# Manual for using SPSS with
# *Principles and Methods of Statistical Analysis*

Having students conduct the data analyses in SPSS software program is an excellent way for them to understand how the computational techniques we frequently use work. We have created a number of step-by-step instructional guides to help you in this regard. Each instructional section is set up to guide your students – step-by-step – through these data analytic techniques with the data sets discussed in the textbook. By recreating the results presented in the textbook through the use of SPSS, students will broaden their understanding of the underlying techniques we use to within our field.

## Contents


| Chapter | Procedures | |
|---|---|---|
| Chapter 2. | Histograms | 3 |
| | Quantile Plots | 5 |
| | Stem-and-Leaf Displays | 7 |
| | Box Plots | 8 |
| | Normal Quantile Plots | 10 |
| | Kolmogorov-Smirnov-Lilliefors Goodness of Fit Test | 11 |
| | Shapiro-Wilk W Test | 11 |
| Chapter 3. | Generating Populations | 12 |
| | Adding, Subtracting, Multiplying, Dividing by Constants, z-scores | 12 |
| | Adding, Subtracting Scores from Two Distributions | 13 |
| Chapter 4. | Demonstrating confidence Intervals for the Mean of a Normal Distribution | 17 |
| Chapter 5. | Trimmed means, M-estimators | 18 |
| | MAD (Median of Absolute Deviations from the Median) | 19 |
| | Winsorized Means, Winsorized Variances | 21 |
| | Bootstrap Estimators | 25 |
| Chapter 7. | Student's t, -Satterthwaite t | 27 |
| | Empirical quantitle-quantile plots | 28 |
| | Standardized Effect sizes | 30 |
| Chapter 8. | Binomial test | 32 |
| | Chi Square Goodness of Fit Test | 33 |
| Chapter 10. | Bivariate Normal Distribution Hypothesis Tests | 34 |
| | Bivariate Normal Distribution Confidence Intervals | 34 |
| | Bootstrap Confidence Intervals for Population Correlations | 35 |
| | Spearman r, Kendall's Tau | 37 |
| | Chi-square Test for Association | 38 |
| Chapter 11. | Linear Regression F and t tests | 40 |
| Chapter 12. | Checking Assumptions in Regression | 41 |
| | Non-linear Regression, lack of fit tests | 42 |

| | | |
|---|---|---|
| Chapter 13. | Point biserial r | 46 |
| Chapter 14. | One-way ANOVA | 47 |
| | Relational Effect Size Measures | 48 |
| | Two-way ANOVA | 49 |
| Chapter 15. | Simple Slopes of Continuous x Continuous | 51 |
| | Simple Slopes of Categorical x Continuous | 56 |

*The dataset titled **"SPSS Data File Barlett 2015"** is used for the following examples **UNLESS** otherwise noted*

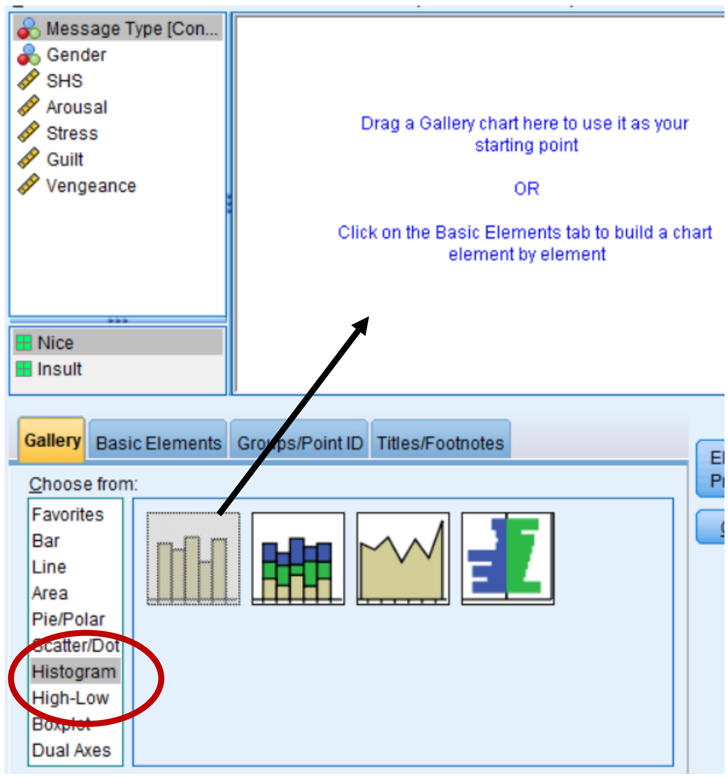
## *Chapter 2 – Examining Our Data*

### I. Histograms

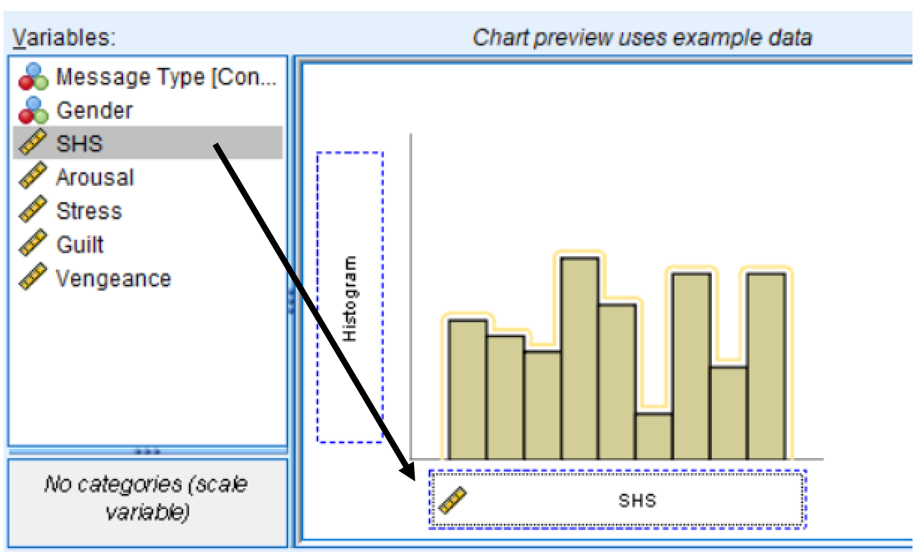
***Objective***: Create a histogram of the variable State Hostility Scale Score (*SHS*)

1. Click on **Graphs**, then select **Chart Builder**.

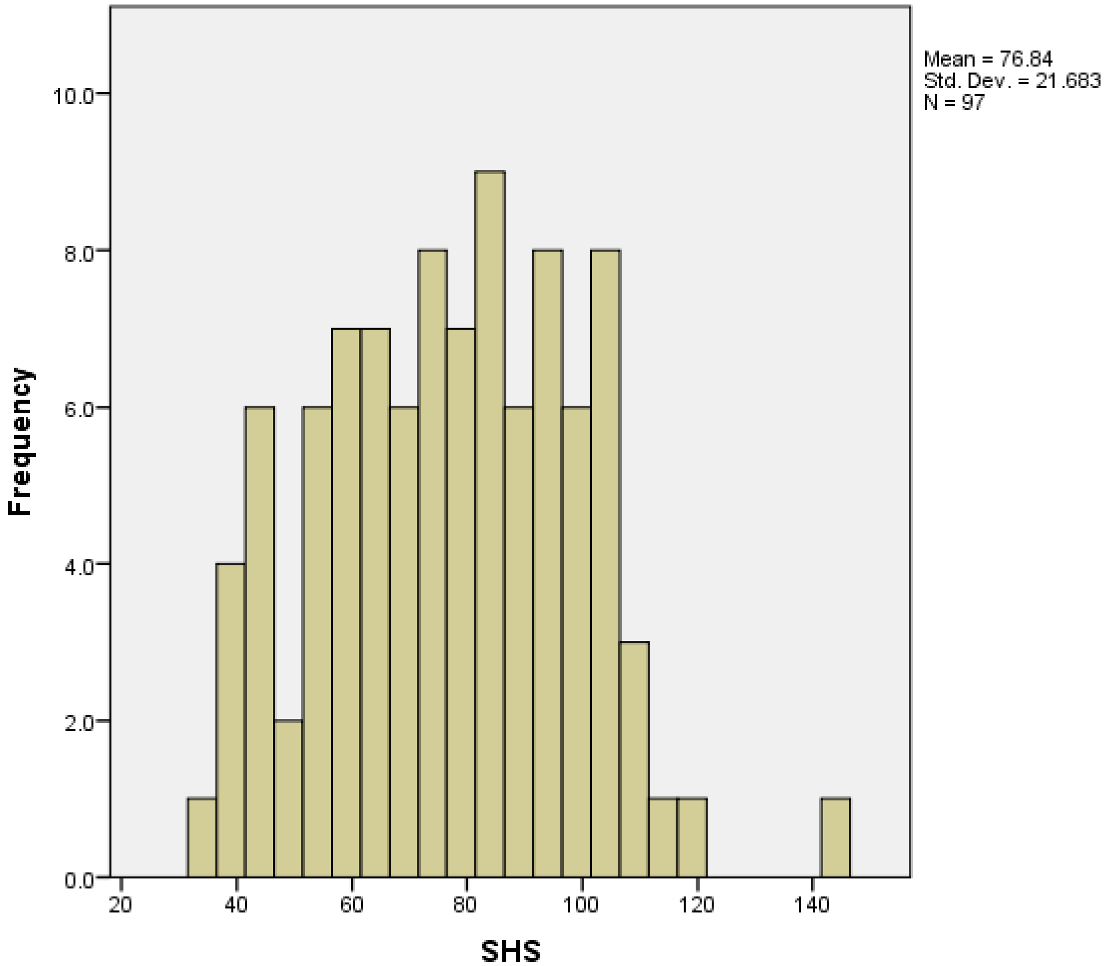
2. In the **Choose From** box, select **Histogram**.
Click/drag the **Simple Histogram** to the Chart Preview box




3. Click/drag the variable (i.e., *SHS*) to the x-axis



4. Click **OK**. The following histogram will be generated in the output screen.

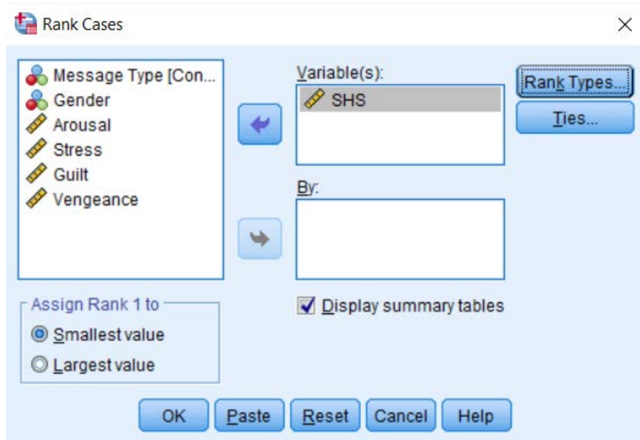


## II. Quantile plots

***Objective***: Create a quantile plot of the variable State Hostility Scale Score (*SHS*)

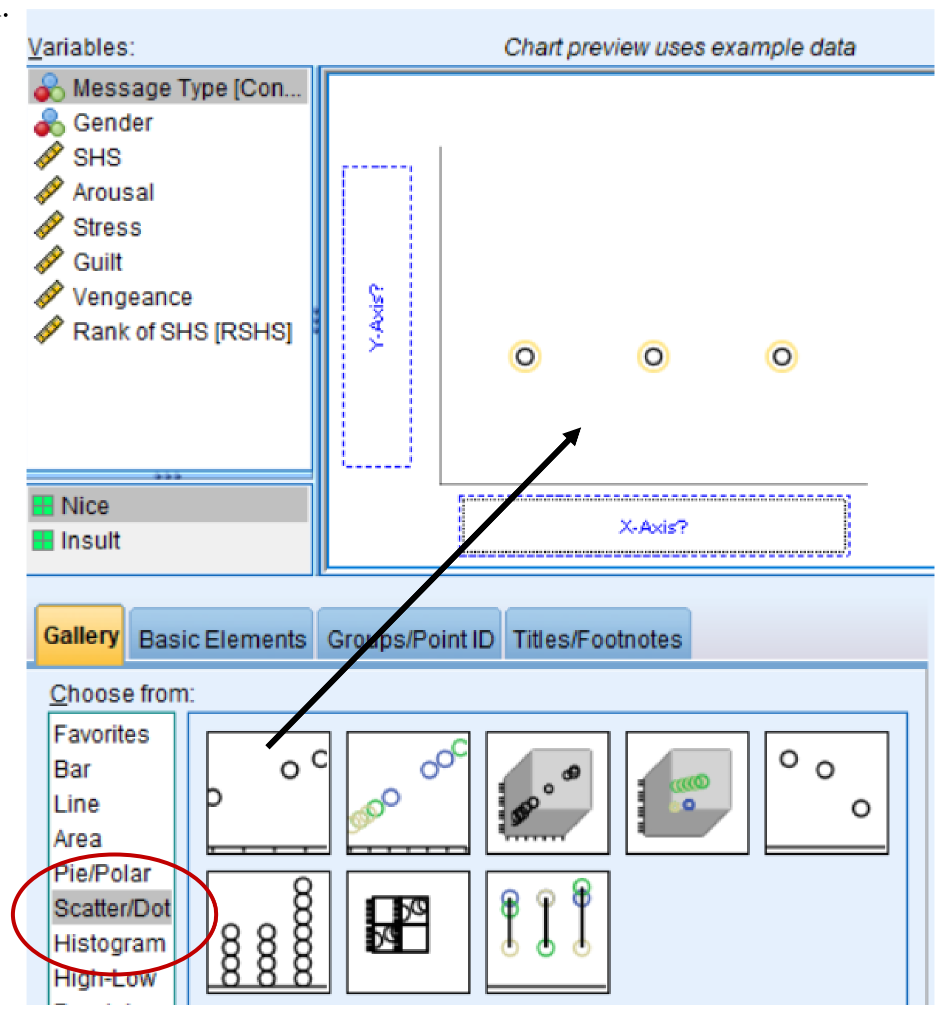
1. Click **Transform**, then select **Rank Cases**.

2. Highlight *SHS* and click/drag to **Variable(s)** box.

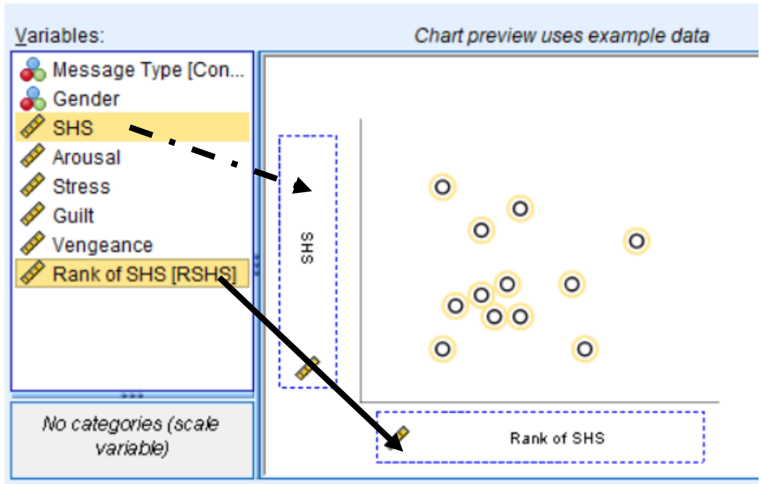



3. Click **OK**. This creates a new variable with the ranked *SHS* scores (labeled *RSHS*)

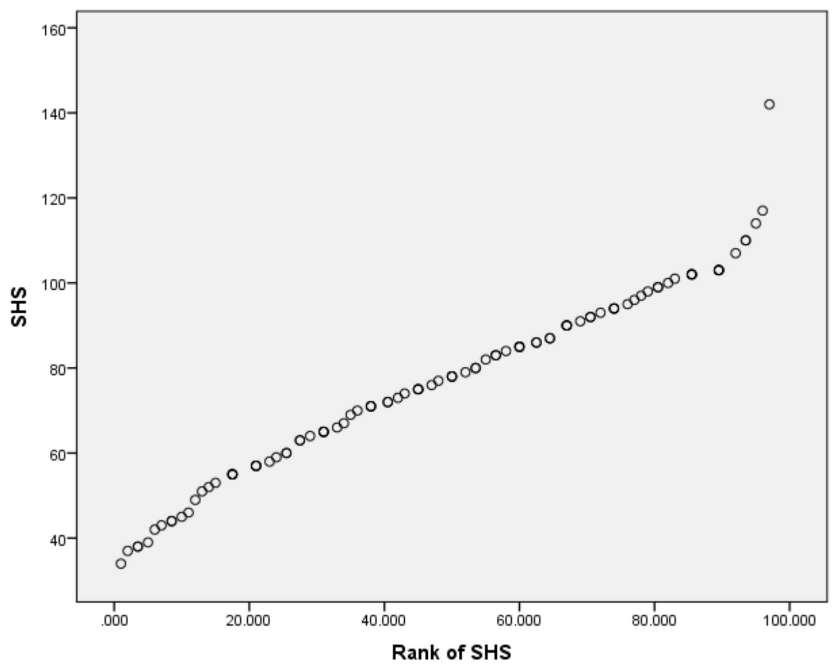
4. Click **Graphs**, then select **Chart Builder**. Select **Scatter/Dot**, and click/drag **Simple Scatter** to Chart Preview section.



5. Click/drag *Rank* (*RSHS*) to x-axis, *SHS* to y-axis. Click **OK**




6. The graph will generate in the Output screen:

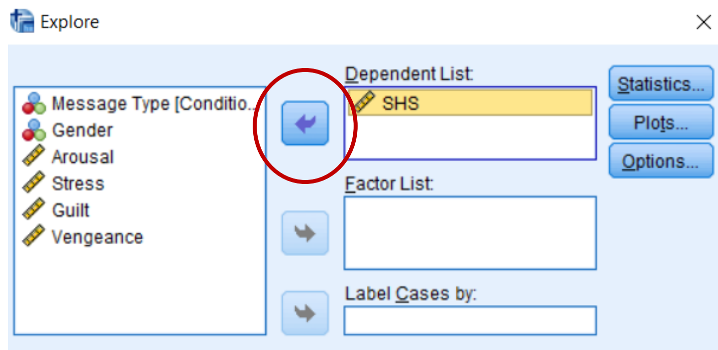


## III. Stem-and-leaf displays

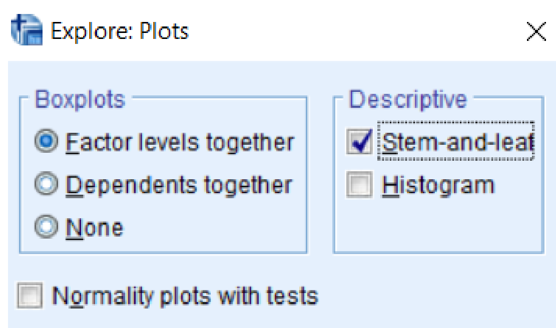
***Objective***: Create a stem-and-leaf display of the variable State Hostility Scale Score (*SHS*)

1. Click **Analyze**, then select **Descriptive Statistics**, then select **Explore**

2. Highlight the variable (i.e., *SHS*) then click the arrow to put it in the **Dependent List**




3. Click **Plots**, and select **Stem-and-leaf**. Click **Continue**, then click **OK**.




4. The following result will appear in the Output screen.

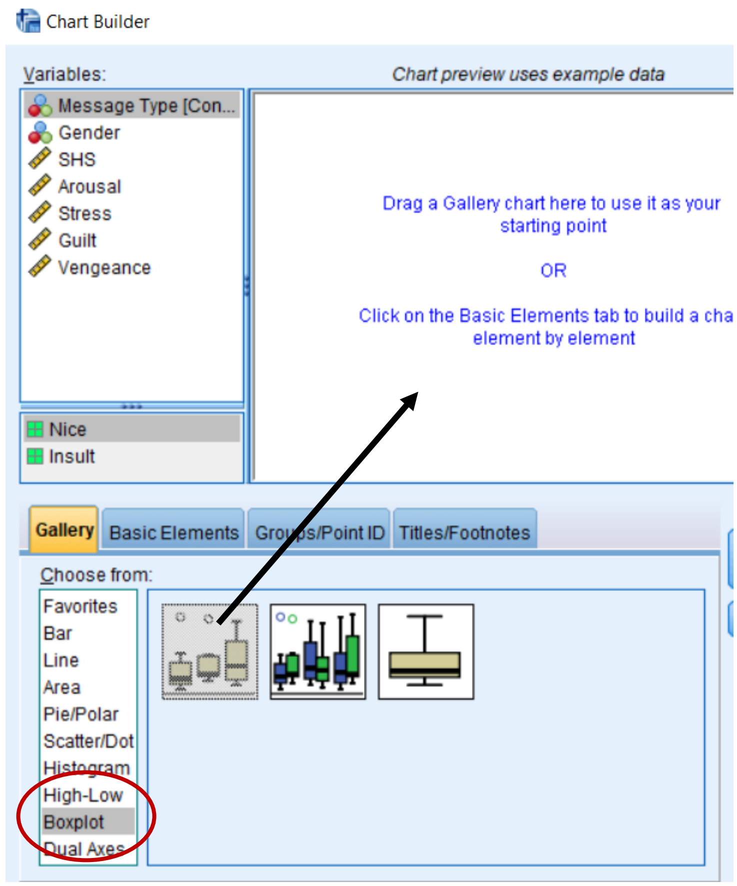
```
SHS Stem-and-Leaf Plot

 Frequency    Stem &  Leaf

     5.00        3 .  47889
     7.00        4 .  2344569
    12.00        5 .  123555577789
    11.00        6 .  00334555679
    17.00        7 .  01112234555678889
    13.00        8 .  0023345556677
    16.00        9 .  0001223444567899
    11.00       10 .  01222233337
     4.00       11 .  0047
      .00       12 .
      .00       13 .
     1.00       14 .  2

 Stem width:    10
 Each leaf:        1 case(s)
```

## IV. Box Plots

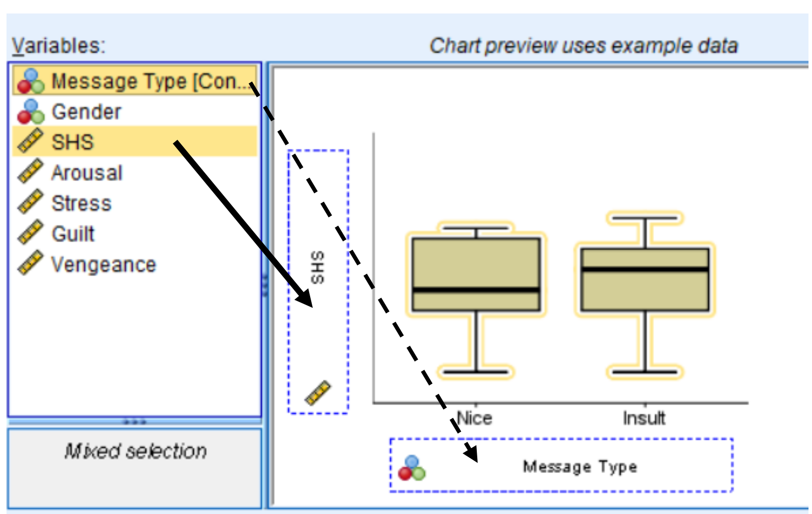
***Objective***: Create a box-plot of the variable State Hostility Scale Score (*SHS*) by two levels of the condition of Message (*Nice, Insult*)

1. Click on **Graphs**, then select **Chart Builder**.

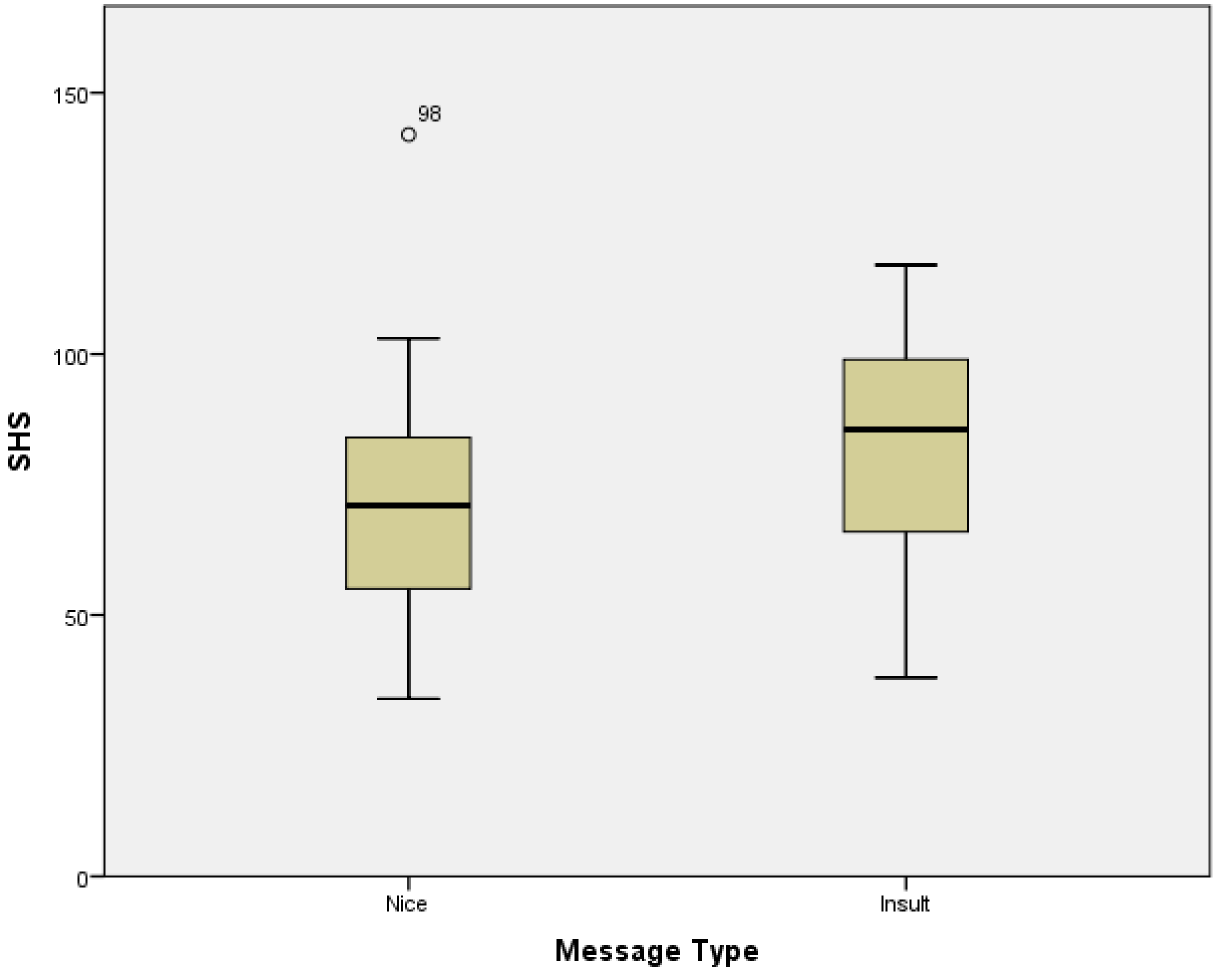
2. In the **Choose From** box, select **Boxplot**.
Click/drag the **Simple Boxplot** to the Chart Preview box




3. Click/drag the variable (i.e., *SHS*) to the y-axis and the categorical variable (i.e., *Message Type*) to the x-axis. Click **OK**.



4. The following result will appear in the Output screen.

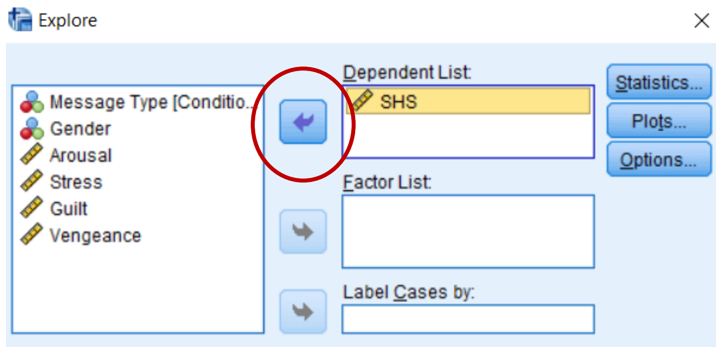


## V. Normal Quantile Plots (Q-Q)

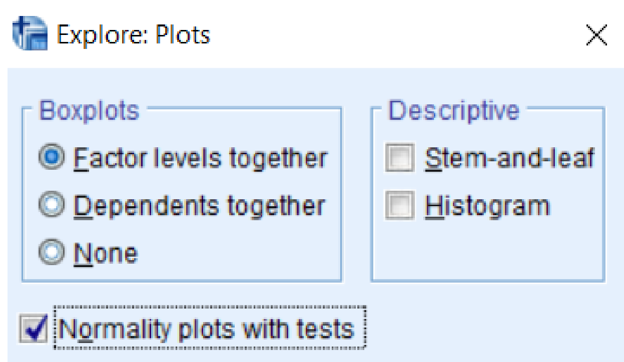
***Objective***: Create a normal quantile plot of the variable State Hostility Scale Score (*SHS*)

1. Click **Analyze**, then select **Descriptive Statistics**, then select **Explore**

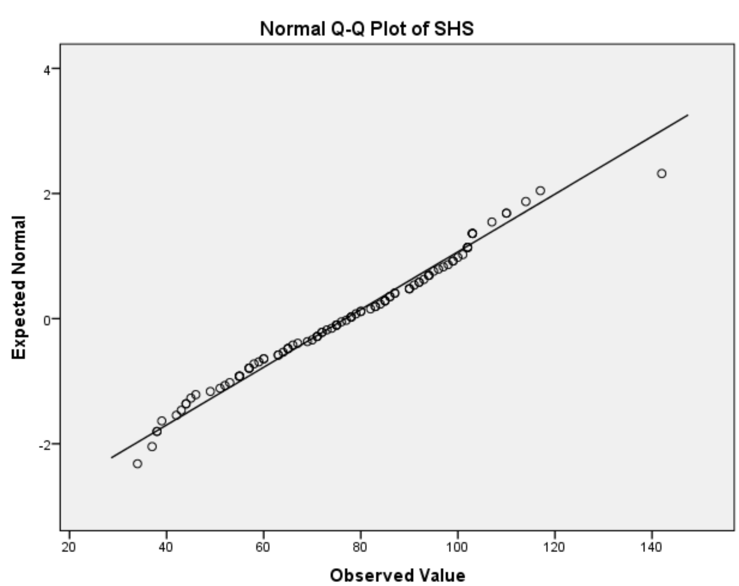
2. Highlight the variable (i.e., *SHS*) then click the arrow to put it in the **Dependent List**




3. Click **Plots**, and select **Normality Plots with tests**. Click **Continue**, then click **OK**.




4. The following result will appear in the Output screen.



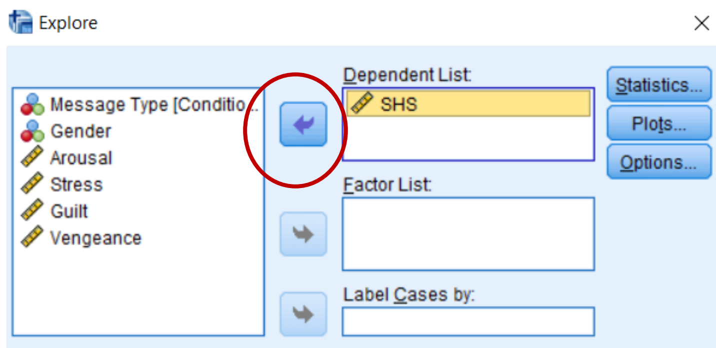
## VI. Goodness of Fit Test to a Normal Distribution

***Objective***: Conduct a goodness-of-fit test on the variable State Hostility Scale Score (*SHS*)

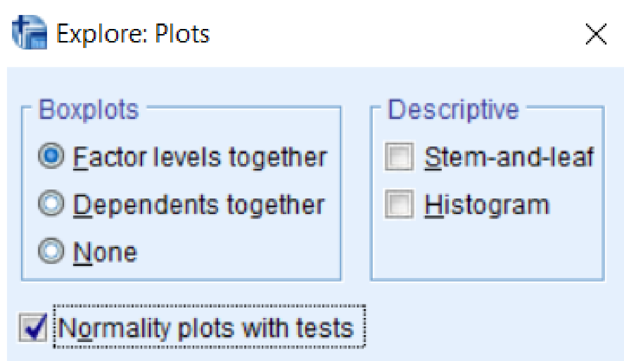
****Note:** When n < 2000, the result is the *Shapiro-Wilk Test*. When n > 2000, the result is the *Kolmogorov-Smirnov Test*. In SPSS, both tests are shown.

1. Click **Analyze**, then select **Descriptive Statistics**, then select **Explore**

2. Highlight the variable (i.e., *SHS*) then click the arrow to put it in the **Dependent List**




3. Click **Plots**, and select **Normality Plots with tests**. Click **Continue**, then click **OK**.




4. The following result will appear in the Output screen.

**Tests of Normality**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| SHS | .058 | 97 | .200* | .982 | 97 | .199 |

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

# Chapter 3: Properties of Distributions

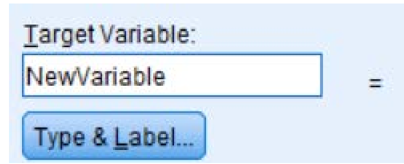
## I. Using the "Compute Variable " Function (adding, subtracting, multiplying, dividing by constants)

***Objective***: Adding 10 to the *Vengeance* variable

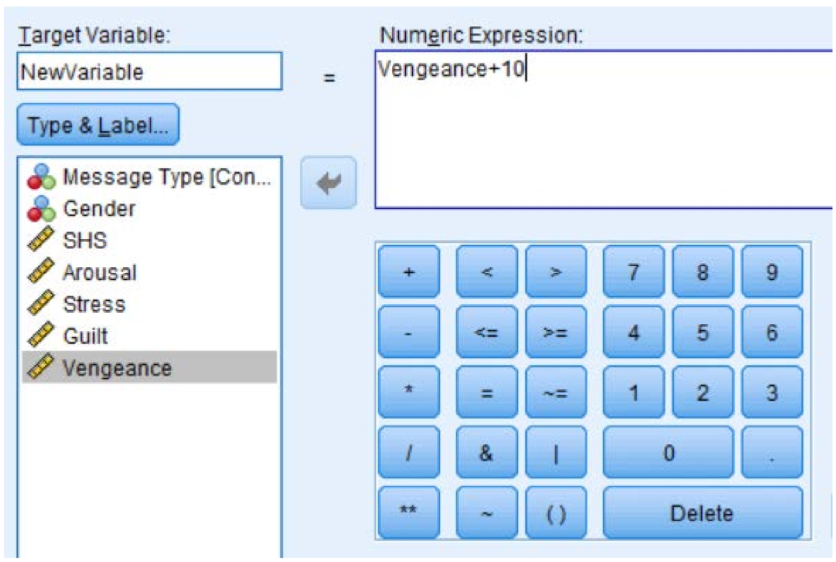
**Note that this example adds a constant to a variable. The same steps can be used to subtract, multiply, and divide constants to variables as well. **

1. Click **Transform**, and select **Compute Variable.**

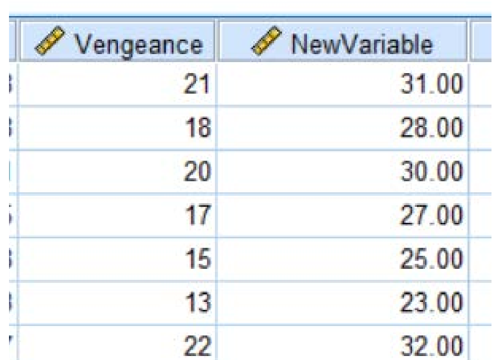
2. Type in a new variable name (i.e., *NewVariable*) into **Target Variable**.




3. Highlight *Vengeance*. Click/drag to the **Numeric Expression** box and then input "+10" after.




4. Click **OK**. The new variable will appear in the data set:



| Vengeance | NewVariable |
|---|---|
| 21 | 31.00 |
| 18 | 28.00 |
| 20 | 30.00 |
| 17 | 27.00 |
| 15 | 25.00 |
| 13 | 23.00 |
| 22 | 32.00 |

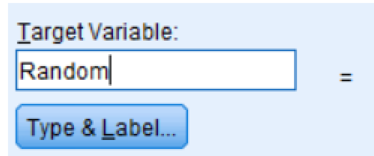
## II. Generating a Random Population

***Objective***: Generating a random normally-distributed population

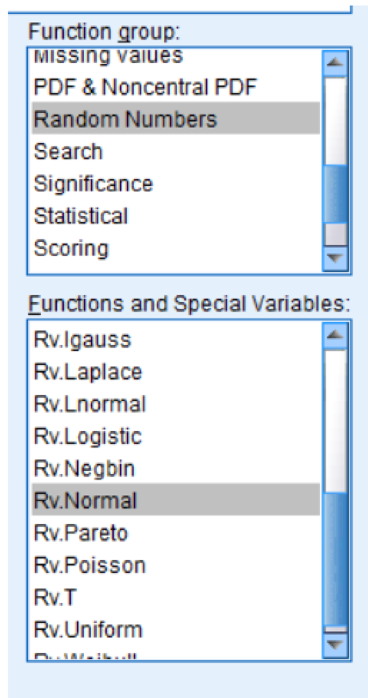
**This assumes you are using another dataset (i.e., you are *not* starting from scratch).**

1. Click **Transform**, and select **Compute Variable.**

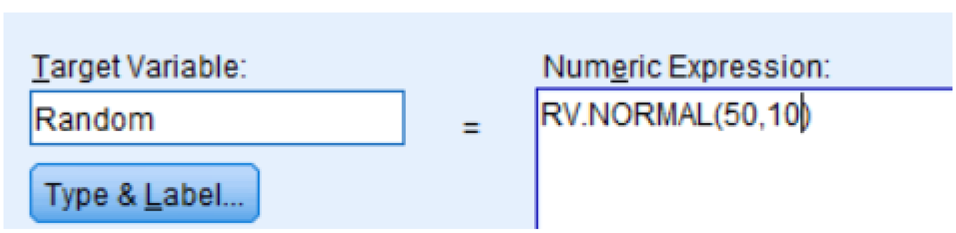
2. Type in new variable name (i.e., *Random*) into **Target Variable**.




3. In **Function Group**, select **Random Numbers**.
Then in **Functions and Special Variables**, double click on **Rv.Normal**.




4. *RV.Normal(?,?)* should now appear in the **Numeric Expression** box.
Input the mean and standard deviation you are using to create a normal distribution. For this example, we used a mean of 50 and a standard deviation of 10.




5. Click **OK**. The data table will fill the rows with random numbers.

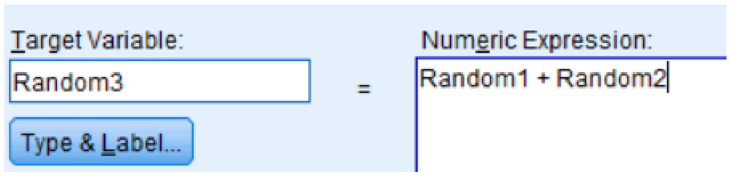
| Vengeance | Random |
|---|---|
| 21 | 40.90 |
| 18 | 49.63 |
| 20 | 47.24 |
| 17 | 46.40 |
| 15 | 31.44 |
| 13 | 32.33 |
| 22 | 46.83 |

**<u>III. Adding/Subtracting Scores from Two Different Distributions</u>**

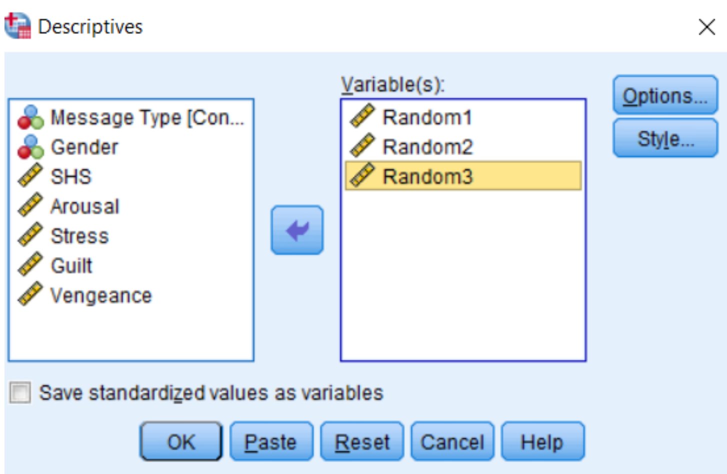
***<u>Objective</u>***: The purpose of this example is to show "proof" of Theorem 3 (p. 68)

1. To ensure no systematic relationship between variables, create 2 random normal samples using Ex 2, Ch 3 instructions above. We labeled these as *Random1* (mean of 50, SD of 10) and *Random2* (mean of 5, SD of 1)

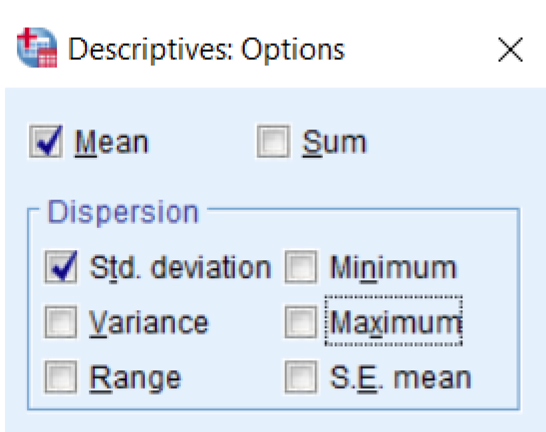
2. Using the instructions from Ex 1, Ch 3 from above, create a new variable (called *Random3*) by adding together *Random1* and *Random2*.




3. Click **<u>Analyze</u>**. Select **<u>Descriptive Statistics</u>**, then **<u>Descriptives</u>**. Highlight *Random1, Random2, Random3* and click/drag to the **<u>Variable(s)</u>** box.




4. Click **<u>Options</u>**. Select **<u>Mean</u>** and **<u>Standard Deviation</u>**. Click **<u>Continue</u>**, then **<u>OK</u>**.



5. You should get results similar to the one below.
To exemplify Theorem 3, note that the first two means (*Random1* and *2*) add to equal *Random3*'s mean.

**Descriptive Statistics**

| | N | Mean | Std. Deviation |
|---|---|---|---|
| Random1 | 114 | 49.9541 | 10.00620 |
| Random2 | 114 | 5.1239 | .88946 |
| Random3 | 114 | 55.0780 | 9.89674 |
| Valid N (listwise) | 114 | | |

# Chapter 4: Estimating Parameters of Populations from Sample Data

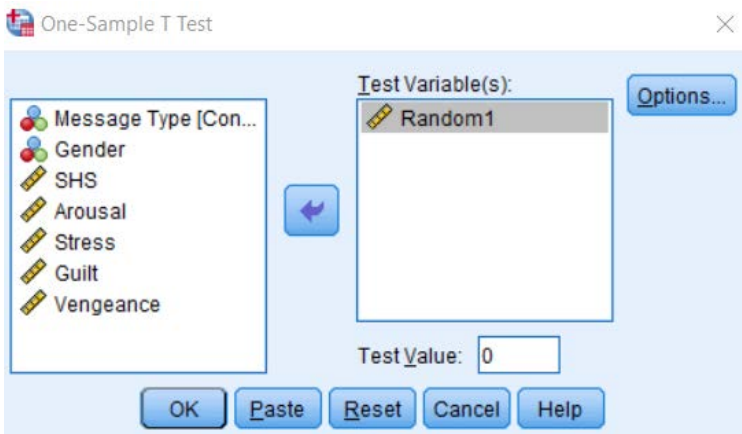
## I. Confidence Intervals for the Mean of a Normal Distribution

***Objective***: To produce a sample confidence interval

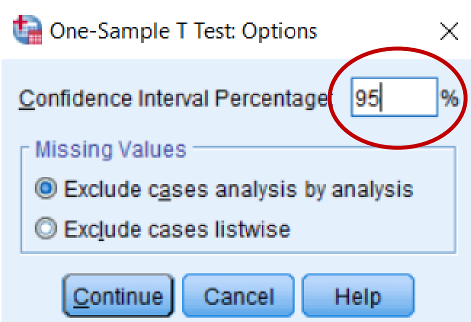
1. Create a random normal sample using Ex 2, Ch 3 instructions above. We labeled this as *Random1* (mean of 50, SD of 10).

2. Click **Analyze**, then **Compare Means**. Select **One-Sample T-Test**

3. Highlight *Random1* and click/drag it to the **Test Variable(s)** box.




4. Click **Options**, and enter the confidence interval desired (default is 95%).




5. Click **Continue**, then **OK**. The results will appear in the Output screen.

**One-Sample Test**

| | Test Value = 0 | | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | |
| | t | df | Sig. (2-tailed) | Mean Difference | Lower | Upper |
| Random1 | 53.303 | 113 | .000 | 49.95410 | 48.0974 | 51.8108 |

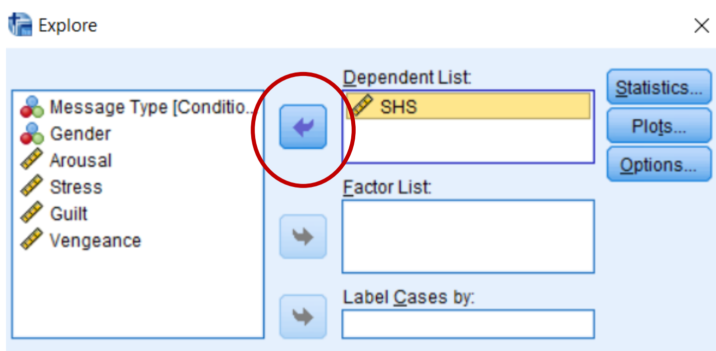
# Chapter 5: Resistant Estimators of Parameters

## I. Trimmed Mean (5%) & M-Estimator (Huber's, Tukey's, Hampel's, Andrew's)

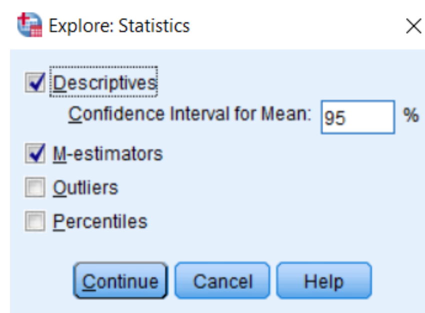
***Objective***: To produce the 5% trimmed mean and M-Estimators for *State Hostility score* (*SHS*)

1. Click **Analyze**, then select **Descriptive Statistics**, then select **Explore**

2. Highlight the variable (i.e., *SHS*) then click the arrow to put it in the **Dependent List**




3. Click **Statistics**, and select **M-estimators** and **Descriptives**. Click **Continue**, then click **OK**.




4. The following results will show in the Output screen. The 5% trimmed mean is located in the Descriptives section and the M-Estimators are located underneath.

**Descriptives**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| SHS | Mean | | 76.84 | 2.202 |
| | 95% Confidence Interval for Mean | Lower Bound | 72.46 | |
| | | Upper Bound | 81.21 | |
| | 5% Trimmed Mean | | 76.71 | |
| | Median | | 78.00 | |
| | Variance | | 470.160 | |
| | Std. Deviation | | 21.683 | |
| | Minimum | | 34 | |
| | Maximum | | 142 | |
| | Range | | 108 | |
| | Interquartile Range | | 35 | |
| | Skewness | | .055 | .245 |
| | Kurtosis | | -.345 | .485 |

**M-Estimators**

| | Huber's M-Estimator[a] | Tukey's Biweight[b] | Hampel's M-Estimator[c] | Andrews' Wave[d] |
|---|---|---|---|---|
| SHS | 77.36 | 77.04 | 77.08 | 77.01 |

a. The weighting constant is 1.339.

b. The weighting constant is 4.685.

c. The weighting constants are 1.700, 3.400, and 8.500

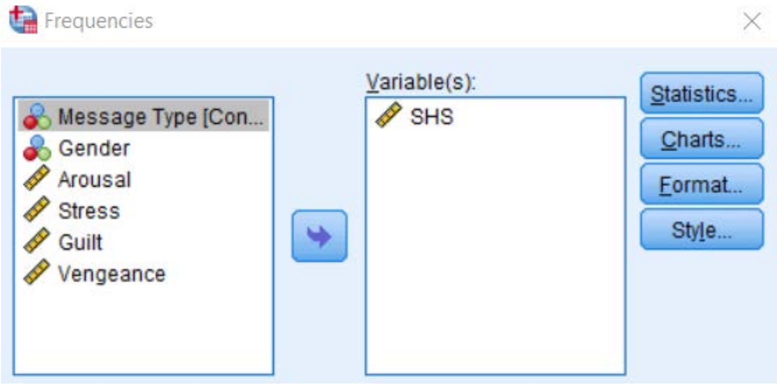
d. The weighting constant is 1.340*pi.

**II. MAD (Median of the Absolute Deviations from the median)**

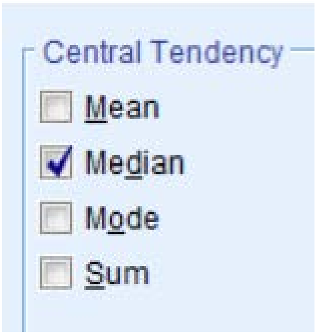
***Objective***: To produce the MAD for *State Hostility score* (*SHS*)

1. Click **Analyze**, then select **Descriptive Statistics**, then select **Frequencies**

2. Highlight the variable (i.e., *SHS*) then click the arrow to put it in the **Variable(s)** box




3. Click on **Statistics**, then select **Median** under **Central Tendency**. Click **Continue**, then **OK**. The results will appear in the Output Screen. Note what the median is for the following steps.

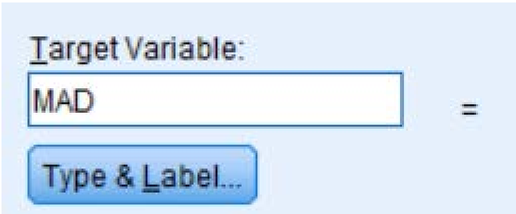



**Statistics**

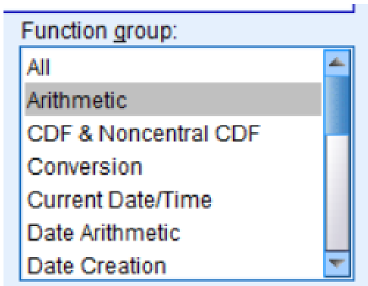
SHS

| | | |
|---|---|---|
| N | Valid | 97 |
| | Missing | 17 |
| Median | | 78.00 |

4. Click on Transform, then Compute Variable. In the Target Variable, put the name of the variable we are creating (i.e., MAD).

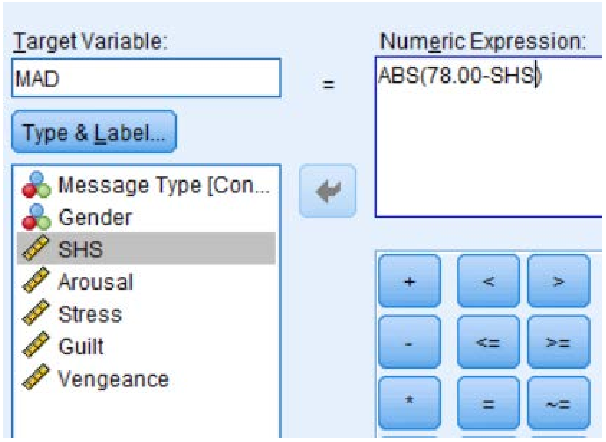



5. In the ***Function Group***, select *Arithmetic*.



Under ***Functions and Special Variables***, double click on *Abs*.

6. *ABS(?)* should appear in the **Numeric Expression** box. In the parentheses, input the median (i.e., *78.00*), then put "-", then highlight *SHS* and click/drag it after the "-" sign. Click **OK**.




7. The *MAD* variable will populate with the absolute deviations from the median for each *SHS* score. To find the 'actual' MAD score, calculate the median for the *MAD* variable using steps 1, 2, and 3:

**Statistics**

MAD

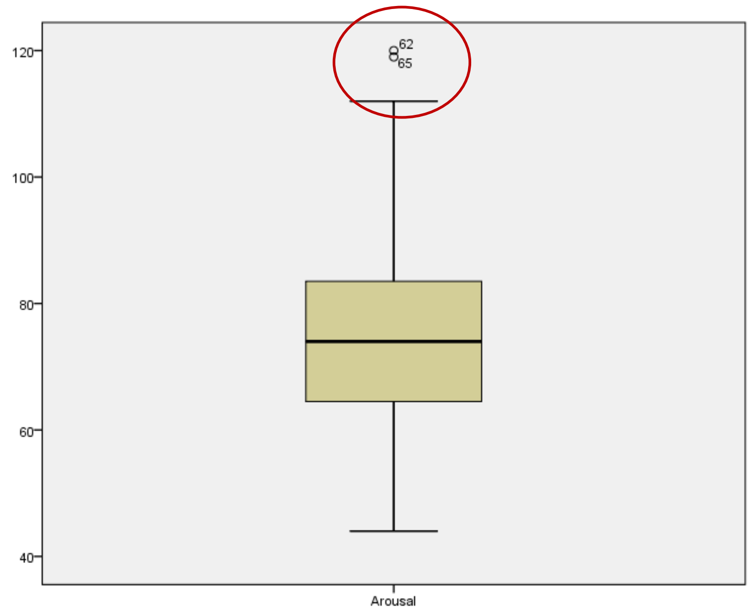
| | | |
|---|---|---|
| N | Valid | 97 |
| | Missing | 17 |
| Median | | 16.0000 |

## III. Winsorized Means & Variances

***Objective***: To produce the winsorized mean and variance for *Arousal*

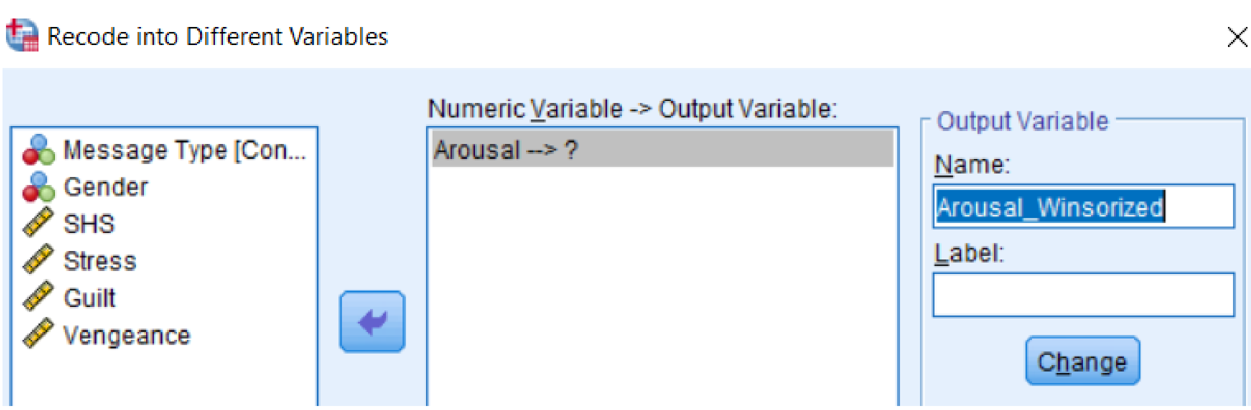
*****Note that this is just one way to determine which outliers need to be winsorized.*****

1. First step is to identify the outliers.
For this example, we produced a boxplot of the variable *Arousal* (see Ch 2 Ex 4 on how to produce this plot). Note that any outliers are labeled with the case number – in this example, it is case numbers 62 & 65. Locate the *Arousal* score for these two rows (119 and 120 respectively).

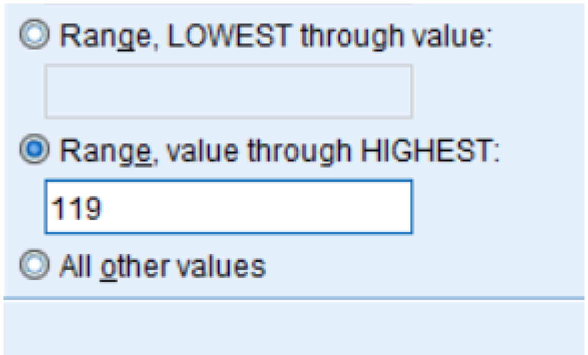


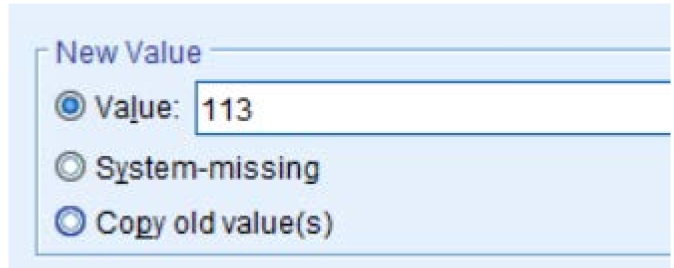

2. Determine what the highest value in the distribution is that is NOT considered to be an outlier (i.e., smaller than 119). You can create the stem-and-leaf display (Ch 2 Ex??) or a frequency table to identify the value. In this example, the score is 112. Therefore, we are going to create a new variable that changes the values of 119 and 120 to a value of 113 (1 value higher than 112). **Note that if you had outliers that were on the lower end of the distribution, you would do the same except do 1 value lower. **

3. Click **Transform**, then select **Recode into Different Variables**. Highlight the variable (i.e., *Arousal*), and click/drag to the **Input Variable -> Output Variable** box. Then in the **Output Variable** section, type the name of the new variable (i.e., *Arousal_Winsorized*).



4. Select **Old and New Values**, then click **Range, Value through HIGHEST**. Enter the lower value of the outliers (i.e., 119). Then in the **New Value** section, select **Value** and enter the replacement value (i.e., 113). Click **Add**; this will add this new transformation into the **Old->New** box.

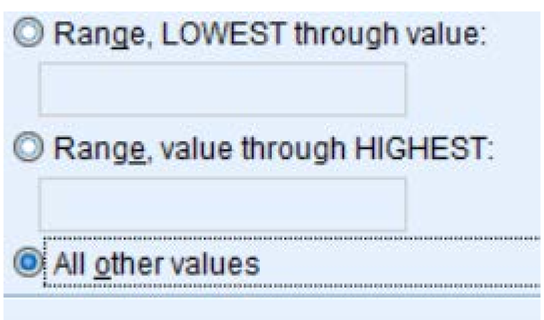


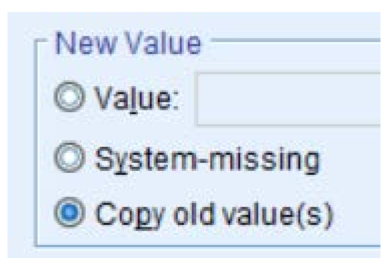



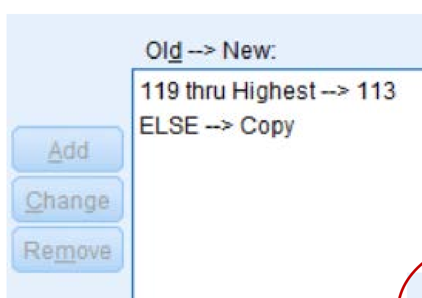


5. If you have lower valued outliers, you would do the same by selecting **Range, Lowest through value** (determine the replacement value the same manner by doing 1 less).

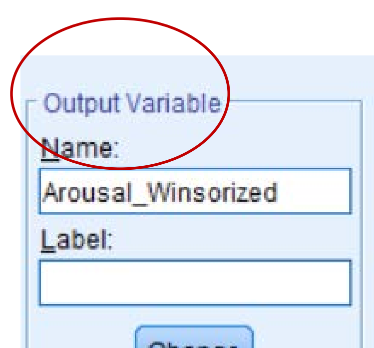
6. To keep all other values in the distribution the same, select **All other values**, then click **Copy old value(s)** in the **New Value** section. Click **Add** to include in the **Old->New** box.



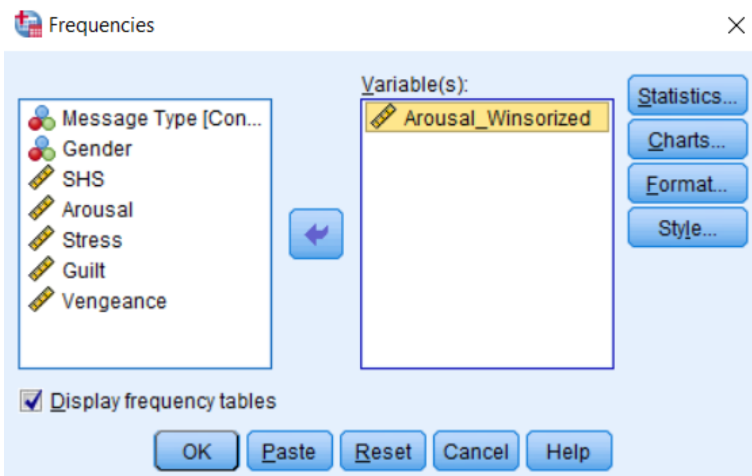




7. Click **Continue**. Then select **Change in the Output Variable** section.

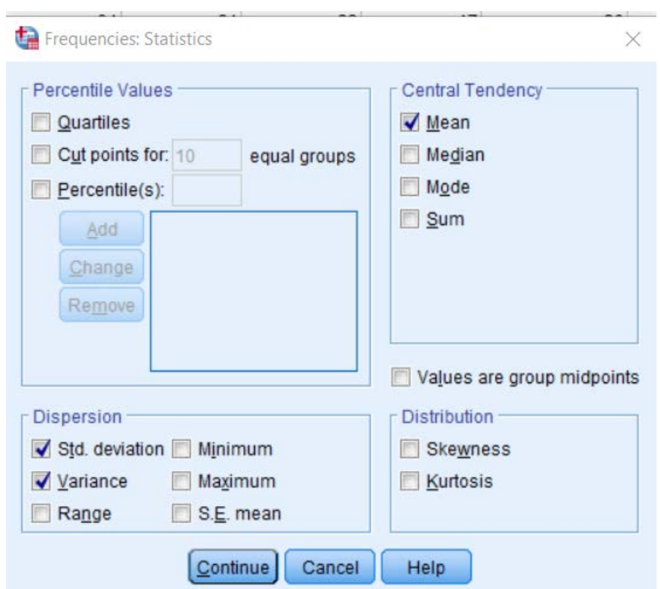


8. Click **OK**. The new variable will be included in the dataset, with the outliers replaced by the values you selected.

9. Find the mean and variance/standard deviation of this new variable by clicking **Analyze**, selecting **Descriptives**, then clicking **Frequencies**. Highlight the winsorized variable (i.e., *Arousal_Winsorized*) and click/drag into the **Variable(s)** box.




10. Click **Statistics**, then select *Mean*, *Standard Deviation*, and *Variance*.
Click **Continue**, then **OK**.



11. The results will be generated in the Output screen.

**Statistics**

Arousal_Winsorized

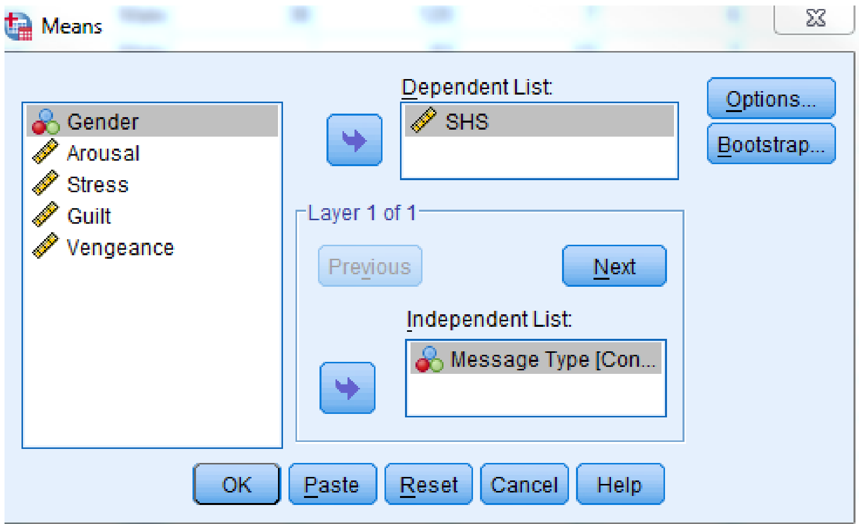
| | | |
|---|---|---|
| N | Valid | 100 |
| | Missing | 14 |
| Mean | | 74.4000 |
| Std. Deviation | | 15.07557 |
| Variance | | 227.273 |

**IV. Bootstrap Estimators**

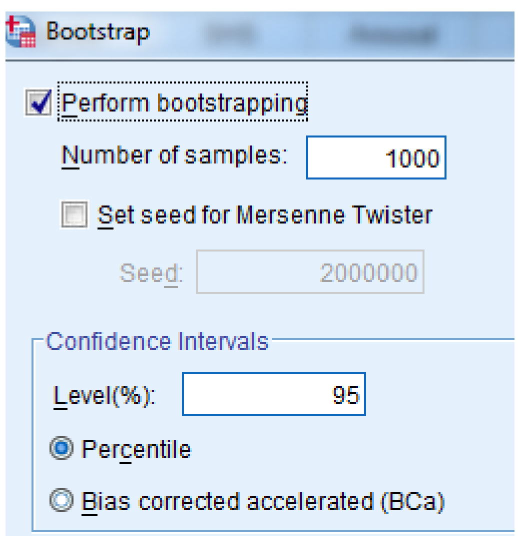
***Objective***: To compare the *State Hostility score* (*SHS score*) between the two levels of Message (*Insult, Nice*)

1. Click **Analyze**, then **Compare Means**, and select **Means**

2. Highlight *SHS* and click/drag it to the **Dependent List** box. Highlight *Message Type* and click/drag it to the **Independent List** box.




3. Click **Bootstrap**. Select ***Perform Bootstrapping***, and enter the number of samples you would like bootstrapped (default is 1000). Enter the confidence level in the ***Confidence Intervals Level (%)*** box (default is 95).



4. Click **Continue** then **OK**. The results will generate in the output screen:

**ANOVA Table[a]**

| | | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|---|
| SHS * Message Type | Between Groups | (Combined) | 2714.400 | 1 | 2714.400 | 6.079 | .015 |
| | Within Groups | | 42420.961 | 95 | 446.536 | | |
| | Total | | 45135.361 | 96 | | | |

a. With fewer than three groups, linearity measures for SHS * Message Type cannot be computed for split: $bootstrap_split = 0.

**Report**

SHS

| Message Type | | Statistic | Bootstrap[a] | | | |
|---|---|---|---|---|---|---|
| | | | Bias | Std. Error | 95% Confidence Interval Lower | 95% Confidence Interval Upper |
| Nice | Mean | 70.91 | -.06 | 3.09 | 64.80 | 76.92 |
| | N | 43 | 0 | 5 | 33 | 53 |
| | Std. Deviation | 21.508 | -.591 | 2.817 | 15.898 | 27.036 |
| Insult | Mean | 81.56 | .05 | 3.01 | 75.59 | 87.39 |
| | N | 54 | 0 | 5 | 44 | 64 |
| | Std. Deviation | 20.828 | -.234 | 1.636 | 17.317 | 23.550 |
| Total | Mean | 76.84 | .00 | 2.17 | 72.64 | 81.09 |
| | N | 97 | 0 | 0 | 97 | 97 |
| | Std. Deviation | 21.683 | -.197 | 1.377 | 18.866 | 24.167 |

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

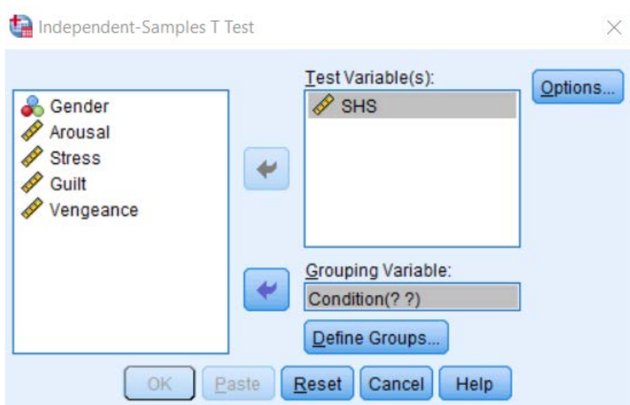
# Chapter 7: Independent Groups t-Test

## I. Student's t-test & Welch-Satterthwaite t-test

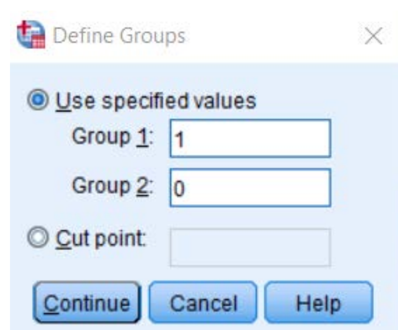
***Objective***: To compare the *State Hostility score* (*SHS*) between the two levels of Message (*Insult, Nice*)

1. Click **Analyze**, then **Compare Means**. Select **Independent-Samples T-Test**.

2. Select the dependent variable (i.e., *SHS*) and click/drag it to the **Test Variable(s)** box. Select the categorical independent variable (i.e., *Message Type*) and click/drag it to the **Grouping Variable** box.




3. Click **Define Groups**. You must input the value labels you used to code the categorical variable (i.e., *1* and *0*).




4. Click **Continue**, then **OK**. The results will be displayed in the Output screen. The Welch's test is the t-value for when **Equal Variances are not assumed**. In this particular example, since we do not reject the null hypothesis of equal variances using Levene's Test, we would use the **Equal Variances Assumed** results.

**Independent Samples Test**

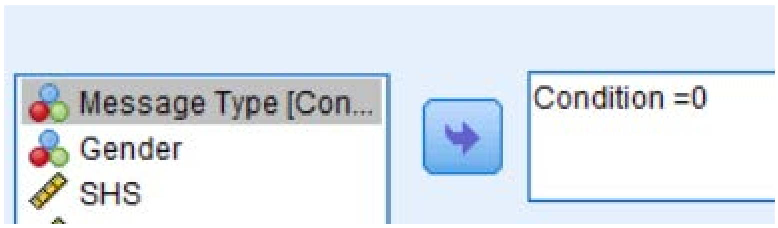
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| SHS | Equal variances assumed | .051 | .822 | 2.466 | 95 | .015 | 10.649 | 4.319 | 2.074 | 19.223 |
| | Equal variances not assumed | | | 2.456 | 88.873 | .016 | 10.649 | 4.335 | 2.035 | 19.262 |

## II. Empirical quantile-quantile plots

***Objective***: To create an empirical quantile-quantile plot of the *State Hostility score* (*SHS*) between the two levels of Message (*Insult*, *Nice*)

1. Click **Data**, then **Select Cases**. Click **If condition is satisfied**, and click the **If** button.

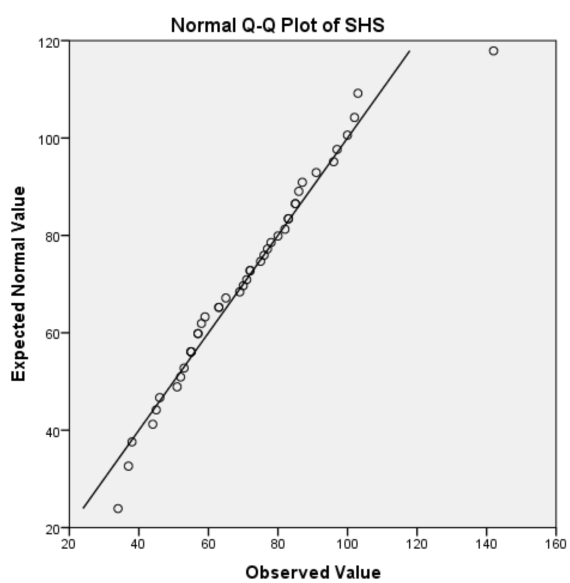
2. Highlight *Message Type* and click/drag into the expression box. Type "-" and then one of the values used to code the levels of *Message Type* (i.e., 1 or 0). We did "0" first.



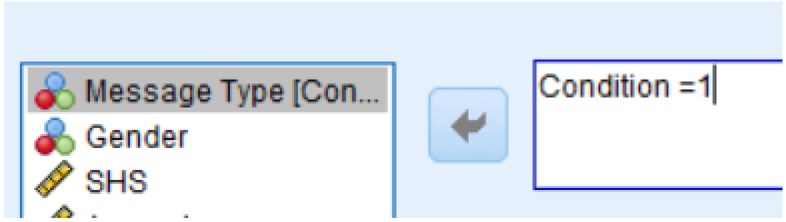

3. Click **Continue**, then **OK**. This only selects cases that are in that level (i.e., *Nice Message*).

4. Click **Analyze**, select **Descriptive Statistics** and then **Q-Q plots**

5. Highlight *SHS* and click/drag to the **Variables** box. Click **OK**. The result will appear in the Output screen. Note that this is the q-q plot only for those in the *Nice Message* condition.




6. Complete Steps 1, 2, and3, this time selecting the other level (i.e., value of 1, *Insult Message*)




7. Complete Steps 4 and 5 to obtain the q-q plot for the *Insult Condition*:

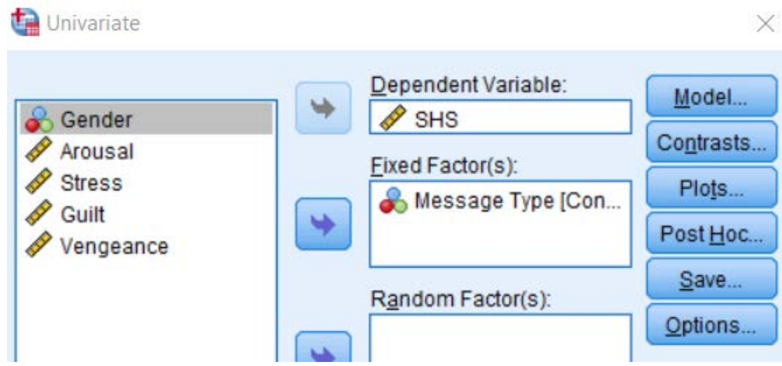
**III. Standardized effect sizes**

***Objective***: To produce the standardized effect size (i.e., *Cohen's d*) after comparing the *State Hostility score* (*SHS*) between the two levels of Message (*Insult*, *Nice*)

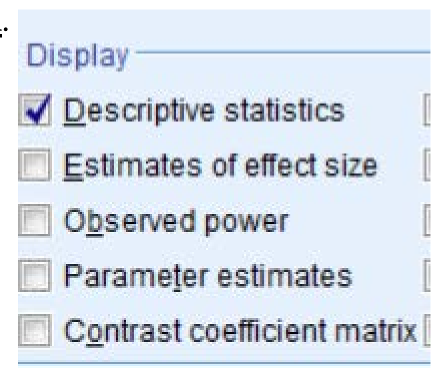
SPSS does not produce Cohen's d outright; however, we can use an online calculator (i.e., http://www.uccs.edu/~lbecker/) to input the necessary information to find Cohen's d.

1. Click **Analyze**, **then General Linear Model**, then **Univariate**.

2. Highlight *SHS* and click/drag it to the **Dependent Variable** box. Highlight *Message Type* and click/drag it to the **Fixed Factors(s)** box.




3. Click **Options**, select ***Descriptive Statistics***. Click **Continue** then **OK**.



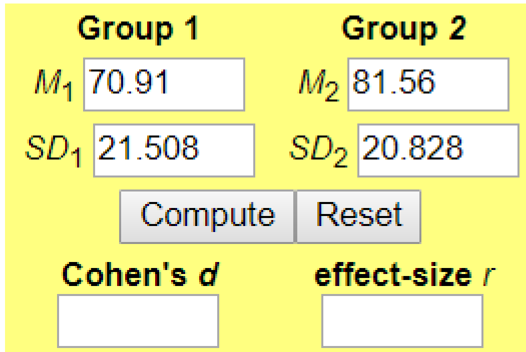

4. The means and standard deviations are located in the **Descriptive Statistics** box in the output

**Descriptive Statistics**

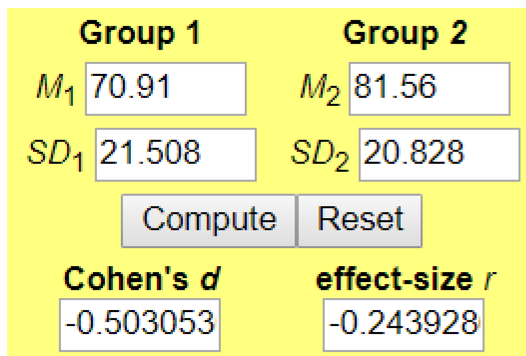
Dependent Variable: SHS

| Message Type | Mean | Std. Deviation | N |
|---|---|---|---|
| Nice | 70.91 | 21.508 | 43 |
| Insult | 81.56 | 20.828 | 54 |
| Total | 76.84 | 21.683 | 97 |

5. Next navigate to an online effect size calculator (e.g., http://www.uccs.edu/~lbecker/ ) and input the necessary information. Click **Compute**.




6. The results will generate in the box:



# Chapter 8: Test for nominal data

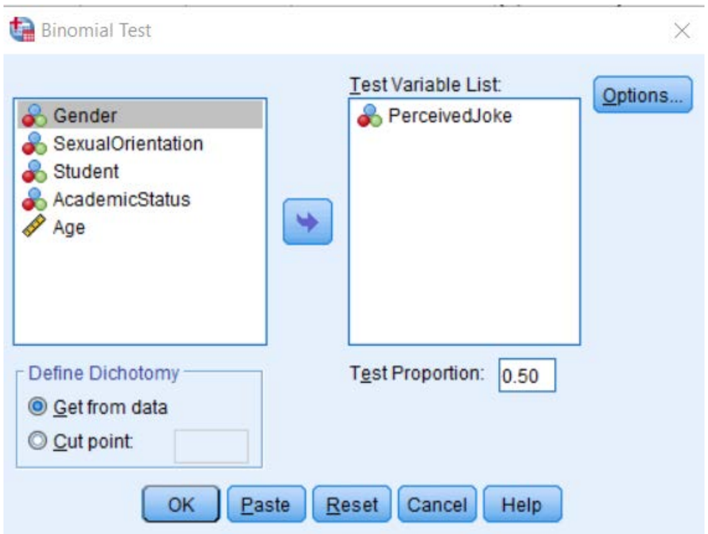
## I. Binomial test

The dataset ***"binomial dataset (subversive humor)"*** is used for this example, where participants were asked to interpret a subversive joke as either "subversive" (i.e., success) or "not subversive" (i.e., failure)

***Objective***: To determine if participants are more likely to interpret a subversive racial joke as subversive.

1. Click **Analyze**, then **Nonparametric Tests**, then **Legacy Dialogs**, and select **Binomial**.

2. Highlight variable (i.e., *PerceivedJoke*) and click/drag to the **Test Variable List**. Input **Test Proportion** desired (default is .50). Click **OK**




3. Result will generate in the Output screen. Recall that the null hypothesis is to determine if the *Observed Proportion* (i.e., .58) is equal to the *Test Proportion* (i.e., .50). We look at the p-value (i.e., .132) and conclude that our observed proportion is not significantly different from the test proportion.

**Binomial Test**

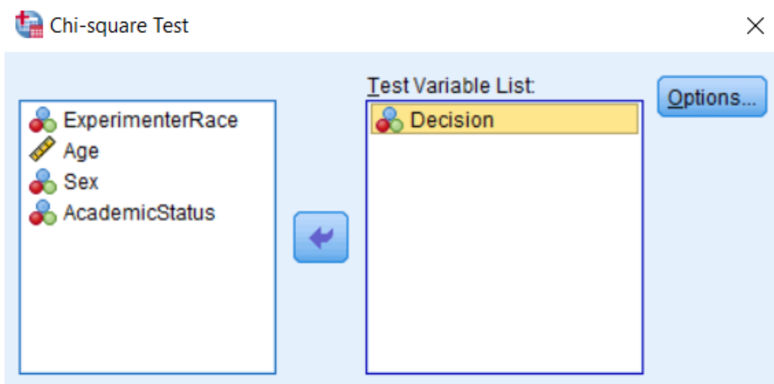
| | | Category | N | Observed Prop. | Test Prop. | Exact Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| PerceivedJoke | Group 1 | Failure | 65 | .58 | .50 | .132 |
| | Group 2 | Success | 48 | .42 | | |
| | Total | | 113 | 1.00 | | |

## II. Chi square goodness-of-fit test

The dataset ***"chi square dataset (diversity)"*** is used for this example, where participants were asked to choose between either writing or verbally criticizing a proposed diversity initiative. ***Objective***: To determine if participants prefer one response option (i.e., verbal or written) over the other

1. Click **Analyze**, then **Nonparametric Tests**, then **Legacy Dialogs**, and select **Chi Square**.

2. Highlight the variable (i.e., Decision) and click/drag to the Test Variable List. Click OK.




3. The results will generate in the Output screen:

**Decision**

| | Observed N | Expected N | Residual |
|---|---|---|---|
| Written | 56 | 76.0 | -20.0 |
| Verbal | 96 | 76.0 | 20.0 |
| Total | 152 | | |

**Test Statistics**

| | Decision |
|---|---|
| Chi-Square | 10.526[a] |
| df | 1 |
| Asymp. Sig. | .001 |

# Chapter 10: Exploring Relationships Between Two Variables

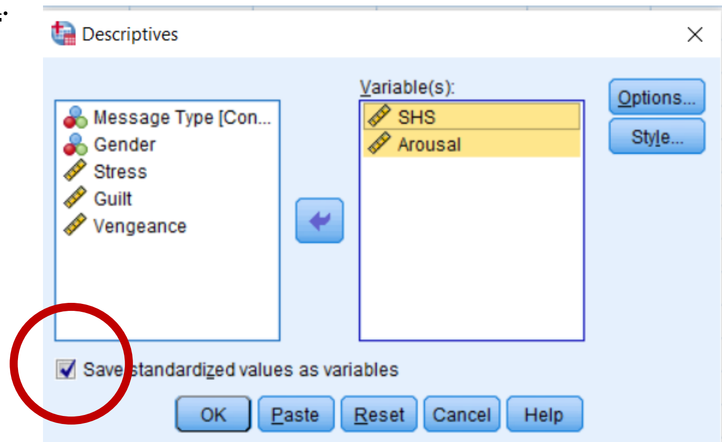
## I. Bivariate Normal Distribution Hypothesis Test and Confidence Intervals of Correlation between two variables

***Objective***: To determine if the relationship (i.e., correlation) between *SHS* and *Arousal* is significant (i.e., different from 0); Create a confidence interval around the correlation between the two variables of interest; Conduct bootstrapping analyses around the correlation

We are able to find the confidence interval using the ***Regression*** function, however we need to standardize *SHS* and *Arousal* prior to doing so.

1. Click on **Analyze**, then **Descriptive Statistics**, then select **Descriptives**.

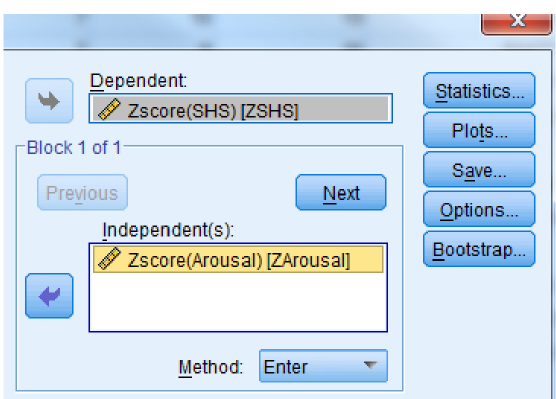
2. Highlight each variable (i.e., *SHS*, *Arousal*) and click/drag them to the **Variable(s)** box. Select **Save standardized values as variables**. Click **OK**.



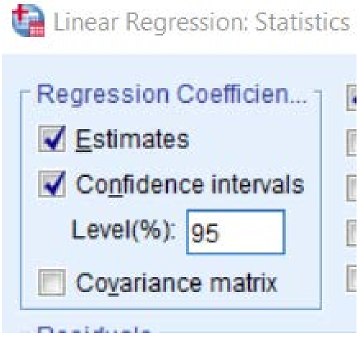

3. This creates two new columns, one for standardized *SHS* (i.e., *ZSHS*) and one for standardized *Arousal* (i.e., *ZArousal*).

4. Click **Analyze**, then **Regression**, and select **Linear**.

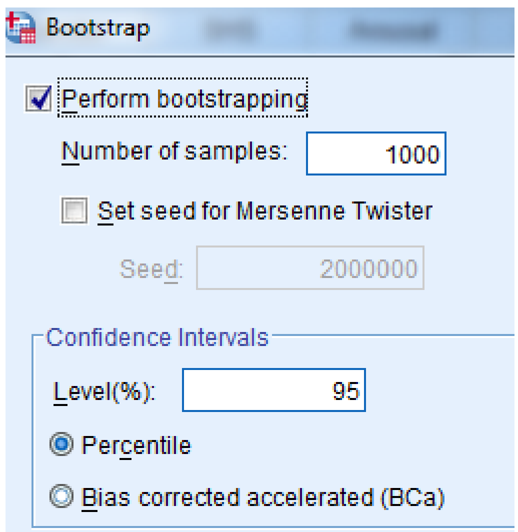
5. Highlight one of the variables of interest (e.g., *ZSHS*) and click/drag it to the **Dependent** box. Highlight the second variable of interest (e.g., *ZArousal*) and click/drag to the **Independent(s)** box.



6. Click **Statistics**. Select ***Estimates*** and ***Confidence Intervals***. Input level of confidence you are interested in (default is 95%). Click **Continue**, then **OK**.




7. Click **Bootstrap**. Select ***Perform Bootstrapping***, and enter the number of samples you would like bootstrapped (default is 1000). Enter the confidence level in the ***Confidence Intervals Level (%)*** box (default is 95).




8. The correlation and confidence interval are located in the **Coefficients** section of the output.
Correlation of **–.505**, 95% CI of **–.662 to –.309**

**Coefficients**[a]

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. | 95.0% Confidence Interval for B Lower Bound | 95.0% Confidence Interval for B Upper Bound |
|---|---|---|---|---|---|---|---|---|
| 1 | (Constant) | .001 | .091 | | .007 | .994 | -.181 | .182 |
| | Zscore(Arousal) | -.485 | .089 | -.505 | -5.460 | .000 | -.662 | -.309 |

a. Dependent Variable: Zscore(SHS)

9. The results from the bootstrapping analyses are located in the **Bootstrap for Coefficients** section:

**Bootstrap for Coefficients**

| Model | | B | Bootstrap[a] | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | 95% Confidence Interval | |
| | | | Bias | Std. Error | Sig. (2-tailed) | Lower | Upper |
| 1 | (Constant) | .001 | .003 | .093 | .991 | -.183 | .189 |
| | Zscore(Arousal) | -.485 | .000 | .084 | .001 | -.655 | -.314 |

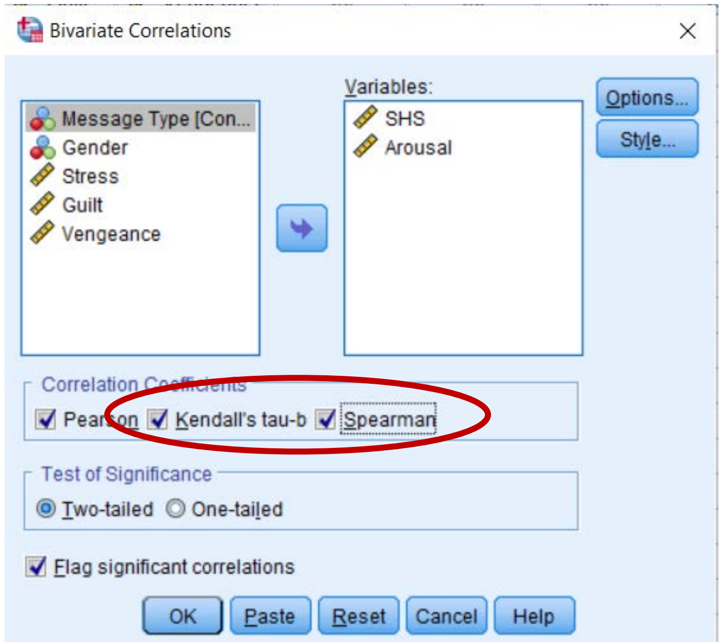
a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

## II. Spearman's Rho & Kendall's Tau

***Objective***: Conduct *Spearman's Rho/Kendall's Tau* correlation on the variables *SHS* and *Arousal*

1. Click **Analyze**, then **Correlate**, then select **Bivariate**.

2. Highlight each variable (i.e., *SHS*, *Arousal*) and click/drag them to the **Variables** box. Click ***Kendall's tau*** and ***Spearman***. Click **OK**.




3. Results will appear in the Output screen:

**Correlations**

| | | | SHS | Arousal |
|---|---|---|---|---|
| Kendall's tau_b | SHS | Correlation Coefficient | 1.000 | -.338** |
| | | Sig. (2-tailed) | . | .000 |
| | | N | 97 | 89 |
| | Arousal | Correlation Coefficient | -.338** | 1.000 |
| | | Sig. (2-tailed) | .000 | . |
| | | N | 89 | 100 |
| Spearman's rho | SHS | Correlation Coefficient | 1.000 | -.478** |
| | | Sig. (2-tailed) | . | .000 |
| | | N | 97 | 89 |
| | Arousal | Correlation Coefficient | -.478** | 1.000 |
| | | Sig. (2-tailed) | .000 | . |
| | | N | 89 | 100 |

**. Correlation is significant at the 0.01 level (2-tailed).

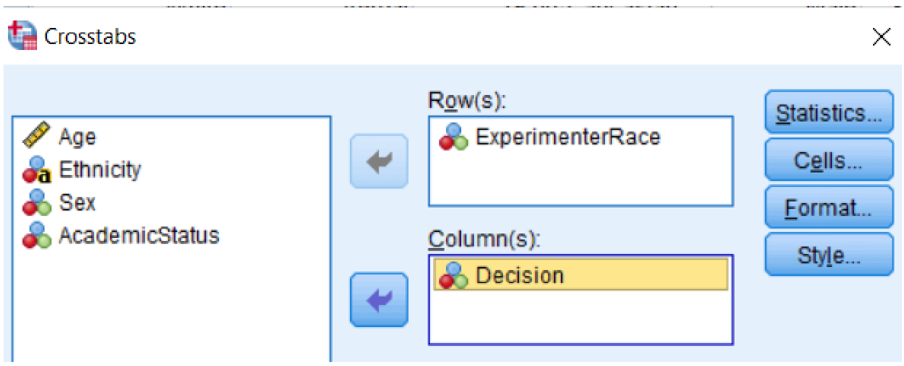
## III. Chi square test for Association

**Note that the dataset labeled* ***chi square data set (diversity)*** *was used for this example**

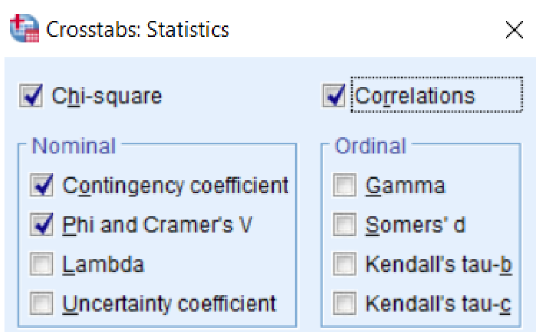
***Objective***: Test the association, using the Fisher's exact test, between two nominal variables: *Experimenter's Race (White, Black)* and *Decision (Verbal, Written)*

1. Click **Analyze**, then **Descriptive Statistics**, then select **Crosstabs**

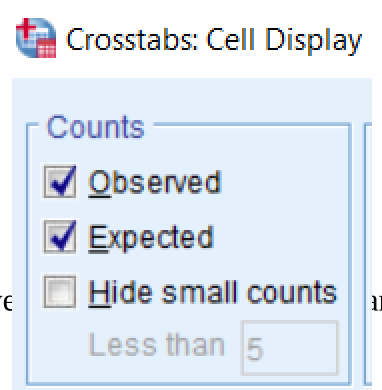
2. Highlight one of the variables of interest (e.g., *ExperimenterRace*) and click/drag it to the **Row** box. Highlight the other variable of interest (e.g., *Decision*) and click/drag it to the **Columns** box.




3. Click **Statistics**. Select **Chi-square**. Click **Continue**.




4. Click **Cells**. Select ***Observed*** and ***Expected*** in the **Counts** section. Click **Continue**, then **OK**.




5. ***Fisher's Exact Test*** result as we … are located in the **Chi-Square**

**Tests** box, generated in the output screen:

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 4.830[a] | 1 | .028 | | |
| Continuity Correction[b] | 4.119 | 1 | .042 | | |
| Likelihood Ratio | 4.882 | 1 | .027 | | |
| Fisher's Exact Test | | | | .030 | .021 |
| Linear-by-Linear Association | 4.799 | 1 | .028 | | |
| N of Valid Cases | 152 | | | | |

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 26.53.

b. Computed only for a 2x2 table

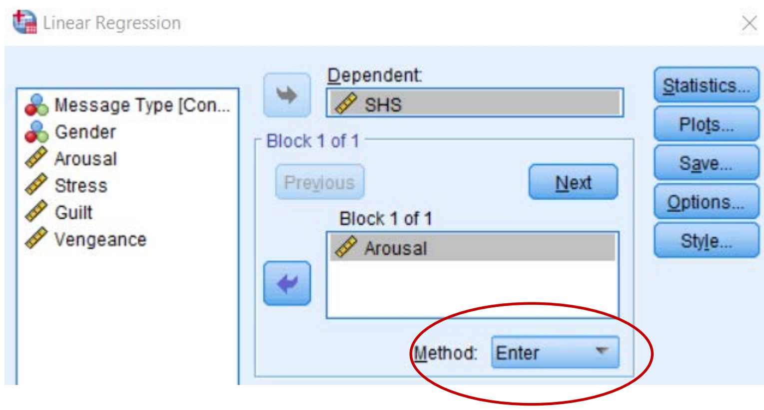
# Chapter 11: Linear Regression Model

## I. Linear Regression: F and t statistics

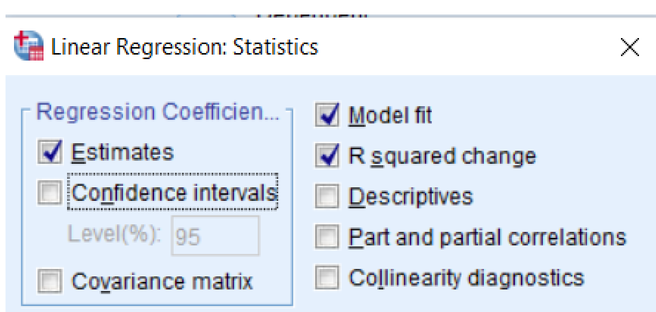
***Objective***: To determine if the correlation coefficient between two variables in a regression analysis is significantly different than zero

1. Click **Analyze**, then **Regression**, the select **Linear**

2. Select criterion variable (i.e., *SHS*) and click/drag to **Dependent**. Highlight predictor variable (i.e., *Arousal*) and click/drag to **Block 1**. Be sure that the ***Enter*** method is selected.




3. Click **Statistics**. Select ***Estimates***, ***Model fit***, ***R Squared Change***. Click **Continue**, then **OK**.




4. The results will generate in the Output screen. The $R^2$, *F* statistic, and *p*-value will be in the **Model Summary** section of the results.

**Model Summary**

| | | | | | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .505[a] | .255 | .247 | 18.658 | .255 | 29.813 | 1 | 87 | .000 |

a. Predictors: (Constant), Arousal

# Chapter 12: Closer Look at Linear Regression

## I. Checking assumptions in regression

***Objective***: Checking the assumptions for Regression –

A. Independence of Observations
B. Linearity between predictor and criterion
C. Variables are from a normal distribution
D. No multicollinearity issues among predictors
E. Homoscedasticity

A. This is something that is determined and controlled for within the design of the study.

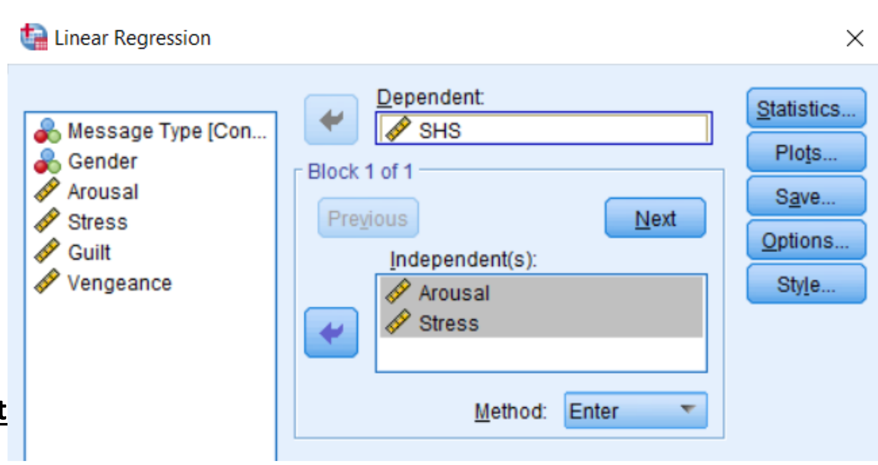
B. To check for linearity between the predictor and criterion, conduct a bivariate correlation using the instructions from Chapter 10's ***"Bivariate Normal Distribution Hypothesis Test & Confidence Intervals of Correlation between two variables"***. Using the magnitude of the correlation and associated p-value along with scatter plots to determine if a linear relationship exists.

C. To check that the variables each come from a normal distribution, graph their distribution using Chapter 2's "***Histograms"*** instructions.

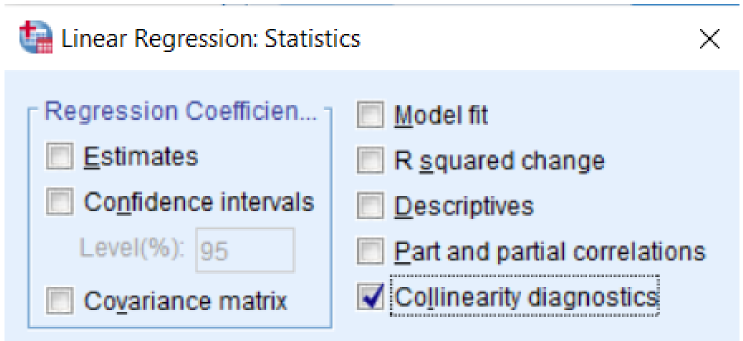
D. To ensure no ***multicollinearity*** among multiple predictors, conduct a Linear Regression model and look at the Variance Inflation Factor (VIF) scores.
**For this example, we will need at least 2 predictors in the regression model. Therefore, we will be using *Arousal* and *Stress* as predictors and *SHS* as the criterion. **

1. Click **Analyze**, then **Regression**, the select **Linear**

2. Select criterion variable (i.e., *SHS*) and click/drag to **Dependent**. Highlight the predictor variables (i.e., *Arousal, Stress*) and click/drag to **Independent(s)**. Be sure that the ***Enter*** method is selected.




3. Click **Statist**




4. The VIF scores are located in the **Coefficients** box. The "rule of thumb" is that VIF scores above 3 are indicators of multicollinearity among the predictors.

**Coefficients[a]**

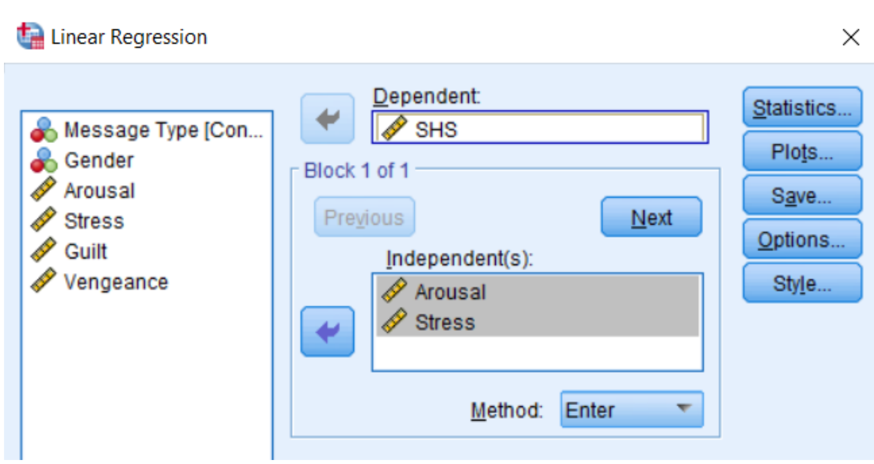
| Model | | Collinearity Statistics Tolerance | VIF |
|---|---|---|---|
| 1 | Arousal | .737 | 1.356 |
| | Stress | .737 | 1.356 |

a. Dependent Variable: SHS

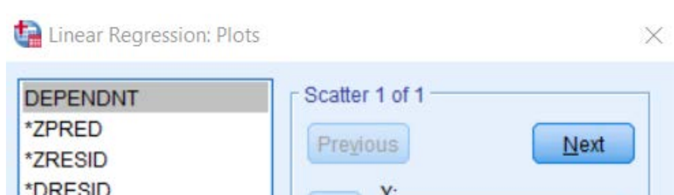
E. To test of ***homoscedasticity***, look at the plot of the residuals of the model fit.

1. Click **<u>Analyze</u>**, then **<u>Regression</u>**, the select **<u>Linear</u>**

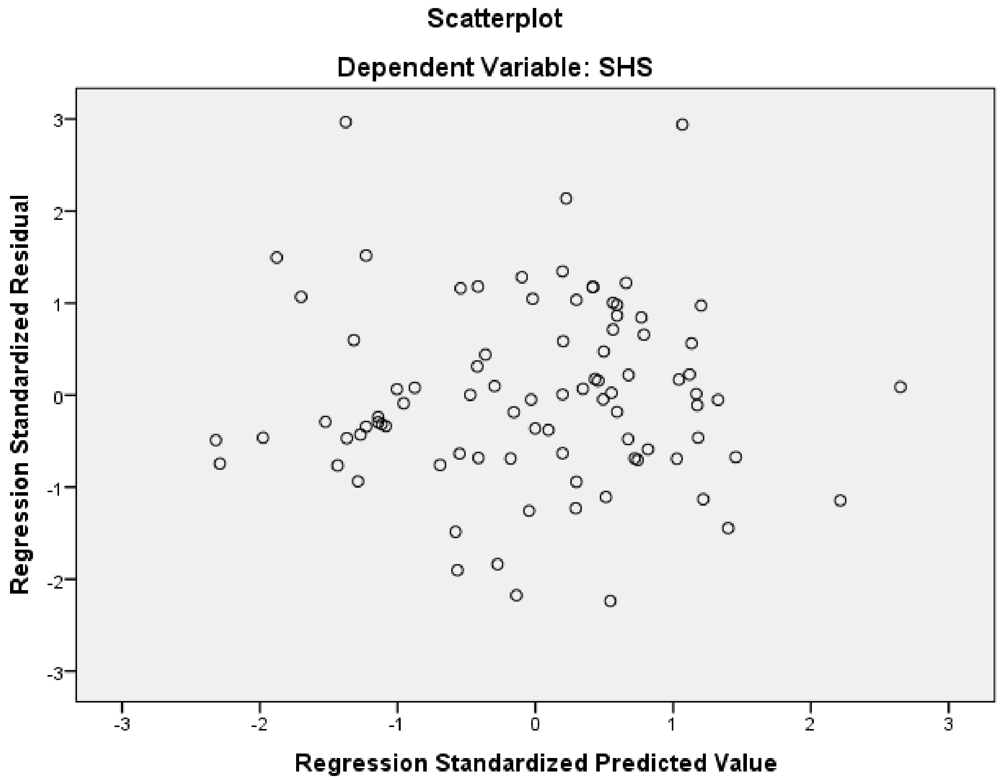
2. Select criterion variable (i.e., *SHS*) and click/drag to **<u>Dependent</u>**. Highlight the predictor variables (i.e., *Arousal, Stress*) and click/drag to **<u>Independent(s)</u>**. Be sure that the ***Enter*** method is selected.




3. Select **<u>Plots</u>**. Highlight *ZResid* and click/drag to the **<u>Y</u>** box, highlight *ZPred* and click/drag to the **<u>X</u>** box. Click **<u>Continue</u>**, then **<u>OK</u>**.



4. The residual plot will generate in the Output screen:

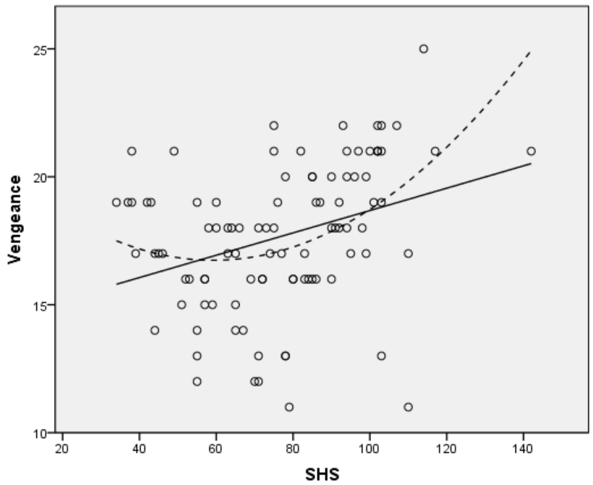


## II. Non-linear regression, Lack-of-fit

***Objective***: Conduct a non-linear regression and compare it to linear regression for the same variables to determine which model best fits the data

**Note that this example is using polynomial regression.**

We will be using the *Vengeance* variable as a predictor and *SHS* as the criterion.
An initial graph (using Chart Builder – Legacy Dialogs), we see that there is a possible non-linear relationship (i.e., quadratic) between the two variables:

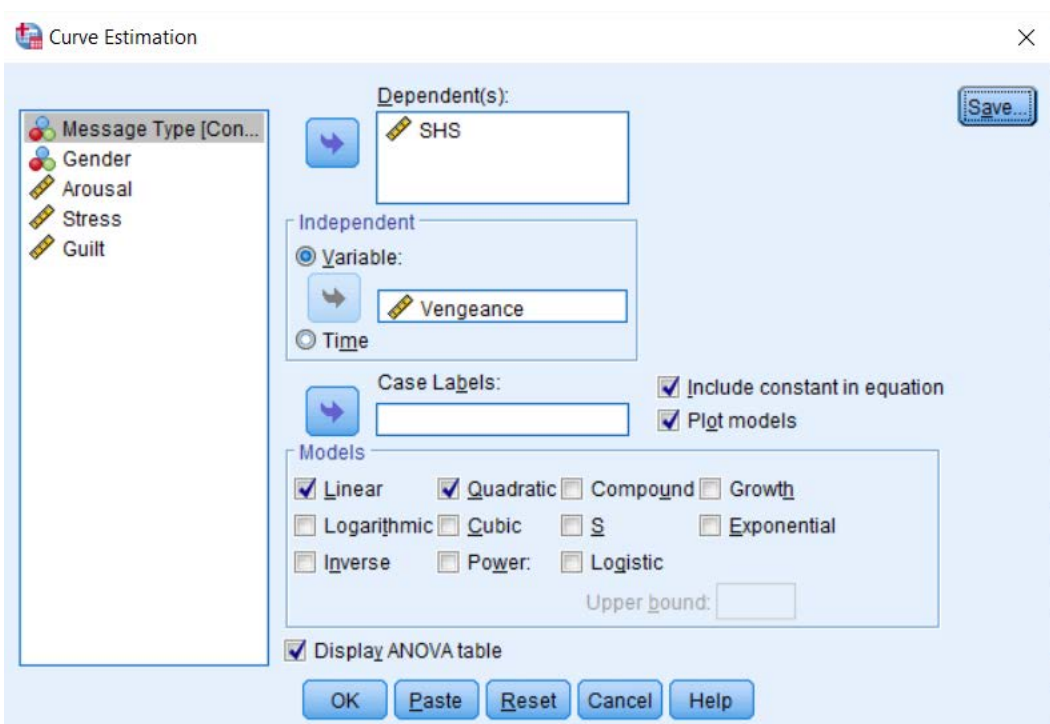



1. Click **Analyze**, then **Regression**, and select **Curve Estimation**

2. Highlight *SHS* and click/drag over to the **Dependent(s)** box. Highlight *Vengeance* and click/drag over to the **Independent Variable** box.

Select ***Linear*** and ***Quadratic*** in the **Models** section.

Click **OK**.



3. We can compare the $R^2$ values of each model to determine which model accounts for more of the variance in *SHS*.

***Linear***

**Model Summary**

| R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|
| .333 | .111 | .101 | 20.640 |

The independent variable is Vengeance.

**ANOVA**

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 4986.845 | 1 | 4986.845 | 11.706 | .001 |
| Residual | 40044.114 | 94 | 426.001 | | |
| Total | 45030.958 | 95 | | | |

The independent variable is Vengeance.

**Coefficients**

| | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. |
| Vengeance | 2.536 | .741 | .333 | 3.421 | .001 |
| (Constant) | 31.924 | 13.264 | | 2.407 | .018 |

***Quadratic***

**Model Summary**

| R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|
| .452 | .205 | .188 | 19.624 |

The independent variable is Vengeance.

**ANOVA**

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 9216.844 | 2 | 4608.422 | 11.967 | .000 |
| Residual | 35814.115 | 93 | 385.098 | | |
| Total | 45030.958 | 95 | | | |

The independent variable is Vengeance.

**Coefficients**

| | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. |
| Vengeance | -19.671 | 6.737 | -2.581 | -2.920 | .004 |
| Vengeance ** 2 | .642 | .194 | 2.930 | 3.314 | .001 |
| (Constant) | 218.615 | 57.724 | | 3.787 | .000 |

# Chapter 13: Another Way to Scale the size of Treatment Effects

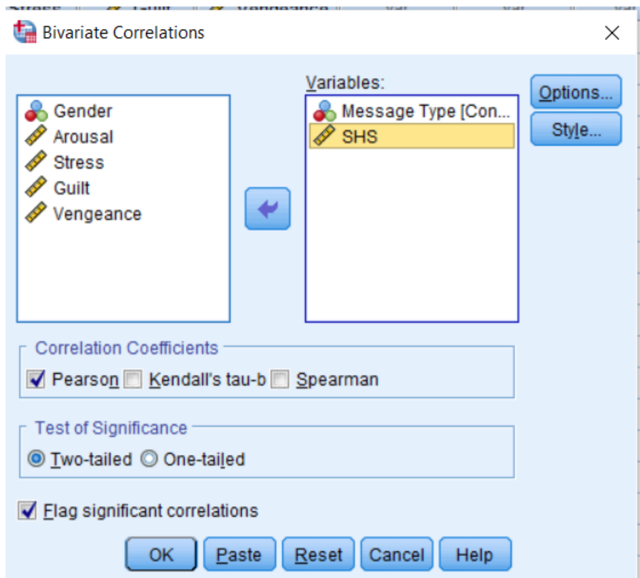
## I. Point biserial r

***Objective***: Test relationship between a dichotomous variable (i.e., *Message Type: Nice, Insult*) and a continuous variable (i.e., *SHS score*).

In SPSS, the Pearson correlation coefficient is interpreted as the point biserial correlation coefficient if one of the variables is a dichotomous categorical variable.

1. Click **Analyze**, **Correlate**, then **Bivariate**

2. Highlight the two variables of interest (i.e., *Message Type*, *SHS*) and click/drag over the **Variables** box. Select ***Pearson*** and click **OK**.




3. The results will generate in the Output screen:

**Correlations**

| | | Message Type | SHS |
|---|---|---|---|
| Message Type | Pearson Correlation | 1 | .245* |
| | Sig. (2-tailed) | | .015 |
| | N | 114 | 97 |
| SHS | Pearson Correlation | .245* | 1 |
| | Sig. (2-tailed) | .015 | |
| | N | 97 | 97 |

*. Correlation is significant at the 0.05 level (2-tailed).

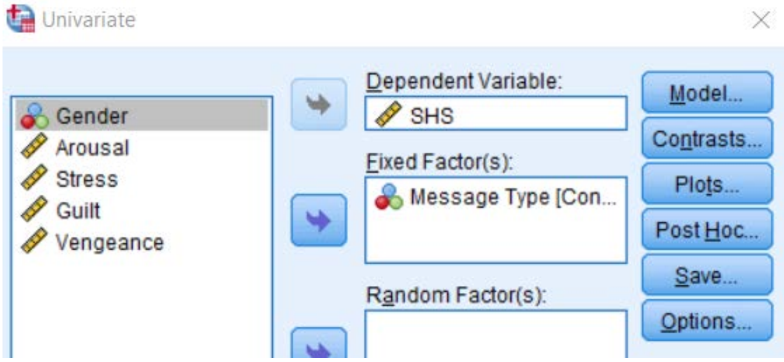
# Chapter 14: Analysis of Variance (ANOVA)

## I. One-way ANOVA

***Objective***: Compare the mean of *SHS* score between two levels of *Message type (Nice, Insult)*

1. Click **Analyze**, **General Linear Model**, then **Univariate**.

2. Highlight *SHS* and click/drag it to the **Dependent Variable** box. Highlight *Message Type* and click/drag it to the **Fixed Factors(s)** box.




3. Click **Options** to include other information wanted (i.e., Parameter Estimates, Descriptive Statistics, etc.). Click **Continue** then **OK**.

4. The results will generate in the Output screen:

**Tests of Between-Subjects Effects**

Dependent Variable: SHS

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 2714.400[a] | 1 | 2714.400 | 6.079 | .015 |
| Intercept | 556437.946 | 1 | 556437.946 | 1246.120 | .000 |
| Condition | 2714.400 | 1 | 2714.400 | 6.079 | .015 |
| Error | 42420.961 | 95 | 446.536 | | |
| Total | 617787.000 | 97 | | | |
| Corrected Total | 45135.361 | 96 | | | |

a. R Squared = .060 (Adjusted R Squared = .050)

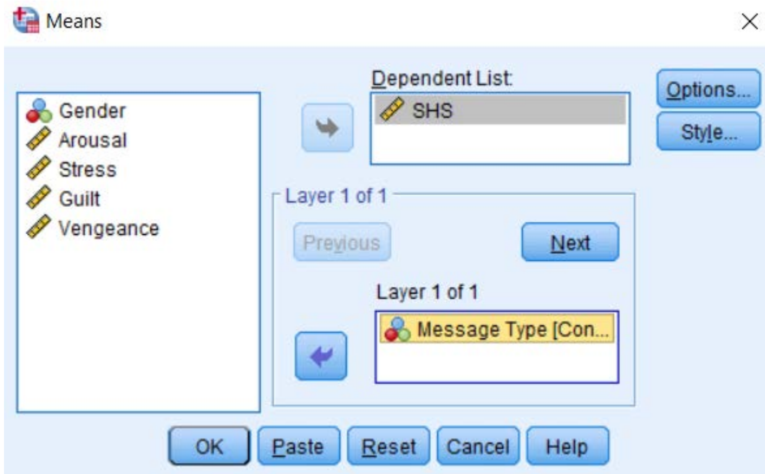
## II. Relational Effect Size Measures

### Eta squared, Partial eta squared

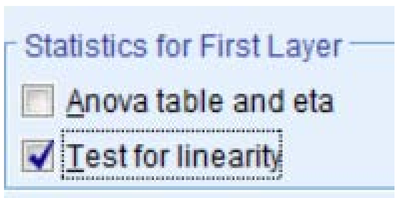
***Objective***: To produce relational effect sizes after comparing the *State Hostility score* (*SHS*) between the two levels of Message (*Insult*, *Nice*)

1. Click **Analyze**, **Compare Means**, then **Means**.

2. Highlight *SHS* and click/drag it to the **Dependent List** box. Highlight *Message Type* and click/drag it to the **Layer** box.




3. Click **Options**, select ***Test for Linearity***. Click **Continue** then **OK**.




4. The results will generate in the output screen, located in the ***Measures of Association*** section.

**Measures of Association**

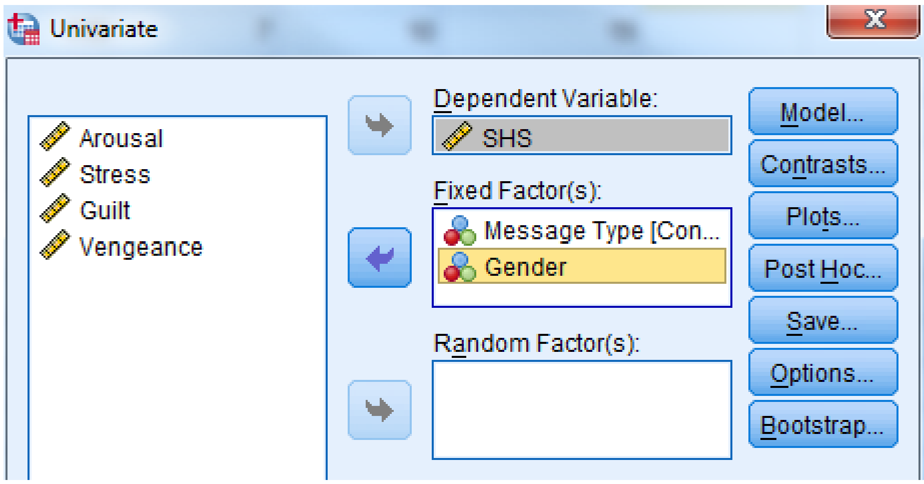
| | Eta | Eta Squared |
|---|---|---|
| SHS * Message Type | .245 | .060 |

# III. Two-way ANOVA

***Objective***: Compare the mean of *SHS score* between *Message* type (*Nice, Insult*) and *Gender* (*Male, Female*)

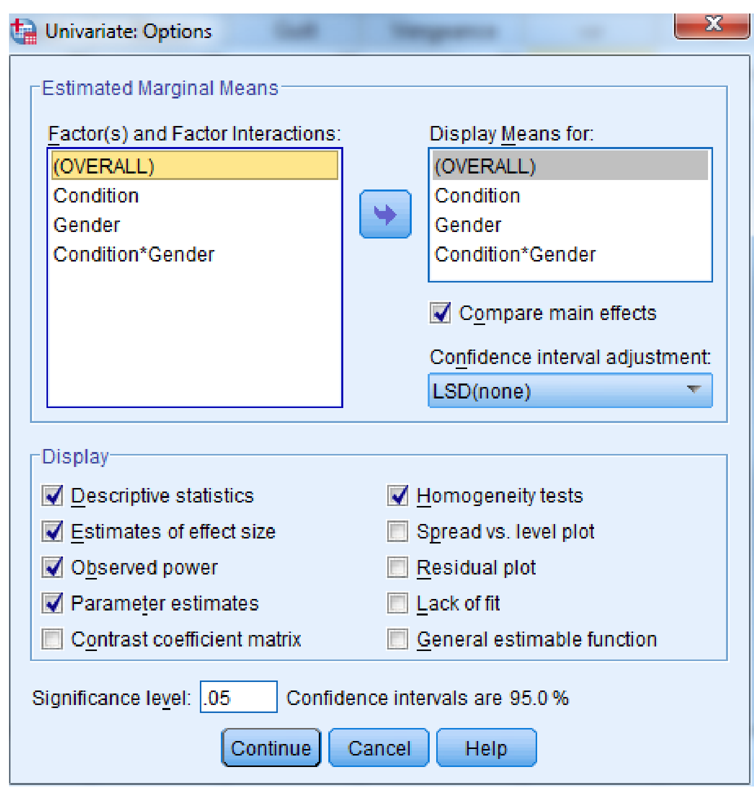
1. Click **Analyze**, **General Linear Model**, then select **Univariate**

2. Highlight *SHS* and click/drag over to the **Dependent Variable** box. Highlight *Message Type* and *Gender*, then click/drag over to the **Fixed Factor(s)** box.




3. Click **Model**, and select ***Full Factorial***. Click **Continue**.

4. Click **Options**, and highlight/click/drag all the factors (*Overall, Condition, Gender, Condition*Gender*) over to the **Display Means** box. Check ***Compare Main Effects***, and select the test desired (LSD is default). You can also select any other additional information you may need (i.e., ***Descriptive Statistics, Parameter Estimates***). Click **Continue**, then **OK**.



5. The main ANOVA table is labeled as the **<u>Tests of Between-Subjects Effects</u>**, indicating whether the model is significant, the main effects, and two-way interaction effect

**Tests of Between-Subjects Effects**

Dependent Variable: SHS

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power[b] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | 3132.756[a] | 3 | 1044.252 | 2.312 | .081 | .069 | 6.936 | .565 |
| Intercept | 470199.919 | 1 | 470199.919 | 1041.092 | .000 | .918 | 1041.092 | 1.000 |
| Condition | 1731.208 | 1 | 1731.208 | 3.833 | .053 | .040 | 3.833 | .491 |
| Gender | 230.038 | 1 | 230.038 | .509 | .477 | .005 | .509 | .109 |
| Condition * Gender | 186.479 | 1 | 186.479 | .413 | .522 | .004 | .413 | .097 |
| Error | 42002.605 | 93 | 451.641 | | | | | |
| Total | 617787.000 | 97 | | | | | | |
| Corrected Total | 45135.361 | 96 | | | | | | |

a. R Squared = .069 (Adjusted R Squared = .039)

b. Computed using alpha = .05

Overall *Model*: $F(3, 93) = 2.312$, $p = .081$

Main Effect of *Condition*: $F(1, 93) = 3.833$, $p = .053$

Main Effect of *Gender*: $F(1, 93) = 0.509$, $p = .477$

Interaction *Condition x Gender*: $F(1, 93) = 0.413$, $p = .522$

# Chapter 15 – Multiple Regression & Beyond

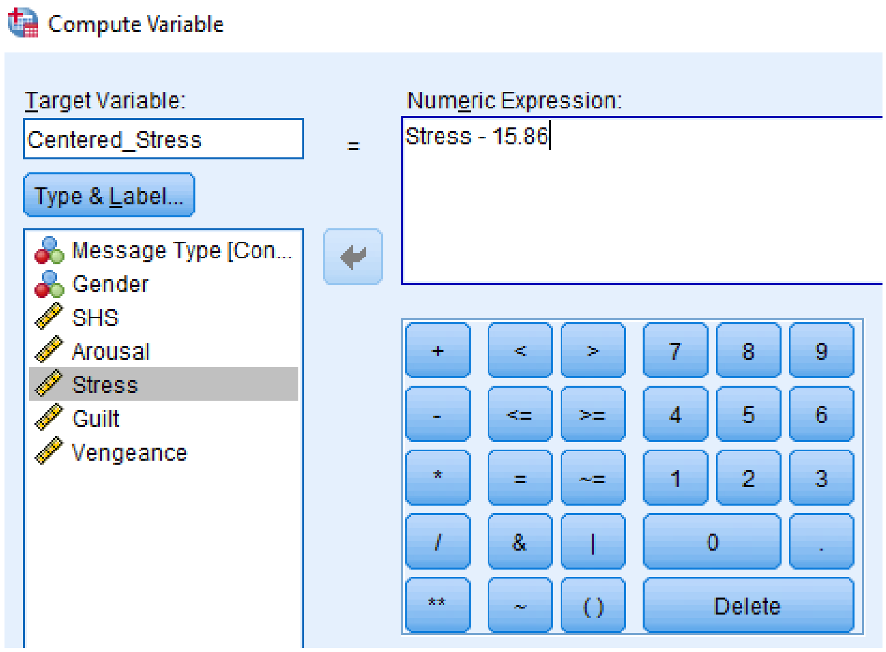
## I. Testing the Simple Slopes of a Continuous x Continuous Interaction

**Objective**: Conduct a multiple regression and probe the interaction by testing the simple slopes

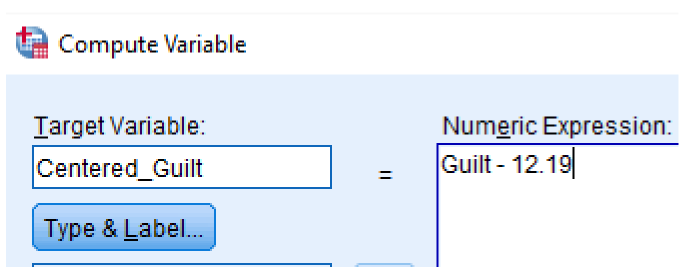
For this example, we are using the *SHS* as the criterion and the *Stress* score, *Guilt* score, and two-way interaction as predictors.

1. Before we conduct analyses, we must first center the predictors (i.e., *Stress*, *Guilt*). We first need to determine the mean of each variable by using the ***Descriptive Statistics*** function. The mean of *Stress* = 15.86, the mean of *Guilt* = 12.19.

2. We created a new variable by using the ***Compute Variable*** function (see Ch 3 Ex 1 for details). For example, we created a new variable titled *Centered_Stress* by subtracting the mean from each *Stress* score:

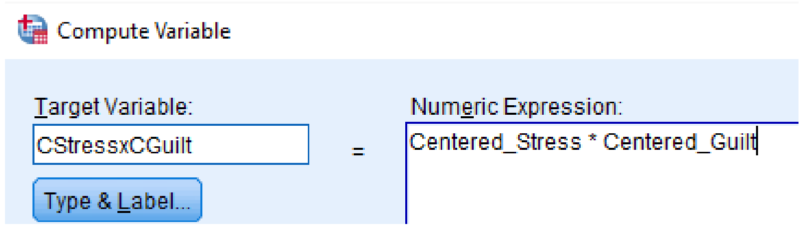



3. We do the same procedure to create *Centered_Guilt*:

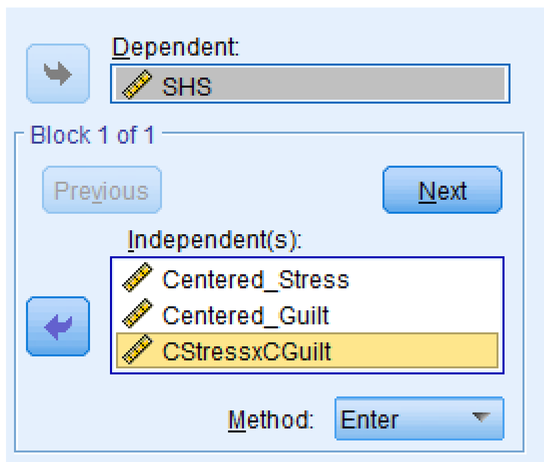



4. Next we create the two-way interaction (i.e., C*StressxCGuilt*) using the *Centered_Stress x*

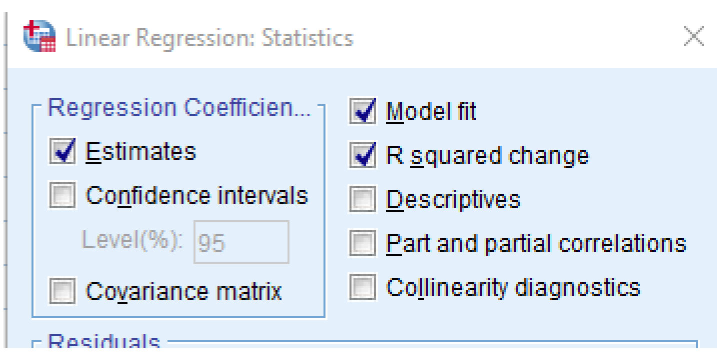
*Centered_Guilt* and the ***Compute Variable*** function:




5. We then conduct a regression analysis by clicking **Analyze**, **Regression**, then selecting **Linear**. Highlight and click/drag *SHS* to the **Dependent** box. Highlight and click/drag each predictor into the **Independent(s)** box: *Centered_Stress, Centered_Guilt, CStressxCGuilt*




6. Click **Statistics**. Select ***Estimates***, ***Model Fit***, ***R_squared change***. Click **Continue** then **OK**.




7. The results will include ***Model Summary***, ***ANOVA*** table, and ***Coefficients*** section.

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .646[a] | .417 | .398 | 17.155 | .417 | 21.020 | 3 | 88 | .000 |

a. Predictors: (Constant), CStressxCGuilt, Centered_Stress, Centered_Guilt

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 18558.922 | 3 | 6186.307 | 21.020 | .000[b] |
| | Residual | 25898.295 | 88 | 294.299 | | |
| | Total | 44457.217 | 91 | | | |

a. Dependent Variable: SHS

b. Predictors: (Constant), CStressxCGuilt, Centered_Stress, Centered_Guilt

**Coefficients[a]**

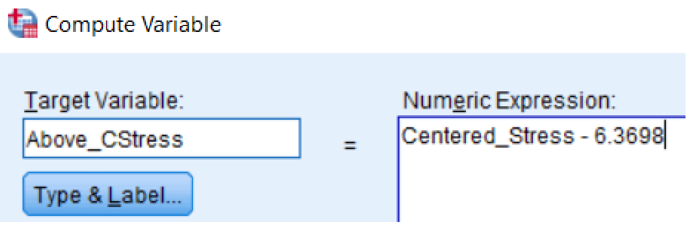
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 77.639 | 2.075 | | 37.412 | .000 |
| | Centered_Stress | 1.306 | .397 | .376 | 3.289 | .001 |
| | Centered_Guilt | 1.638 | .577 | .337 | 2.840 | .006 |
| | CStressxCGuilt | -.047 | .054 | -.076 | -.872 | .385 |

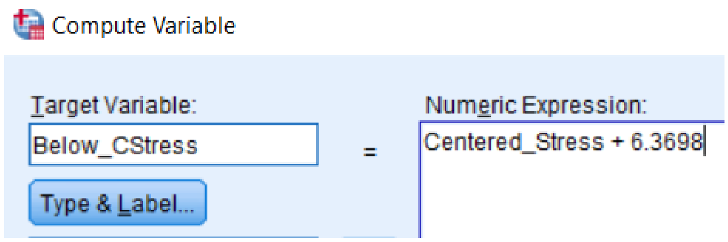
a. Dependent Variable: SHS

8. Even though there is not a significant two-way interaction, we are going to probe the interaction for the purposes of this example. We will test the Simple Slopes of *Guilt* at different levels of *Stress*: 1 standard deviation below the mean, at the mean, and 1 standard deviation above the mean. You can find the standard deviation by using the ***Descriptive Statistics*** function in SPSS: the SD of *Stress* is 6.3698.

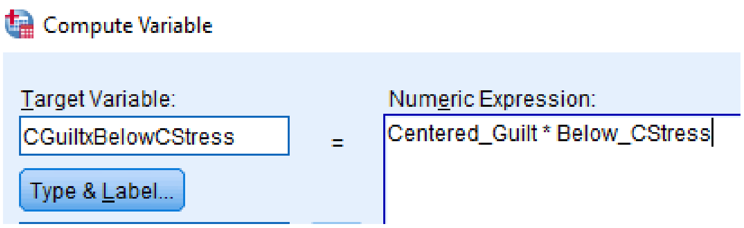
9. Following the same procedures in Step 2, we create 2 new variables: first one (i.e., *Below_CStress*) 1 SD below the mean of *Stress*, second one (i.e., *Above_CStress*)1 SD above the

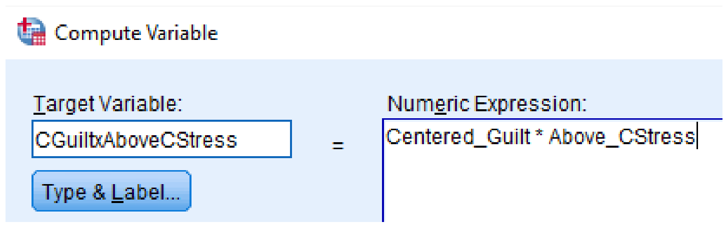
mean of *Stress*.



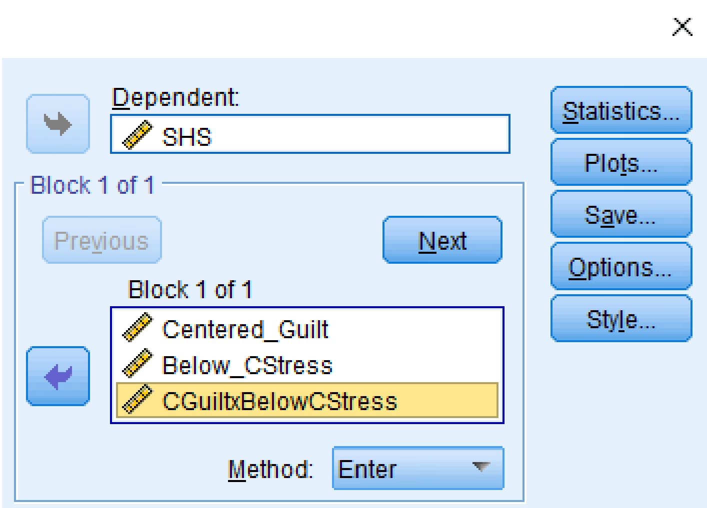



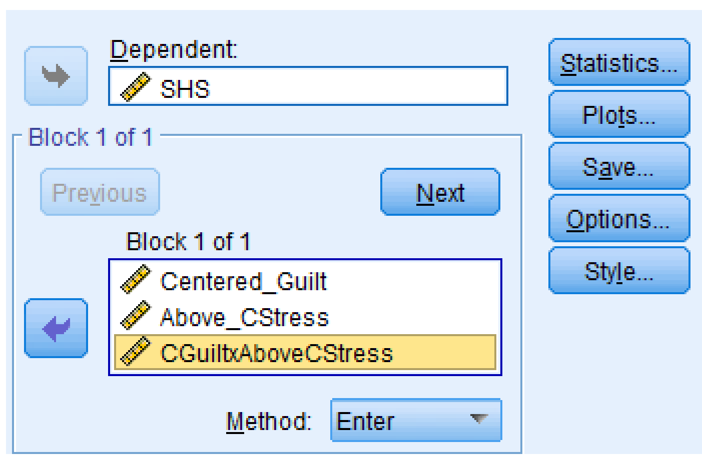

10. Then create 2 new interaction terms with *Centered_Guilt*, using these two new variables:




11. Conduct two new regression analyses, replacing *Centered_Stress* with *Above* and *Below Centered Stress* variables and the appropriate interaction terms:




12. We look at the ***Unstandardized Coefficients*** (i.e., ***B***) in the ***Coefficients*** section of each analyses:

**Coefficients[a]**

| Model | | Unstandardized Coefficients B | Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 69.322 | 3.470 | | 19.980 | .000 |
| | Centered_Guilt | 1.939 | .768 | .399 | 2.525 | .013 |
| | Below_CStress | 1.306 | .397 | .376 | 3.289 | .001 |
| | CGuiltxBelowCStress | -.047 | .054 | -.110 | -.872 | .385 |

a. Dependent Variable: SHS

**Coefficients[a]**

| Model | | Unstandardized Coefficients B | Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 85.955 | 3.059 | | 28.096 | .000 |
| | Centered_Guilt | 1.336 | .560 | .275 | 2.387 | .019 |
| | Above_CStress | 1.306 | .397 | .376 | 3.289 | .001 |
| | CGuiltxAboveCStress | -.047 | .054 | -.084 | -.872 | .385 |

a. Dependent Variable: SHS

a. The value of 1.939 is the slope of *Guilt* at 1 SD below the mean of *Stress*; this is significantly different than a slope of 0 ($t$ = 2.53, $p$ = .01)

b. The value of 1.336 is the slope of *Guilt* at 1 SD above the mean of *Stress*; this is significantly different than a slope of 0 ($t$ = 2.39, $p$ = .02)

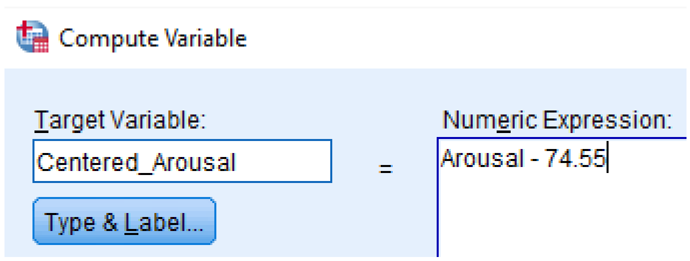
## II. Testing the Simple Slopes of a Categorical x Continuous Interaction

**Objective**: Conduct a multiple regression and probe the interaction by testing the simple slopes

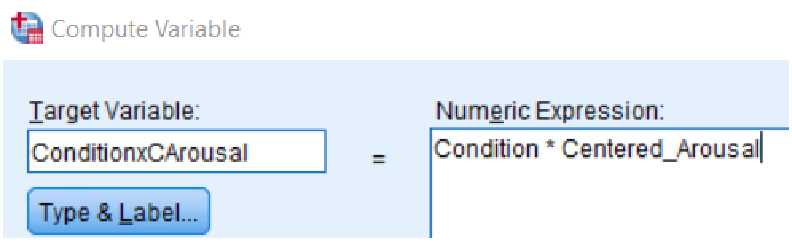
For this example, we are using the *SHS* as the criterion and the *Arousal* score, *Message Type* (dummy coded with *Insult* = 1, *Nice* = 0), and two-way interaction as predictors.

1. Before we conduct analyses, we must first center the continuous predictor (i.e., *Arousal*). We first need to determine the mean by using the ***Descriptive Statistics*** function. The mean of *Arousal* = 74.55.

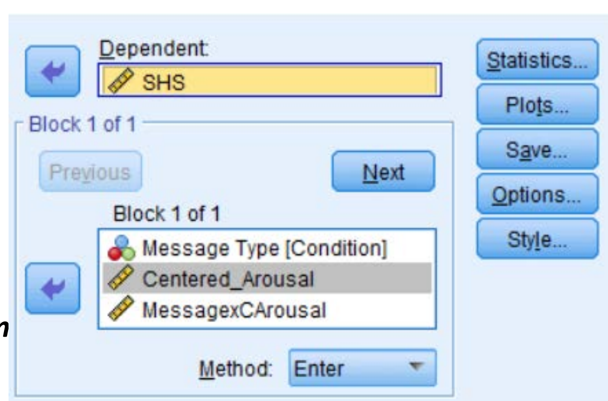
2. We created a new variable by using the ***Compute Variable*** function (see Ch 3 Ex 1 for details). For example, we created a new variable titled *Centered_Arousal* by subtracting the mean from each *Arousal* score




4. Next we create the two-way interaction (i.e., *ConditiontxCArousal*) using the ***Compute Variable*** function:

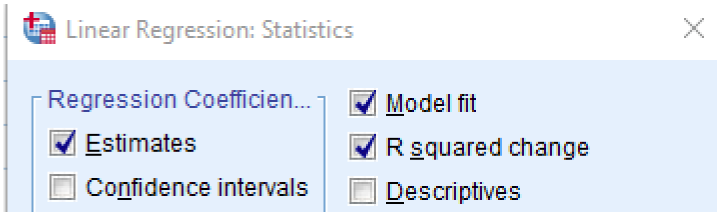



5. We then conduct a regression analysis by clicking **Analyze**, **Regression**, then selecting **Linear**. Highlight and click/drag *SHS* to the **Dependent** box. Highlight and click/drag each predictor into the **Independent(s)** box: *Message Type (Condition), Centered_Arousal, ConditionxCArousal*




6. Click **Statistics**. Select ***Estin*** … ***tinue*** then **OK**.

7. The results will




*ts* section.

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .587[a] | .345 | .322 | 17.704 | .345 | 14.913 | 3 | 85 | .000 |

a. Predictors: (Constant), MessagexCArousal, Message Type, Centered_Arousal

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 14023.023 | 3 | 4674.341 | 14.913 | .000[b] |
| | Residual | 26642.618 | 85 | 313.443 | | |
| | Total | 40665.640 | 88 | | | |

a. Dependent Variable: SHS

b. Predictors: (Constant), MessagexCArousal, Message Type, Centered_Arousal

**Coefficients[a]**

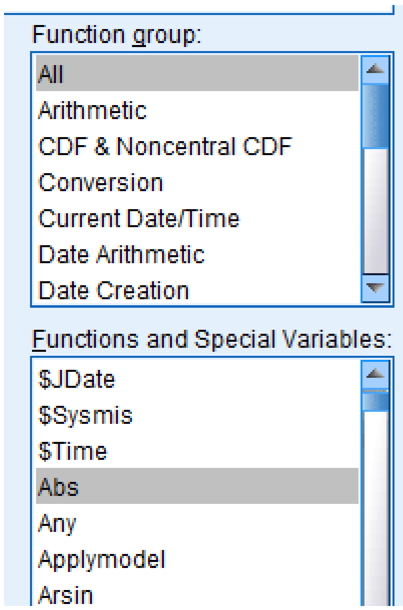
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 70.929 | 2.733 | | 25.956 | .000 |
| | Message Type | 11.223 | 3.760 | .262 | 2.985 | .004 |
| | Centered_Arousal | -.875 | .164 | -.651 | -5.342 | .000 |
| | MessagexCArousal | .407 | .236 | .210 | 1.724 | .088 |

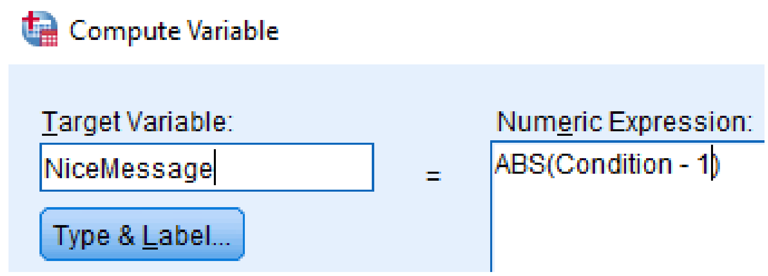
a. Dependent Variable: SHS

8. Even though there is not a significant two-way interaction, we are going to probe the interaction for the purposes of this example. We will test the Simple Slopes of *Arousal* at different levels of *Message Type*: *Insult, Nice*

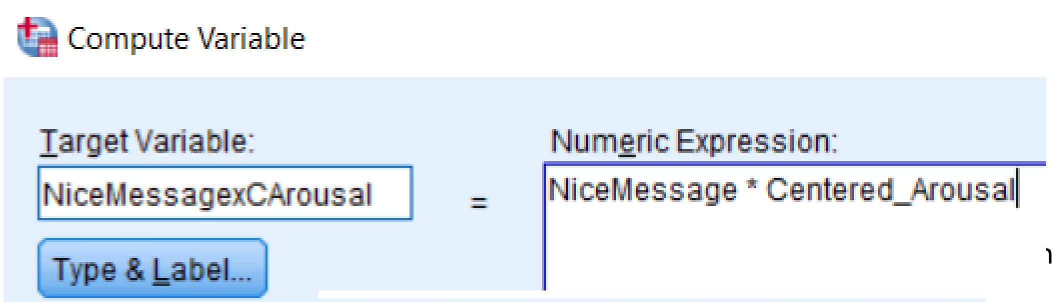
9. Our *Message Type (Condition)* variable is already dummy coded with *Insult* = 1, so this will be used for *InsultxArousal* Simple Slope (i.e., *ConditionxCArousal).* Next we need to re-code the *Condition* variable where *Nice* = 1 to create the interaction term for *Nice Message x Arousal*. To do so, following the same procedures in Step 2, we create a new variable where we will

subtract a 1 from each value in the *Condition* group. However, we will need to take the absolute value in order to have +1 rather than –1.
To do so, in the ***Compute Variable*** function screen, select ***All*** in the **<u>Function</u>** group, and double-click ***Abs*** in the ***Functions and Special Variables*** section. This will put *ABS()* into the **<u>Numeric Expression</u>** box. Next we name our new variable (i.e., *NiceMessage*), and inside the parentheses click/drag *Condition*, then "-1":

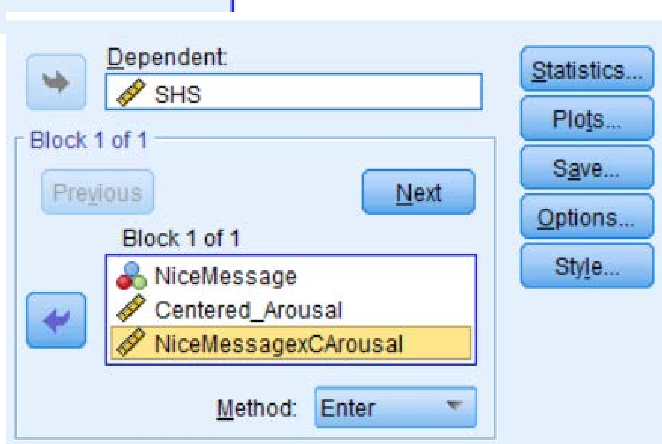



9. To create the interaction term for *NiceMessage by Arousal*, we, again following the same procedures in Step 2, we create a new variable *NiceMessage_CArousal*. Note again that the interaction term for *Insult Message x Arousal* is the original interaction term we used before (*ConditionxCArousal*).




11. Conduct ne
appropriate



12. We look at the ***Unstandardized Coefficients*** (i.e., ***B***) in the ***Coefficients*** section of each analyses. Note that the first one is for the *Insult Message*, which was a part of the original Regression Analyses output:

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 70.929 | 2.733 | | 25.956 | .000 |
| | Message Type | 11.223 | 3.760 | .262 | 2.985 | .004 |
| | Centered_Arousal | -.875 | .164 | -.651 | -5.342 | .000 |
| | MessagexCArousal | .407 | .236 | .210 | 1.724 | .088 |

a. Dependent Variable: SHS

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 82.153 | 2.583 | | 31.801 | .000 |
| | NiceMessage | -11.223 | 3.760 | -.262 | -2.985 | .004 |
| | Centered_Arousal | -.468 | .170 | -.348 | -2.748 | .007 |
| | NiceMessagexCArousal | -.407 | .236 | -.218 | -1.724 | .088 |

a. Dependent Variable: SHS

a. The value of –.875 is the slope of *Arousal* in the *Insult Message Condition*; this is significantly different than a slope of 0 ($t = -5.342$, $p < .0001$)

b. The value of –.468 is the slope of *Arousal* in the *Nice Message Condition*; this is significantly different than a slope of 0 ($t = -2.748$, $p = .007$)