**Lab 13 – Fall 2016**

Goals: This lab demonstrates:

 1) How to fit a two-way factorial ANOVA

 2) How to estimate marginal means (lsmeans) and differences among lsmeans

 3) How to set JMP defaults

 4) How to get JMP help

**Fitting a two-way factorial ANOVA model:**

Load the Diesel.txt data set. Analyze / Fit Model. Put FUEL and BRAND in the Construct Model Effects box. Then, select both variables in the Select Columns box and click Cross to add FUEL\*BRAND to the model. Then run the model.

The ANOVA table is divided into two pieces:

1. The Error information is in the Analysis of Variance box of output.
2. F tests for individual factors are in the Effect Tests box of output.

The pooled standard deviation (variability of observations around their group means) is the root Mean Square Error in the Summary of Fit box.

The marginal (Least Squares) Means tables for each factor are found in one of two places.

If you Fit Model with the default Effect Leverage emphasis, the LSMEANS are found in the columns to the right of the main results. The one under FUEL contains the lsmeans for each fuel type, averaged over the two brands of engine. The one under BRAND contains the lsmeans for each brand, averaged over the three types of fuel.

If you Fit Model with the Minimal Report emphasis, the LSMEANS are found by expanding the Effect Details tab found at the bottom of the single column of results. Click on the light grey triangle by Effect Details and that tab will expand to show the lsmeans for each level of each factor and each combination (treatment).

Note: The numbers we will use are in the Least Sq Means column. These are the averages that I defined in lecture. The values in the Mean column are the "one-bucket" averages that are sometimes appropriate and usually not.

here is a shortcut to creating the interaction variable: Select the two variables in the Select Columns box, then click Macros and select Full factorial from the menu. JMP will put both variables and their interaction into the model box.

**Further things you can do with LSMEANS:**

If you click the red triangle by the name of the factor (or name of a factor if you have more than one), the menu provides various things you do with the LSMEANS. The most relevant is to click LSMEANs Student’s T. You get a table with a box for each pair of levels. The four numbers in each box, from top to bottom are:

 The estimated difference

 The standard error of that difference

 and the lower and upper values for the 95% confidence interval for the difference.

If you take 402 or another course that discusses multiple comparisons among means, you will learn about alternatives to the unadjusted T tests that are done by LSMEANS Students T. JMP provides Tukey's HSD multiple comparisons if you use the LSMEANS Tukey HSD option and Dunnett's (one to many comparisons) if you use LSMEANS Dunnett.

If you want the exact p-value for a comparison of two means, you need to use LSMeans Contrast, which works like Custom Test. See me if you need this.

**Set JMP defaults:**

You have probably noticed that JMP has many default behaviours. For example, Fit Model centers polynomials by default when you include square or product terms in the model. If you don’t want this, you can turn this off each time or you can change the default so that “Center Polynomials” is not selected. To change defaults, select File / Preferences from the main menu in any JMP window. There are huge number of options, organized by categories. All the statistical options are in the Platforms dialog. That opens a long list of analyses as a menu of Platforms. The ones that we have worked with are:

Distribution: to change default plots produced by Analyze / Distribution

Distribution Summary Statistic: to change default numerical summaries produced by Analyze / Distribution

Graph Builder: to change default characteristics of the Graph / Graph Builder graphs

Overlay Plot: to change default characteristics of the Graph / Overlay Plot graphs

Scatterplot Matrix: to change default characteristics of the scatterplot matrix (Analyze / Multivariate Methods / Multivariate)

Fit Least Squares: to change default output for Fit Y by X and Fit Model when Y is continuous

**Help for JMP:** This is available in various places.

The 301 lab pages will be kept available until the next time I teach 301. They are then revised for each year.

The Help menu in JMP provides various resources:

 Help Contents / Search / Index: typical help file information that can be searched for specific things

 Books provides electronic versions to books that were (long ago) the printed documentation for JMP.

 These are up-to-date for the current version of JMP.

 The books that are most relevant for what we’ve covered are:

 Basic Analysis: for Fit Distribution and Fit Y by X.

 Fitting Linear Models: for multiple regr. and ANOVA (the Fit Model stuff)

**Self Assessment Questions:**

The data in PRACEXAM.txt are from a study of perceived helpfulness of two types of exam preparation (review or doing a practice exam). Students are grouped by their class standing, STANDING (low, medium or high) and the type of exam prep. they used, PREP. The response variable, RATING, is an 11 point rating scale for the perceived helpfulness of the exam prep (0 = not helpful at all to 10 = extremely helpful). Start by fitting a two-way ANOVA model, with interaction, to these data.

1. Test whether there is an interaction (i.e., null hypothesis of no interaction) between PREP and STANDING. What are the F statistic and p-value?

2. Does average perceived helpfulness differ among the three levels of class standing?

3. Is the difference between the two types of preparation the same for all levels of class standing?

4. Estimate the average difference between practice and review (the two levels of PREP, averaged over class standing.

5. What is a 95% confidence interval for the average difference between practice and review

6. Is it appropriate to use the average difference (from Q3) to describe the difference seen in low standing students?

**Answers:**

1. F = 1.77 with p=0.17.

Note: These are the F test for PREP\*STANDING.

2. No evidence of a difference (p = 0.12), looking at the F test for the STANDING factor

3. No evidence of an interaction (p = 0.17).

4. 1.29 (Practice higher than Review)

5. (0.62, 1.96)

6. Yes, because there is no evidence of an interaction.