

## JMP Guide

(Compiled from STAT 301 students-Spring 2017 and updated by Dr. Ziegler)

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### **Descriptive Statistics and Graphs for Quantitative Variable (One Mean):**

- Go to *Analyze, Distribution*.
- Put your quantitative variable in the *Y, Columns* box.
- Click *OK*.
- Click the red triangle next to your variable name and select *Display Options, Horizontal Layout*.
- Click the red triangle next to your variable name and select *Histogram Options, Prob Axis*.
- Right click on the horizontal axis labels and select *Add axis label...* Type in the name of the variable in the box and click *OK*.
- Click the red triangle next to *Summary Statistics* and select *Customize Summary Statistics*.
- Add extra summary statistics values as needed.

### **Descriptive Statistics and Graphs for Categorical Variable (One Proportion):**

- Go to *Analyze, Distribution*.
- Put your variable of interest in the *Y, Columns* box.
- Click *OK*.
- Click the red triangle next to your variable name and select *Histogram Options and Separate Bars*.
- Click the red triangle next to your variable name and select *Display Options, Horizontal Layout*.
- Click the red triangle next to your variable name and select *Histogram Options, Prob Axis*.
- Right click on the horizontal axis labels and select *Add axis label...* Type in the name of the variable in the box and click *OK*.
- Click the red triangle next to your variable name and select *Histogram Options, Separate Bars*.

### **Descriptive Statistics and Graphs for Comparing Multiple Means using *Distribution*:**

- Go to *Analyze, Distribution*.
- Put your quantitative variable in the *Y, Columns* box.
- Put your categorical variable in the *By* box.
- Click *OK*.
- Click the red triangle next to your variable name for each group and select *Display Options, Horizontal Layout*.
- Click the red triangle next to your variable name for each group and select *Histogram Options and Prob Axis*.
- Change the limits and scale of each histogram so they are on the same scale. Double-click on a number on the x-axis of each histogram, one at a time. For each, change the *Minimum* to a value equal to or below the overall minimum and change the *Maximum* to a value equal to or above the overall maximum. Use the same values for all histograms. Edit the *Increment* and *# Minor Ticks* to be the same for all histograms.

- Click the red triangle next to *Summary Statistics* for each group and select *Customize Summary Statistics*.
- Add extra summary statistic values as needed.

### **Descriptive Statistics and Graphs for Comparing Multiple Means using *Fit Y by X*:**

- Go to *Analyze, Fit Y by X*.
- Put the *quantitative (response)* variable in the *Y, response* box and *categorical (explanatory)* variable in the *X, factor* box.
- Click *OK*.
- To see the means, standard deviations, and sample sizes for each group, click on the red arrow next to *One-way Analysis* and select *Means and Std Dev*.
- To see the histograms for each group, click on the red arrow next to *One-way Analysis* and select *Display Options, Histograms*.
- To see the boxplots for each group, click on the red arrow next to *One-way Analysis* and select *Display Options, Boxplots*.

### **Confidence Interval for One Mean:**

- Go to *Analyze, Distribution*.
- Select your variable of interest and place in in the *Y, Columns* box.
- Click *OK*.
- Click the red triangle next to the name of the variable you are analyzing.
- Hover over “Confidence Interval” and select the probability you wish to use for your confidence level.
- Your computed confidence interval will appear at the bottom of your data window under “*Mean: Lower CI and Upper CI*.”

### **Hypothesis Test for One Mean:**

- Go to *Analyze, Distribution*.
- Select your variable of interest and place in in the *Y, Columns* box.
- Click *OK*.
- Click the red triangle next to the name of the variable you are analyzing.
- Select *Test Mean*.
- Enter the hypothesized mean into the first box. Leave the second box empty.
  - The second box would give a *z*-distribution instead of a *t*-distribution.
- Click *OK*.
- Under the heading *Test Mean*, a new set of output will appear.
- Identify the test statistic in the output.
- Below the test statistic will be the *p*-values. Match the sign from the  $H_a$  to select the *p*-value of interest.
  - Prob > |t| is the *p*-value for a two-tailed test.
  - Prob > t is the *p*-value for a right-tailed test.
  - Prob < t is the *p*-value for a left-tailed test.

### **Confidence Interval for Difference in Two Independent Means:**

- Go to *Analyze, Fit Y by X*.
- Put your quantitative variable in the *Y, Response* box and your categorical group variable in the *X, Factor* box.
- Click *OK*.
- For un-equal variances: Click the red triangle next to *One-way Analysis* and select *t test*.
- For equal variances: Click the red triangle next to *One-way Analysis* and select *means/ANOVA/Pooled t*.
- The *Upper CL Dif* and *Lower CL Dif* is the 95% confidence interval.
  - To change the confidence interval, for example 99%, click the red down arrow next to *Oneway Analysis*.
  - Select *Set a Level* and choose the significance level.
- To see the histograms for each group, click on the red arrow next to *One-way Analysis* and select *Display Options, Histograms*

### **Hypothesis Test for Difference in Two Independent Means:**

- Go to *Analyze, Fit Y by X*.
- Put your quantitative variable in the *Y, Response* box and your categorical group variable in the *X, Factor* box.
- Click *OK*.
- For un-equal variances: Click the red triangle next to *One-way Analysis* and select *t test*.
- For equal variances: Click the red triangle next to *One-way Analysis* and select *means/Anova/Pooled t*.
- The test statistic and *p*-values show up on the bottom right.
- *P*-value:
  - $\text{Prob} > |t|$  is the *p*-value for a two-tailed test.
  - $\text{Prob} > t$  is the *p*-value for a right-tailed test.
  - $\text{Prob} < t$  is the *p*-value for a left-tailed test.

### **Confidence Interval for Difference in Means with Paired Data:**

- Create a column of differences.
  - Make sure your data is in two columns.
  - Go to *Cols, New Columns...*
  - Give your new column a name such as *Differences*.
  - Select *Column Properties, Formula*.
  - Click on the name of one of your columns.
  - Click on the – sign at the top in the middle.
  - Click on the name of your other column.
  - Click *OK* and *OK*.
- Go to *Analyze, Distribution*.
- Select your difference variable and place in in the *Y, Columns* box.
- Click *OK*.
- Click the red triangle next to the name of the difference variable.
- Hover over *Confidence Interval* and select the probability you wish to use for your confidence level.
- Your computed confidence interval will appear at the bottom of your data window under “*Mean: Lower Cl and Upper Cl.*”

### **Hypothesis Test for Difference in Means with Paired Data:**

- Create a column of differences.
  - Make sure your data is in two columns.
  - Go to *Cols, New Columns....*
  - Give your new column a name such as *Differences*.
  - Select *Column Properties, Formula*.
  - Click on the name of one of your columns.
  - Click on the – sign at the top in the middle.
  - Click on the name of your other column.
  - Click *OK* and *OK*.
- Go to *Analyze, Distribution*.
- Select your difference variable and place in in the *Y, Columns* box.
- Click *OK*.
- Click the red triangle next to the name of the difference variable and select *Test Mean*.
- Enter the hypothesized mean 0 into the first box. Leave the second box empty.
- Click *OK*.
- Under the heading *Test Mean*, a new set of output will appear.
- Identify the test statistic in the output.
- Below the test statistic will be the *p*-values. Match the sign from the  $H_a$  to select the *p*-value of interest.
  - Prob > |t| is the *p*-value for a two-tailed test.
  - Prob > t is the *p*-value for a right-tailed test.
  - Prob < t is the *p*-value for a left-tailed test.

### **Scatterplot using Graph Builder:**

- Click on *Graph, Graph Builder*.
- Drag your quantitative explanatory variable to the *x*-axis and the quantitative response variable to the *y*-axis.
- Click the small icon at the top that shows a small scatter plot with a line on it.
- Right click on the scatterplot. Go to *Line of Fit* and select *Equation*.
- If you would like to split your points by categories, drag your categorical grouping variable to the *Overlay* box on the top right.
- If we would like to make a Graphical Representation of the Prediction Intervals, on the bottom left next to *Confidence*, click on the *Prediction* box. The graph should now show a lighter shaded blue band. This gives the prediction intervals.
- Click *Done* on the top left.

### **Scatterplot Matrix and Correlation Matrix:**

- Go to *Analyze, Multivariate methods, Multivariate*.
- Place all the variables in the *Y, Column* box.
- Click *OK*.

### **Simple Linear Regression using *Fit Y by X*:**

- Go to *Analyze, Fit Y by X*.
- Put the response variable in the *Y, Response* box and the explanatory variable in the *X, Factor* box.
- Click *OK*.
- Click on the red triangle next to *Bivariate Fit* and select *Fit Line*.
- To add the residual plots, click on the red triangle next to *Linear Fit* in the middle of the output, and select *Plot Residuals*. You will want to look at the first plot (*Residual by Predicted Plot*) and last plot (*Residual Normal Quantile Plot*).
- To get confidence intervals for the estimates, right click on any number in the *Parameter Estimates* section, go to *Columns*, and check *Lower 95%* and *Upper 95%*.

### **Linear Regression using *Fit Model*:**

- Go to *Analyze, Fit Model*.
- Put the response variable in the *Y* box.
- Select the explanatory variable(s) and click the *Add* button to put the variables in the *Construct Model Effects* box.
- Click *Run*.
- To show the regression equation, click on the red triangle next to *Response* and select *Estimates, Show Prediction Expression*.
- To get confidence intervals for the estimates, click on the red triangle next to *Response* and select *Regression Reports, Show all Confidence Intervals*.
- To compute predictions, click on the red triangle next to *Response* and select *Estimates, Multiple Comparisons*. Enter the values of *x* you would like to make predictions for.

### **VIF:**

- In the *Fit Model* output:
- Hold the cursor over the *t Ratio* in the *Parameter Estimates* part of the output.
- Next right click and select *Columns, VIF*.

### **Creating Indicator Variables:**

- Option 1: Recoding
  - Highlight the Column of the categorical variable.
  - Click on *Cols, Recode*.
  - Replace the categories with numbers in the *New Values* column.
  - Click *Recode*. JMP will label this new column as 'categorical variable name 2'.
  - Right click on your new column, 'categorical variable name 2' and click *Column Info...*
  - Change *Data Type* to *Numeric* and *Modeling Type* to *Continuous*.
  - Click *OK*.
- Option 2: Indicator Columns (DO NOT USE IF YOU HAVE MISSING DATA)
  - Highlight the Column of the categorical variable.
  - Click on *Cols, Utilities, Make Indicator Columns*.
  - Click *OK*.

### **Multiple Regression including Interaction using *Fit Model*:**

- If you have any categorical variables to include in the interaction term(s), create indicator variables in JMP.
- Go to *Analyze, Fit Model*.
- Put the response variable in the *Y* box.
- Select the explanatory variables and click the *Add* button to put the variables in the *Construct Model Effects* box.
- Highlight the two explanatory variables you would like to include in the interaction in the *Select Columns* box on the left.
- Click *Cross* to add the interaction into the *Construct Model Effects* box.
- Click on the red triangle next to *Model Specification* and uncheck *Center Polynomials*.
- Click *Run*.
- To show the regression equation, click on the red triangle next to *Response* and select *Estimates, Show Prediction Expression*.

### **Multiple Regression with Quadratic Term using *Fit Model*:**

- If you have any categorical variables to include in the interaction term(s), create indicator variables in JMP.
- Go to *Analyze, Fit Model*.
- Put the response variable in the *Y* box.
- Select the explanatory variable(s) and click the *Add* button to put the variables in the *Construct Model Effects* box.
- Highlight the explanatory variable you would like to include in the quadratic term in the *Select Columns* box on the left.
- Click *Macros* and select *Polynomial to Degree* to add the interaction into the *Construct Model Effects* box.
- Click on the red triangle next to *Model Specification* and uncheck *Center Polynomials*.
- Click *Run*.
- To show the regression equation, click on the red triangle next to *Response* and select *Estimates, Show Prediction Expression*.

### **Normal Quantile Plot and Histogram for Residuals using *Fit Model*:**

- Go to the *Fit Model* output.
- Normal Quantile Plot:
  - Click on the red triangle next to *Response*.
  - Go to *Row Diagnostics*, then click on *Plot Residual by Normal Quantiles*.
- Histogram:
  - Click on the red triangle next to *Response*.
  - Go to *Save Columns*, then click on *Residuals*.
  - Go to *Analyze, Distribution*.
  - Put *Residual* in the *Y, Columns* box.
  - Click *OK*.

### **Transformation: Create New Variable that is the Natural Log of a Different Variable:**

- Go to *Cols, New column*.
- Name the new column with natural log in it (e.g.,  $\ln(\text{variable})$ ).
- Select *Column Properties, Formula*.
- On the left, click on *Transcendental, ln*.
- Click on the variable you would like to transform in the *Columns*. Click *OK* and *OK*.

### **Leverage/Influence Plot:**

- Fit your model using *Fit Model*.
- In your *Fit Model* output, click on the red triangle next to *Response* and select *Save Columns, Residuals*.
- Go back to the original JMP data set.
- Compute the standardized residuals:
  - Go to *cols, New Column*.
  - Give the column a name of “Standardized Residuals.”
  - Select *Column Properties, Formula*.
  - Click on the column *Residual*, click on the  $\div$  button in the middle, then type the value of your root mean square error in the denominator. You can find the value of your root mean square error in the *Fit Model* output.
  - Click *OK* and *OK*.
- Store your leverage values (hats):
  - Go back to your *Fit Model output*. Click on the red triangle next to *Response* and select *Save Columns, Hats*.
- Store your Cook’s D values:
  - Go back to your *Fit Model output*. Click on the red triangle next to *Response* and select *Save Columns, Cook’s D Influence*.
- Create the Leverage and Influence Plot:
  - Click on *Graph, Graph Builder*.
  - Drag the *Standardized Residuals* to the Y-axis and the *Leverage Values* (labeled as h) to the x-axis.
  - Drag the *Cook’s D* to the *Size* box on the right.
  - To get a legend for *Cook’s D*, drag *Cook’s D* to the *Color* box on the right.
  - Change the x-axis label to “*Leverage Values*” and the title to “*Leverage and Influence Plot*.”
  - Unclick the small icon at the top that shows a small scatterplot with a curve on it.
  - Right click on the y-axis and select *Axis Settings...*
  - In the *Reference Lines* section, type 0 in the *Value* box.
  - Click *Add* and *OK*.
  - Add additional horizontal reference lines at -2 and +2, and possibly at -3 and +3.
  - Right click on the x-axis and select *Axis Settings...*
  - In the *Reference Lines* section, type the cutoff values for high and very high leverage in the *Value* box. For the high value, type in *High Leverage* in the *Label* box. For the very high value, type in *Very High Leverage* in the *Label* box.
  - Click *Add* and *OK*.
  - Click *Done*.



### **Prediction Intervals and Confidence Intervals for a Mean at Specific Values of $X^*$ using *Fit Model*:**

- Go to the original JMP data set and scroll down to the end. We need to create a row for the  $X^*$  value we want to compute the intervals for. Type the value of  $X^*$  in the last row and appropriate column. Do not type any other values in the data table.
- Fit your model using *Fit Model*.
- Go to your *Fit Model* output. Click on the red triangle next to *Response* and select *Save Columns, Mean Confidence Interval*.
- Click on the red triangle next to *Response* again and select *Save Columns, Indiv Confidence Interval*.
- Go to your data table and look at the last four columns in the last row where you typed the value of  $X^*$ .
- The columns for *95% Mean* gives the confidence interval and the columns for *95% Indiv* gives the prediction interval. Note that this also gives the intervals for every observation in the dataset.

### **Model Selection-RMSE, $R^2$ , Adjusted $R^2$ , and Mallow's $C_p$ :**

- Go to *Analyze, Fit Model*.
- Put the response variable in the *Y* box.
- Select the explanatory variable(s) and click the *Add* button to put the variables in the *Construct Model Effects* box.
- For *Personality* on the top right, select *Stepwise* from the dropdown menu.
- Click *Run*.
- Click on the red triangle next to *Stepwise Fit* and select *All Possible Models*.
- Change the *Number of best models to see:* to be a large number such as 100.
- Click *OK*.
- Each model will be shown at the bottom. To see the RMSE,  $R^2$ , Adjusted  $R^2$ , Mallow's  $C_p$  for each model, select the radio button in the last column for each model separately. The values are shown towards the top.

### **Model Selection-Backward Elimination:**

- Go to *Analyze, Fit Model*.
- Put the response variable in the *Y* box.
- Select the explanatory variable(s) and click the *Add* button to put the variables in the *Construct Model Effects* box.
- For *Personality* on the top right, select *Stepwise* from the dropdown menu.
- Click *Run*.
- Change the *Stopping Rule* to *P-value threshold*.
- Change the *Prob to Leave* to 0.05.
- Change the *Direction* to *Backward*.
- Select *Enter All* and click *Go*.
- The steps are shown at the bottom in the *Step History* and the chosen variables are checked in the *Current Estimates*.
- Click *Run Model*.

### **Partial F-test: Hypothesis Test for Categorical Variable with More Than 2 Levels in Regression using *Fit Model*:**

- Fit your model using *Fit Model*.
- Click on the red triangle next to *Response* and select *Estimates, Custom Test*.
- At the bottom of your output, a list of boxes will appear. At the very bottom, click *Add Column* until you have the same number of columns as the number of predictors you plan to test (the number of categories for your categorical variable minus one).
- In the first column, replace the 0 with a 1 for the first category.
- In the second column, replace the 0 with a 1 for the next category.
- Repeat for all categories.
- Click *Done*.
- The output shown in the box is the results for the test of your categorical variable.

### **One-way ANOVA using *Fit Y by X*:**

- Go to *Analyze, Fit Y by X*.
- Put the *quantitative (response)* variable in the *Y, response* box and *categorical (explanatory)* variable in the *X, factor* box.
- Click *OK*.
- Click on the red arrow next to *One-way Analysis* and select *Means/Anova*.
- To see the standard deviations and sample sizes for each group, click on the red arrow next to *One-way Analysis* and select *Means and Std Dev*.
- To see the histograms for each group, click on the red arrow next to *One-way Analysis* and select *Display Options, Histograms*.
- To see the boxplots for each group, click on the red arrow next to *One-way Analysis* and select *Display Options, Boxplots*.
- To create a normal quantile plot:
  - Click on the red arrow next to *One-way Analysis* and select *Save, Save Residuals*.
  - Go to your data table; you should see a column labeled *Y centered by X*. These are the residuals.
  - Go to *Analyze, Distribution*.
  - Put your residual variable in the *Y, Columns* box.
  - Click *OK*.
  - Click the red triangle next to your variable name and select *Normal Quantile Plot*.
- If you want to create a residual plot:
  - Click on the red arrow next to *One-way Analysis* and select *Save, Save Residuals* if you have not already.
  - Click on the red arrow next to *One-way Analysis* and select *Save, Save Predicted*.
  - Go to the data table.
  - Select *Graph, Graph Builder*, and put your residuals on the y-axis and predicted values on the x-axis. JMP will label the column of residuals as *Y centered by X* and label the column of predicted values as *Y mean by X*.
  - Put appropriate labels on your axis.

### **One-way ANOVA using *Fit Model*:**

- Go to *Analyze, Fit Model*.
- Put the *quantitative (response)* variable in the *Y* box and *categorical (explanatory)* variable in the *Construct Model Effects* box.
- Click *Run*.
- To create a normal quantile plot, click on the red arrow next to *Response* and select *Row Diagnostics, Plot Residual by Normal Quantiles*.

### **Multiple Comparisons with One-way ANOVA using *Fit Y by X*:**

- Go to *Analyze, Fit Y by X*.
- Put quantitative variable in the *Y, Response* box and your categorical variable in the *X, Factor* box.
- Click *OK*.
- Click on the red triangle next to *Oneway Analysis* and select *Means/ANOVA*.
- To change the confidence level, click on red triangle next to *Oneway Analysis* and select *Set  $\alpha$  level* and enter your value.
- Click on the red triangle next to *Oneway Analysis* and select *Compare Means, All Pairs, Tukey HSD*.

### **Scatterplot with Manually Added Simple Linear Regression Lines using *Graph Builder*:**

- Click on *Graph, Graph Builder*.
- Drag your quantitative explanatory variable to the *x*-axis and the quantitative response variable to the *y*-axis.
- Unclick the small icon at the top that shows a small scatter plot with a curve on it.
- Right click on the scatterplot. Go to *Customize....*
- Click on the + on the top left.
- Select *Templates, Y Function*.
- Replace *\_function\_of\_x\_* with the value of your *y*-intercept + value of the slope \* *x*. For example, if your simple linear regression equation was  $\hat{y} = 10 + 2 * x$ , you would type in  $10 + 2 * x$ .
- If you would like to change the color of the line, select *Templates, Pen Color*. Replace “blue” with any standard color (e.g., “red”).
- Click on *Apply*.
- If you would like to add more simple linear regression lines, click on the + again and add in the new equation.
- If you would like to add text describing what the lines refer to, click on the + again.
- Select *Templates, Text*.
- Replace *\_x\_* with the *x* coordinate you would like the text to show up with and *\_y\_* with the *y* coordinate you would like the text to show up.
- Replace *\_text\_* with your text (e.g., “Average X2”).
- Once you have finished adding regression lines and text, click on *OK*.
- Click *Done* on the top left.

### **Contingency Tables and Chi-Square Test for Independence using *Fit Y by X*:**

- Go to *Analyze, Fit Y by X*.
- Put the *categorical (response)* variable in the *Y, response* box and *categorical (explanatory)* variable in the *X, factor* box.
- Click *OK*.
- To see the expected counts, click on the red arrow next to *Contingency Table* and select *Expected*.

### **Logistic Regression with Quantitative Explanatory Variable(s):**

- Go to *Analyze, Fit Model*.
- Put the *categorical (response)* variable in the *Y* box and *quantitative (explanatory)* variable in the *Construct Model Effects* box.
- Click *Run*.
- To remove the points for the graph, click on the red arrow next to *Nominal Logistic Fit*, select *Plot Options*, and uncheck *Show Points*.