Chapter 201

Descriptive Statistics – Summary Tables

Introduction

This procedure is used to summarize continuous data. Large volumes of such data may be easily summarized in statistical lists of means, counts, standard deviations, etc. Up to 8 categorical group variables may be used to calculate summaries for individual group combinations. The summary lists may be output directly to a new dataset.

This procedure produces lists of the following summary statistics:

- **Count**
- **Missing Count**
- **Sum**
- **Mean**
- **Standard Deviation (Std Dev)**
- **Standard Error (Std Error)**
- **Lower 95% Confidence Limit for the Mean (95% LCL)**
- **Upper 95% Confidence Limit for the Mean (95% UCL)**
- **Median**
- **Minimum**
- **Maximum**
- **Range**
- **Interquartile Range (IQR)**
- **10th Percentile (10th Pctile)**
- **25th Percentile (25th Pctile)**
- **75th Percentile (75th Pctile)**
- **90th Percentile (90th Pctile)**
- **Variance**
- **Mean Absolute Deviation (MAD)**
- **Mean Absolute Deviation from the Median (MADM)**
- **Coefficient of Variation (COV)**
- **Coefficient of Dispersion (COD)**
- **Skewness**
- **Kurtosis**

Types of Categorical Variables

Note that we will refer to two types of categorical variables: *Group Variables* and *Break Variables*.

The values of a *Group Variable* are used to define the rows, sub rows, and columns of the summary table. Up to two Group Variables may be used per table. Group Variables are not required.

Break Variables are used to split a database into subgroups. A separate report is generated for each unique set of values of the break variables.

Data Structure

The data below are a subset of the Resale dataset provided with the software. This (computer simulated) data gives the selling price, the number of bedrooms, the total square footage (finished and unfinished), and the size of the lots for 150 residential properties sold during the last four months in two states. This data is representative of the type of data that may be analyzed with this procedure. Only the first 6 of the 150 observations are displayed.

Resale Dataset (Subset)

State	Price	Bedrooms	TotalSqft	LotSize
Nev	260000	2	2042	10173
Nev	66900	3	1392	13069
Vir	127900	2	1792	7065
Nev	181900	3	2645	8484
Nev	262100	2	2613	8355
Nev	147500	2	1935	7056

Missing Values

Observations with missing values in either the group variables or the continuous data variables are ignored. The procedure also allows you to specify up to 5 additional values to be considered as missing in categorical group variables.

Summary Statistics

The following sections outline the summary statistics that are available in this procedure.

Count

The number of non-missing data values, *n*. If no frequency variable was specified, this is the number of rows with non-missing values.

Missing Count

The number of missing data values. If no frequency variable was specified, this is the number of rows with missing values.

Sum

The sum (or total) of the data values.

$$Sum = \sum_{i=1}^{n} x_i$$

Mean

The average of the data values.

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Variance

The sample variance, s^2, is a popular measure of dispersion. It is an average of the squared deviations from the mean.

$$s^2 = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}$$

Standard Deviation (Std Dev)

The sample standard deviation, *s*, is a popular measure of dispersion. It measures the average distance between a single observation and the mean. It is equal to the square root of the sample variance.

$$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

Standard Error (Std Error)

The standard error of the mean, a measure of the variation of the sample mean about the population mean, is computed by dividing the sample standard deviation by the square root of the sample size.

$$s_{\bar{x}} = \frac{s}{\sqrt{n}}$$

95% Confidence Interval for the Mean (95% LCL & 95% UCL)

This is the upper and lower values of a 95% confidence interval estimate for the mean based on a *t* distribution with *n* – 1 degrees of freedom. This interval estimate assumes that the population standard deviation is not known and that the data for this variable are normally distributed.

$$95\%\ \text{CI} = \bar{x} \pm t_{a/2,n-1} s_{\bar{x}}$$

Minimum

The smallest data value.

Maximum

The largest data value.

Range

The difference between the largest and smallest data values.

$$Range = Maximum - Minimum$$

Percentiles

The $100p^{th}$ percentile is the value below which $100p$% of data values may be found (and above which $100(1 - p)$% of data values may be found). The $100p^{th}$ percentile is computed as

$$Z_{100p} = (1 - g)X_{[k_1]} + gX_{[k_2]}$$

where k_1 equals the integer part of $p(n + 1)$, $k_2 = k_1 + 1$, g is the fractional part of $p(n + 1)$, and $X_{[k]}$ is the k^{th} observation when the data are sorted from lowest to highest.

Median

The median (or 50th percentile) is the "middle number" of the sorted data values.

$$Median = Z_{50}$$

Interquartile Range (IQR)

The difference between the 75th and 25th percentiles (the 3rd and 1st quartiles). This represents the range of the middle 50% of the data. It serves as a robust measure of the variation in the data.

$$IQR = Z_{75} - Z_{25}$$

Mean Absolute Deviation (MAD)

A measure of dispersion that is not affected by outliers as much as the standard deviation and variance. It measures the average absolute distance between a single observation and the mean.

$$MAD = \frac{\sum_{i=1}^{n} |x_i - \bar{x}|}{n}$$

Mean Absolute Deviation from the Median (MADM)

A measure of dispersion that is even more robust to outliers than the mean absolute deviation (MAD) since the median is used as the center point of the distribution. It measures the average absolute distance between a single observation and the median.

$$MADM = \frac{\sum_{i=1}^{n}|x_i - Median|}{n}$$

Coefficient of Variation (COV)

A relative measure of dispersion used to compare the amount of variation in two samples. It is calculated by dividing the standard deviation by the mean. Sometimes it is referred to as COV or CV.

$$COV = \frac{s}{\bar{x}}$$

Coefficient of Dispersion (COD)

A robust, relative measure of dispersion. It is calculated by dividing the robust mean absolute deviation from the median (MADM) by the median. It is frequently used in real estate or tax assessment applications.

$$COD = \frac{MADM}{Median} = \frac{\left(\frac{\sum_{i=1}^{n}|x_i - Median|}{n}\right)}{Median}$$

Skewness

Measures the direction and degree of asymmetry in the data distribution.

$$Skewness = \frac{m_3}{m_2^{3/2}}$$

where

$$m_r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^r}{n}$$

Kurtosis

Measures the heaviness of the tails in the data distribution.

$$Kurtosis = \frac{m_4}{m_2^2}$$

where

$$m_r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^r}{n}$$

Example 1 – Basic Variable Summary Report (No Group Variables)

The data used in this example are in the Resale dataset.

Setup

To run this example, complete the following steps:

1 Open the Resale example dataset

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **Resale** and click **OK**.

2 Specify the Descriptive Statistics – Summary Tables procedure options

- Find and open the **Descriptive Statistics – Summary Tables** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 1a** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab	
Data Variable(s)	**Price, Bedrooms, Bathrooms, Garage, TotalSqft**
Statistics	**Count, Mean, Std Dev, 95% LCL, 95% UCL**
Report Options (*in the Toolbar*)	
Variable Labels	**Column Labels**

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Summary Table

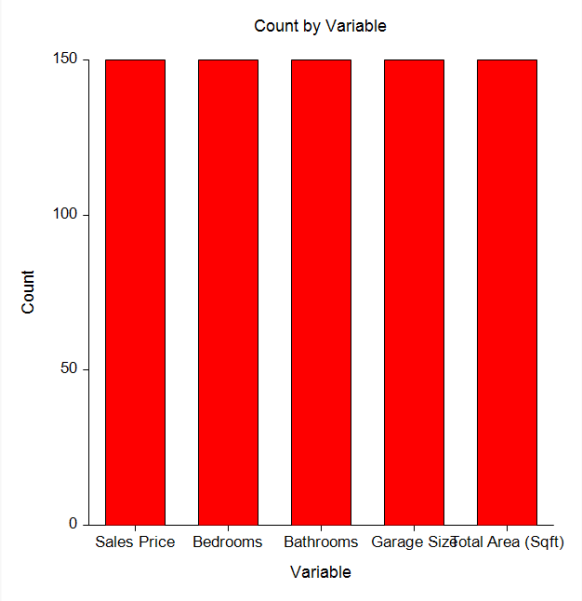
Summary Table

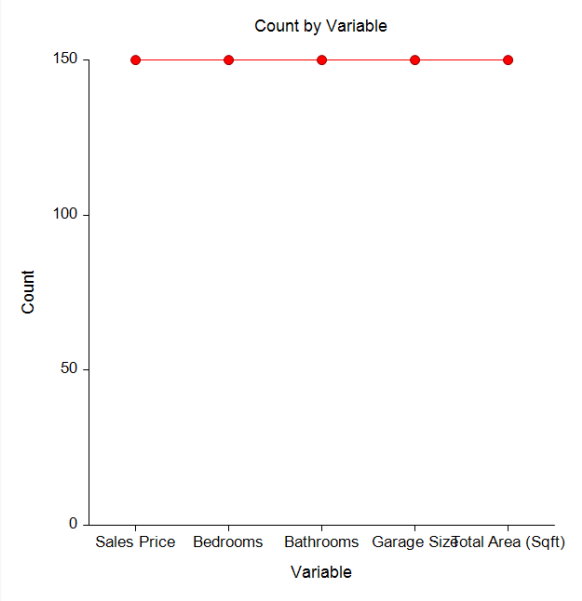
Statistic	Variable				
	Sales Price	Bedrooms	Bathrooms	Garage Size	Total Area (Sqft)
Count	150	150	150	150	150
Mean	174392	2.42	2.4	1.266667	1893.38
Standard Deviation	97656.81	0.8919476	0.8047677	0.5636252	754.2496
Lower 95% CL Mean	158636	2.276093	2.270158	1.175731	1771.689
Upper 95% CL Mean	190148	2.563908	2.529842	1.357602	2015.071

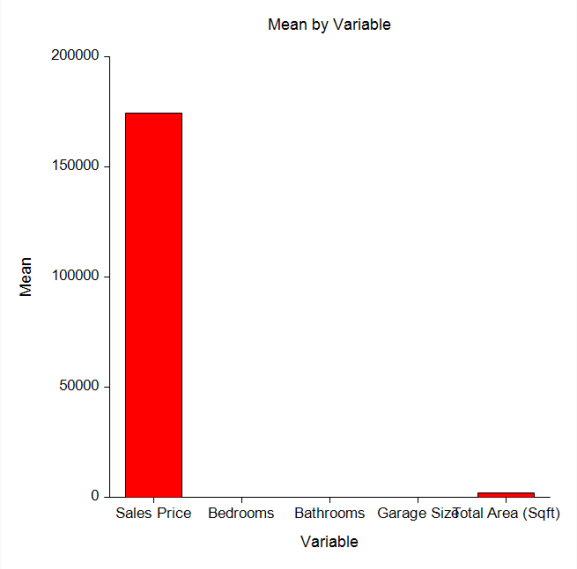
The table is created with the statistics as rows and the data variables as columns when the positions are both set to “Auto”.

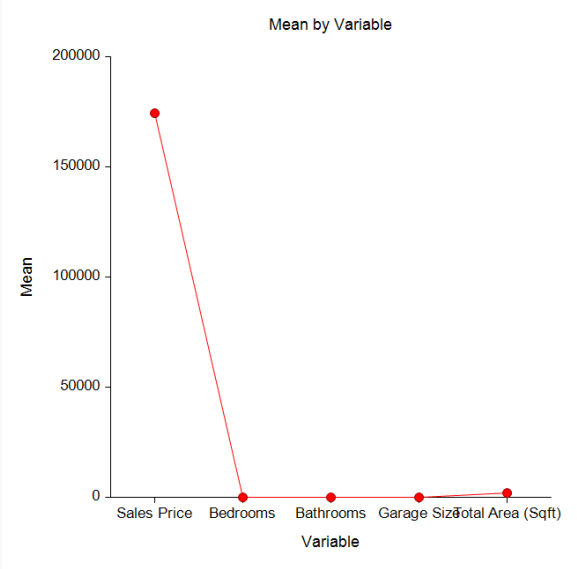
Plots of Each Statistic

Plots of Each Statistic









(More Plots Follow)

The plots are not very informative because the variables have vastly different scales.

Example 1b – Adjust Item Table Positions (Data Variables in Rows and Statistics in Columns)

To rotate the table, all we have to do is change the position of one of the items. To do this, change **Data Variable(s) Position** to **Rows** and run the procedure again to get the results.

4 Modify the Data Variable(s) Position

- The settings for this example are listed below and are stored in the **Example 1b** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab

Data Variable(s) Position ..... **Rows**

5 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Summary Table

	Statistic				
Variable	**Count**	**Mean**	**Standard Deviation**	**Lower 95% CL Mean**	**Upper 95% CL Mean**
Sales Price	150	174392	97656.81	158636	190148
Bedrooms	150	2.42	0.8919476	2.276093	2.563908
Bathrooms	150	2.4	0.8047677	2.270158	2.529842
Garage Size	150	1.266667	0.5636252	1.175731	1.357602
Total Area (Sqft)	150	1893.38	754.2496	1771.689	2015.071

The table is now rotated with the data variables as rows and the statistics as columns. Notice that the actual summary statistic values are exactly the same.

Example 2 – Variable Summary Report (One Group Variable)

The data used in this example are in the Resale dataset.

Setup

To run this example, complete the following steps:

1 Open the Resale example dataset

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **Resale** and click **OK**.

2 Specify the Descriptive Statistics – Summary Tables procedure options

- Find and open the **Descriptive Statistics – Summary Tables** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 2a** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab	
Data Variable(s)	**Price, TotalSqft, LotSize**
Statistics	**Count, Mean, Std Dev**
Include Group Variable 1	**Checked**
Variables	**State**

Report Options (*in the Toolbar*)	
Variable Labels	**Column Labels**
Data Labels	**Value Labels**

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Summary Table

Summary Table

State	Statistic	Variable: Sales Price	Variable: Total Area (Sqft)	Variable: Lot Size (Sqft)
Nevada	Count	88	88	88
	Mean	170762.5	1881.33	8571.454
	Standard Deviation	98665.72	788.569	2419.88
Virginia	Count	62	62	62
	Mean	179543.5	1910.484	8076.597
	Standard Deviation	96771.49	708.6572	2301.226
Total	Count	150	150	150
	Mean	174392	1893.38	8366.913
	Standard Deviation	97656.81	754.2496	2376.334

The table displays the group variable values as the rows, the statistics as the subrows, and the data variables as the columns. The plots are not shown because they are not very informative because the variables have vastly different scales. Totals are given for the group variable.

Example 2b – Adjust Item Table Positions (Data Variables in Rows, Statistics in Sub Rows, and Group Variable in Columns)

To rotate the table, all we have to do is change the position of one of the items. To do this, change **Data Variable(s) Position** to **Rows** and run the procedure again to get the results.

4 Modify the Data Variable(s) Position

- The settings for this example are listed below and are stored in the **Example 2b** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab

Data Variable(s) Position ..... **Rows**

5 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Summary Table

		State		
Variable	**Statistic**	**Nevada**	**Virginia**	**Total**
Sales Price	Count	88	62	150
	Mean	170762.5	179543.5	174392
	Standard Deviation	98665.72	96771.49	97656.81
Total Area (Sqft)	Count	88	62	150
	Mean	1881.33	1910.484	1893.38
	Standard Deviation	788.569	708.6572	754.2496
Lot Size (Sqft)	Count	88	62	150
	Mean	8571.454	8076.597	8366.913
	Standard Deviation	2419.88	2301.226	2376.334

The table is now rotated with the data variables as rows and the group variable values as columns. Notice that the actual summary statistic values are exactly the same.

Example 2c – Adjust Item Table Positions (Data Variables in Rows, Group Variable in Sub Rows, and Statistics in Columns)

To change the table so that statistics are presented as columns with the group variable as subrows and the data variables as rows, change the position of **Statistics** to **Columns** with the position for Data Variable(s) still set to Rows and run the procedure again to get the results.

6 Modify the Statistics Position

- The settings for this example are listed below and are stored in the **Example 2c** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab

Statistics Position.....**Columns**

7 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Summary Table

		Statistic		
Variable	**State**	**Count**	**Mean**	**Standard Deviation**
Sales Price	Nevada	88	170762.5	98665.72
	Virginia	62	179543.5	96771.49
	Total	150	174392	97656.81
Total Area (Sqft)	Nevada	88	1881.33	788.569
	Virginia	62	1910.484	708.6572
	Total	150	1893.38	754.2496
Lot Size (Sqft)	Nevada	88	8571.454	2419.88
	Virginia	62	8076.597	2301.226
	Total	150	8366.913	2376.334

The table now has the data variables as rows and the group variable values as subrows with the statistics as columns.

Example 3 – Variable Summary Report (Two Group Variables)

The data used in this example are in the Pain dataset. In this example we will show you how to make even more customizations to adjust the appearance of the tables and plots and how easy it is to make position adjustments.

Setup

To run this example, complete the following steps:

1 Open the Pain example dataset

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **Pain** and click **OK**.

2 Specify the Descriptive Statistics – Summary Tables procedure options

- Find and open the **Descriptive Statistics – Summary Tables** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 3a** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab	
Data Variable(s)	**Pain**
Statistics	**Mean, Minimum, 25th Pctile, Median, 75th Pctile, Maximum**
Include Group Variable 1	**Checked**
Variables	**Drug**
Include Group Variable 2	**Checked**
Variables	**Time**

Report Options Tab	
Display Group Variable Marginal Totals on the Summary Tables	**Unchecked**
Use Short Statistical Names on Reports and Plots	**Checked**
Sum, Mean, CI Limits Decimal Places	**2**

Plots Tab: Separate Plots	
Show Bar Charts	**Checked**
Show Line Charts	**Unchecked**

Bar Chart Format (*Click the Button*)	
Numeric Axis Tab	
Max (Boundaries)	**100**

Plots Tab: Combined Plots

Show Bar Charts.....**Checked**
Show Line Charts .....**Unchecked**

Bar Chart Format (*Click the Button*)

Group Axis Tab

Lower Axis Tick Label Layout (*Click the Button*)
Alignment .....**Right**
Rotation Angle.....**45**
Margin Above the Text **10**

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

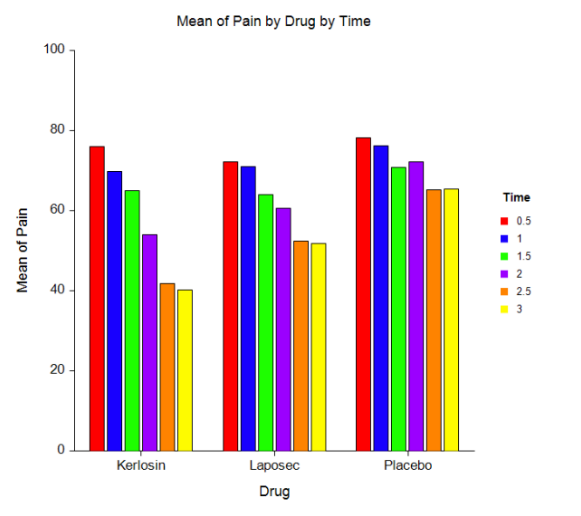
Output

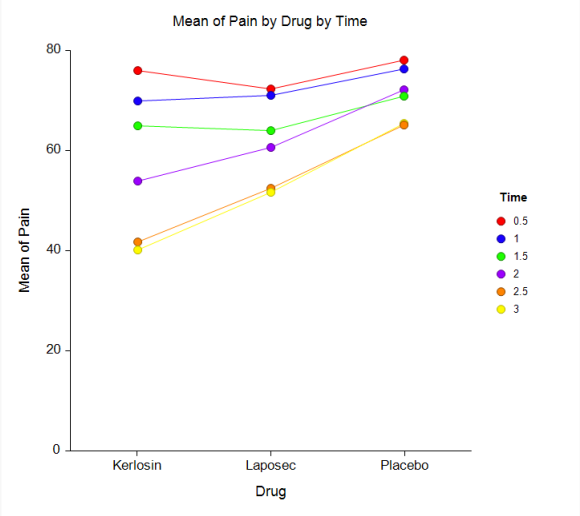
Summary Table of Pain

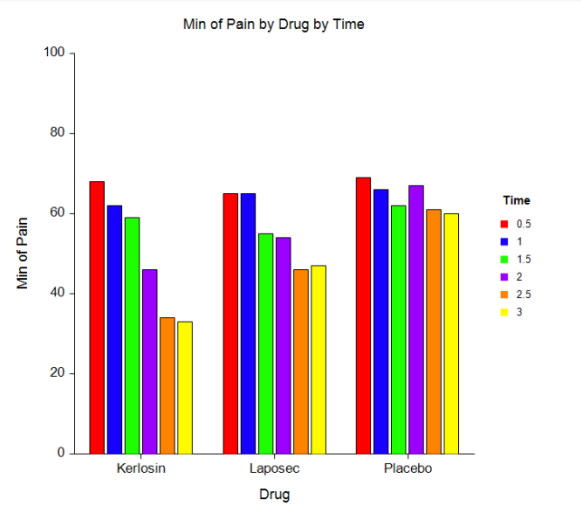
		Time					
Drug	**Statistic**	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**
Kerlosin	Mean	76.00	69.86	65.00	54.00	41.71	40.14
	Min	68	62	59	46	34	33
	25th Pctile	71	64	61	47	36	37
	Median	77	68	65	56	43	41
	75th Pctile	81	77	69	57	46	45
	Max	83	80	72	64	48	46
Laposec	Mean	72.29	71.00	64.00	60.57	52.43	51.71
	Min	65	65	55	54	46	47
	25th Pctile	68	67	60	56	47	49
	Median	71	71	65	61	53	50
	75th Pctile	78	77	68	65	56	56
	Max	79	78	70	66	58	58
Placebo	Mean	78.14	76.29	70.86	72.14	65.14	65.43
	Min	69	66	62	67	61	60
	25th Pctile	71	69	64	70	63	62
	Median	79	78	70	73	65	67
	75th Pctile	87	82	76	73	68	68
	Max	87	84	81	76	69	70

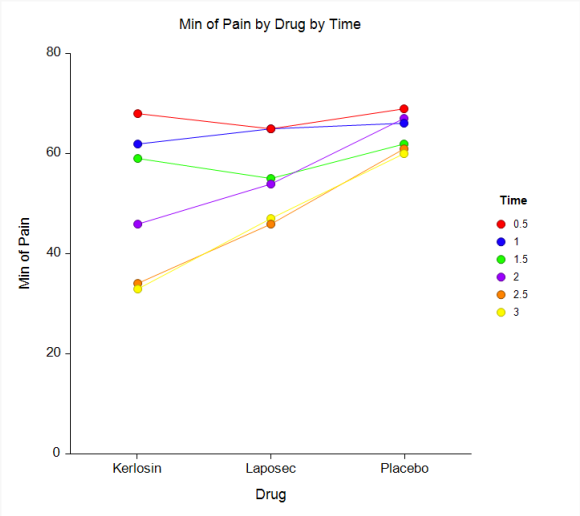
The table is displays Group Variable 1 (Drug) values as the rows, the statistics as the subrows, and Group Variable 2 (Time) values as the columns.

Plots of Each Statistic for Pain





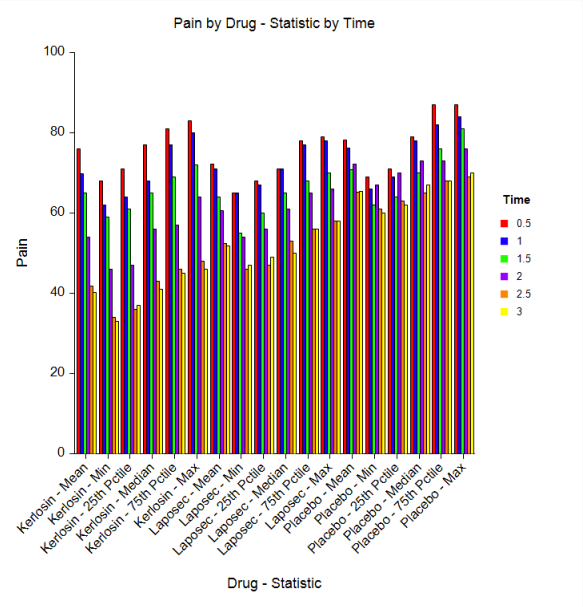


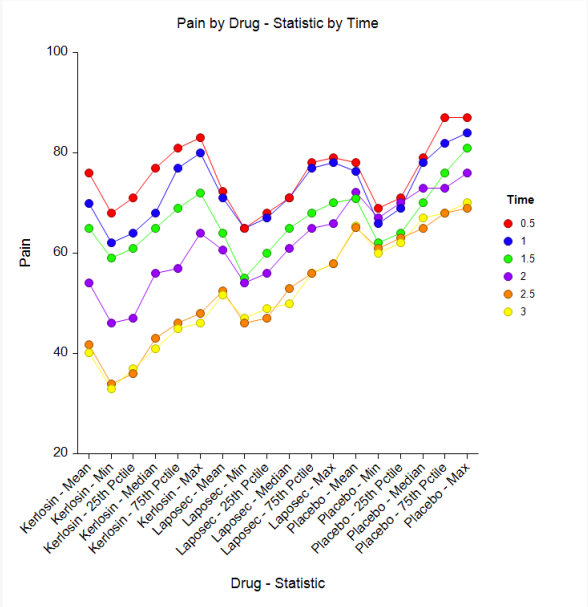


(More Plots Follow)

Individual plots are created with the table row item (Group Variable 1 --- “Drug”) on the group (X) axis and the table column item (Group Variable 2 --- “Time”) as the legend variable. A separate plot is created for each statistic. These plots are very useful for seeing overall trends. From the plots shown here, it is apparent that the average and minimum pain response is lower for both drugs than for placebo and that the pain control is better over time. Kerlosin appears to control pain the best from these results. Statistical tests would need to be performed, however, to assert statistical significance in the differences.

Combined Plot(s) of Pain





The combined plot displays all of the information in the table. We rotated the group axis labels so they would not overlap and be readable. The table row item (Group Variable 1 --- “Drug”) and table sub row item (Statistic) are combined on the group (X) axis. The table column item (Group Variable 2 --- “Time”) is the legend variable.

Example 3b – Adjust Item Table Positions (Group 2 Variable in Rows, Group 1 Variable in Sub Rows, and Statistics in Columns)

To change the orientation on the tables and plots, simply change the position of the items. We will display the **Statistics as the columns** and **Time as the rows**. This will put **Drug as the sub row**.

4 Modify the Statistics and Group Variable 2 Positions

- The settings for this example are listed below and are stored in the **Example 3b** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab

Statistics Position.....**Columns**
Group Variable 2 Position.....**Rows**

5 Run the procedure

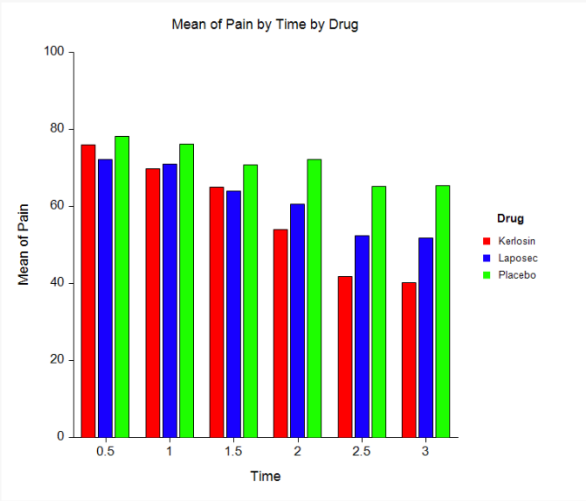
- Click the **Run** button to perform the calculations and generate the output.

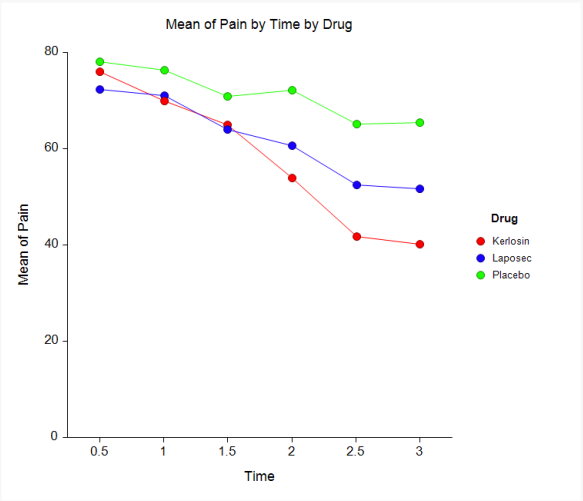
Summary Table of Pain

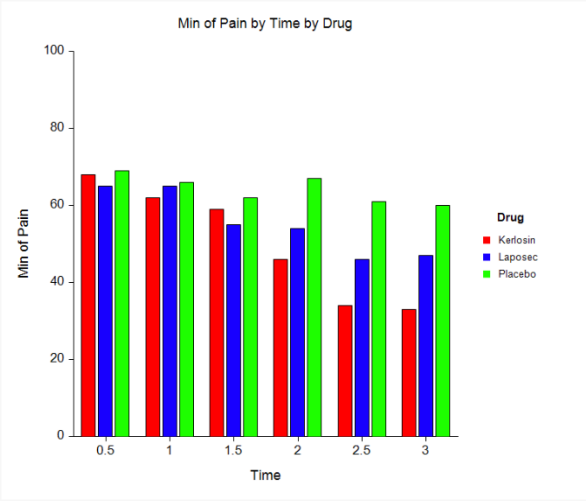
		Statistic					
Time	**Drug**	**Mean**	**Min**	**25th Pctile**	**Median**	**75th Pctile**	**Max**
0.5	Kerlosin	76.00	68	71	77	81	83
	Laposec	72.29	65	68	71	78	79
	Placebo	78.14	69	71	79	87	87
1	Kerlosin	69.86	62	64	68	77	80
	Laposec	71.00	65	67	71	77	78
	Placebo	76.29	66	69	78	82	84
1.5	Kerlosin	65.00	59	61	65	69	72
	Laposec	64.00	55	60	65	68	70
	Placebo	70.86	62	64	70	76	81
2	Kerlosin	54.00	46	47	56	57	64
	Laposec	60.57	54	56	61	65	66
	Placebo	72.14	67	70	73	73	76
2.5	Kerlosin	41.71	34	36	43	46	48
	Laposec	52.43	46	47	53	56	58
	Placebo	65.14	61	63	65	68	69
3	Kerlosin	40.14	33	37	41	45	46
	Laposec	51.71	47	49	50	56	58
	Placebo	65.43	60	62	67	68	70

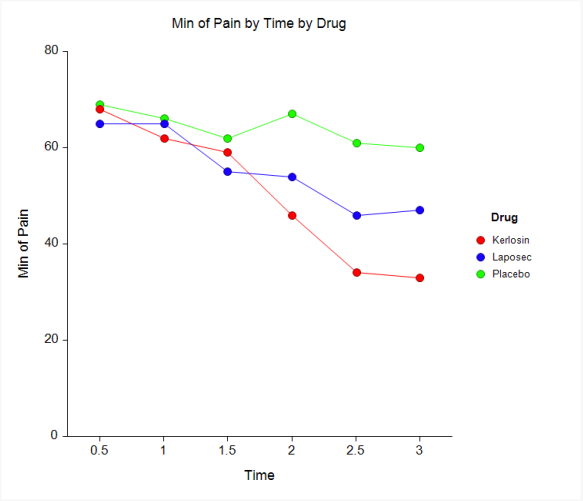
The table displays Group Variable 2 (Time) values as the rows, Group Variable 1 (Drug) values as the subrows, and the statistics as the columns.

Plots of Each Statistic for Pain





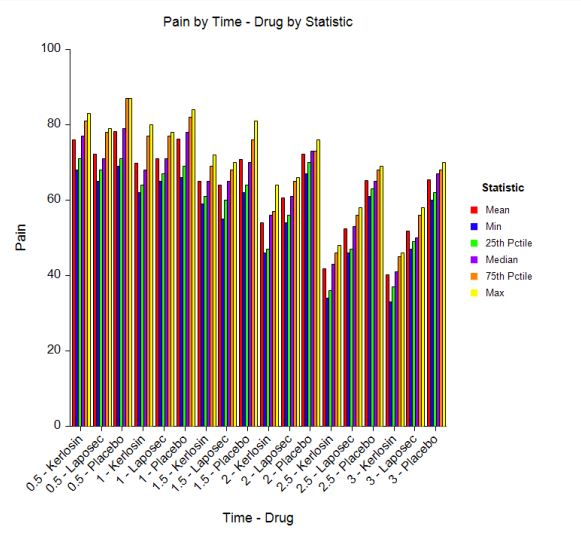


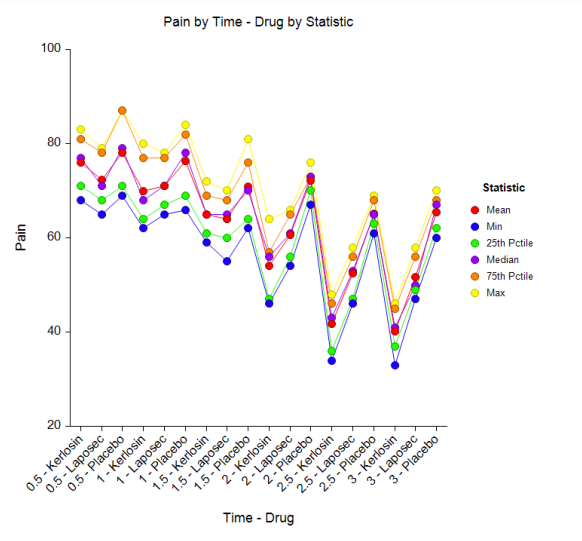


(More Plots Follow)

The individual plots are different now with the table row item (Group Variable 2 --- “Time”) on the group (X) axis and the table column item (Group Variable 1 --- “Drug”) as the legend variable. A separate plot is created for each statistic. These plots are again useful for seeing overall trends. There is a very distinct reduction in pain over time.

Combined Plot(s) of Pain





Again, the combined plot displays all of the information in the table. The table row item (Group Variable 2 --- "Time") and table sub row item (Group Variable 1 --- "Drug") are combined on the group (X) axis. The table column item (Statistic) is the legend variable.

Example 3c – Adjust Item Table Positions (Creating a Separate Table for each Data Variable and Statistic Combination)

It is easy to create a separate table for each data variable and statistic combination (this can only be done when there is at least one group variable). We will display a separate table for each statistic with **Time as the rows** and **Drug as the columns**. There will be no sub row item.

6 Modify the Data Variable(s), Statistics, and Group Variable 2 Positions

- The settings for this example are listed below and are stored in the **Example 3c** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Variables Tab

Data Variable(s) Position ..... **Tables**
Statistics Position..... **Tables**
Group Variable 2 Position..... **Rows**

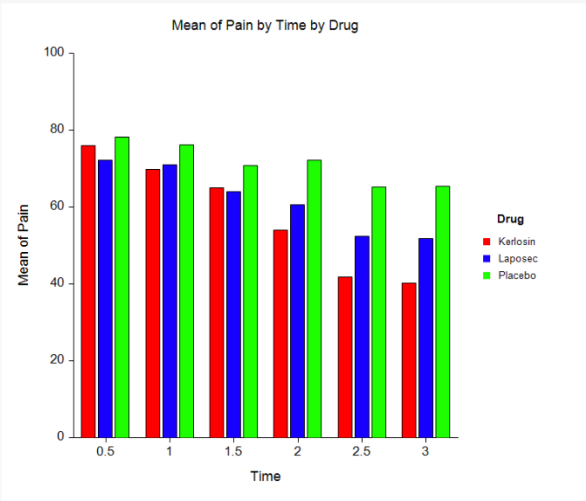
7 Run the procedure

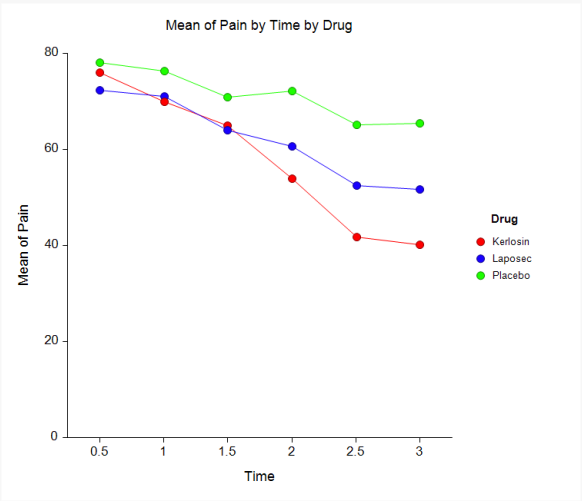
- Click the **Run** button to perform the calculations and generate the output.

Summary Table of Mean of Pain

	Drug		
Time	Kerlosin	Laposec	Placebo
0.5	76.00	72.29	78.14
1	69.86	71.00	76.29
1.5	65.00	64.00	70.86
2	54.00	60.57	72.14
2.5	41.71	52.43	65.14
3	40.14	51.71	65.43

Plot(s) of Mean of Pain

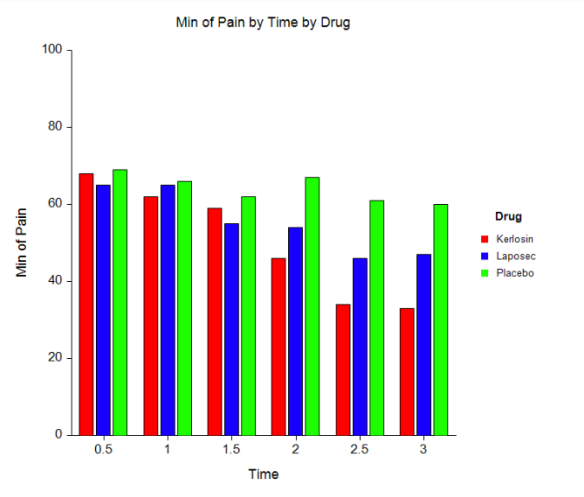


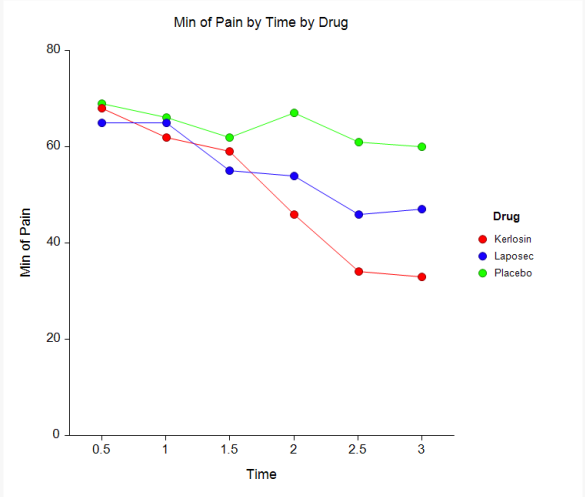


Summary Table of Min of Pain

	Drug		
Time	Kerlosin	Laposec	Placebo
0.5	68	65	69
1	62	65	66
1.5	59	55	62
2	46	54	67
2.5	34	46	61
3	33	47	60

Plot(s) of Min of Pain





(Report continues with table and plot for each Data Variable/Statistic combination)

A separate table is created for each Data Variable/Statistic combination. If more than one data variable were entered, the report would be even longer. There is no combined plot in the output because the combined plot is the same as the individual plot in this case.