PSYC 5143
Spring ‘24
Problem Set #4

These are due on Monday, February 19, at the beginning of class, submitted on Blackboard as an R file. Assume α = .05. Make sure factors are factors rather than character variables.

1) In a study of the relative effectiveness of methods of teaching elementary probability, students read one of three texts: the standard (S), the Low Explanatory (LE), and the High Explanatory (HE). The DV is final exam scores. The (fabricated) data are here.

   a. Using contrast codes to execute the contrasts below (which are orthogonal!), fit a linear model and briefly interpret the slopes of the contrasts (i.e., say what they tell you with respect to the conditions in the experiment). Use the Bonferroni adjustment to decide whether these are significant.

      i. Does reading a text with explanations of any kind (high or low explanatory) lead to higher exam scores than reading a standard text?
      ii. Does reading a highly explanatory test lead to higher exam scores than reading a low explanatory test?

   b. For each parameter estimate associated with the contrasts above, report η^2(aka sr^2 aka `dR-sqr`) and then convert it to an unbiased version (using the formula at right). Finally convert the unbiased η^2 values to f^2.

   $$\boxed{adjusted\ PRE = 1 - (1 - PRE)\left[\frac{n-PC}{n-PA}\right]}$$

   c. Use the `pwr.f2.test()` function to estimate how many participants would be needed to achieve .9 power based on the unbiased effect-size estimates you obtained in part b. (You can use G*Power instead if you’d like; please report all input parameters.) Please note that the sample sizes you come up with may be smaller than those in the hypothetical study; or not.

   d. Report *SSE* for the model you fit in part a.

   e. Fit an intercept-only (i.e., one-parameter) model and report *SSE* for it.

   f. Using the SSE from part d and part e, find *PRE* and convert it to *F*. (Note! There are two parameters different between these two models rather than one.)

   g. Execute a conventional ANOVA on the data using `summary(aov(Y ~ Text, data)` and verify that the *F* statistic in this summary table matches the one you found in part f. (And then take a moment to feel sadness that the ANOVA by itself answers no real questions of interest.)

2) In a study of the effects of reward on learning in rats, four independent groups (*n* = 5 each) receive different reward schedules: always (100%), frequent (75%), infrequent (25%), or never (0%). The number of errors in a 30-trial experiment is in reward.csv; the levels of the condition variable are 1 = always; 2 = frequent; 3 = infrequent; and 4 = never. Assume you want to carry out all six possible pairwise comparisons. Use the `pairwise.t.test` function to answer parts a-c. Simply compare *p*-values to alpha to decide significance.

   a. Using no procedure to control familywise error rate or the false discovery rate, which of the pairwise comparisons are significant?

   b. Using the Bonferroni correction, which of the pairwise contrasts are significant?

   c. Using the Benjamini-Hochberg procedure, which of the pairwise contrasts from part b are significant? (This might or might not be a different answer than in part a.)

   d. Now execute the following code (which also does all pairwise contrasts) – `TukeyHSD(aov(errors ~ condition, data))` – and say which are significant. (Simply compare the `p adj` values to .05.) (This might or might not be a different answer than in parts a or b.)

   e. Which of the procedures (Bonferroni, Benjamini-Hochberg, or Tukey's HSD) leads to the lowest *p*-values (and therefore the greatest power)?