



# Salford Predictive Modeler<sup>®</sup>

## Exploring Data

*This guide describes the facilities in SPM<sup>®</sup> to gain initial insights about a dataset by viewing and generating descriptive statistics.*

© 2019 Minitab LLC. All Rights Reserved.

Minitab®, SPM®, SPM Salford Predictive Modeler®, Salford Predictive Modeler®, Random Forests®, CART®, TreeNet®, MARS®, RuleLearner®, and the Minitab logo are registered trademarks of Minitab, LLC in the United States and other countries. Additional trademarks of Minitab, LLC can be found at [www.minitab.com](http://www.minitab.com). All other marks referenced remain the property of their respective owners.

## Introduction to Exploring Data

SPM® is a comprehensive set of tools to produce predictive, descriptive, and analytical models from datasets of any size, complexity, or organization. In many cases, though, you need to gain better understanding of the data first. The typical challenges an analyst faces when working with an unfamiliar dataset are:

- The quality of the data is not known. No matter how reputable a source of the data is it might still require data cleaning.
- Data dictionary not available or incomplete. The primary role of Variable Name is to identify a column of data. We would like it to convey the purpose and nature of the data too but this might be quite hard to achieve in many cases. Data Technologies (e.g. RDMS) are quite good at enforcing the identity of the column but are pretty indifferent to the descriptive power of the name of a variable.

These challenges usually occur at the beginning of the analysis. In SPM we made sure you have tools to get up and running with new data as soon as possible. Once a dataset is loaded you can browse raw data and obtain simple and elaborate statistics in both tabular and graphical forms.

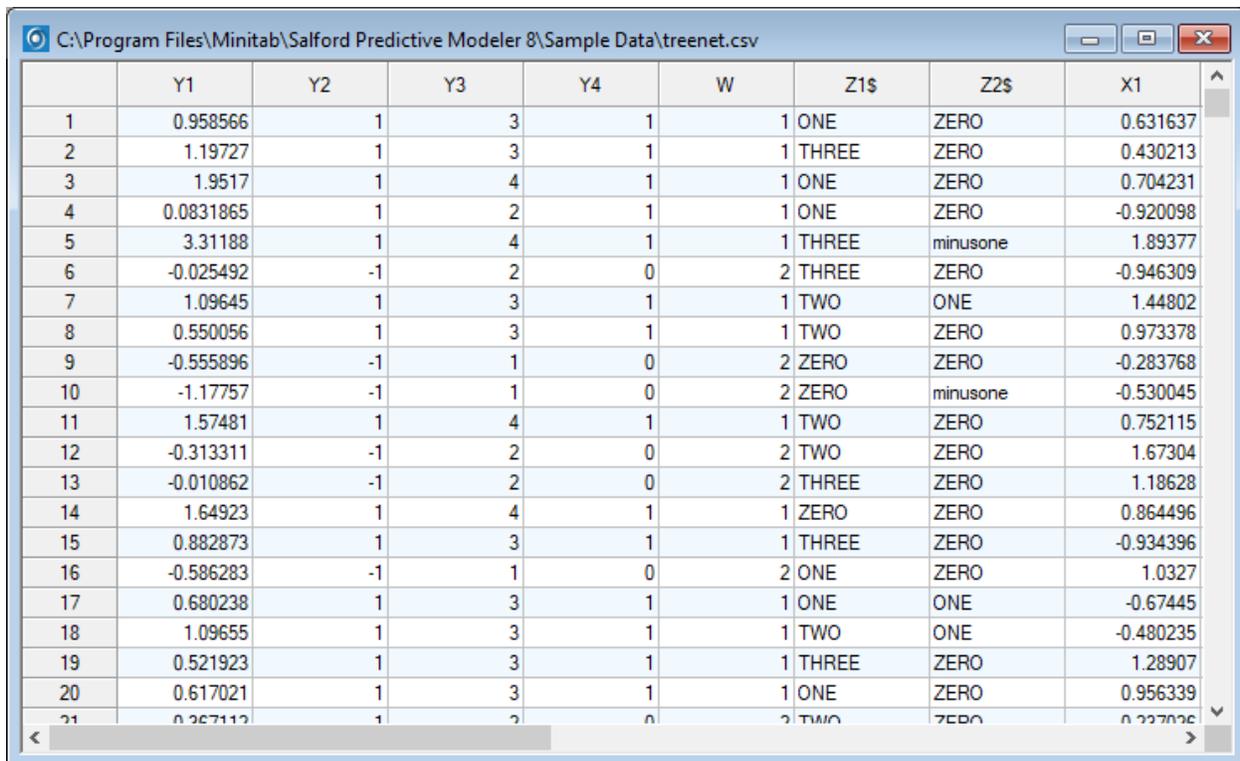
## Opening and Viewing Raw Data

Once you open a dataset, for example, using the **Open** button on the toolbar , data exploring features become available. In this chapter we will work with sample dataset SAMPLE.CSV supplied as part of the SPM installation. It is located in the *Sample Data* folder. Please refer to general SPM documentation about the ways to bring your data into SPM.

To browse raw data select **View>View Data** from the **View** menu.

- ✓ You may simply click on the  button in the toolbar.

As a result, the **View Data** window will appear.



	Y1	Y2	Y3	Y4	W	Z1\$	Z2\$	X1
1	0.958566	1	3	1	1	ONE	ZERO	0.631637
2	1.19727	1	3	1	1	THREE	ZERO	0.430213
3	1.9517	1	4	1	1	ONE	ZERO	0.704231
4	0.0831865	1	2	1	1	ONE	ZERO	-0.920098
5	3.31188	1	4	1	1	THREE	minusone	1.89377
6	-0.025492	-1	2	0	2	THREE	ZERO	-0.946309
7	1.09645	1	3	1	1	TWO	ONE	1.44802
8	0.550056	1	3	1	1	TWO	ZERO	0.973378
9	-0.555896	-1	1	0	2	ZERO	ZERO	-0.283768
10	-1.17757	-1	1	0	2	ZERO	minusone	-0.530045
11	1.57481	1	4	1	1	TWO	ZERO	0.752115
12	-0.313311	-1	2	0	2	TWO	ZERO	1.67304
13	-0.010862	-1	2	0	2	THREE	ZERO	1.18628
14	1.64923	1	4	1	1	ZERO	ZERO	0.864496
15	0.882873	1	3	1	1	THREE	ZERO	-0.934396
16	-0.586283	-1	1	0	2	ONE	ZERO	1.0327
17	0.680238	1	3	1	1	ONE	ONE	-0.67445
18	1.09655	1	3	1	1	TWO	ONE	-0.480235
19	0.521923	1	3	1	1	THREE	ZERO	1.28907
20	0.617021	1	3	1	1	ONE	ZERO	0.956339
21	0.267112	1	2	0	2	TWO	ZERO	0.227026

This display is tailored to handle large amounts of data. The grid works in so-called “Virtual Mode”. Only current “page” of data and some cached pages are retained in memory and the dataset is queried for more pages on demand.

- ⚠ Sometimes querying the dataset multiple times is not what you want. A good example is browsing content from an RDBMS (SQL Server, Oracle etc). If data access latency is too large, consider extracting the data into a local file in, for example, CSV format before browsing.

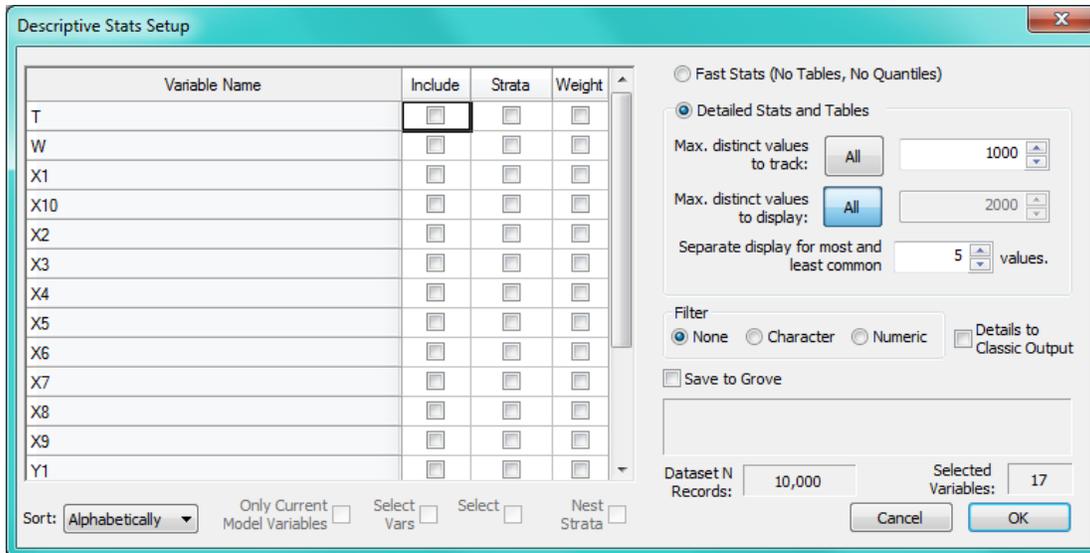
Vertical scroll bar has special features to access pages of data. The buttons allow you, from top to bottom to

- ◆ Jump to the beginning of dataset.
- ◆ Jump one page up.
- ◆ Move one record up.
- ◆ Move one record down.
- ◆ Jump one page down.
- ◆ Jump to the end of the dataset.
- ✓ There is a thumb-bar on the vertical scroll bar in the View Data window.

## Descriptive Statistics

To examine descriptive statistics of the currently open dataset, select **View>Descriptive Stats...** from the **View** menu. You can also use the  toolbar button.

As a result, the **Descriptive Stats Setup** window will appear.



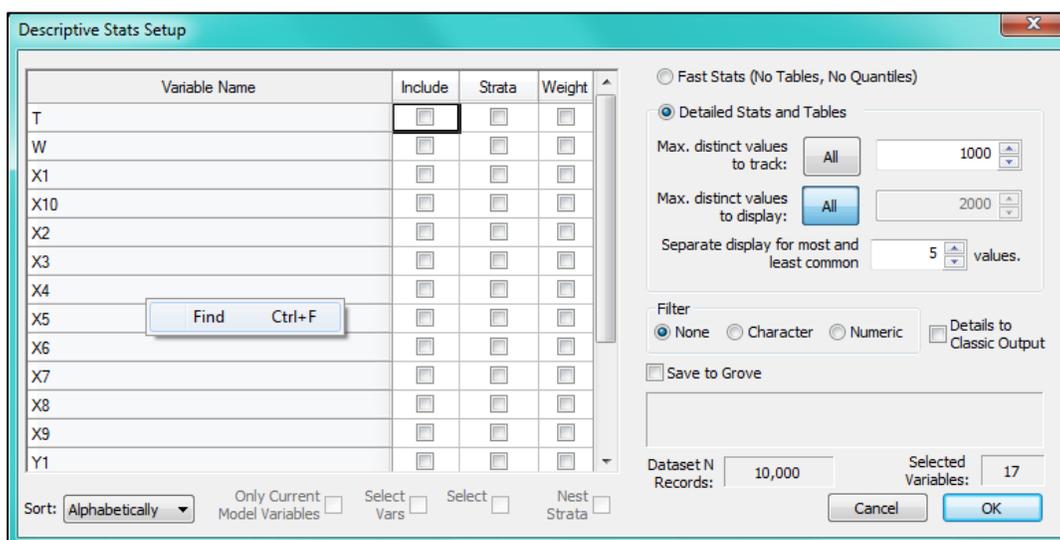
The window is already configured to obtain detailed Descriptive Statistics of all of the variables in the dataset. You can press the **OK** button right away. The defaults are configured so that computations finish in reasonable time for small to mid-sized datasets. For this run we will use most of the features and explain the controls along the way.

## Selecting Variables

The Variable Selection grid allows configuring which variables are included in the computation.

- ✓ Limiting number of variables to compute by excluding ones you are not interested in can speed up computation. This is especially handy when there are variables with very high number of levels (hundreds and thousands).

To facilitate navigation through the list of variables you can sort them Alphabetically or in File Order. Search functionality is accessible through mouse right-click menu of the grid. Use the **Select** checkbox under the Include column to set and reset multiple checkboxes at once.



Variables can also be assigned special roles.

## Strata variables and nested strata

 STRATA <variable>

In addition to full dataset Descriptive Stats, you can request stats for sub-samples identified by levels of a specific variable. In our current dataset variable T defines Learn and Test partitions for analysis. Let's mark T as a Strata variable.

If you have more than one variable listed on the STRATA command, you can specify whether you want nested results with the following option:

 STATS <varlist> / NESTED = YES|NO

## Weight variable

 WEIGHT <variable>

By default each observation is accounted for only once in Descriptive Statistics computations, but you can assign any positive integer or fractional weight to each observation via a Weight variable. Let's specify W as a weight variable.

As a result your Variable Selection should look as follows

Variable Name	Include	Strata	Weight
T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
W	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
X1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X7	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X9	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Pre-defined Variable List Filters

There's an alternative way to quickly select a category of variables. The **Filter** group of controls allows you to quickly request

- Only Character variables
- Only Numeric variables.

Filter

None  Character  Numeric

🔗 This setting overrides the selections made in the Variable Selection grid.

## Configuring computation process

Computation of Descriptive Statistics can become quite resource-intensive on large and complex datasets. You can tailor the process to get the information you need in an acceptable time.

For our Sample.csv analysis, please select Detailed Stats and set both **Max. distinct values to track** and **Max. distinct values to display** to 9997.

Below each computation process configuration setting is described in more details. Note: the STATS command was formerly named DATAINFO.

### Fast Stats (or Brief)

🔗 `STATS <varlist> / FAST = YES`

Sometimes all you need is a quick lookup of some numeric statistics (minimum, maximum, mean). Combined with the variable selection feature, you can get this information quickly.

### Detailed Stats

🔗 `STATS <varlist> / FAST = NO`

In this mode the full set of descriptive statistics is computed. This could be quite performance-intensive even if you select just a few variables with a high number of levels and the dataset is large. There are additional controls to tailor the computation process in this mode.

### Max. distinct values to track

🔗 `DISCRETE MAX=<n, n>`

This setting allows you to limit the number of slots to track distinct values for a variable. If a variable has more than  $n$  levels then frequency information on *first  $n$  levels encountered* will be available in UI. Such Frequency Tables will be labeled incomplete in the GUI.

Lowering the limit can save significant computation resources, especially when you don't care about tabulation for continuous variables with many distinct levels.

### Max. distinct values to display

🔗 `STATS <varlist> / N=<n>`

This setting limits how many levels will be displayed in the resulting frequency table. In contrast to **Max. distinct values to track**, this parameter has no effect on the construction of the frequency table for a specific variable. If **Max. distinct values to track** is greater than the number of levels large enough but **Max. distinct values to display** is smaller, you will get all of the stats derived from the frequency table (e.g. number of distinct values) but frequency tables themselves will be printed incomplete. But, also in contrast to **Max. distinct values to track**, *n most frequent levels* will be displayed.

Lower the limit if you do want all of the information on continuous and high-level categorical variables, but you don't need to see full frequency tables in the results window. Showing frequencies for all distinct levels of continuous variables in a large dataset could easily exhaust UI resources.

### Separate display for most and least common values

```
STATS <varlist> / EXTREMES = <n>
```

Some variables with many levels, both continuous and categorical in nature, might have a significant number of observations sharing the same value. While a full frequency table would be expensive to compute and in many cases useless, these most frequent levels might provide some useful insight. This setting allows specifying a cap on how many most and least common values to track.

### Saving Descriptive Stats

Let's save the descriptive stats for our dataset. For this, check Save to Grove checkbox and specify a file name. Your Descriptive Stats dialog should look like this:

Variable Name	Include	Strata	Weight
T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
W	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
X1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X7	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
X9	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Y1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Fast Stats (No Tables, No Quantiles)  
 Detailed Stats and Tables  
 Max. distinct values to track: All 9997  
 Max. distinct values to display: All 9997  
 Separate display for most and least common: 5 values.  
 Filter:  None  Character  Numeric  Details to Classic Output  
 Save to Grove  
 C:\data\_mining\_salford\stats\_sample.grv  
 Dataset N Records: 10,000 Selected Variables: 16

Click **OK** to start the computation.

The following controls configure how results of Descriptive Stats computation are saved.

### Details to Classic Output

```
STATS <varlist> / SILENT = NO
```

When this setting is ON, the Classic Output window will contain all Descriptive Stats in textual form. This might be useful if you need to compare descriptive stats for several datasets.

## Save to Grove

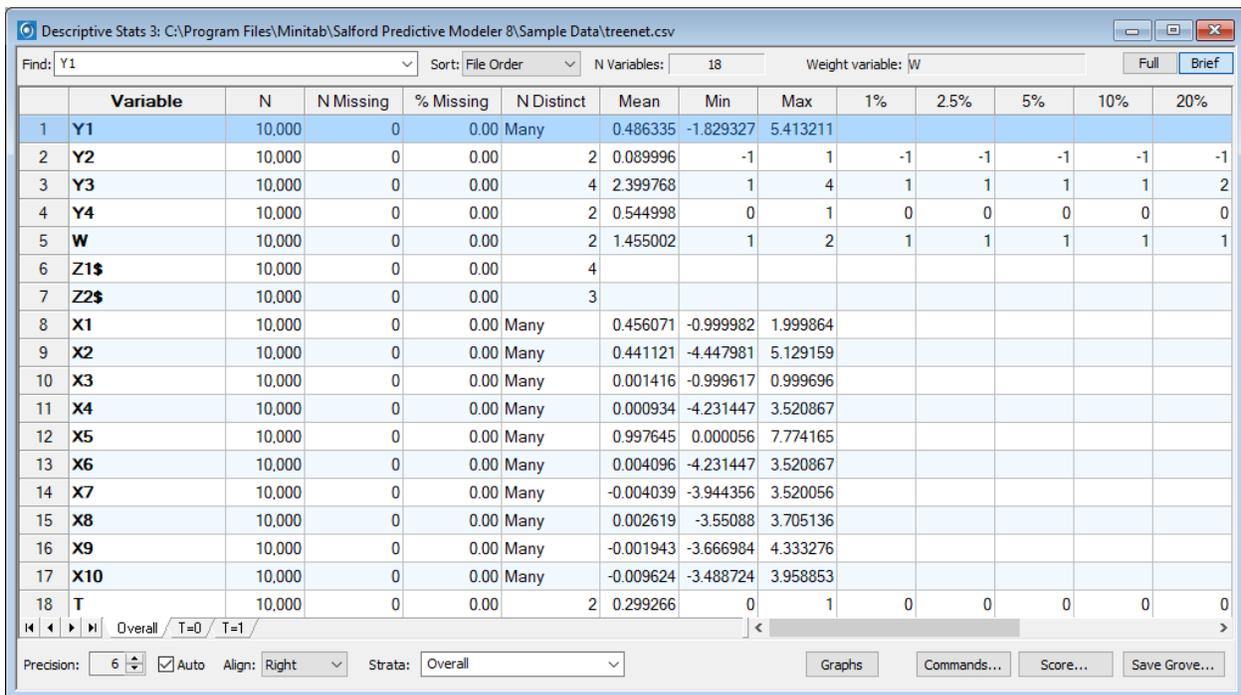
 GROVE "<File name>"

Just like other SPM analysis methods, Descriptive Stats can save the results into a Grove file. You can open this file in the GUI at any time to access Descriptive Stats without recomputing them.

Note: Descriptive Stats can also be saved post-computation via the **Save Grove** button in the resulting window.

## Browsing Descriptive Stats

Once the computation is done, or if you open a Grove file containing previously computed results, you will see the Descriptive Stats window. Here's what the results window looks like for our example:



	Variable	N	N Missing	% Missing	N Distinct	Mean	Min	Max	1%	2.5%	5%	10%	20%
1	Y1	10,000	0	0.00	Many	0.486335	-1.829327	5.413211					
2	Y2	10,000	0	0.00	2	0.089996	-1	1	-1	-1	-1	-1	-1
3	Y3	10,000	0	0.00	4	2.399768	1	4	1	1	1	1	2
4	Y4	10,000	0	0.00	2	0.544998	0	1	0	0	0	0	0
5	W	10,000	0	0.00	2	1.455002	1	2	1	1	1	1	1
6	Z1\$	10,000	0	0.00	4								
7	Z2\$	10,000	0	0.00	3								
8	X1	10,000	0	0.00	Many	0.456071	-0.999982	1.999864					
9	X2	10,000	0	0.00	Many	0.441121	-4.447981	5.129159					
10	X3	10,000	0	0.00	Many	0.001416	-0.999617	0.999696					
11	X4	10,000	0	0.00	Many	0.000934	-4.231447	3.520867					
12	X5	10,000	0	0.00	Many	0.997645	0.000056	7.774165					
13	X6	10,000	0	0.00	Many	0.004096	-4.231447	3.520867					
14	X7	10,000	0	0.00	Many	-0.004039	-3.944356	3.520056					
15	X8	10,000	0	0.00	Many	0.002619	-3.55088	3.705136					
16	X9	10,000	0	0.00	Many	-0.001943	-3.666984	4.333276					
17	X10	10,000	0	0.00	Many	-0.009624	-3.488724	3.958853					
18	T	10,000	0	0.00	2	0.299266	0	1	0	0	0	0	0

Note the **Full/Brief** switch in the top right corner.

## Descriptive Stats in Brief Mode

By default, the display is in Brief mode. You can quickly get an idea of

- ◆ How much of the data is missing?
- ◆ How many distinct values each column has?
- ◆ What are the range and the mean in each column?
- ◆ What are the boundaries of specific percentiles?

Note that some variables (e.g. X2, X4) have "Many Values" as the number of distinct levels. This means these variables have too many levels to tabulate given how the run was configured. The maximal number of levels for a frequency table is configured in the Descriptive Stats Setup dialog. If full tabulation is not available some of the stats are zero or empty.

Since we specified the Strata variable, these stats are available both for the overall dataset and for each stratum (T=0 and T=1 sheets in this particular example).

	Variable	N	N Missing	% Missing	N Distinct	Mean
1	Y1	7,000	0	0.00	Many	0.476791
2	Y2	7,000	0	0.00	2	0.08676
3	Y3	7,000	0	0.00	4	2.394554
4	Y4	7,000	0	0.00	2	0.54338
5	W	7,000	0	0.00	2	1.45662
6	Z1\$	7,000	0	0.00	4	
7	Z2\$	7,000	0	0.00	3	
8	X1	7,000	0	0.00	Many	0.465357
9	X2	7,000	0	0.00	Many	0.445642
10	X3	7,000	0	0.00	Many	-0.005761
11	X4	7,000	0	0.00	Many	0.000654
12	X5	7,000	0	0.00	Many	0.99996
13	X6	7,000	0	0.00	Many	-0.001587
14	X7	7,000	0	0.00	Many	0.000112
15	X8	7,000	0	0.00	Many	0.00546
16	X9	7,000	0	0.00	Many	-0.000125
17	X10	7,000	0	0.00	Many	-0.013232

You can use the **Find** drop-down on the top pane to lookup a variable by name. To do this, either

- ◆ Select a variable from the drop-down list. Variables are always sorted in File Order.
- ◆ Start typing a variable name into the box. As you type, the grid will reposition itself to the variable that starts with the sub-string you typed.

The **Sort** drop-down allows resorting variables in the grid, either Alphabetically or in File Order. Navigation tools are quite helpful when the list of variables is large. Other controls on the bottom pane of the window allow you to

- ◆ Specify Precision of the numbers in the grid.
- ◆ Let the grid figure out the precision by checking the **Auto** checkbox.
- ◆ **Align** content of the cells in the grid.
- ◆ Choose the displayed **Strata**.
- ◆ Generate **Graphs**.
- ◆ View **Commands** of the SPM session.
- ◆ **Score** the descriptive statistics.
- ◆ Save the contents of the descriptive statistics by clicking **Save Grove**.

### Descriptive Stats in Full Mode

Now, let's switch to **Full** mode.

Descriptive Stats 3: C:\Program Files\Minitab\Salford Predictive Modeler 8\Sample Data\treenet.csv

Find: Y1 Sort: File Order N Variables: 18 Weight variable: W

Y1 DESCRIPTIVE		Y2 DESCRIPTIVE		Y3 DESCRIPTIVE	
N	10000	N	10000	N	10000
N Missing	0	N Missing	0	N Missing	0
N = 0	0	N = 0	0	N = 0	0
N <> 0	10000	N <> 0	10000	N <> 0	10000
N Distinct Values	Many	N Distinct Values	2	N Distinct Values	4
Mean	0.48633	Mean	0.089996	Mean	2.3998
Std. Deviation	1.1822	Std. Deviation	0.996	Std. Deviation	1.0025
Skewness	1.0121	Skewness	-0.18073	Skewness	0.23537
Coeff Variation	2.4308	Coeff Variation	11.067	Coeff Variation	0.41775
Cond. Mean	0.48633	Cond. Mean	0.089996	Cond. Mean	2.3998
Sum of Weights	12945	Sum of Weights	12945	Sum of Weights	12945
Sum	6295.6	Sum	1165	Sum	31065
Variance	1.3976	Variance	0.99201	Variance	1.005
Kurtosis	0.76931	Kurtosis	-1.9673	Kurtosis	-1.0103
Std. Error Mean	0.012533	Std. Error Mean	0.010559	Std. Error Mean	0.010628

Buttons: LOCATION, VARIABILITY, QUANTILES, FREQUENCY TABLES

FREQUENCY TABLES			
	Most	% of Total	N
1	Least		
2	All (Showing first 100)		

Overall / T=0 / T=1

Precision: 6 Auto Align: Right Strata: Overall

Buttons: Graphs, Commands..., Score..., Save Grove...

In this mode, Descriptive Stats for a variable are organized in vertical sections. Each variable occupies a column. You can use the **Find** and **Sort** drop-down menus to navigate to a specific variable. For example, type X1 into the **Find** box. As a result you should now see X1 in the left-most column.

Descriptive Stats 3: C:\Program Files\Minitab\Salford Predictive Modeler 8\Sample Data\treenet.csv

Find: Y1 Sort: File Order

Y1 DESCRIPTIVE	
N	10000
N Missing	0
N = 0	0
N <> 0	10000
N Distinct Values	Many
Mean	0.48633
Std. Deviation	1.1822
Skewness	1.0121
Coeff Variation	2.4308
Cond. Mean	0.48633
Sum of Weights	12945
Sum	6295.6
Variance	1.3976
Kurtosis	0.76931
Std. Error Mean	0.012533

Continue to type in X10. Now the grid scrolled to X10.

DESCRIPTIVE	
N	10000
N Missing	0
N = 0	0
N <> 0	10000
N Distinct Values	Many
Mean	-0.0096239
Std. Deviation	0.99354
Skewness	0.028442
Coeff Variation	-103.24
Cond. Mean	-0.0096239
Sum of Weights	12945
Sum	-124.58
Variance	0.98712
Kurtosis	0.085147
Std. Error Mean	0.010533

Buttons and near the title of each section allow you to expand and collapse the content. Buttons and in the top left corner of the grid are helpful to collapse or expand all the sections.

- ✓ This display can also be used to get a quick idea about a particular statistic or group of statistics across all the variables. A convenient way to do this is to expand just the section of interest and scroll through all the variables.

The following sections are available.

TARGET	
	DESCRIPTIVE
	LOCATION
	VARIABILITY
	QUANTILES
	FREQUENCY TABLES

**Descriptive**

<b>X3</b>	
<b>DESCRIPTIVE</b>	
N	10000
N Missing	0
N = 0	0
N <> 0	10000
N Distinct Values	9997
Mean	0.001416
Std. Deviation	0.56366
Skewness	-0.007863
Coeff Variation	398.08
Cond. Mean	0.001416
Sum of Weights	12945
Sum	18.33
Variance	0.31771
Kurtosis	-1.1404
Std. Error Mean	0.0059758

This section contains an extended set of descriptive stats computed by the engine. There are quite a few of them in addition to ones displayed in Brief mode. This section contains the following stats:

- ◆ N
- ◆ N Missing
- ◆ N = 0
- ◆ N <> 0 (not equal to)
- ◆ N Distinct Values
- ◆ Mean
- ◆ Std. Deviation
- ◆ Skewness
- ◆ Coefficient Variation
- ◆ Conditional Mean
- ◆ Sum of Weights
- ◆ Sum
- ◆ Variance
- ◆ Kurtosis
- ◆ Std. Error Mean

Note that we don't have Median and Range in the list. The reason is these values are more conveniently represented by the sections below.

**Location**

LOCATION	
Mean	0.001416
Median	0.005324
Range	1.9993

This section helps you understand the location of the variable on the number line. The relevant stats are grouped together:

- ◆ Mean
- ◆ Median
- ◆ Range

**Variability**

VARIABILITY	
Std. Deviation	0.56366
Variance	0.31771
Intrqrt Range	0.95079

This section contains stats to describe the dispersion of the variable. It contains the following stats:

- ◆ Std. Deviation
- ◆ Variance
- ◆ Interquartile range

**Quantiles**

QUANTILES	
100% Max	0.9997
99%	0.97809
97.5%	0.94546
95%	0.89378
90%	0.78021
75% Q3	0.47669
50% Median	0.005324
25% Q1	-0.4741
10%	-0.78628
5%	-0.89654
2.5%	-0.94752
1%	-0.97784
0% Min	-0.99962

This section allows you to assess probability distribution of the variable by showing most important percentiles.

**Frequency Tables**

FREQUENCY TABLES			
Most	% of Total	N	Cum %
-0.029892	0.02	3	0.02
-0.996623	0.02	2	0.04
-0.996505	0.02	2	0.05
-0.995954	0.02	2	0.07
-0.994886	0.02	2	0.08
Least			
-0.999617	0.01	1	0.01
-0.999426	0.01	1	0.02
-0.998722	0.01	1	0.02
-0.998547	0.01	1	0.03
-0.997873	0.01	1	0.04
All			
-0.999617	0.01	1	0.01
-0.999426	0.01	1	0.02
-0.998722	0.01	1	0.02
-0.998547	0.01	1	0.03
-0.997873	0.01	1	0.04
-0.997838	0.01	1	0.05
-0.997696	0.01	1	0.05

This section contains frequency tabulation of the variables. Each row contains a value of the variable along with percentage of total records, number of records, and cumulative percentage. Note that for some variables, the limit on frequency tabulation prevented from capturing the full frequency table.

- ✓ Note that the stats for T are on Overall pane, but not on T=0 or T=1 pane. The stats for the Strata variable in a particular stratum are degenerate.

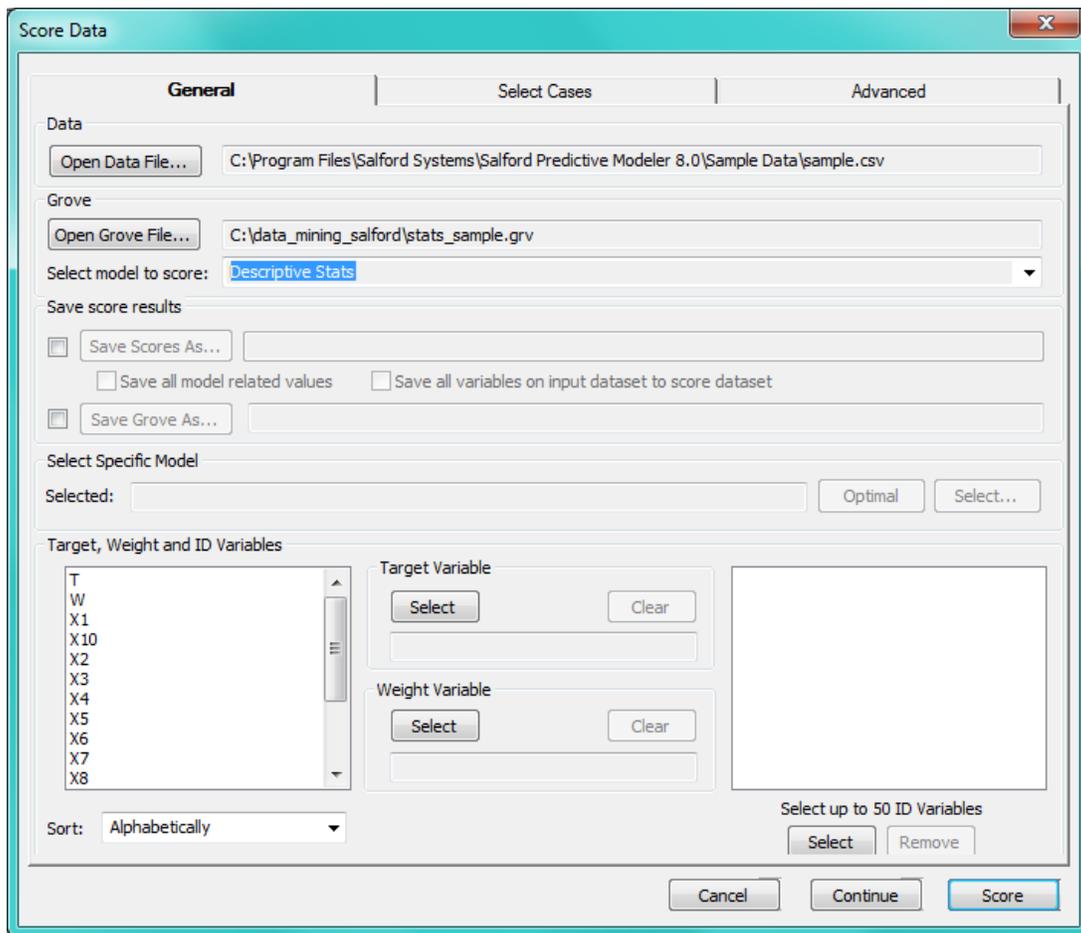
T				
QUANTILES				
FREQUENCY TABLES				
	Most	% of Total	N	Wgt. N
	0	70.00	7000	9071
	1	30.00	3000	3874
	Least			
	1	30.00	3000	3874
	0	70.00	7000	9071
	All			
1	0	70.00	7000	9071
2	1	30.00	3000	3874

Overall / T=0 / T=1

### Scoring Descriptive Statistics

SPM 8 now offers the option to score new data through tabulated descriptive statistics; a useful feature for missing value imputation. Simply click the **Score** button at the bottom of the Descriptive Stats window

to open the Score Data dialog:



In the Data section, choose a new data file that you wish to score. The Descriptive Stats grove from which you clicked the Score button is automatically populated in the Grove section. Finally, choose an output data file in the Save score results section. This particular example (sample.csv) does not contain missing values and will not benefit from the scoring process. However, if you have new data with missing values, this data will be filled in with imputed values from the descriptive statistics (means, by default). For more detailed information on missing value imputation, see the corresponding section of this manual (Data Imputation).

## Sorting and Selecting a Keep List

Typically, the first stage of data analysis is exploring the data through descriptive statistics, as seen above. You may wish to continue your analysis with only a subset of these variables based on what you have observed in the Descriptive Stats output. For example, return to the Brief view of the sample.csv statistics:

Descriptive Stats 6: C:\Program Files\Minitab\Salford Predictive Modeler 8\Sample Data\sample.csv

Find: Y1 Sort: File Order N Variables: 16 Weight variable: W

	Variable	N	N Missing	% Missing	N Distinct	Mean	Min	Max	1%	2.5%	5%	10%	20%	25% Q1
1	Y1	10,000	0	0.00	Many	0.486335	-1.829327	5.413211						
2	Y2	10,000	0	0.00	2	0.089996	-1	1	-1	-1	-1	-1	-1	-1
3	Y3	10,000	0	0.00	4	2.399768	1	4	1	1	1	1	2	2
4	Z1\$	10,000	0	0.00	4									
5	Z2\$	10,000	0	0.00	3									
6	X1	10,000	0	0.00	9,997	0.456071	-0.999982	1.999864	-0.967673	-0.924183	-0.854543	-0.725503	-0.494977	-0.374555
7	X2	10,000	0	0.00	Many	0.441121	-4.447981	5.129159						
8	X3	10,000	0	0.00	9,997	0.001416	-0.999617	0.999696	-0.977842	-0.947522	-0.896544	-0.786277	-0.573377	-0.474098
9	X4	10,000	0	0.00	Many	0.000934	-4.231447	3.520867						
10	X5	10,000	0	0.00	9,995	0.997645	0.000056	7.774165	0.009014	0.025069	0.055131	0.111001	0.226713	0.289448
11	X6	10,000	0	0.00	Many	0.004096	-4.231447	3.520867						
12	X7	10,000	0	0.00	Many	-0.004039	-3.944356	3.520056						
13	X8	10,000	0	0.00	Many	0.002619	-3.55088	3.705136						
14	X9	10,000	0	0.00	8,999	-0.001943	-3.666984	4.333276	-2.317965	-1.94796	-1.631104	-1.290033	-0.826589	-0.664124
15	X10	10,000	0	0.00	9,997	-0.009624	-3.488724	3.958853	-2.316299	-1.960456	-1.647763	-1.269833	-0.839692	-0.674501
16	T	10,000	0	0.00	2	0.299266	0	1	0	0	0	0	0	0

Precision: 6 Auto Align: Right Strata: Overall

Sort the variable list by ascending distinct values by clicking once on the N Distinct column:

Descriptive Stats 6: C:\Program Files\Minitab\Salford Predictive Modeler 8\Sample Data\sample.csv

Find: Y1 Sort: File Order N Variables: 16 Weight variable: W

	Variable	N	N Missing	% Missing	N Distinct	Mean	Min	Max	1%	2.5%	5%	10%	20%	25% Q1
1	Y2	10,000	0	0.00	2	0.089996	-1	1	-1	-1	-1	-1	-1	-1
2	T	10,000	0	0.00	2	0.299266	0	1	0	0	0	0	0	0
3	Z2\$	10,000	0	0.00	3									
4	Y3	10,000	0	0.00	4	2.399768	1	4	1	1	1	1	2	2
5	Z1\$	10,000	0	0.00	4									
6	X9	10,000	0	0.00	8,999	-0.001943	-3.666984	4.333276	-2.317965	-1.94796	-1.631104	-1.290033	-0.826589	-0.664124
7	X5	10,000	0	0.00	9,995	0.997645	0.000056	7.774165	0.009014	0.025069	0.055131	0.111001	0.226713	0.289448
8	X3	10,000	0	0.00	9,997	0.001416	-0.999617	0.999696	-0.977842	-0.947522	-0.896544	-0.786277	-0.573377	-0.474098
9	X1	10,000	0	0.00	9,997	0.456071	-0.999982	1.999864	-0.967673	-0.924183	-0.854543	-0.725503	-0.494977	-0.374555
10	X10	10,000	0	0.00	9,997	-0.009624	-3.488724	3.958853	-2.316299	-1.960456	-1.647763	-1.269833	-0.839692	-0.674501
11	X7	10,000	0	0.00	Many	-0.004039	-3.944356	3.520056						
12	X8	10,000	0	0.00	Many	0.002619	-3.55088	3.705136						
13	X2	10,000	0	0.00	Many	0.441121	-4.447981	5.129159						
14	X6	10,000	0	0.00	Many	0.004096	-4.231447	3.520867						
15	X4	10,000	0	0.00	Many	0.000934	-4.231447	3.520867						
16	Y1	10,000	0	0.00	Many	0.486335	-1.829327	5.413211						

Precision: 6 Auto Align: Right Strata: Overall

This ability to sort the variable list can be extended to all columns in this window. Now, let's say you only wish to continue the analysis with variables that have very few distinct levels. Highlight the top 6 variables, right-click, and select New Keep List:

	Variable	N	N Missing	% Missing	N Distinct	Mean	Min	Max	1%	2.5%	5%	10%	20%	25% Q1
1	Y2			0.00	2	0.089996	-1	1	-1	-1	-1	-1	-1	-1
2	T			0.00	2	0.299266	0	1	0	0	0	0	0	0
3	Z2\$			0.00	3									
4	Y3			0.00	4	2.399768	1	4	1	1	1	1	2	2
5	Z1\$			0.00	4									
6	X9	10,000	0	0.00	8,999	-0.001943	-3.666984	4.333276	-2.317965	-1.94796	-1.631104	-1.290033	-0.826589	-0.664124
7	X5	10,000	0	0.00	9,995	0.997645	0.000056	7.774165	0.009014	0.025069	0.055131	0.1111001	0.226713	0.289448
8	X3	10,000	0	0.00	9,997	0.001416	-0.999617	0.999696	-0.977842	-0.947522	-0.896544	-0.786277	-0.573377	-0.474098
9	X1	10,000	0	0.00	9,997	0.456071	-0.999982	1.999864	-0.967673	-0.924183	-0.854543	-0.725503	-0.494977	-0.374555
10	X10	10,000	0	0.00	9,997	-0.009624	-3.488724	3.958853	-2.316299	-1.960456	-1.647763	-1.269833	-0.839692	-0.674501
11	X7	10,000	0	0.00	Many	-0.004039	-3.944356	3.520056						
12	X8	10,000	0	0.00	Many	0.002619	-3.55088	3.705136						
13	X2	10,000	0	0.00	Many	0.441121	-4.447981	5.129159						
14	X6	10,000	0	0.00	Many	0.004096	-4.231447	3.520867						
15	X4	10,000	0	0.00	Many	0.000934	-4.231447	3.520867						
16	Y1	10,000	0	0.00	Many	0.486335	-1.829327	5.413211						

This action opens a new notepad with a KEEP statement followed by the selected variables. From here, it's simple to submit this window to tell SPM which variables you'd like included in the analysis. You can confirm the variable selection by opening the Model Setup window.

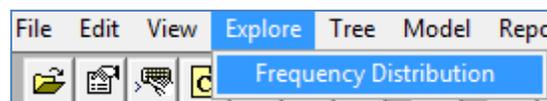
```

REM Selected variables from: Descriptive Stats 6: C:\Program Files\Minitab\5
KEEP Y2, T, Z2$, Y3, Z1$

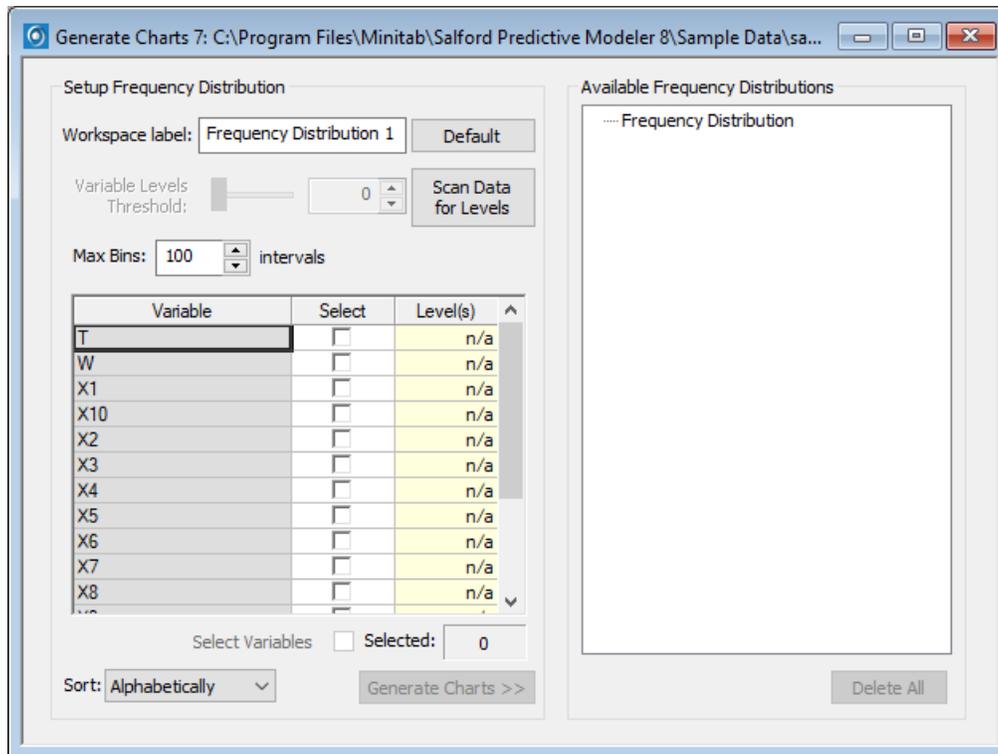
```

## Exploring Frequency Distributions

You can explore Frequency Distributions of variables in a graphical form. Select **Explore>Frequency Distribution** from the **Explore** menu.

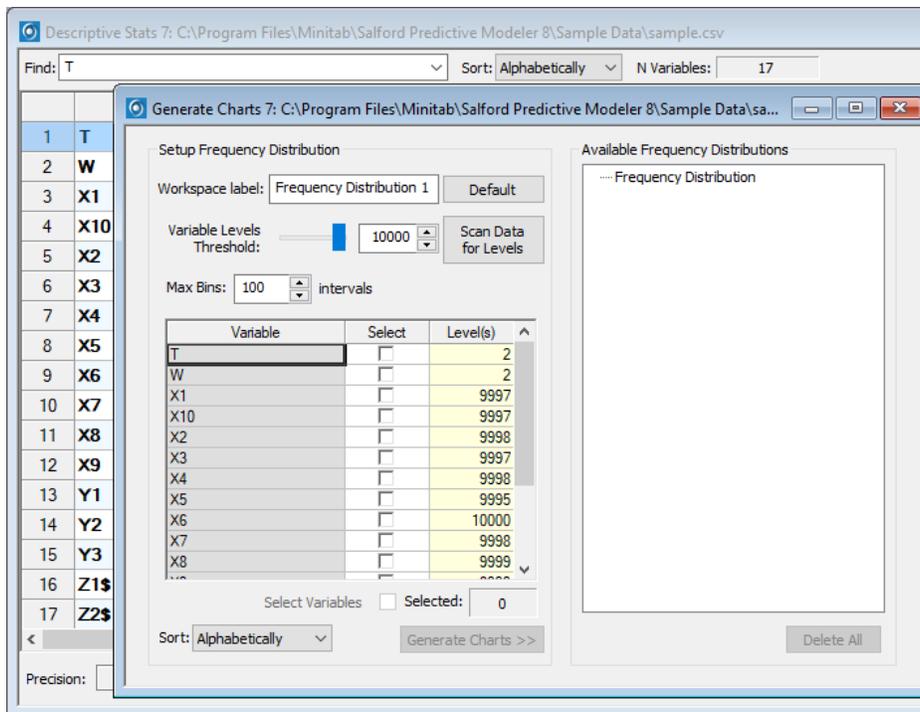


As a result, the Generate Charts dialog will appear:

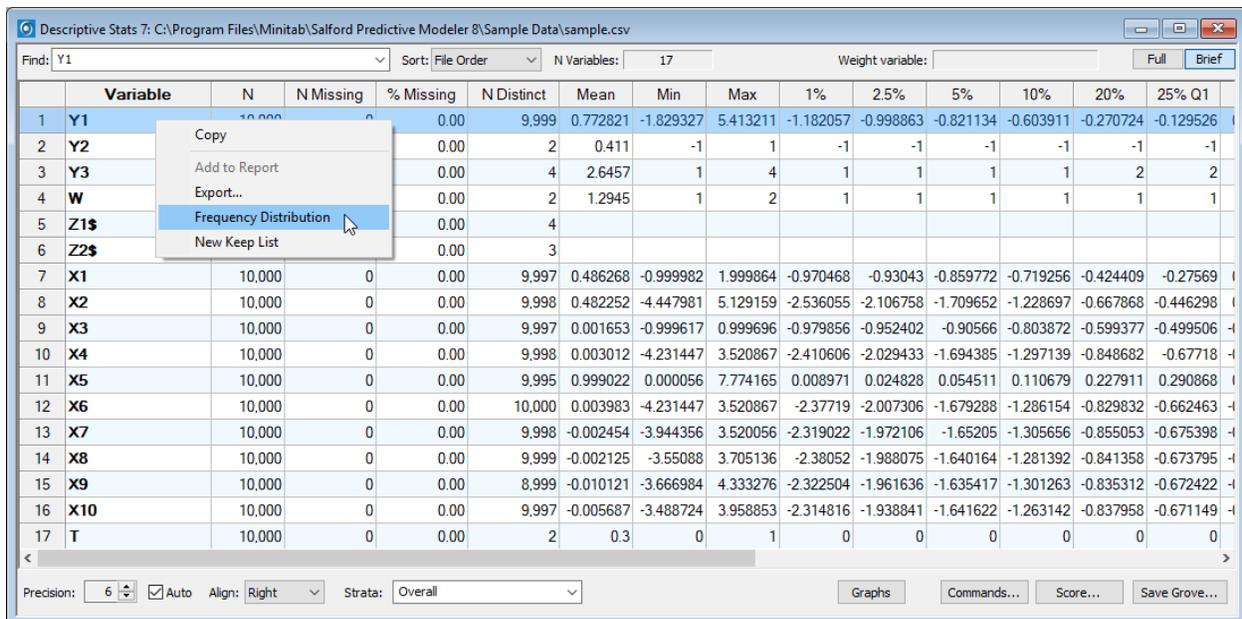


Note that the Level(s) column is not populated by default. To obtain level information, full Descriptive Stats have to be computed. This is a potentially lengthy operation. By skipping it, you can proceed directly to requesting charts for the variables of interest.

- ✓ You can bring in level information by clicking the **Scan Data for Levels** button. This will run Descriptive Stats for all variables and populate the Level(s) column. **Variable Levels Threshold** control will become available to filter out variables with too many levels.



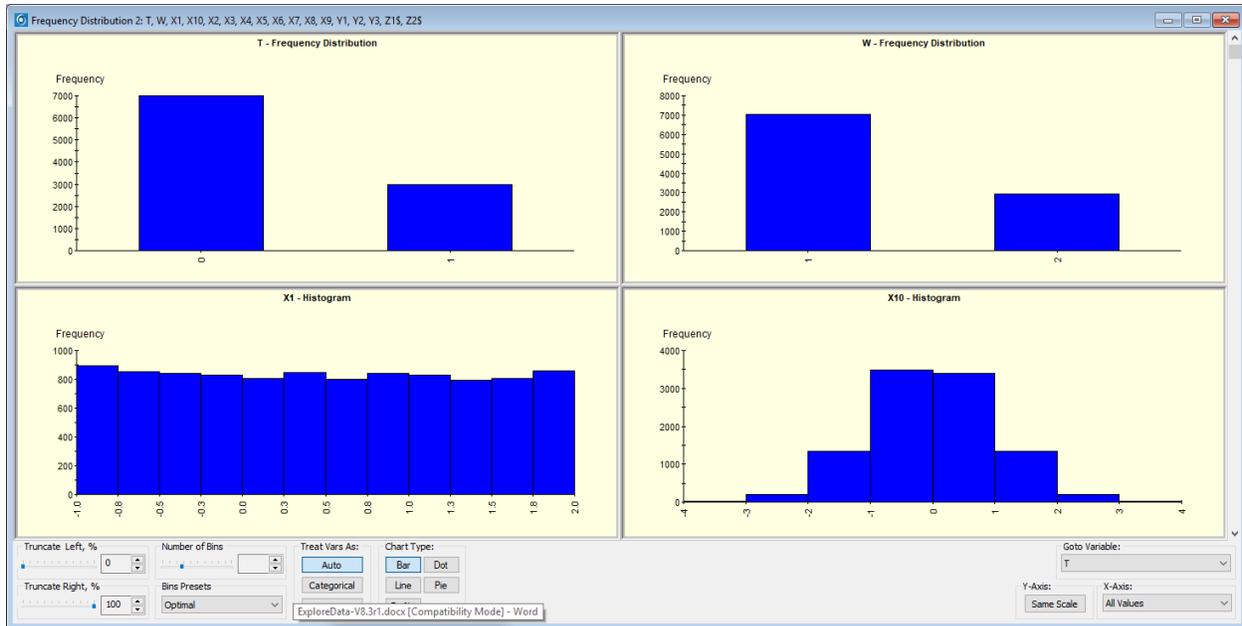
Since Frequency Distribution is powered by the Descriptive Stats results, you can always navigate from Descriptive Stats to a Generate Charts window via right-clicking or by clicking the **Graphs** button at the bottom of the window:



The controls in the Generate Charts window allow you to specify a group of charts you're interested in seeing in a single display. You can specify **Workspace Label** for the group for better reference. If a variable has more than **Max Bins** levels, the values get binned and a histogram is displayed. Otherwise the chart will show a full frequency distribution. A variable selection grid lets you specify variables of interest.

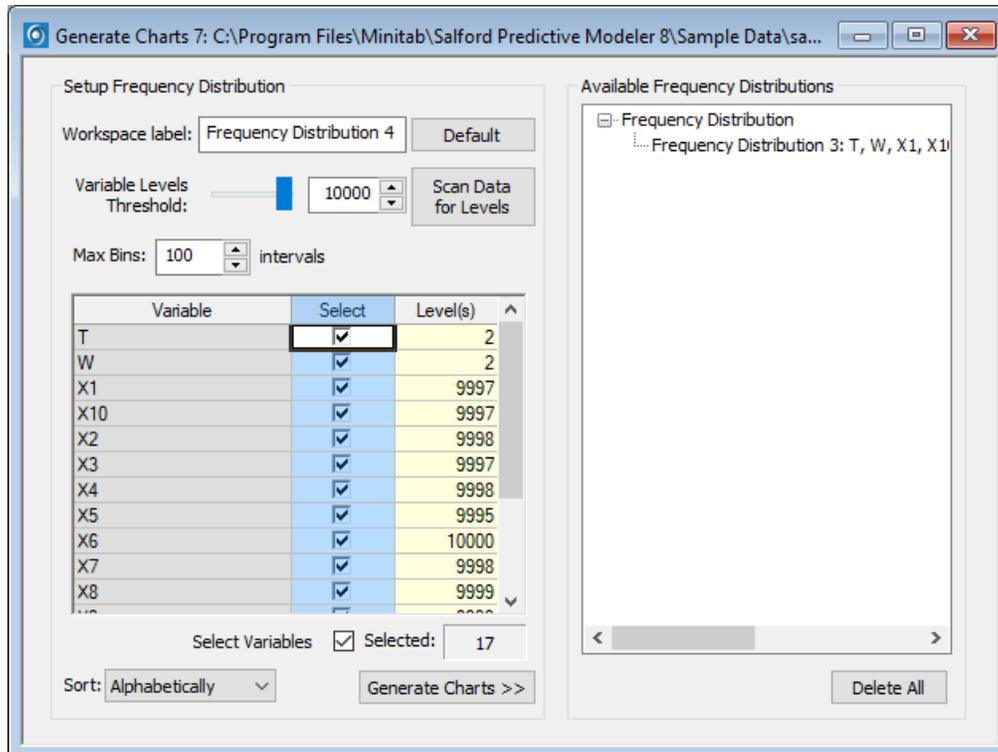
Let's request Frequency Distribution plots for all variables in the dataset. You can select the entire column and mark the **Select** checkbox above to select all individual variables. Once a selection is made, the **Generate Charts** button will be enabled.

As a result you will see a Frequency Distribution window:



- ✓ Histograms are incomplete for variables with too many levels (e.g. X10 on the screenshot above). This is due to the cap on number of levels to tabulate during Descriptive Stats. Generate charts dialog uses default caps to ensure acceptable performance. You can configure your Descriptive Stats run and then request a Frequency Distribution display from it.

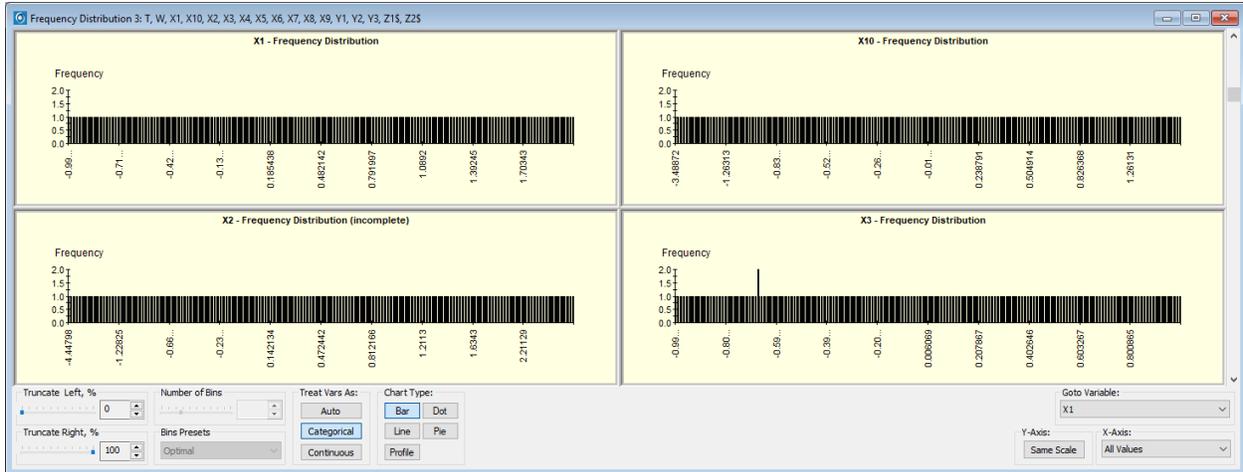
The Generate Charts window that you used to configure the run is still available. It keeps track of all chart groups produced and provides an easy way to navigate to each of them via the right-hand side navigation panel.



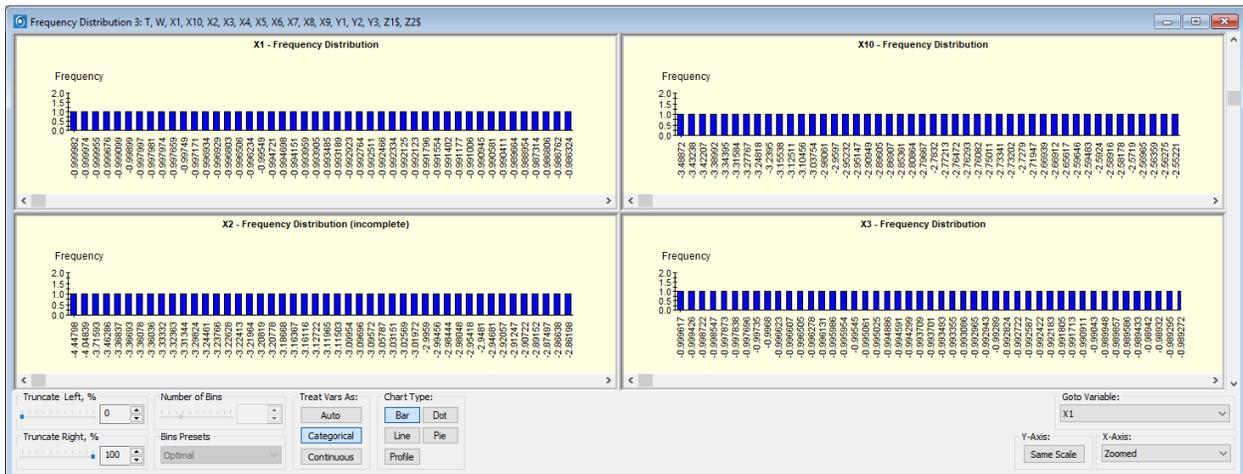
The Frequency Distribution window shows up to four plots at the same time. If there are more than four plots, you can scroll up and down to get to a plot of interest. The **Goto Variable** drop-down box is a handy way to navigate to a variable by name. You can make the Y-axis scale the same for all charts using the **Same Scale** button. These are just a few of the controls on the lower tool panel of the window:



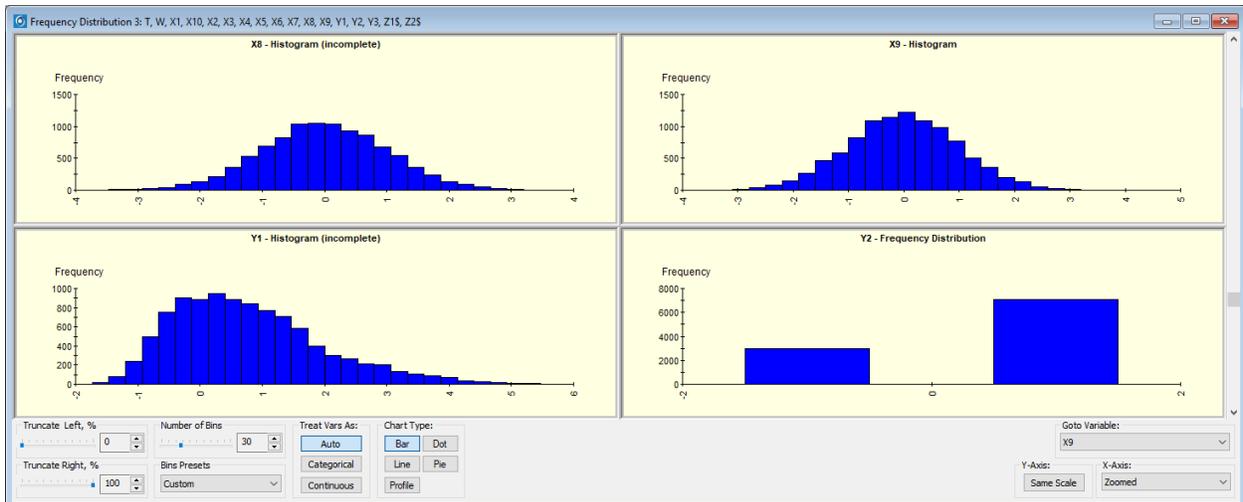
Variables treated as continuous are displayed as histograms. For categorical variables, a full frequency table is displayed. By default, the decision on whether a variable is continuous or categorical comes from the SPM engine. The **Treat Vars As** group of controls lets you override this. In addition to the default, you can opt to treat all variables as either Continuous or Categorical. The dataset we are examining contains quite a few variables with large numbers of levels. If you request to treat them as Categorical, the Frequency Distribution will try to plot each individual level. If you navigate to X1 and click **Categorical** you might see something like this:



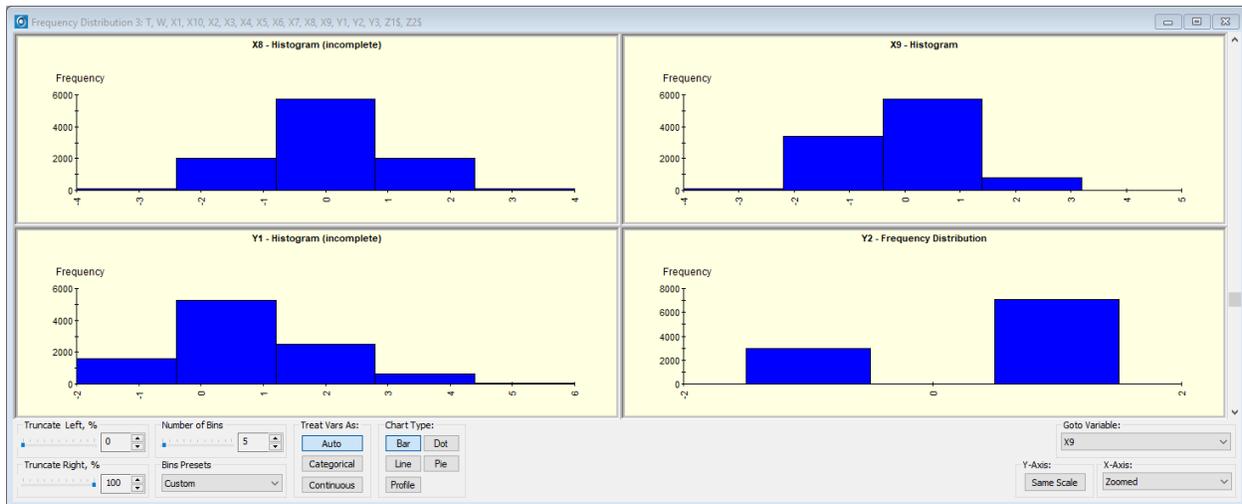
It is apparent that usability of these charts is limited. To improve this, you can switch the **X-Axis** drop-down box from **All Values** to **Zoomed**. Now you can scroll each chart horizontally and explore the levels of interest:



Let's switch **Treat Vars As** back to **Auto** and navigate to X9. Since X9 and X10 are continuous, **Binning** controls determine how the levels are binned.



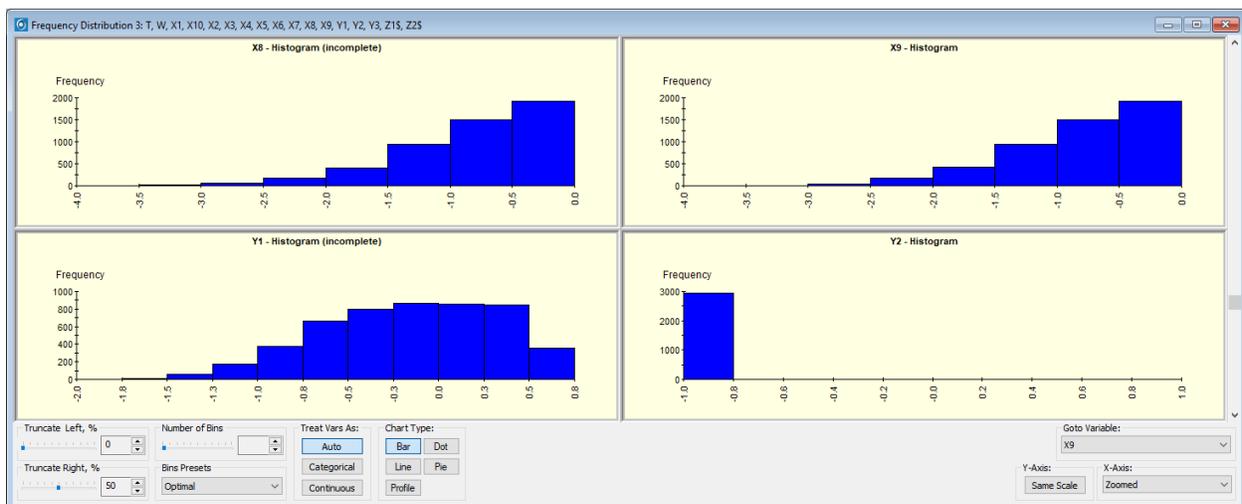
Now let's reduce **Binning** number down to 5.



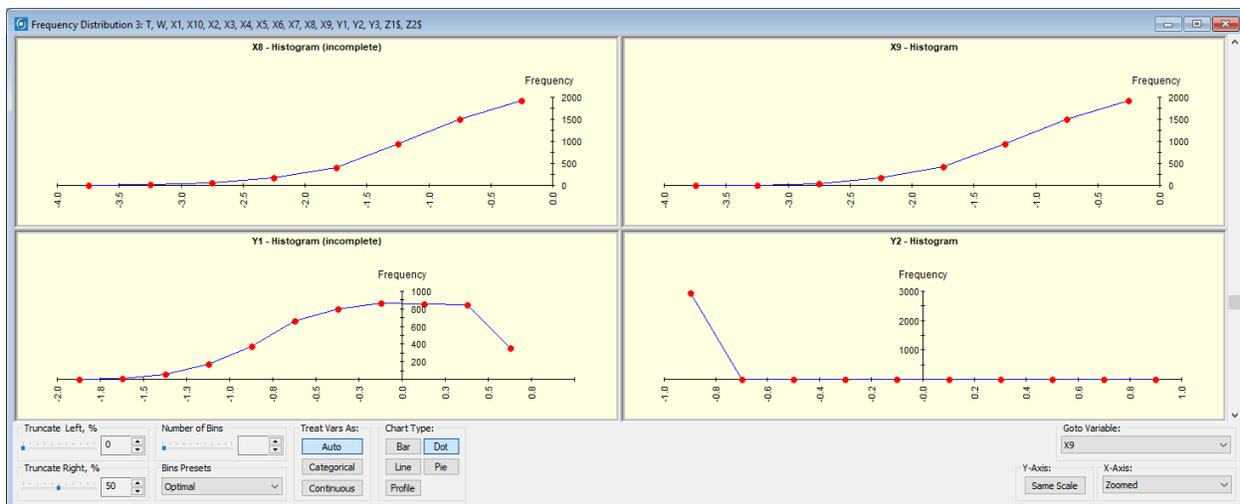
You can also switch between the following **Bins Presets**:

- ◆ For **Custom** preset, the **Number of Bins** slider defines the number of bins for all continuous variables. This is the default.
- ◆ For **Optimal** preset, the number of bins is determined individually for each variable. This is useful when looking side-by-side at variables with radically different distributions.

Let's switch back to **Optimal** number of bins. Note that you're seeing essentially the same histogram for X9. Note that the left-most 6 bins are obscured by much more populated ones to the right. Let's truncate 50% of levels using the **Truncate Right** control. As a result you can now see the left side of the distribution in more details.



Sometimes it is convenient to use an alternative chart type for a histogram. For each chart type, there's a button in the **Chart Type** group of controls. For example, here is the same screenshot with chart type changed to **Dot**.



## Exploring Correlated Variables

To compute correlations among the variables in a dataset, select **Explore>Correlation** from the menu or click the shortcut  in the toolbar. The Correlation Setup window will appear:

The 'Correlation Setup' dialog box contains the following elements:

Variable Name	Include
T	<input checked="" type="checkbox"/>
W	<input checked="" type="checkbox"/>
X1	<input checked="" type="checkbox"/>
X10	<input checked="" type="checkbox"/>
X2	<input checked="" type="checkbox"/>
X3	<input checked="" type="checkbox"/>
X4	<input checked="" type="checkbox"/>
X5	<input checked="" type="checkbox"/>
X6	<input checked="" type="checkbox"/>
X7	<input checked="" type="checkbox"/>
X8	<input checked="" type="checkbox"/>
X9	<input checked="" type="checkbox"/>
Y1	<input checked="" type="checkbox"/>
Y2	<input checked="" type="checkbox"/>
Y3	<input checked="" type="checkbox"/>
Z1\$	<input checked="" type="checkbox"/>

Correlation type: **Pearson's product-moment**

All possible matrices (may be very time consuming)

Data exploring settings:  Use only the first several records: 10000

Print matrices: **Default (9 columns)**

Filter:  None  Character  Numeric

Save to File

Save to Grove

Dataset N Records: 10,000 Selected Variables: 17

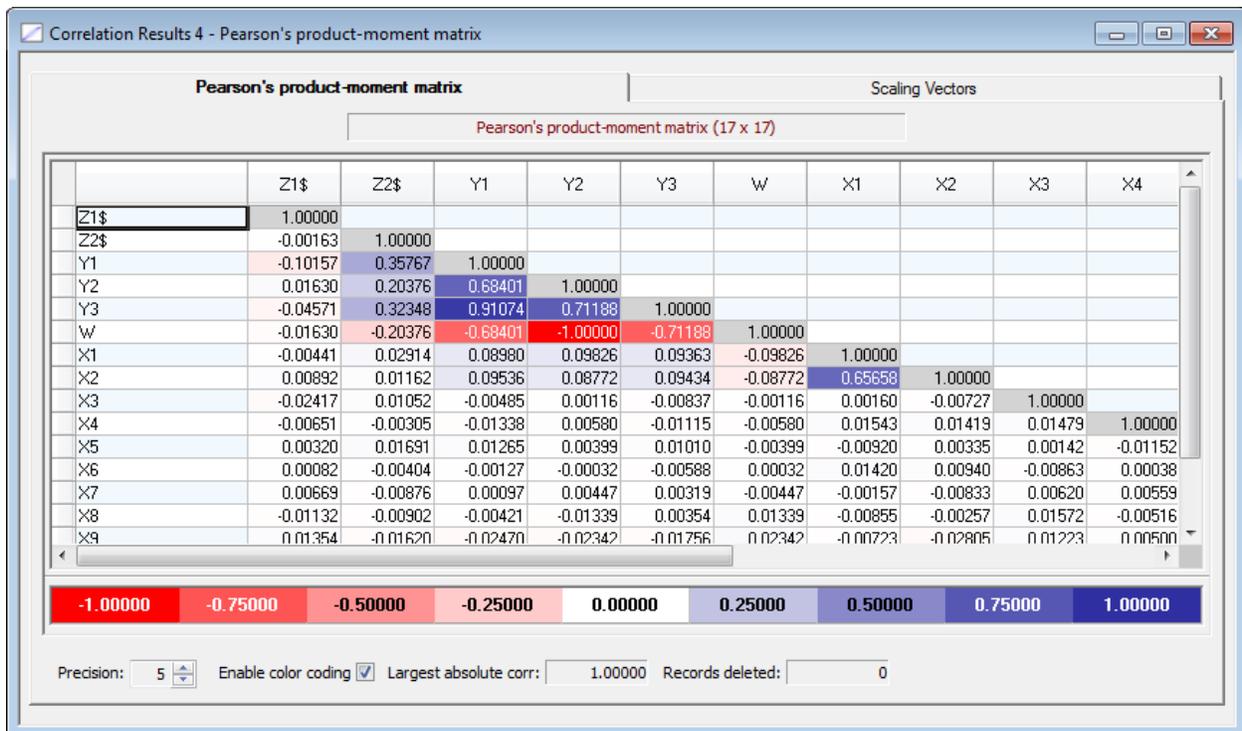
Sort: **Alphabetically** Only Current Model Variables  Select

As with the Descriptive Stats setup, you have a variable selection grid with the ability to sort either alphabetically or in file order. Options to the right include:

- ◆ Correlation type allows for different computation measures. These include
  - Sum of cross products
  - Covariance
  - Pearson's product-moment

- Normal Euclidean distances
  - Skewness
  - Variance
  - Spearman's rank-order
  - Kendal Tau-b rank-order
  - Positive matching dichotomous
  - Jaccard's dichotomous
  - Simple matching dichotomous
  - Anderberg's dichotomous
  - Tanimoto's dichotomous
  - City Block distances
  - All possible matrices (may be very time consuming)
- ◆ Speed up compute time by only using the first N records
  - ◆ Size of printed matrices
  - ◆ Filtering by variable type
  - ◆ Saving correlation results to a file and/or grove

Continue with the default values by clicking OK.



Tabs with the designated correlation measure(s) will be displayed with a matrix of color-coded values. Darker red indicates a strong negative correlation, white indicates little to no correlation, and darker

purple indicates a strong positive correlation. Options at the bottom of the window include adjusting precision and disabling color-coding. Also reported is the largest absolute correlation present in the table and the number of records deleted. The correlation feature uses strict listwise deletion for missing data; any record with any missing variables will be omitted.