## Psychology 318 Final Exam

## June 9, 2009

### 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. **Always assume homogeneity of variance unless told otherwise.**

11. **Always indicate degree of freedom in your answers whenever it is appropriate.**

12. **Always use an  level of .05 unless told otherwise.**

13. Good luck!

### Grading

Problem Points Grader

1a-d 29 Andy

1e-h 26 Tim

2a-b 20 Courtney

3a-d 15 Zach

4 10 Yu

TOTAL /100

1. Bird Products Inc. has developed a new drug, SmartChirp, designed to increase bird intelligence. Bird Products Inc. plans to test SmartChirp on two types of birds: Parakeets and Cockatoos. In the design of the experiment:

Factor 1 is amount of SmartChirp per day that a bird is given. Birds are given either 1, 5, or 9 gms per day for a month.

Factor 2 is type of bird: Parakeet or Cockatoo.

This produces a 3 x 2 design. There are n = 4 birds in each of the six groups.

At the end of the study, all birds have their intelligence measured on the bird IQ (BIQ) test. Their scores are summarized in the table below. Note that lots of means, sums and sums of squared scores are provided, many of which will be helpful for calculating your answers.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Amount of SmartChirp | | |  |
|  |  | 5 gm | 9 gm |  |
| Parakeets | Xi112 = 7,446  T11 = 154  M11 = 38.50 | Xi212 = 10,825  T21 = 195  M21 = 48.75 | Xi312 = 31,400  T31 = 340  M31 = 85.00 | Xij12 = 49,671  TR1 = 689 |
| Cockatoos | Xi122 = 3,230  T12 = 112  M12 = 28.00 | Xi222 = 6,166  T22 = 156  M22 = 39.00 | Xi322 = 17,000  T32 = 260  M32 = 65.00 | Xij22 = 26,396  TR2 = 528 |
|  | Xi1j2 = 10,676  TC1 = 266 | Xi2j2 = 16,991  TC2 = 351 | Xi3j2 = 48,400  TC3 = 600 | T = 1,217 |

Note that the following is true

Xijk2 = 76,067

Tjk2 = 281,821

TCj2 = 553,957

TRk2 = 753,505

Row 1: Tj12 = 177,341

Row 2: Tj22 = 104,480

Column 1: T1k2 = 36,260

Column 2: T2k2 = 62,361

Column 3: T3k2 = 183,200

a) Perform a two-way ANOVA on these data; i.e., complete the ANOVA table below (including criterion F's). Use the space on the previous page for computing sums of squares. (15 points)

ANOVA

Source df SS MS Obt F Crit F

Between

Amount (A)

Bird Type (B)

AxB

Within

b) Compute the ***90***% confidence interval that goes around each of the cell means, Mjk. (NOTE: you need compute only one confidence interval). (5 points)

c) Compute the ***90***% confidence interval that goes around each of the column means, MCj. (NOTE: you need compute only one confidence interval) (5 points)

d) Consider two planned hypotheses:

H1: Bird intelligence increases linearly with amount of SmartChirp (for all birds).

H2: Cockatoos aren't as smart as Parakeets

Make up independent sets of weights corresponding to these hypotheses and put them in the two tables below (for your convenience, the means are reproduced in the bottom table).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Weights: | Amount of SmartChirp | | |  |
| Hypothesis 1 |  | 5 gm | 9 gm |  |
| Parakeets |  |  |  |  |
| Cockatoos |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Weights: | Amount of SmartChirp | | |  |
| Hypothesis 2 |  | 5 gm | 9 gm |  |
| Parakeets |  |  |  |  |
| Cockatoos |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Amount of SmartChirp | | |  |
| Means |  | 5 gm | 9 gm |  |
| Parakeets | 38.50 | 48.75 | 85.00 |  |
| Cockatoos | 28.00 | 39.00 | 65.00 |  |

What percent of SSB is accounted for by your two hypotheses and the residual? Are the hypotheses and the residual statistically significant? (Again, be sure to include relevant Criterion F's). (4 points)

ANOVA

Source df SS MS Obt F Crit F % var

Between

H1

H2

Rsid

Within

e) Consider Parakeets only. Can you reject the null hypothesis of SmartChirp effect? Assume homogeneity of variance throughout. (5 points)

f) Re-do part (e) but do not assume population variances of Parakeets and Cockatoos to be necessarily the same. (5 points)

g) Test the alternative hypothesis that Cockatoos are more *variable* (in terms of intelligence) than are Parakeets against the null hypothesis that variability is the same for the two kinds of birds. Use the = .05 level. Given your answer, do you think the test in Part (e) or Part (f) above would be the more appropriate one? Briefly explain your answer. (5 points)

h) Do not assume homogeneity of variance *at all*. Compute the 80% confidence interval around M11. (5 points)

2. Consider a within-subjects design with J = 6 conditions, K = 13 subjects, and n = 5 observations per subject per condition. In this experiment, you can compute sum of squares and mean squares within (SSW and MSW), between (SSB and MSB), due to conditions (SSC and MSC), due to subjects (SSS and MSS), due to subject-by-condition interaction (SSI and MSI) and total (SST and MST).

a) Suppose you were asked to make up data for this experiment. Describe the necessary and sufficient conditions such that MSC would be zero *and* MSW would be greater than zero? (8 points)

b) Suppose you discovered that your research assistant was lazy and ran only one person through the experiment 13 times rather than going to the trouble of getting 13 separate people. This means, of course, that this one person goes through all J=6 conditions 5 times per condition. You may assume that each of this person’s 13 go-throughs of the experiment are independent of each other.

What would be the relations among the expectations of MSC, MSS, MSI, MSW, MST, and 2e. Answer this question both assuming that the null hypothesis of no condition effect is true and that the null hypothesis of no condition effect is false? (7 points)

3. Is there a relation between number of office hours attended in a calculus class and the final grade in the class? Ten students are observed during the class. Both their average number of weekly office hours (X-score) and their final grades (Y-scores on a scale from 1-4) are observed. The following are the summary data.

X = 25

Y = 30

[nXY - (XY)] = 190

[nX2 - (X)2] = 345

[nY2 - (Y)2] = 166.8

a) What is the best-fitting regression equation (including, of course, values of the slope, b and the intercept, a) for obtaining a predicted final exam score (Y') from number of office hours? (5 points)

b) What is the regression equation (again including values for b and a) for obtaining a predicted office-hour score (X') from final exam score? (5 points)

c) What are the Pearson rand Pearson r2 between the X and Y scores? (5 points)

d) What are the variances (S2) of the Y scores and of the (Y-Y’) scores? (5 points)

4. Consider all families with two kids. Suppose that 48 such families are observed. Of them 19 have two boys and 16 have two girls.

Can you reject, at the 0.05 level, the null hypothesis that each child in a family has a .5 probability of being a boy and each child is independent of each other child? (10 points)