## Psychology 318 Exam #5

## June 2, 2010

### Instructions

1. Use a pencil, not a pen

2. Put your name on each page where indicated, and in addition, put your section on this page.

3. Exams will be due at 10:20!

4. If you find yourself having difficulty with some problem, go on to the rest of the problems, and return to the troublemaker if you have time at the end of the exam.

5. Leave your answers as reduced fractions or decimals to three decimal places.

6. CIRCLE ALL ANSWERS: You will lose credit if an answer is not circled!!

7. Check to make sure that you have all questions (see grading below)

8. SHOW ALL YOUR WORK: An answer that appears from nowhere will receive no credit!!

9. Don't Panic!

10. Assume homogeneity of variance unless told otherwise.

11. Good luck!

### Grading

Problem Points Grader

1a-b 20 Jianli

2a-e 55 Leanna

3 10 Alec

4 15 Chris

TOTAL /100

1. Ashley and Jane are twins. Ashley likes partying, while Jane likes studying. However, they both do well enough during high school to get into the Formidable Institute of Technology (FIT). In their Freshman year, they take exactly the same courses, one of which is statistics.

At FIT, it is known, from analyses of all students who have ever gone there, that the correlation over students between Freshman-year grade-point average (GPA) and Sophomore-through-Senior GPA is r = 0.10. Also, the mean GPA for each of the four years is known to be 3.0 with a standard deviation of 1.1.

At the end of their Freshman years at FIT, Ashley and Jane return home for the summer. Ashley has earned a GPA of 2.0 during her Freshman year, while Jane has earned a GPA of 3.5 during the same year, taking the same courses.

Their parents are pleased with Jane. However, they do something that parents should generally not do, which is to say to Ashley, “We can't believe that your GPA is one and a half points lower than your sister’s! Why can't you be more like her? Is this the way it’s going to be throughout your four years at FIT?”

a) Based on her knowledge of statistics, what might Ashley say in response to her parents about what her and Jane’s future GPA’s are expected to be? In particular, what two GPA values should Ashley compute and what would the values be? (15 points)

b) What reasons can you think of for why the correlation between Freshman-year GPA and Sophomore-through-Senior GPA is so low? (5 points)

2. An experiment is done examining effects of age on digit span (digit span refers to the number of digits that can be successfully recalled from short-term memory).

The investigators have a theory that incorporates the following two hypotheses:

Hypothesis 1: In the age range from 6 to 50 years, digit span will *increase* linearly with age in years.

Hypothesis 2: In the age range from 51 to 90 years, digit span will *decrease* linearly with age in years.

An experiment is run with n = 20 subjects in each of J = 8 groups. Groups correspond to age, which range from 6 to 90 mg. The specific ages are shown in the leftmost column of the table below. **CAUTION: The ages are not all evenly spaced!** (For the moment, don’t worry about the means in the rightmost column).

|  |  |  |  |
| --- | --- | --- | --- |
| Age (years) | Wj(1) | Wj(2) | Mj (digits recalled) |
| 6 |  |  | 3 |
| 8 |  |  | 3 |
| 16 |  |  | 5 |
| 30 |  |  | 8 |
| 45 |  |  | 7 |
| 65 |  |  | 6 |
| 70 |  |  | 3 |
| 90 |  |  | 2 |

a) Determine weights corresponding to Hypothesis 1 and Hypothesis 2. The two sets of weights should be independent of one another. Make each set of weights as simple as possible in the following sense: All weights should be integers and the absolute values of your weights should be as small as possible. Fill in these weights in the table above. (20 points)

b) The data from the experiment are in the right column of the above table (mean number of digits recalled for each group). Note that SSB = 677.50. Compute sums of squares corresponding to the two hypotheses and to the residual from the two hypotheses. (10 points)

c) Construct an ANOVA table containing all information relevant to doing these kinds of planned comparisons. Use the .05  level. Based on the ANOVA table, what should be concluded?

ASSUME: SSW = 3,800. (10 points)

d) What is the Pearson **r** (*not* r2) between the weights and the means for each of the two hypotheses? (5 points)

e) Compute w2, i.e., the percent of total variance in the experiment that is accountable to variation in age (10 points)

3. Suppose you have a set of J means, Mj, and a corresponding set of weights for a planned comparison, Wj. Now suppose that you make up a new set of weights, Wj’ by multiplying each of your original weights by some constant, k, i.e., for each condition j, Wj’ = kWj.

Show algebraically that, in general (i.e., not using a specific example) that the sum of squares you’d get by using the Wj’ weights would be the same as it would using the original Wj weights. (10 points)

4. You work for Probability Security at the Hardhat Casino in Las Vegas. You are asked to monitor the coin tosser in the game of “Twosies.” In this game, the tosser tosses two coins, a penny and a quarter, repeatedly and of consequence is whether the two coins come up both heads, both tails, or a head and a tail.

You wish to evaluate the null hypothesis that the tosser’s coins are both fair, i.e., that they have equal probabilities of coming up heads and tails *and* that the two coins are independent of each other. So you observe 1,000 tosses. The frequencies are as follows.

Two heads: 325

One head and one tail: 340

Two tails: 335

Test the null hypothesis that the coins are fair and they are independent. Use the .05  level.

 (15 points)