**PSY 870: Module 4 Problem Set**

**2** × **3 Between-Subjects Factorial ANOVA: Study Environments by Gender**

This study investigates whether study environment affects academic performance. In addition, this study investigates whether sex of student "moderates" the effect of study environment on academic performance (that is, do males and females differ in how much benefit they get from studying in certain environments).

During the first half of the spring semester, 120 male students and 120 female students in grade 10 at a public high school in a large metropolitan area in the southwestern region of the United States were randomly assigned to one of three study environment: study in front of the TV, at the library, or in the food court. The students could ONLY study in the environment to which they were assigned during the research period. At the end of the 7-week research period, mid-term GPA was computed for each student. A change score was computed for each student: each student's spring midterm GPA was subtracted from his or her GPA for the preceding fall semester. The difference was each student's GPA Improvement score. The GPA improvement score was used to measure academic performance.

**Directions:**

Using the SPSS 2 × 3 ANOVA data file for Module 4 (located in Topic Materials), answer the following questions.NOTE: Helpful hints are provided here for you to use while answering these questions. There is no separate answer sheet/guide to use while doing this assignment.

1. What are the two independent variables in this study? What is the dependent variable?
2. Why is a two-way between-subjects factorial ANOVA the correct statistic to use for this research design?
3. Did you find any errors that the researcher made when setting up the SPSS data file (Remember to check the variable view)? If so, what did you find? How did you correct it?
4. Run Descriptive Statistics on the dependent variable data. What do the skewness and kurtosis values tell you about whether the data satisfy the assumption of normality?
5. Perform a between-subjects factorial ANOVA on the data.
   1. What do the results of the Levene's Test tell you about your data? What does this mean in terms of interpreting the outcomes of the ANOVA?
   2. What do the results of the Tests of Between-Subjects Effects tell you? Was there a significant main effect of Environment on GPA improvement? Was there a significant main effect of Sex on GPA improvement? Was there a significant interaction effect of Environment X Sex on GPA improvement? Report the results for each of these questions providing the actual *F*-value and *p* value using the following format: *F*(df1, df2) = \_\_\_\_, *p* = .\_\_\_ or if the *p* is shown as .000, write it as p < .001; an example of this formatting is *F*(1, 400) = 15.4, *p* = .02).
   3. Use eta squared to provide effect size/proportion of variance accounted associated with each F-value. If the *F*-value for a main effect and/or for an interaction effect is statistically significant, what is the eta squared (2) value associated with that outcome?

HINT:

***Report*** eta squared, 2; ***ignore*** partial eta squared that SPSS can provide. You have to calculate eta squared yourself. It is not given to you by SPSS, but you can use what SPSS provides to calculate it. Eta squared is calculated by using the values in the column headed "Type III Sum of Squares" from the table with the results for Tests of Between-Subjects Effects." To compute eta squared, which would be notated as 2, take that source's Type III Sum of Squares and divide it by the value for Corrected Total in the same column. For example, if the Type III Sum of Squares for Environment had been 4.5 rather than 4.696, you would divide 4.5 by 14.677 to get the effect size for Environment. If the Type III Sum of Squares for Sex had been 2.0, you also would divide that by 14.677, etc. Interpret these eta squared results for effect size using the following guidelines from Cohen (1988):

* .01 ~ small
* .06 ~ medium
* .14 ~ large
  1. If the result for the main effect of Environment was statistically significant, what did you find out when you performed post hoc tests (Tukey HSD) to look at possible statistically significant differences in the pairs of means for Environment groups?
  2. If the result for the interaction of Environment X Sex was statistically significant, what follow up tests did you perform to understand what was going on here? That is, what did you do to find out what was different for males in the various study Environments versus for females in the various study Environments in effects on GPA improvement? What did you learn?
  3. When you have a factorial ANOVA and the interaction effect is significant, does the researcher give much attention to any significant main effects when interpreting the results of the study?

1. Citing the results of your statistical analyses, what is the conclusion you can draw (and support) regarding research question that was posed in this research (see problem statement)? Write a results section for this study that expresses and supports this conclusion.

HINT:

Use the sample write-up of the results for the Two-Way Between-Subjects ANOVA example that is in the textbook to see what you should report and how to say it. Just substitute the correct language and values for the analyses you have done for this problem.