PSY 5301: Research Methods

Instructions: please complete each problem below and submit your completed exam in Canvas using one of two file formats: either (1) write your solutions on paper and scan to a PDF, or (2) embed photos of your solutions in a Word/OpenOffice document. On either method, please show (or describe) as much work as possible. Report your final answers rounded to 2 decimal places. Data files can be found in the exam3data.zip file on Canvas.

1. An experiment was conducted in which students in three classes were randomly assigned to three treatment groups. Students in Group 1 were given quizzes weekly. Students in Group 2 were given quizzes every other day. Finally, students in Group 3 were given quizzes every day. End-of-course achievement scores were recorded for each student. The data are available in the file problem1.csv.

   Perform a Bayesian ANCOVA testing the impact of quiz frequency on end-of-course achievement scores, with general academic ability as a covariate. Write up the results, being sure to include the following elements:

   (a) a description of the analysis performed
   (b) a list of potential models
   (c) the models which increased their model odds after observing data
   (d) a report of the model with highest posterior probability
   (e) a comparison of this model (i.e., BF_{10}) against the next best fitting model
   (f) the inclusion (or exclusion) Bayes factors for each predictor
   (g) an estimate (with 95% credible interval) of the covariate effect.

2. Consider the following data:

X	7	5	6	3	4
Y	11	7	8	3	6

   (a) Compute the linear regression equation for predicting Y from X.
   (b) Perform an ANOVA to test whether X is a significant predictor of Y.

3. Consider the following data:

X	6	3	5	6	4	6
Y	4	1	0	7	2	4

   (a) Compute the linear regression equation for predicting Y from X.
   (b) Perform an ANOVA to test whether X is a significant predictor of Y.

4. A researcher is interested in the relationship between height and income for a sample of $N = 10$ people. Heights were classified in five categories and had a mean of 3 with $SS = 20$. Income, measured in thousands, had a mean score of 66 with $SS = 7430$. Further, the correlation between height and income was found to be 0.78.

   - Find the regression equation for predicting income from height score. What is the predicted income for someone in the fourth height category (i.e., $X = 4$)?

   - What proportion of variance in income is accounted for by the regression equation? Is this proportion statistically significant?

5. Researchers were interested in the relationships among opinions about education and religion and overall happiness. All subjects completed two questionnaires. First, they filled out a survey rating different words on their meaningfulness or pleasantness. Critically, they rated importance of words related to both education and religion. Scores were rated on a Likert scale from 1 (not important) to 5 (very important). The data set problem5.csv contains the averages for the words by type (education or religion). Then they completed a happiness questionnaire. Do education ratings mediate the relationship between importance of religion and happiness? To do this mediation analysis, complete the following steps:

   (a) Draw a path diagram for the direct model ($X \xrightarrow{c} Y$) and estimate the total effect c.

   (b) Draw a path diagram for the mediation model ($X \xrightarrow{a} M \xrightarrow{b} Y$) and estimate the effects a and b.

   (c) Use the estimates obtained in parts (a) and (b) to calculate the direct effect c' (i.e., the effect of X on Y after controlling for the mediator M).

   (d) Use Sobel's (1982) method to test the mediation model. That is, test $\mathcal{H}_0 : ab = 0$ (i.e., no mediation occurred) against $\mathcal{H}_1 : ab \neq 0$. Report both a p-value and a Bayes factor and interpret the results of the test.