Version 8.3.3

User's Guide

Please make sure your copy of the program is up-to-date. The most recent version is 8.3.3 (updated on March 3rd, 2008). Several computation and interface problems have been fixed in this version.

Contents

Introduction and Cautionary Notes

This program was developed to address the need for a reliable method of analyzing short streams (n<30 per phase) of autocorrelated time-series data. While many approaches have been developed over the past several years to address this need, each has significant limitations.

This approach permits the user to answer the following question: "What is the empirical probability of finding a relationship between my dependent variable and my intervention variable as large as I did amongst random data points with the same amount of autocorrelation and phase n-sizes?" This is, in many ways, similar to the traditional null hypothesis testing paradigm which could be expressed as the following conditional probability statement: "If my dependent variable was actually unrelated to my intervention variable, what is the probability that I would find a relationship as large as I did?" We believe that the answers to both of these questions are valuable in making inferences about the significance of observed results. However, we realize that there is room for debate on this issue.

The primary assumption of the Simulation Modeling Analysis (SMA) approach is that the simulation data streams generated by the program are representative of the "population" of data streams from which one's actual data is drawn. As of yet, we cannot offer a means of testing this assumption. Thus, caution should be used when making any inferences using SMA.

While Simulation Modeling Analysis (SMA) is likely not going to prove be the only, or even best way to handle short time-series data streams in the long-run, at the present time it appears to offer the best protection against type-I error while providing adequate power to detect real effects with very short streams of autocorrelated data. The approach is arguably unconventional, but it appears uniquely suited to analyze very short time-series data streams. The type-I error control and power appear to break down as the data streams approach 30 points per phase in length. Fortunately, this is about the point at which more conventional statistical approaches begin to work reliably.

CAUTION: SMA should NOT be used with long streams of time-series data (>29 data points per phase), and it should not be used in the absence of solid logic and reasoning regarding the nature of any observed changes. Further, statistical significance in no way indicates *causality*. Even if a very strong relationship exists between one's dependent variable and intervention variable, it CANNOT be concluded that the intervention *caused* the observed change. The only way to make causal inferences is to exercise careful experimental controls.

Data Handling & The Data Window

Data can be entered manually by typing into the data window. The [TAB] key and the arrow keys can be used to navigate from cell to cell.

For analysis of single variables over time, the dependent measure goes in the first column labeled "Var1(DV)" and the phase information goes in the second column labeled "Var2(PHASE)".

For cross-correlation analyses, each variable of interest gets entered into a separate column.

NOTE: CLICKING ON THE FIGURE IN THE FIGURE WINDOW WILL OVERWRITE THE PHASE VARIABLE WITH ZEROS AND ONES. A vertical line will be drawn on the figure indicating phase demarcation and the "Var2(PHASE)" column will be overwritten with zeros representing the baseline phase and ones representing the treatment phase.

Data can be saved, opened, copied and pasted into and out of the data window. See the Menu's section for details.

There are only 199 available rows in the data window. NOTE THAT THIS PROGRAM SHOULD NOT BE USED WITH MORE THAN 30 DATA POINTS PER PHASE. OTHER, MORE CONVENTIAL TECHNIQUES ARE AVAILABLE FOR LARGER TIME SERIES DATA SETS.

CCAP Data

| Time	Var1(DV)	Var2(PHASE)
1	4	0
2	6	0
3	5	0
4	4	0
5	5	0
6	4	0
7	5	0
8	5	0
9	6	0
10	5	0
11	3	1
12	2	1
13	3	1
14	2	1
15	1	1
16	1	1
17	2	1
18	1	1
19	1	1
20	1	1
21		
22		
23		

Menus
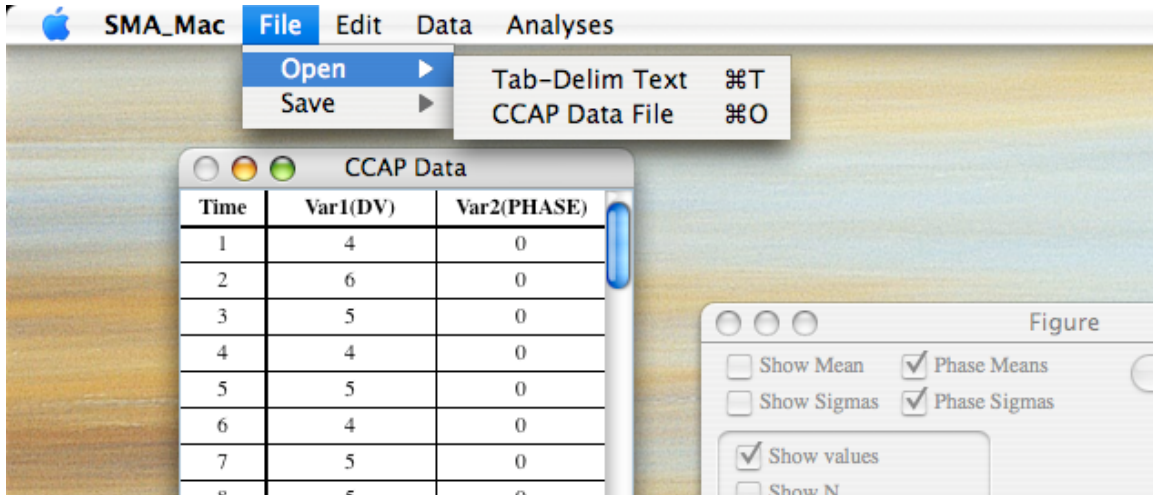
File Menu

The File Menu contains options for opening and saving data sets. You can open and save as tab-delimited text (recommended) which is readable (and writable) by most software packages, or as a SMA Datafile (only readable by the SMA program).

Edit Menu
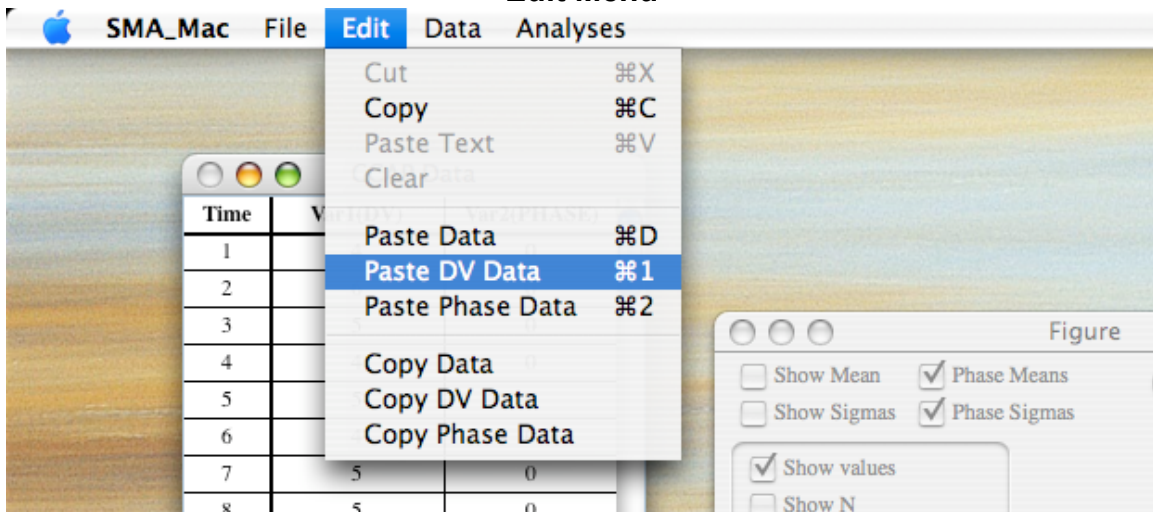
Copy (Command-C) and Paste Test (Command-V) will copy information from the Output Window, NOT the data file.

Paste Data (Command-D) will attempt to paste data into both columns. The data being pasted must be formatted as tab-delimited text in 2 columns (which is the case for Excel or SPSS datafiles). Thus, if you copy two adjacent columns of data from Excel or SPSS, it should paste into the data window properly. If the

data is not formatted correctly, it will not populate the data window properly. Attempts to run stats on improperly formatted data will result in erros and/or crashes of the program.

You can copy and paste data to and from either the Var1 or Var2 columns. Copy and Paste DV Data (Command-1) will copy or paste data from column 1. Copy and Paste Phase Data (Command-2) will copy or paste from column 2.
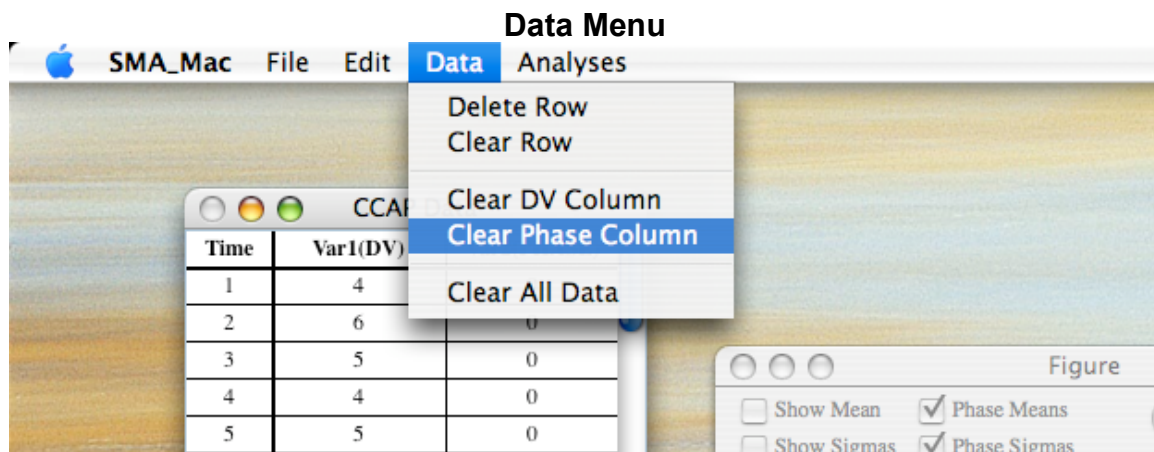
Data Menu

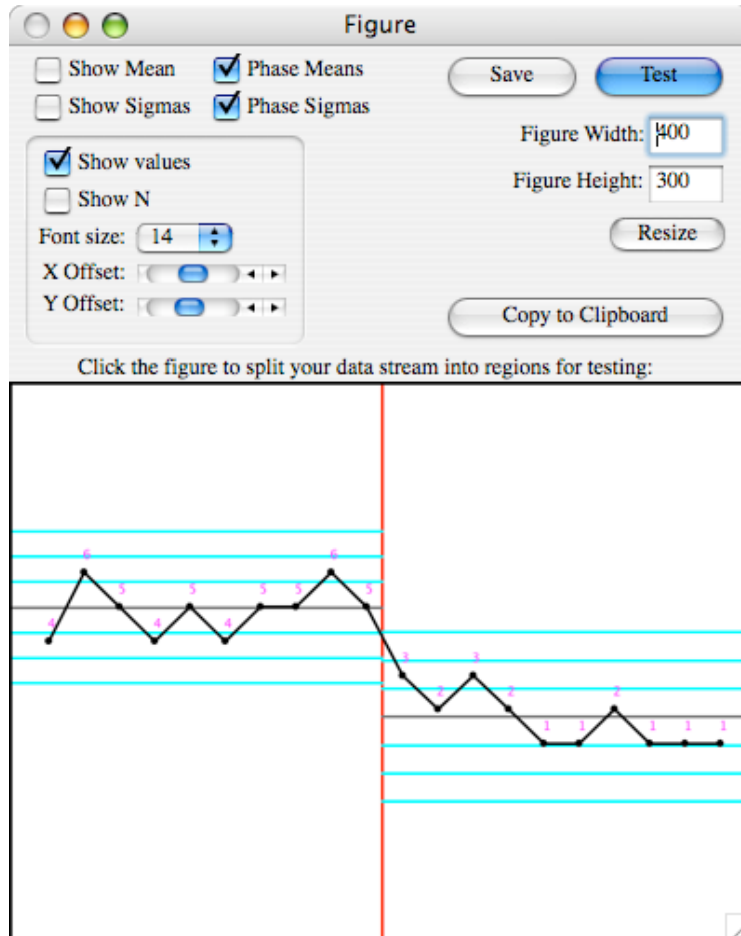You can delete or clear entire rows of data as well as clear entire columns of data from the Data Menu. You can also clear all data.
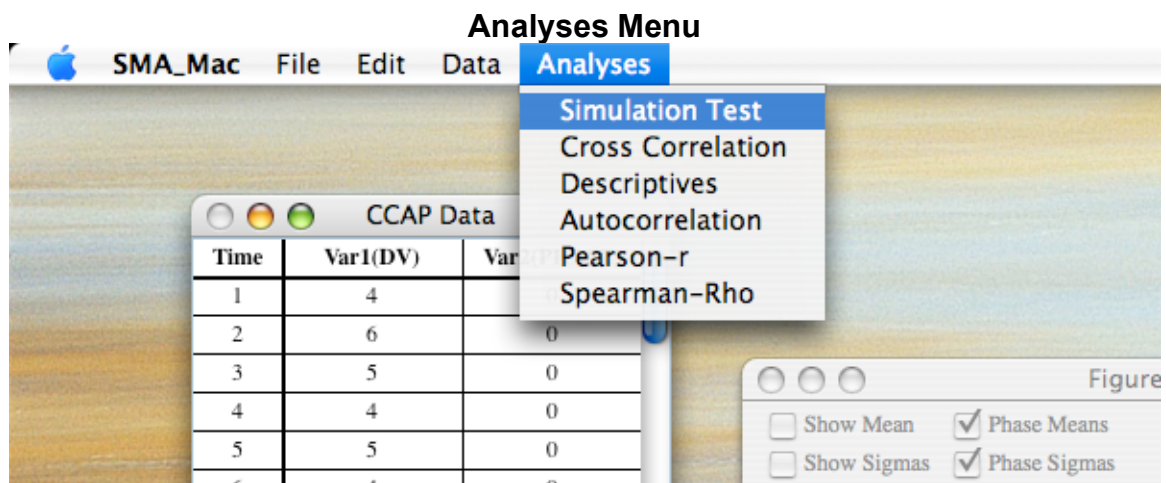
Analyses Menu

By selecting the available analyses from the Analyses Menu, a window will appear unique to the analysis chosen. See the description of each corresponding analysis window for details.

Figure Window

The "Figure Window" or main window will display your data graphically. It updates automatically as you enter or change data in the "Data Window." You can adjust the size of the figure by typing new values into the Figure Width and Figure Height boxes and then clicking 'Resize'.

If you check 'Show Mean' the mean of your entire series will be displayed graphically. If you check 'Show Sigmas' light blue lines appear on either side of the mean showing 1, 2 and 3 standard deviations.

If you click on the figure, the program will insert a phase-demarcation line. NOTE: THIS WILL OVERWRITE YOUR PHASE DATA IN THE DATA WINDOW WITH ZEROS AND ONES (where 0 represents the first phase of your data and 1 represents the subsequent phase). Once your data has been demarcated by clicking on the figure, you can check 'Phase Means' to graphically depict the means for each phase. You can also check 'Phase Sigmas' to represent 1,2 and 3 standard deviations on either side of each phase mean.

If you check 'Show Values' the program will display the numeric value of each data point on the figure. If you check 'Show N' the program will display the data point numbers. You can adjust the font-size for this display as well as the x and y offset distance. The offset distance is the distance of the displayed values from the data points on the figure. Higher X-Offset moves the displayed values to the right. Lower X-Offset moves them to the left. Higher Y-Offset moves the displayed values down while lower Y-Offset moves them up.

If you click the 'Save' button you will be prompted to export your picture in one of a number of available image export formats.

Clicking the 'Test' button takes you directly to the Simulation Model analysis window.

The 'Copy to Clipboard' button attempts to copy the image for later pasting into a separate graphics program.

Simulation Modeling Window

This window allows you to edit parameters of the simulation data streams that will be generated. The program assumes that you have <u>two phases</u> in your dataset and it automatically evaluates your data to derive the default model. The N-Size boxes will be pre-populated with the program's calculation of the length of each of the first two phases of your dataset (determined by parsing the Var2(PHASE) column from the Data Window.

You can set the values of the intercepts and slopes for each phase of the simulations in your null model. With the Intercept and Slope values for each phase set to zero, the program will generate simulation streams that are random-normal (default) with no trends or patterns other than those introduced by autocorrelation.

Autocorrelation Estimates
The program automatically estimates the autocorrelation coefficient from your entire dataset and populates the Autocorr boxes. This value will be the programmed autocorrelation value for the simulation streams. The default model is lag-1 autoregressive. You can change the lag in the Lag box and the autocorrelation estimate will automatically update in the Autocorr box.

By checking 'Use indiv. Phase AR Estimates', the program will estimate the autocorrelation value for each phase individually. NOTE: PRELIMINARY EVALUATION OF SMA INDICATES THAT THE MOST CONSERVATIVE APPROACH IS TO USE THE AUTOCORRELATION ESTIMATE FOR THE ENTIRE DATASET IN THE SIMULATION MODELS. BY USING INDIVIDUAL PHASE AUTOCORRELATION ESTIMATES, YOUR TYPE-ONE ERROR RATE MAY INCREASE WITH SMALL N-SIZES.

The '*Overall AR Estimate*' and associated Lag box toward the right side of the window are for reference only and do not get entered into the model. Changing the Lag value will show you the autocorrelation estimate for the entire dataset at the specified lag.

Error Terms
The properties of the error terms in the simulation models can be specified in the 'Errors' section of the window. The default is that the errors will have a mean of zero and a standard deviation of one.

Available Statistics
The simulation model can be set-up to use one of three different statistics. The default is Pearson's-r (the parametric correlation between your dependent variable and your phase vector). Most of the empirical testing of SMA was done with Pearson's-r and thus, this is the recommended approach. Alternatively, you can use Spearman's Rho (a non-parametric approach). There does not appear to be any appreciable advantage to using Spearman over Pearson in the SMA application, although if you're the phases of your data deviate extensively from a Normal distribution, Spearman may be preferred. The Partial Correlation option runs the simulation test on the correlation between your dependent variable and your phase variable **after partialling-out** the relationship between your dependent variable with a null slope vector. This is the most conservative approach available in the package and it will tell you how well your data is associated with your phase variable after controlling for the possibility that your data actually began increasing or decreasing systematically during the baseline phase and continued doing so into the seconds phase uninterrupted by the intervention. Note, that power may be significantly reduced by using this approach with very short data streams.

Statistical Process Control
If you check 'Test Last Data Point', the program will perform additional analyses on the last data point in your series to determine how "unusual" or unexpected it is. This option can be used for Statistical Process Control (SPC) applications.

Number of Stimulations
You can set the number of simulations to run. 5000 is the suggested minimum, but higher numbers will produce better reliability from test to test.

Testing Level and Slope Change

By leaving the 'Test for level change' box checked, the program will test how well you data fits with a phase vector with Phase-A N-Size and Phase-B N-Size specified above. It assigns zeros to phase-A and ones to phase-B. By leaving 'Test for Slope change' checked, the program will also test your data against a slope vector that increases linearly during phase-A and decreases linearly during phase-B. Checking 'Test all Slope Vectors' will test your data against 5 different slope models (described in the Simulation Model Output Section).

Custom Models

If you wish to test your data's fit with a custom model (e.g., 3 or more phases or a variety of slope patterns), enter the pattern (model) into the Var2(PHASE) column of the Data Window and check the 'Use PHASE Vector' box. Uncheck 'Test for level change' and uncheck 'Test for slope change'. The program will test your dependent variable (and the simulations) against the values in the Var2(PHASE) column.

Significance Tables

If you check 'Show Significance Tables' the program will output p-values for a full range of absolute r-values (0.00 to 1.00). This feature can be used to determine the critical r-value to reach a desired alpha.

See the Simulation Model Output section for more details.

Cross-Correlation Window

Simulation Model Cross Lags

DV1		DV2		
N-Size	20	N-Size	20	**OK**
Intercept:	0	Intercept:	0	**Cancel**
Slope:	0	Slope:	0	

Errors (DV1)
- Autocorr: 0.8260
- Lag: 1
- Mean: 0
- StDev: 1

Errors (DV2)
- Autocorr: 0.8947
- Lag: 1
- Mean: 0
- StDev: 1

☑ Bonferroni Correct Significance
Number of Lags: 5

Number of simulations: 1000
Nominal Alpha: .05

This window displays the basic parameters for the cross-correlation simulation model. The program automatically populates the values for DV1 and DV2 N-sizes with the number of data points in each corresponding column in the Data Window. The null random normal model assumes no intercept or slope values for either value. The program estimates the autocorrelation coefficient for each variable and populates the corresponding Autocorr fields. The default is lag-1 autoregressive, but changing the lag value will result in automatic recalculation of the autocorrelation estimate for the specified lag. The default error mean and standard deviation are o and 1 respectively.

If 'Bonferroni Correct Significance' is checked (default) the program will adjust the Nominal Alpha level by dividing it by the 'Number of Lags' to run *2 +1. This is because if the 'Number of Lags' is set to 5, the program will run 5 correlations with DV1 leading DV2, 5 correlations with DV2 leading DV1, and 1 correlation at lag zero (a total of 11 comparisons). The number of simulations can be specified. More simulations means more reliability of results. Note, that the cross-correlations take a little longer to run than a basic Simulation Model.

See the Cross-Correlation Output section for more details.

Descriptives Window

This window allows you to select a group of descriptive statistics to run. Additionally, you can run bootstrapped (empirical) estimates of confidence intervals around the means.

NOTE: THE DESCRTIPVE FEATURES ARE RUN FOR THE ENTIRE DATA SET FIRST. THEN, THE PROGRAM ATTAMPTS TO DIVIDE YOUR DATASET INTO GROUPS BASED ON THE DIFFERENT LEVELS OF Var2(PHASE). IT WILL AUTOMATICALLY PRESENT DESCRIPTIVES FOR EACH OF THE LEVELS FOUND IN Var2(PHASE).

See the Descriptives Output section for more details.

Autocorrelation Window

Bootstrapped Autocorrelation

Number of Bootstraps: 1000

Number of Lags: 3

OK

Cancel

Data Type

( ) Use raw data

( ) Use residuals of fitted OLS model

( ) Remove phase effect (algebraic)

This window prompts for options in calculating autocorrelation estimates. It will provide autocorrelation estimates for as many lags as you specify in the 'Number of Lags' field. Additionally, the program will bootstrap the significance level of the autocorrelation estimates by running as many bootstraps as you specify in the 'Number of Bootstraps' field.

You can estimate autocorrelation using the raw data from the Var1(DV) column of the Data Window. Additionally, you can first remove linear trends from the data using a simple Ordinary Least Squares (OLS) model, and then estimate autocorrelation of the residuals. You can also estimate autocorrelation after removing a phase level-effect. Here the program subtracts each data point from its phase mean and then calculates autocorrelation on these new values.

NOTE: THE AUTOCORRELATION FEATURES ARE RUN FOR THE ENTIRE DATA SET FIRST. THEN, THE PROGRAM ATTAMPTS TO DIVIDE YOUR DATASET INTO GROUPS BASED ON THE DIFFERENT LEVELS OF Var2(PHASE). IT WILL AUTOMATICALLY PRESENT AUTOCORRELATION ESTIMATES FOR EACH OF THE LEVELS FOUND IN Var2(PHASE).

See the Autocorrelation Output section for more details.

Pearson r Window
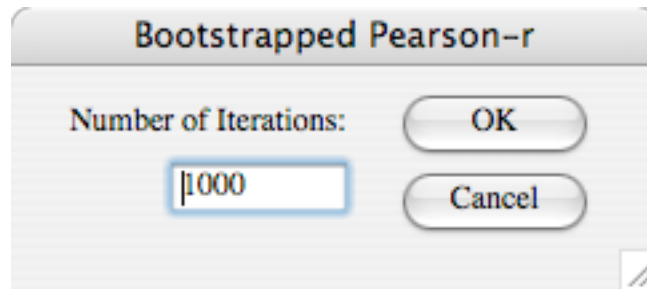
This feature provides the Pearson-r correlation between Var1(DV) and Var2(PHASE) from the Data Window. It will then calculate the empirical p-value using bootstrap methods with the number of iterations specified in the text prompt.

See the Pearson-r Output section for more details.

Spearman Rho Window

Bootstrapped Rho

Number of Iterations:

1000

OK

Cancel
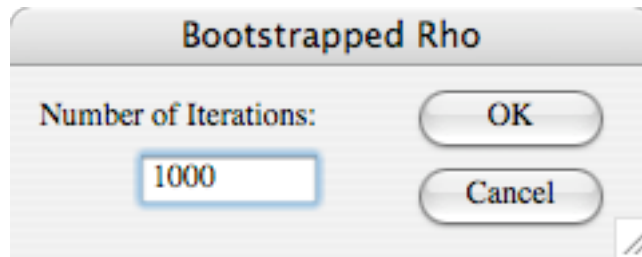
This feature provides the Spearman Rho correlation between Var1(DV) and Var2(PHASE) from the Data Window. It will then calculate the empirical p-value using bootstrap methods with the number of iterations specified in the text prompt.

See the Spearman Rho Output section for more details.

Output Window


```
————————————————————————
Simulation Modeling
Pearson - R
————————————————————————

Valid N-Size of sample = 20
N-size of simulations = 20
Number of simulations = 5000
Error Mean = 0
Error StDev = 1

PHASE-A (Simulation Characteristics)
Phase-A N-size = 10
Programmed Slope = 0
Programmed Intercept = 0
Programmed Autocorr = 0.8260281
Errors follow the lag-1 autoreg. model

PHASE-B (Simulation Characteristics)
Phase-B N-size = 10
Programmed Slope = 0
Programmed Intercept = 0
Programmed Autocorr = 0.8260281
```

Clear   Close   Save   Print

This window will appear after any analysis is run. The output of consecutive analyses is appended to the text in the window. You can clear the text by clicking the 'Clear' button. You can close the window by clicking the 'Close' button. You can save the text in the window as a text file by clicking the 'Save' button. And You can print the text in the window using the 'Print' button.

Simulation Modeling Output

```
_____

Simulation Modeling
Pearson - R
_____

Valid N-Size of sample = 20
N-size of simulations = 20
Number of simulations = 5000
Error Mean = 0
Error StDev = 1
```

This chunk describes the basic characteristics of the simulation model. The program created 5000 data streams each with 20 data points. For each random data point, the error term had a mean of 0 and a standard deviation of 1.

```
PHASE-A (Simulation Characteristics)
Phase-A N-size = 10
Programmed Slope = 0
Programmed Intercept = 0
Programmed Autocorr = 0.8260281
Errors follow the lag-1 autoreg. model
```

This chunk describes the details of phase A of the random data streams. There were 10 data points in phase-A with no programmed slope or intercept (a random null model). The data points were programmed to be autocorrelated .826 at lag-1.

```
PHASE-B (Simulation Characteristics)
Phase-B N-size = 10
Programmed Slope = 0
Programmed Intercept = 0
Programmed Autocorr = 0.8260281
Errors follow the lag-1 autoreg. model
```

This chunk describes the details of phase B of the random data streams. There were 10 data points in phase-B with no programmed slope or intercept (a random null model). The data points were programmed to be autocorrelated .826 at lag-1.

```
PHASE-A Mean = 4.9
PHASE-B Mean = 1.7
Last point Z-Score = 1.27119

SPC: Last data point analysis:
p = 0.4798
p(corrected) = 0.999999
```

This chunk describes the actual data being analyzed. The mean for phase-A is 4.9 and the mean for phase-B is 1.7. If "Test last data point" was checked in the Simulation Test Window, the program will output the z-score of the last data point in the data stream. For Statistical Process Control (SPC) applications, the empirical probability of attaining that z-score by chance alone (accounting for autocorrelation and n-size) is presented. This probability is also presented after being corrected for multiple comparisons.

```
Test for Level Change
Level Vector = |0|0|0|0|0|0|0|0|0|0|1|1|1|1|1|1|1|1|1|1|
R = -0.907, p = 0.0102
```

This chunk shows the results for the simulation test for level change between phases. It first shows the actual values used for the level vector. In this case, there are 10 zeros (baseline) followed by 10 ones (treatment phase). The correlation between the actual dependent variable and the phase vector is presented along with the empirical probability of attaining a correlation of that magnitude by chance alone in a sample of 5000 random data streams with the same n-size and programmed level of autocorrelation.

```
Test for Slope Change
Slope Vector = |1|2|3|4|5|6|7|8|9|10|10|9|8|7|6|5|4|3|2|1|
R = +0.227, p = 0.5672
```

This chunk shows the results for the simulation test for one type of slope change between phases. It first shows the actual values used for the slope vector. In this case, the slope vector increases linearly during the baseline phase and decreases linearly during the treatment phase. The correlation between the actual dependent variable and the slope vector is presented along with the empirical probability of attaining a correlation of that magnitude by chance alone in a sample of 5000 random data streams with the same n-size and programmed level of autocorrelation.

If "Test All Slope Vectors" was checked in the Simulation Test Window, the program will output 5 additional slope models.

```
Slope Vector 1
|1|2|3|4|5|6|7|8|9|10|10|9|8|7|6|5|4|3|2|1|
R = +0.227, p = 0.5672

Slope Vector 2
|0|0|0|0|0|0|0|0|0|0|1|2|3|4|5|6|7|8|9|10|
R = -0.875, p = 0.0228

Slope Vector 3
|1|2|3|4|5|6|7|8|9|10|11|11|11|11|11|11|11|11|11|11|
R = -0.684, p = 0.0968

Slope Vector 4
|1|2|3|4|5|6|7|8|9|10|11|12|13|14|15|16|17|18|19|20|
R = -0.846, p = 0.0218

Slope Vector 5
|1|2|3|4|5|6|7|8|9|10|1|2|3|4|5|6|7|8|9|10|
R = -0.118, p = 0.7600
```

These chunks show the results for the simulation test for five different standard slope models. They each first show the actual values used for slope vector. Slope Vector 1 is the same as the slope vector described above. Slope Vector 2 is flat during the baseline phase and then increases during the treatment phase. So, a significant *negative* correlation would indicate that the actual dependent variable was relatively flat during the baseline phase and then *decreased* during the treatment phase. Slope Vector 3 increases linearly during the baseline phase and then levels-out during the treatment phase. Slope Vector 4 Increases linearly straight through from baseline to treatment. Slope Vector 5 increases during baseline and then immediately drops and increases again during the treatment phase.

If "Show Significance Tables" was checked in the Simulation Test Window, the program outputs the empirical probability of attaining all possible correlations (to 2 decimal places). By scanning the p-values, one can determine the correlation magnitude required to reach a critical value. For example in the table below, a correlation of .85 is required to reach a p of .05 after accounting for autocorrelation and n-size.

```
|R|=0.00   p = 1.000
|R|=0.01   p = 0.990
|R|=0.02   p = 0.979
|R|=0.03   p = 0.970
|R|=0.04   p = 0.960
|R|=0.05   p = 0.951
|R|=0.06   p = 0.942
|R|=0.07   p = 0.933
|R|=0.08   p = 0.924
|R|=0.09   p = 0.912
|R|=0.10   p = 0.905
|R|=0.11   p = 0.895
|R|=0.12   p = 0.883
|R|=0.13   p = 0.872
```

```
|R|=0.14   p =  0.861
|R|=0.15   p =  0.853
|R|=0.16   p =  0.844
|R|=0.17   p =  0.834
|R|=0.18   p =  0.823
|R|=0.19   p =  0.812
|R|=0.20   p =  0.803
|R|=0.21   p =  0.791
|R|=0.22   p =  0.781
|R|=0.23   p =  0.770
|R|=0.24   p =  0.759
|R|=0.25   p =  0.750
|R|=0.26   p =  0.739
|R|=0.27   p =  0.731
|R|=0.28   p =  0.722
|R|=0.29   p =  0.712
|R|=0.30   p =  0.702
|R|=0.31   p =  0.690
|R|=0.32   p =  0.679
|R|=0.33   p =  0.666
|R|=0.34   p =  0.654
|R|=0.35   p =  0.643
|R|=0.36   p =  0.632
|R|=0.37   p =  0.621
|R|=0.38   p =  0.611
|R|=0.39   p =  0.601
|R|=0.40   p =  0.588
|R|=0.41   p =  0.576
|R|=0.42   p =  0.563
|R|=0.43   p =  0.553
|R|=0.44   p =  0.541
|R|=0.45   p =  0.529
|R|=0.46   p =  0.515
|R|=0.47   p =  0.504
|R|=0.48   p =  0.492
|R|=0.49   p =  0.480
|R|=0.50   p =  0.469
|R|=0.51   p =  0.454
|R|=0.52   p =  0.441
|R|=0.53   p =  0.430
|R|=0.54   p =  0.418
|R|=0.55   p =  0.407
|R|=0.56   p =  0.396
|R|=0.57   p =  0.383
|R|=0.58   p =  0.374
|R|=0.59   p =  0.362
|R|=0.60   p =  0.350
|R|=0.61   p =  0.335
|R|=0.62   p =  0.325
|R|=0.63   p =  0.313
|R|=0.64   p =  0.303
|R|=0.65   p =  0.291
|R|=0.66   p =  0.276
|R|=0.67   p =  0.261
|R|=0.68   p =  0.250
|R|=0.69   p =  0.239
|R|=0.70   p =  0.224
|R|=0.71   p =  0.212
|R|=0.72   p =  0.199
|R|=0.73   p =  0.186
|R|=0.74   p =  0.173
|R|=0.75   p =  0.163
|R|=0.76   p =  0.151
|R|=0.77   p =  0.139
|R|=0.78   p =  0.125
```

```
|R|=0.79   p = 0.113
|R|=0.80   p = 0.102
|R|=0.81   p = 0.089
|R|=0.82   p = 0.077
|R|=0.83   p = 0.066
|R|=0.84   p = 0.055
|R|=0.85   p = 0.044
|R|=0.86   p = 0.034
|R|=0.87   p = 0.029
|R|=0.88   p = 0.024
|R|=0.89   p = 0.018
|R|=0.90   p = 0.013
|R|=0.91   p = 0.009
|R|=0.92   p = 0.006
|R|=0.93   p = 0.002
|R|=0.94   p = 0.001
|R|=0.95   p = 0.001
|R|=0.96   p = 0.000
|R|=0.97   p = 0.000
|R|=0.98   p = 0.000
|R|=0.99   p = 0.000
|R|=1.00   p = 0.000
```

Cross-Lag Correlation Output

```
_____

Cross Correlations
Simulation Modeling for Significance Testing
Bonferroni Corrected for Multiple Comparisons
_____

Number of simulation models = 1000
Number of lags to display = 5
Valid pairwise N = 20
Alpha = 0.0045455
Var1 leading Var2
```

This block describes the basic cross correlation model parameters. If "Bonferroni Correct Significance" was checked on the cross-correlation window, the alpha value will be equal to the preset alpha (default=.05) divided by the number of lags investigated plus one (for lag-0).

The program will always display results assuming Var1 (from the Data window) will lead Var 2. Thus, if the significant lags are greater than zero (like Lag+1 and Lag+2 in the example below), it indicates that changes in Var1 precede changes in Var2. If the significant lags were negative (e.g., Lag-01 through Lag-5), this would indicate that changes in Var2 precede changes in Var1. Significant lags are shown in the figure with O's instead of dots.

```
LAG:-05 r=+0.06  p= 0.407          |.
LAG:-04 r=+0.20  p= 0.239          |....
LAG:-03 r=+0.40  p= 0.090          |..........
LAG:-02 r=+0.46  p= 0.061          |...........
LAG:-01 r=+0.56  p= 0.049          |..............
LAG:0   r=+0.79  p= 0.001          |OOOOOOOOOOOOOOOOOOOO
LAG:+01 r=+0.94  p= 0.000          |OOOOOOOOOOOOOOOOOOOOOOOOO
LAG:+02 r=+0.72  p= 0.002          |OOOOOOOOOOOOOOOOOO
LAG:+03 r=+0.52  p= 0.048          |.............
LAG:+04 r=+0.44  p= 0.067          |..........
LAG:+05 r=+0.32  p= 0.143          |.......
```

If the correlation at any lag was negative (<0), the O's or dots in the figure would appear on the left side of the vertical line. Note that positive correlations suggest the following possibilities:
1) As Var1 increases, Var2 increases at some lag
2) As Var1 decreases, Var2 decreases at some lag
or 3) Both 1 and 2 are true

Negative correlations suggest the following possibilities:
1) As Var1 increases, Var2 decreases at some lag
2) As Var1 decreases, Var2 increases at some lag
or 3) Both 1 and 2 are true

Descriptives Output

First, the program outputs the selected descriptives for the entire data set along with the bootstrapped confidence interval around the mean.

```
——————————————————————

Descriptives

——————————————————————

ALL DATA
N = 20
Number of iterations = 5000
Median = 3.5

Mean = 3.3
95% C.I. = 2.55 TO 4.05

StdDev = 1.763519
OLS Slope = -0.2586466
Intercept = 6.015789
```

Next, the program attempts to organize the variable in the Var1(DV) column of the Data Window based on the values in the Var2(PHASE) column. It will output descriptives along with the boostrapped confidence interval for each level of Var2(PHASE)

```
——————————————————————

Descriptives

——————————————————————

PHASE: 0
N = 10
Number of iterations = 5000
Median = 5

Mean = 4.9
95% C.I. = 4.5 TO 5.3

StdDev = 0.7
OLS Slope = 0.0666667
Intercept = 4.533333

——————————————————————

Descriptives

——————————————————————

PHASE: 1
N = 10
Number of iterations = 5000
Median = 1.5

Mean = 1.7
95% C.I. = 1.3 TO 2.2

StdDev = 0.781025
OLS Slope = -0.2121212
Intercept = 2.866667

—————————————————————————————————
```

Autocorrelation Output

First, the program outputs the autocorrelation estimates for the entire data set along with the bootstrapped p-value.

```
_____

Autocorrelations
_____

ALL DATA
N-Size = 20


Lag-1 = +0.826, p = .0001

Lag-2 = +0.661, p = .0001

Lag-3 = +0.566, p = .0001
```

Next, the program attempts to organize the variable in the Var1(DV) column of the Data Window based on the values in the Var2(PHASE) column. It will output autocorrelation estimates along with the boostrapped p-value for each level of Var2(PHASE)

```
_____

Autocorrelations
_____

PHASE: 0
N-Size = 10


Lag-1 = -0.229, p = .365

Lag-2 = -0.056, p = .493

Lag-3 = -0.067, p = .482
_____

Autocorrelations
_____

PHASE: 1
N-Size = 10


Lag-1 = +0.366, p = .052

Lag-2 = +0.250, p = .087

Lag-3 = +0.030, p = .31
_____
```

Pearson-r Output

The program outputs the Pearson-r correlation between both columns from the Data Window along the bootstrapped significance level.

```
_____

Bootstrapped Pearson r

_____

Valid N-Size = 20
Missing Pairwise = 0
Number of iterations = 1000

Pearson r = -0.9072768, p = .0001


_____
```

Spearman Rho Output

The program outputs the Spearman Rho correlation between both columns from the Data Window along the bootstrapped significance level.

_____

```
Bootstrapped Spearman Rho
```

_____

```
Valid N-Size = 20
Missing Pairwise = 0
Number of iterations = 1000

Rho = -0.8838835, p = .0001
```

_____