# Lab 09: Mixing Continuous and Categorical Predictors (ANCOVA)

As always, indicate your answers using a different color font or shading to clearly separate your answers from the questions. When you are finished, save the file as "lab09\_FIRST\_LAST" using **your** first name and **your** last name, and then upload the file as a Word Document or .pdf on Canvas.

## For the first two questions, we will be using the data\_TEACHING.csv datafile to explore the effects of two different science curricula delivered by two different teachers. Our outcome will be students’ scores at the end of the class and we will have two categorical factors of Curriculum (+1 = the new experimental curriculum; -1 = the traditional “control” curriculum) and Teacher (+1 = Teacher A and -1 = Teacher B). Ideally, we would like to see an effect of curriculum (in either direction), but not an effect of teacher (as hopefully our teachers have similar efficacy, baseline student abilities, etc.). **Importantly, we want to control for pre-test as covariate.** By taking this extra step, we account for the fact that different students had different levels of proficiency at the start of the study.

## Question 1.

1A. **Create a scatterplot showing post-test scores as a function of pre-test scores and CURRICULUM**. Turn on the linear regression line for each group and marginal density plots:

1B. **Create a scatterplot showing post-test scores as a function of pre-test scores and TEACHER**. Turn on the linear regression line for each group and marginal density plots:

1C. Next, create a **mean-centered** version of the pre-test variable called “pretest.c”. Note that the mean pre-test score in these data is 50.0. Next, in the linear regression tab, create a multiple regression with score as the dependent variable, and put pretest.c, curriculum, and teacher in the covariate box. Include the Curriculum x Teacher interaction in your model. **Insert the output of that regression below**.

1D. Note that our previous model ignored potential interactions between our categorical factors and the covariate. **Thus, this model assumed regression slopes to be homogenous.** To test if this assumption is acceptable, add Pretest x Curriculum, Pretest x Teacher, and Pretest x Teacher x Curriculum interactions to your model. **Insert the output of that regression below**.

1E. Finally, given your full regression equation in 1D, solve the regression equation to get the predicted values for the 4 participants described below:

1. Average pre-test score, New Curriculum, Teacher A:

2. Average pre-test score, Old Curriculum, Teacher A:

3. Pre-test score of 60, New Curriculum, Teacher A:

4. Pre-test score of 60, Old Curriculum, Teacher A:

## Question 2.

2A. Next, we will analyze the same data, but using the ANCOVA option under the ANOVA tab in Jamovi. Select ANCOVA, set score as your dependent variable, curriculum and teacher will be your fixed factors, and pretest.c will be the covariate. **Insert the resulting ANCOVA table below**:

2B. Given the statistically significant interaction, we should perform post-hoc tests to better understand where the differences lie in these data**. Assume we want to conduct all pair-wise comparisons for post-hoc tests, how many tests would that be**?

2C. Using the post-hoc tab under the ANCOVA menu, turn on all pairwise comparisons for the curriculum x teacher interaction. Enable both “no correction” and the “Bonferroni” correction for multiple comparisons. **Insert the post-hoc comparison table below**.

2D. Note that the p-values for the Bonferroni correction are different from the p-values for the no-correction option. **Explain how these values differ mathematically**.

2F. Finally, provide a **written interpretation** of the main-effects and the interactions, controlling for pre-test as a covariate. Be sure to include an interpretation of your post-hoc tests.

## Question 3.

Finally, we want to conduct a brand-new ANCOVA using a different dataset, either one of your own or one from class (e.g., the data\_GAME example also has pre- and post-test scores, making it suitable for this analysis).

3A. **Create scatterplot showing the dependent variable as a function of the covariate and the INDEPENDENT variables**. Turn on the linear regression line for each group and the marginal density plots:

3B. Next, we will analyze the data using the ANCOVA option under the ANOVA tab in Jamovi. Select ANCOVA, set your dependent variable, select your independent variable/s as your fixed factors, and select your covariate. **Insert the resulting ANCOVA table below**:

3C. Next, provide a test of your different assumptions. Insert the results that speak to each assumption below. Clearly state whether that assumption was met or not:

**1. Normality of the residuals:**

**2. Homogeneity of the residuals:**

**3. Homogeneity of the regression slopes:**

3D. Finally, provide a **written interpretation** of the main-effects and the interactions, controlling for the covariate. Be sure to include an interpretation of your post-hoc tests, if any.