Name_____________________________ Please circle your TA: Adam Suzanne Yiyu

# Psychology 318 Exam #3
# May 3, 2017

## 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. Assume homogeneity of variance unless told otherwise.

10 Use $\alpha$ = .05 unless told otherwise.

## Grading

| Problem | Points | Grader |
|---|---|---|
| 1a-c | 60 | Yiyu |
| 1d-f | 20 | Suzanne |
| 2a-e | 20 | Adam |

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1. An educational psychologist develops three new techniques, Technique A, Technique B, and Technique C for teaching Spanish vocabulary. They are all to be compared with the standard technique now in use. Thus there are (June 23) = 4 Teaching Methods in all.

   An additional variable is the grade at which the techniques are first introduced. They are taught to students who begin learning Spanish in Grades 2, 6, or 10. So this produces a design involving J = 4 levels of teaching technique (the current standard plus the three new techniques) and K = 3 levels of starting grade.

   There are n = 20 students in each of the 12 conditions.

   All students are given a standard Spanish vocabulary test when they graduate from high school. Scores can range from 0 to 20.

   Various results are shown in the tables below. Note that the type of result shown in each table is indicated **in bold** at the upper left of the table. Various marginals are also provided.

Teaching Method

| **$\Sigma x_{ijk}^2$'s** | Standard | Technique A | Technique B | Technique C | Sums |
|---|---|---|---|---|---|
| Grade 2 | 1,140.3 | 6,889.7 | 6,523.0 | 7,035.0 | 21,588.0 |
| Grade 6 | 1,087.8 | 3,267.1 | 3,464.9 | 3,624.1 | 11,443.9 |
| Grade 10 | 1,087.8 | 2,472.2 | 2,564.3 | 2,700.7 | 8,825.0 |
| Sums | 3,315.9 | 12,629.0 | 12,552.2 | 13,359.8 | 41,856.9 $= \Sigma\Sigma\Sigma X_{ijk}^2$ |

| **$T_{jk}$'s** | Standard | Technique A | Technique B | Technique C | $T_{Rk}$'s |
|---|---|---|---|---|---|
| Grade 2 | 138 | 366 | 356 | 370 | 1,230 |
| Grade 6 | 134 | 248 | 256 | 262 | 900 |
| Grade 10 | 134 | 214 | 218 | 224 | 790 |
| $T_{Cj}$'s | 406 | 828 | 830 | 856 | 2,920 = T |

| **$M_{jk}$'s** | Standard | Technique A | Technique B | Technique C | $M_{Rk}$'s |
|---|---|---|---|---|---|
| Grade 2 | 6.900 | 18.300 | 17.800 | 18.500 | 15.375 |
| Grade 6 | 6.700 | 12.400 | 12.800 | 13.100 | 11.250 |
| Grade 10 | 6.700 | 10.700 | 10.900 | 11.200 | 9.875 |
| $M_{Cj}$ | 6.767 | 13.800 | 13.833 | 14.267 | 12.167 = M |

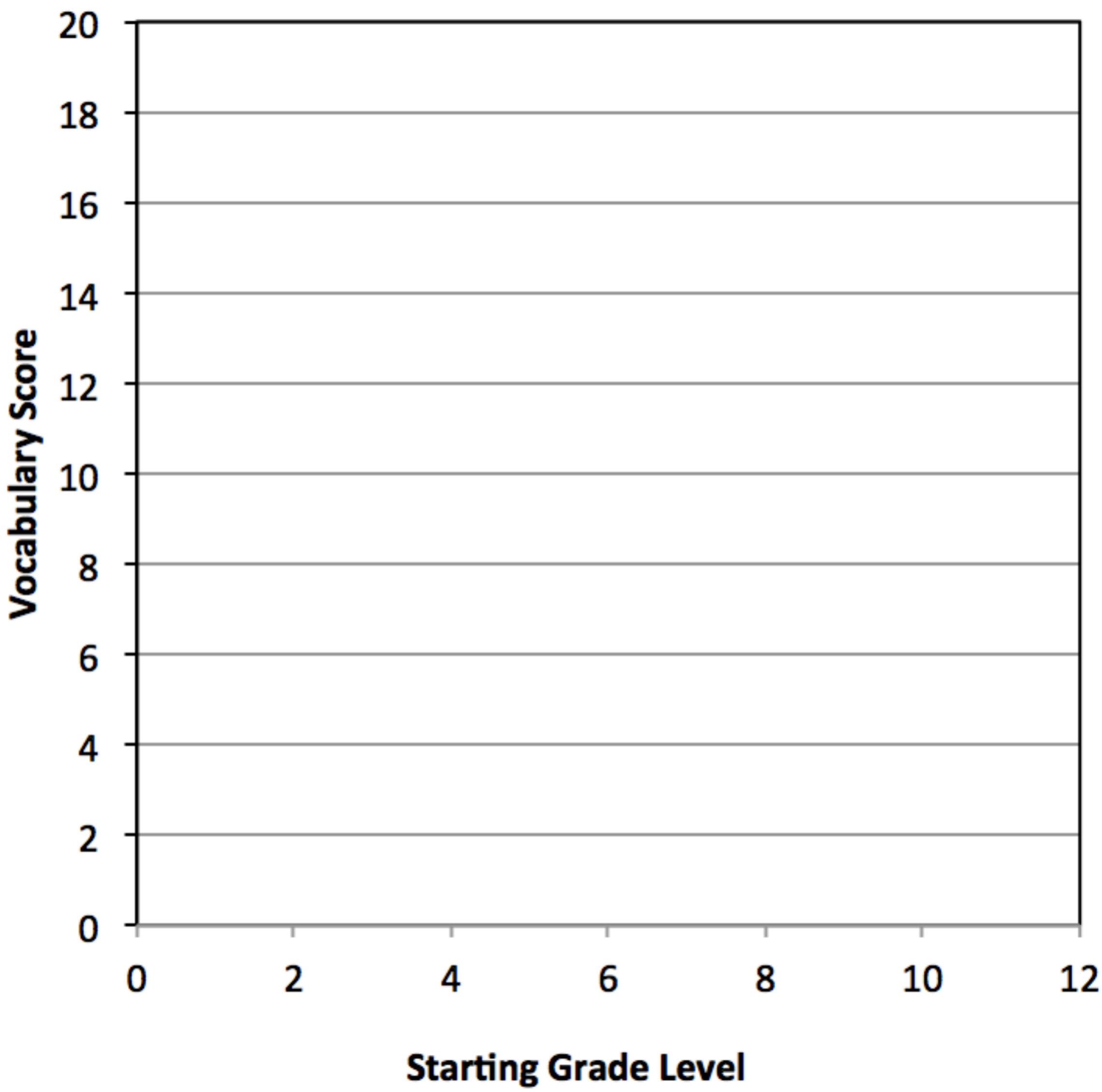
For your convenience we have calculated the following terms for you:

$\Sigma\Sigma\Sigma x_{ijk}^2 =$ 41,857
$\Sigma\Sigma T_{jk}^2 =$ 791,728
$\Sigma T_{Cj}^2 =$ 2,272,056
$\Sigma T_{Rk}^2 =$ 2,947,000
$T^2 =$ 8,526,400

(CAUTION: these sums of squared things haven't been divided by anything)

Problem 1 (continued)

a) Graph your data on the axes below (a rough graph will suffice and don't worry about confidence intervals). **Note that grade is plotted along the X-axis**. Then explain, as if to someone with very little knowledge of statistics, what your data mean. **Be as brief as you can.** (10 points)



Problem 1 (continued)

b) Carry out a standard ANOVA on these data. Use $\alpha = .05$. Arrange your results in an ANOVA table. Include SST and dfT in your table. (26 points)

Problem 1 (continued)

c) Compute 95% confidence interval magnitudes around $M_{jk}$, $M_{Cj}$, $M_{Rk}$, and M (the grand mean). (24 points)

Problem 1 (continued)

d) Is there a statistically significant effect of teaching method for Grade 2 only? (Don't forget that you're still assuming complete homogeneity of variance). (5 points)

e) Repeat Part (d) but with the following homogeneity of variance assumption: $\sigma^2$ is the same for each of the four Grade-2 cells; however $\sigma^2$ for the Grade-2 cells is not necessarily the same as it is for the other two grades. (7 points)

f) Using the same homogeneity of variance assumption as in Part (e) compute a 95% confidence interval magnitude suitable for each Grade-2 cell mean, $M_{j1}$ and for the Grade-2 row mean, $M_{R1}$. (8 points)

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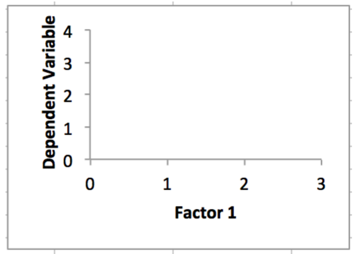
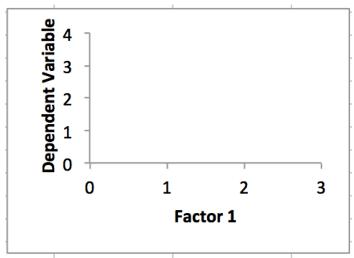
2. Draw rough graphs on the axes provided that represent data from 2 x 2 designs such that the following is true. Assume that Independent Variable 1 is the column variable and Independent Variable 2 is the row variable. Plot Independent Variable 1 along the horizontal axis and label everything. (4 points apiece)

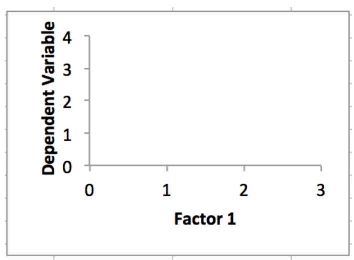
a) SSC = 0; SSR = 0; SSI > 0



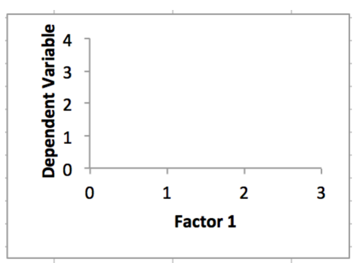

b) SSC = 0; SSR > 0; SSI = 0




c) SSC = 0; SSR = 0; SSI = 0




d) SSC > 0; SSR = 0; SSI = 0




e) SSC > 0; SSR > 0; SSI > 0