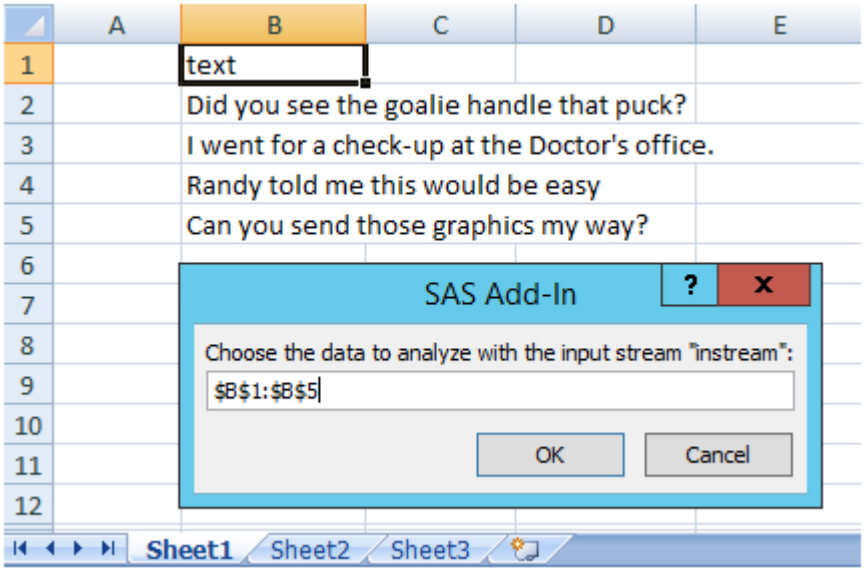
5. Click the **Reports** button on the **SAS** tab.

6. Click the stored process that you created earlier.

   Note: The name of this stored process will be the name that you assigned to it. This example used the name *TM Stored Process*.



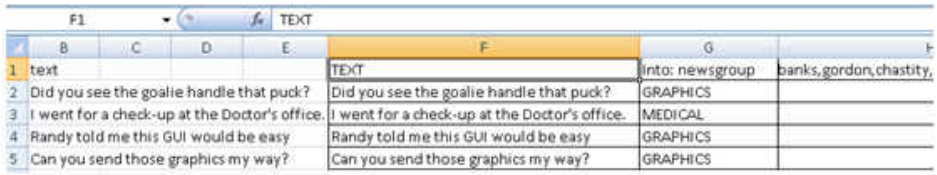
7. Click the pointer icon at the top right, and then select the cells that you want to analyze, as shown below:



8. Click **OK**.

9. Choose to store the results in the existing worksheet.

   Note: In this example, the results are stored in cell F1.



Note: If you see an error message, click **Details** to examine the SAS log that was generated. After you find and correct your error, you can rerun it.

For more information about running SAS Stored Processes from Microsoft Excel, see Beese and Granger, "Excelling with Excel," Proceedings of the SAS Global Forum 2012, Paper 036-2012, SAS Institute Inc., Cary, NC. The paper is available at http://support.sas.com/resources/papers/proceedings12/036-2012.pdf.

Chapter 13

Converting Diagrams and Session Encoding

Converting SAS Text Miner Diagrams from a Previous Version

Releases before SAS Text Miner 5.1 included a **Text Miner** node. The **Text Miner** node is not available on the **Text Mining** tab in SAS Text Miner 14.1. However, you can import a diagram from an earlier release of SAS Text Miner that has a **Text Miner** node in a process flow diagram.

Note: If you import a **Text Miner** node, you will not be able to change its property values or open its Interactive window.

For more information about project conversion from earlier versions of SAS Enterprise Miner to SAS Enterprise Miner 14.1, see the SAS Enterprise Miner Help. For more information about the **Text Miner** node, see "Overview of the Text Miner Node" on page 180.

SAS Text Miner and SAS Session Encoding

For computing, text is stored as numbers that are mapped to letters and symbols for display. This mapping process is called "encoding." Many different encodings exist for different languages, operating systems, and purposes. For example, WLATIN1 is an encoding for Western European languages, and BIG5 encodes characters from the Traditional Chinese language.

SAS Text Miner uses the same encoding settings as the current SAS session. Unless the current SAS session uses UTF-8 encoding, you might not be able to process text correctly if it is in an encoding different from the current SAS session. Furthermore, you cannot view such data sets in the SAS Enterprise Miner Explorer. Instead, start SAS with the encoding settings that correspond to the encoding of the data set that you are analyzing. Alternatively, for some compatible encodings, you can transcode a data set from its encoding to the SAS session encoding. Start SAS and using DATA step, simply copy your data set to a new data set. The new data set will be automatically transcoded to the current session encoding. Note that, using this method, it is possible that some characters cannot be converted between encodings.

Since UTF-8 is capable of representing all text, you can instead run a UTF-8 SAS session if you are working with a data set in another encoding. If your current SAS session uses UTF-8 encoding and the SAS Text Miner input data set contains the entire text of each document in the collection, then the data is transcoded (converted to) UTF-8 encoding. However, it is possible that some characters cannot be transcoded; SAS Text Miner ignores these characters.

For information about SAS session encoding, see *SAS National Language Support (NLS): Reference Guide*.

If your documents reside on the file system, you can also transcode them to the UTF-8 SAS session encoding. If you run the **%TMFILTER** macro or the **Text Import** node in a UTF-8 SAS session, all processed text will be transcoded to UTF-8. It is possible that some characters cannot be transcoded into UTF-8. SAS Text Miner ignores these characters. If a document collection is in multiple encodings or in an encoding different from the current SAS session, then it is recommended that you transcode the documents using this method. For more information about the **%TMFILTER** macro, see "%TMFILTER Macro" on page 143.

Note: It is not recommended to mix documents from various languages in a single SAS Text Miner analysis. Instead, use the language detection feature of the %TMFILTER macro, separate the documents by language, and analyze the subcollections separately.

Overview of the Text Miner Node

Note: The **Text Miner** node is not available on the **Text Mining** tab in SAS Text Miner 14.1. The **Text Miner** node has now been replaced by the functionality in other SAS

Text Miner nodes. You can import diagrams from a previous release of SAS Text Miner that had a **Text Miner** node in the process flow diagram. However, new **Text Miner** nodes can no longer be created, and property values cannot be changed in imported **Text Miner** nodes. For more information, see "Converting SAS Text Miner Diagrams from a Previous Version" on page 179.

The **Text Miner** node enables you to discover and use the information that exists in a collection of documents. The node can process volumes of textual data such as e-mail messages, news articles, web pages, research papers, and surveys, even if they are stored in data formats.

Data is processed in three phases: text parsing, transformation, and document clustering. Text parsing processes textual data into a term-by-document frequency matrix. Transformations such as singular value decomposition (SVD) alter this matrix into a data set that is suitable for data mining purposes. A document collection of several thousand documents and hundreds of thousands of terms can be represented in a compact and efficient form. Finally, the **Text Miner** node enables you to explore the text collection by clustering the documents, reporting on these clusters, and presenting visualizations of this data.

The **Text Miner** node can require a lot of computing time and resources to process a very large collection of documents. If your system has limited resources, try the following:

- Analyze only a sample of the document collection.
- Set some of theses properties to `No`: **Find Entities**, **Noun Groups**, **Terms in Single Document**.
- Reduce the number of requested SVD dimensions or roll-up terms.

  Note: If the **Text Miner** node encounters memory problems generating the SVD, then try rolling up a certain number of terms; the remaining terms are automatically dropped.
- To limit parsing to high-information words, disable all parts of speech except nouns, proper nouns, noun groups, and verbs.

The **Text Miner** node behaves like most nodes in SAS Enterprise Miner except that the **Text Miner** node does not generate portable score code. For more information about the **Text Miner** node, see the following:

Text Miner Node Input Data

Note: The **Text Miner** node is not available on the **Text Mining** tab in SAS Text Miner 14.1. The **Text Miner** node has now been replaced by the functionality in other SAS Text Miner nodes. You can import diagrams from a previous release of SAS Text Miner that had a **Text Miner** node in the process flow diagram. However, new **Text Miner** nodes can no longer be created, and property values cannot be changed in

imported **Text Miner** nodes. For more information, see "SAS Text Miner and SAS Session Encoding" on page 180.

The **Text Miner** node must be preceded by one or more Input Data Source nodes, where each data source contains a document collection to parse. At least one data source must have the role Train. Others can have the roles of **`Train`**, **`Valid`**, **`Test`**, or **`Score`**.

Each observation in a data source represents an individual document in the document collection. The data source can have one of two structures. It can either contain the entire text of each document, or it can contain paths to plain text or HMTL files that contain that text.

- If the data source contains the entire text of each document, then this text must be stored in a character variable that is assigned the role **`Text`**. Note that a SAS variable can hold only 32KB of text. If any document in the collection is larger than that limit, then you should not use this data source structure.

- There are two sample data sets that you can use to create data sources with this structure. For more information, see "SAS Text Miner Sample Data Sets" on page 10.

- If the data source contains paths to files that contain the document text, then these paths must be stored in a character variable that is assigned the role **`Text Location`**. The paths must be relative to the SAS Text Miner server. This structure can be used either for collections that contain smaller documents or documents that exceed the 32KB SAS variable limit.

  TIP

  - To help identify which link represents which document, you can include an additional character variable that contains truncated document text. Give this variable the role **`Text`**.

  - If there is a variable in the data set that contains the location of the unfiltered documents and if you assign this variable the role **`Web Address`**, you will be able access the original source of each document in the Interactive Results viewer.

In many cases, you will need to preprocess textual data before you can import it into a data source. A SAS macro named %TMFILTER is provided with SAS Text Miner. It can be used in file preprocessing to extract text from various document formats or to retrieve text from websites by crawling the web. The macro creates a SAS data set that you can use to create a data source to use as input for the **Text Parsing** node. Depending on which structure (of the two described above) that you use, you will need to adjust the roles of the variables accordingly in the Data Source wizard.

A successful run of the **Text Miner** node requires at least one variable with the role **`Text`** or **`Text Location`** variable. If you have more than one variable with either role (that has a use status of **`Yes`**), then the longest of these variables is used.

Text Miner Node Properties

Contents

Note: The **Text Miner** node is not available on the **Text Mining** tab in SAS Text Miner 14.1. The **Text Miner** node has now been replaced by the functionality in other SAS Text Miner nodes. You can import diagrams from a previous release of SAS Text Miner that had a **Text Miner** node in the process flow diagram. However, new **Text Miner** nodes can no longer be created, and property values cannot be changed in imported **Text Miner** nodes. For more information, see "Converting SAS Text Miner Diagrams from a Previous Version" on page 179.

Text Miner Node General Properties

These are the general properties that are available on the **Text Miner** node:

- **Node ID** — displays the ID that SAS Enterprise Miner automatically assigns the node. Node IDs are especially useful for distinguishing between two or more nodes of the same type in a process flow diagram. For example, the first **Text Miner** node that is added to a diagram will have the node ID **`TEXT`**, and the second Text Miner node that is added will have the node ID **`TEXT2`**.

- **Imported Data** — accesses a list of the data sets that are imported by the node and the ports that provide them. Click the ellipsis button to open the Imported Data window, which displays this list. If data exists for an imported data set, then you can select a row in the list and do any of the following:

  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set

- **Exported Data** — accesses a list of the data sets exported by the node and the ports to which they are provided. Click the ellipsis button to open the Exported Data window, which displays this list. If data exists for an exported data set, then you can select a row in the list and do any of the following:

  - browse the data set
  - explore (sample and plot) the data in a data set
  - view the table and variable properties of a data set

- **Notes** — accesses a window that you can use to store notes of interest, such as data or configuration information. Click the ellipsis button to open the Notes window.

Text Miner Node Train Properties

General Train Properties

These are the training properties that are available on the **Text Miner** node:

- **Variables** — accesses a list of variables and associated properties in the data source. Only variables with the roles Text, Text Location, or Web Address are displayed. Click the ellipsis button to open the Variables window.
- **Interactive** — This property is not available in SAS Text Miner 14.1.
- **Force Run** — specifies whether to rerun the node, even if it has already been successfully run. This function is useful if the underlying input data has changed.

Parse Properties

- **Parse Variable** — (value is populated after the node has run) displays the name of the variable in the input data source that was used for parsing. Depending on the structure of the data source, this variable contains either the entire text of each document in the document collection or it contains paths to plain text or HMTL files that contain that text.
- **Language** — specifies the language to use when parsing text. Only supported languages that are licensed to you are available for selection. For a list of supported languages, see "About SAS Text Miner" on page 5.
- **Stop List** — accesses a window in which you can select a SAS data set that contains terms to exclude from parsing. If you include a stop list, then the terms therein are not included in the node results. Default data sets are provided for several languages. You can edit these data sets or create your own. Click the ellipsis button to open the Select a SAS Table window.
- **Start List** — accesses a window in which you can select a SAS data set that contains the terms to parse. If you include a start list, then terms other than those therein are not included in the node results. Click the ellipsis button to open the Select a SAS Table window.
- **Stem Terms** — specifies whether to stem terms.
- **Terms in Single Document** — specifies whether to parse terms that appear in only one document.
- **Punctuation** — specifies whether to parse punctuation marks as terms.
- **Numbers** — specifies whether to parse numbers as terms.
- **Different Parts of Speech** — specifies whether to identify the parts of speech of parsed terms. If the value of this property is `Yes`, then same terms with different parts of speech are treated as different terms.
- **Ignore Parts of Speech** — accesses a window in which you can select one or more parts of speech to ignore when parsing. Click the ellipsis button to open the Ignore Parts of Speech window. Terms with the selected parts of speech are not parsed and

do not appear in node results. This property is not used if the value of **Different Parts of Speech** is `No`.

- **Noun Groups** — specifies whether to identify noun groups. If stemming is turned on, then noun group elements are also stemmed.

- **Synonyms** — specifies a SAS data set that contains synonyms to be treated as equivalent. Default data sets are provided for several languages. You can edit these data sets or create your own. Click the ellipsis button to open the Select a SAS Table window.

- **Find Entities** — specifies whether to identify the entities of parsed terms.

- **Types of Entities** — accesses a window in which you can select one or more entity classifications to parse. Click the ellipsis button to open the Select Entity Types window.

  Note: If the value of **Find Entities** is `Yes` but you have not selected any entity types in the Select Entity Types window, then all entity types are parsed. In other words, deselecting all entity types has the same effect as selecting all of them.

Transform Properties

- **Compute SVD** — specifies whether to compute the singular-value decomposition (SVD) of the term-by-document frequency matrix.

- **SVD Resolution** — specifies the resolution to use to generate the SVD dimensions.

- **Max SVD Dimensions** — specifies the maximum number, greater than or equal to 2, of SVD dimensions to generate.

- **Scale SVD Dimensions** — specifies whether to scale the SVD dimensions by the inverse of the singular values in order to generate equal variances.

- **Frequency Weighting** — specifies the frequency weighting method to use.

- **Term Weight** — specifies the term weighting method to use.

- **Roll up Terms** — specifies whether to first sort parsed terms in descending order of the value of the term weight multiplied by the square root of the number of documents and then roll up these selected terms as variables on the Document data set.

- **No. of Rolled-up Terms** — specifies the number of terms to use to roll up lower-weighted terms. This property is used if the value of **Roll up Terms** is `Yes`.

- **Drop Other Terms** — specifies whether to drop terms if they are not rolled up in the Document data set. This property is used if the value of **Roll up Terms** is `Yes`.

Cluster Properties

- **Automatically Cluster** — specifies whether to perform clustering analysis. If you select `No`, then the remaining Cluster Properties are not used.

- **Exact or Maximum Number** — specifies whether to find an exact number of clusters or any number less than or equal to a maximum number of clusters.
- **Number of Clusters** — specifies the number of clusters. This is the exact number if the value of **Exact or Maximum Number** is **`Exact`**, and it is the maximum number if the value of **Exact or Maximum Number** is **`Maximum`**.
- **Cluster Algorithm** — specifies the clustering algorithm.
- **Ignore Outliers** — specifies whether to ignore outliers in the clustering analysis. If the value of this property is **`No`**, then do one of the following:
  - for Hierarchical clustering, outliers are removed
  - for Expectation-Maximization clustering, outliers are placed in a single cluster
- **Hierarchy Levels** — (for Hierarchical clustering) specifies the number of levels in the cluster hierarchy. To specify the maximum depth (all levels), enter a period (.).
- **Descriptive Terms** — specifies the number of descriptive terms to display in each cluster.
- **What to Cluster** — specifies whether to cluster roll-up terms or the SVD dimensions.

Text Miner Node Status Properties

These are the status properties that are displayed on the **Text Miner** node:

- **Create Time** — time at which the node was created.
- **Run ID** — identifier of the run of the node. A new identifier is assigned every time the node is run.
- **Last Error** — error message, if any, from the last run.
- **Last Status** — last reported status of the node.
- **Last Run Time** — time at which the node was last run.
- **Run Duration** — length of time required to complete the last node run.
- **Grid Host** — grid host, if any, that was used for computation.
- **User-Added Node** — denotes whether the node was created by a user as a SAS Enterprise Miner Extension node. The value of this property is always **`No`** for the **Text Miner** node.

Text Miner Node Results

Overview of Text Miner Node Results

Note: The **Text Miner** node is not available onthe **Text Mining** tab in SAS Text Miner 14.1. The **Text Miner** node has now been replaced by the functionality in other SAS Text Miner nodes. You can import diagrams from a previous release of SAS Text Miner that had a **Text Miner** node in the process flow diagram. However, new **Text Miner** nodes can no longer be created, and property values cannot be changed in imported **Text Miner** nodes. For more information, see "Converting SAS Text Miner Diagrams from a Previous Version" on page 179.

Results Window for the Text Miner Node

After the **Text Miner** node runs successfully, you can access the Results window in three ways:

- Click **Results** in the Run Status window that opens immediately after a successful run of the **Text Miner** node.
- Click the Results icon on the main Toolbar.
- Right-click the **Text Miner** node, and click **Results**.

The Results window for the **Text Miner** node is similar to the Results window for other nodes in SAS Enterprise Miner. For general information about the Results window, see the SAS Enterprise Miner Help. The icons and main menus are similar to those of other nodes. However, the **View** menu for the **Text Miner** node Results window includes selections to access graphical and tabular results.

Note: You can access the SAS log that was generated by the node processing from the **SAS Results** submenu of the **View** menu. This log can be a useful debugging tool.

Text Miner Node Graphical and Tabular Results

The following are the graphical results in the **Text Miner** node Results window:

- The **Terms: Attribute by Freq** bar chart displays the total frequency of occurrence of terms in the document collection, broken down by attribute. If you position the mouse pointer over a bar, then a tooltip indicates the attribute name and the number of times a term with that attribute appears in the entire document collection.
- The **Terms: # of Docs by Frequency: Histogram** displays the total frequency of occurrence of terms in the document collection, broken down by binned number of documents. If you position the mouse pointer over a bar, then a tooltip indicates the range of the bin and the number of terms that appear in a total number of documents within that range.

- The **Terms: # of Docs by Frequency: Scatter Plot** displays the number of documents in which a term appears versus the frequency of occurrence of that term in the entire document collection. Each data point represents a term. If you position the mouse pointer over a plotted point, then a tooltip indicates the term name, the number of documents in which that term appears, and the number of times that term appears in the entire document collection.

- The **Terms: Freq by Weight** scatter plot displays the frequency of occurrence of terms in the document collection versus the weight of the term. Each data point represents a term. If you position the mouse pointer over a plotted point, then a tooltip indicates the term name, the frequency of occurrence of the term, and the weight of the term.

- The **Terms: Role by Freq** bar chart displays the total frequency of occurrence of terms in the document collection, broken down by term role. Each bar represents a role. If you position the mouse pointer over a bar, then a tooltip indicates the role name and the number of times a term with that role appears in the entire document collection.

- The **Clusters: Freq by RMS** scatter plot (if clustering was performed) displays the number of terms in the clusters versus the root mean squared standard deviation of the clusters. Each data point represents a cluster. If you position the mouse pointer over a plotted point, then a tooltip indicates the number of terms in the cluster, the root mean squared standard deviation of the cluster, and the terms that describe the cluster.

There are two tabular results in the **Text Miner** node Results window:

- The **Terms** table displays information about top-level terms (that is, terms that have no parents above them). All graphical results in the **Text Miner** node Results window are linked to this table. Therefore, you can select an observation in the Terms table, and the associated data points are highlighted in the graphics. Or you can select data points in the graphics, and the associated observations are highlighted in the Terms table.

- (If clustering was performed) The **Clusters** table displays clustering information including cluster ID, percentage of documents in a cluster, number of documents in a cluster, root mean squared standard deviation of the cluster, and terms that describe the cluster.

Table 13.1 *Contents of the Terms Table*

Variable	Description
Term	top-level terms (in lowercase). Terms that are parents are preceded by a plus (+) symbol.
Role	part of speech of the term, entity classification of the term, or the value **`Noun Group`**.
Attribute	attribute of the term.
Freq	number of times that the term appears in the document collection.

Variable	Description
# Documents	number of documents in the collection in which the term appears.
Keep	`Y` if the term is used in the text mining analysis.
Weight	weight of the term

Text Miner Node SAS Output Results

The SAS output from the **Text Miner** node includes variable summary, summary statistics, and information about the terms. Terms in the output are sorted by their weights.

Text Miner Node Output Data

Note: The **Text Miner** node is not available on the **Text Mining** tab in SAS Text Miner 14.1. The **Text Miner** node has now been replaced by the functionality in other SAS Text Miner nodes. You can import diagrams from a previous release of SAS Text Miner that had a **Text Miner** node in the process flow diagram. However, new **Text Miner** nodes can no longer be created, and property values cannot be changed in imported **Text Miner** nodes. For more information, see "Converting SAS Text Miner Diagrams from a Previous Version" on page 179.

The **Text Miner** node outputs the Documents, Validate, Test, Terms, Cluster, and Out data sets. The Validate and Test data sets exist only if the process flow diagram has a **Data Partition** node before the **Text Miner** node. The Cluster data set exists only if you have clustered the documents. To view the output data sets, click the ellipsis button that is associated with the **Exported Data** property of the **Text Miner** node after the node has been run.

The following table lists the variables in the **Documents**, **Validate**, and **Test** data sets:

Variable	Role
original variables from the input data sources	the roles that are defined in the input data sources
Document ID (_document_)	ID
SVD dimensions (_SVD_<num>)	input for the dimensions that are used in a cluster analysis. Otherwise, the role is set to Rejected.
the length of the vector formed from the SVD dimensions that are used (_SVDLEN_)	Rejected
Cluster ID (_CLUSTER_)	Segment

Variable	Role
the probability that a document is categorized into a cluster if expectation-maximization clustering is performed (PROB <num>)	Prediction

The following table lists the variables and their roles in the **Terms** data set.

Variable	Role
Term	Text
Role	Input
Attribute	Input
Freq	Frequency
# Documents	Input
Keep	Input
Term ID	ID
Parent ID	Input
Parent_id	ID
_ispar	Input
oldkey	Input
Weight	Input
SVD dimensions (_SVD_ <num>)	input for the dimensions that are used in a cluster analysis. Otherwise, the role is set to Rejected.
the length of the vector formed from the SVD dimensions that are used (_SVDLEN_)	Rejected

The following table lists the variables and their roles in the **Cluster** data source.

Variable	Role
#	ID
the percentage of documents that are in a cluster (Percentage)	Rejected
SVD dimensions (_SVD_<num>)	Input

Variable	Role
Freq	Rejected
RMS Std.	Rejected
Descriptive Terms	Rejected

Note: The Cluster data source contains only the SVD dimensions that are used in a cluster analysis.

The **Text Miner** node creates an OUT data set to be used as an input to the **Association** node with the role Transaction and the variables _termid_, _DOCUMENT_, and _count_. The _termid_ variable has the role of Target. The OUT data set contains the roles and variables that are required by the **Association** node. Therefore, the **Text Miner** node can be linked to the **Association** node to run a flow diagram with an input data source. For details about the **Association** node, see the SAS Enterprise Miner documentation.

The following tables list the variables and their roles in the **OUT** data set.

Variable	Role
termid	Target
DOCUMENT	ID
count	Rejected

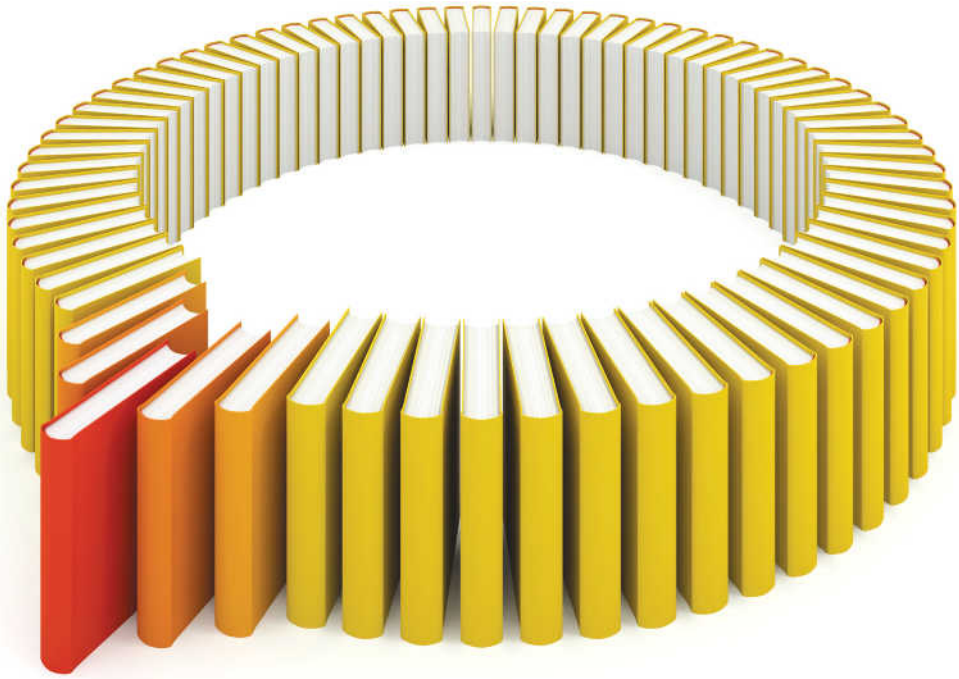
Appendix 1

Additional Information about Text Mining

The following titles are recommended background reading on text mining:

- Berry, M. W. and M. Browne. 1999. *Understanding Search Engines: Mathematical Modeling and Text Retrieval*. Philadelphia: Society for Industrial and Applied Mathematics.
- Bradley, P.S., U.M. Fayyad, and C.A. Reina. 1998. Microsoft Research Technical Report MSR-TR-98-35. Microsoft Corporation. *Scaling EM (Expectation-Maximization) Clustering to Large Database*. Redmond, WA: Microsoft Corporation.
- Deerwester, et al. 1990. "Indexing by Latent Semantic Analysis." *Journal of the American Society for Information Science.* 41(6): 391-407.
- Krishnaiah, P.R., and L.N. Kanal. 1982. *Classification, Pattern Recognition, and Reduction of Dimensionality.* New York: North-Holland Publishing Company.
- Yang, Y. and J.O. Pedersen. 1997. "A Comparative Study on Feature Selection in Text Categorization." *Proceedings of the Fourteenth International Conference on Machine Learning* (ICML'97).

Index



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