Name_____________________________ Please circle your TA: Adam Suzanne Yiyu

Psychology 318 Exam #4
May 17, 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 α = .05 unless told otherwise.

Grading

Problem	Points	Grader
1	15	Suzanne
2a-b	30	Adam
3a-c	26	Adam
4a-f	29	Yiyu

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1. What follows is a design involving three subjects in three conditions with two observations per subject per condition.

Subject	Condition 1	Condition 2	Condition 3	
1	x_{111} = x_{211} = M_{11} =	x_{121} = x_{221} = M_{21} =	x_{131} = x_{231} = M_{31} =	M_{R1} =
2	x_{112} = x_{212} = M_{12} =	x_{122} = x_{222} = M_{22} =	x_{132} = x_{232} = M_{32} =	M_{R2} =
3	x_{113} = x_{213} = M_{13} =	x_{123} = x_{223} = M_{23} =	x_{133} = x_{233} = M_{33} =	M_{R3} =
	M_{C1} =	M_{C2} =	M_{C3} =	

Fill in all the various X_{ijk}'s and M_{jk}'s such that the following is true:

MSC (conditions) = 0

MSR (subjects) > 0

MSI (R x C interaction) > 0

MSW (intrasubject variance) > 0 for all cells in Condition 1, and MSW (intrasubject variance) = 0 for all cells in Conditions 2-3

(15 points)

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2. Does gas mileage of Subaru Foresters differ depending on driving environment? To answer this question, a group of K = 24 Foresters are driven 500 miles in each of four driving environments: City, Suburbs, Country, and Mountains. Each of the 24 cars does each of the 500-mile drives in each driving environment for 12 successive weeks (thus each of the K = 24 cars has a total of n = 12 scores for each of the J = 4 driving environments). In each case mileage (miles per gallon) is recorded.

   (To summarize this design, note that there are J = 4 columns, K = 24 rows, and n = 12 observations within each cell).

   The mean and totals (gas consumption in mpg) for each of the driving environments are as follows:

City	Suburbs	Country	Mountains	
24.0	25.0	34.0	20.0	= M_j's
6,912	7,200	9,792	5,760	= T_j's

Note:	$T =$	29,664
Assume:	$\Sigma\Sigma T_{jk}^2 =$	15,054,816
Note:	$\Sigma T_{Cj}^2 =$	228,676,608
Assume:	$\Sigma T_{Rk}^2 =$	58,744,704
Assume:	$\Sigma\Sigma\Sigma x_{ijk}^2 =$	1,267,240

(CAUTION! These sums haven't been divided by anything)

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a) Construct an ANOVA table that includes total sum of squares and total degree of freedom. Perform an ANOVA. You should be able to carry out three F-tests: for columns, rows, and the interaction. Do each of these three F-tests twice: first assuming "cars" to be a random effect and second assuming "cars" to be a fixed effect. **Use the .01 α-level. Be sure to show the criterion F's**. (22 points)

b) Compute the magnitude of the appropriate "within-subjects" 95% confidence intervals that go around each condition (column) mean—that is, the confidence interval suitable for making inferences about *patterns* of the condition population means. (8 points)

3. Still on the data from Question 2. Consider "cars" to be a random effect. Suppose that the data were presented such that only one score per subject per condition—the mean of the n = 12 scores—were considered.

a) Re-compute all (possible) sums of squares for the experiment. Carry out an ANOVA, again using the .01 α-level. (16 points)

b) Recompute the "within-subjects" confidence interval that you computed in Problem 2, Part c. (5 points)

c) Compute the "real" confidence interval magnitude that goes around each column mean—that is, the confidence interval suitable for making inferences about *the actual values* of the population means. (5 points)

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4. Phoebe, a sociologist interested in characteristics of American cities is investigating the relation between the degree of religious activity in a city and the degree to which the city is gay-friendly.

As part of this work Phoebe determines for n = 11 cities both X = the number of churches in the city and Y = the size of the of the city's gay/lesbian/bisexual/transgender population (GLBT in thousands). These data are shown in the table below (FYI, these data are real, not made-up).

Because it's often relevant, Phoebe also determines the overall population of each city (included in the table).

City	X = number of Churches (hundreds)	Y = GLBT (thousands)	City Population (thousands)
Boston	3.8	51	413
Seattle	5.5	57	452
San Francisco	5.6	96	612
San Jose	4.0	38	644
Dallas	19.8	59	836
San Diego	4.1	64	911
Phoenix	13.6	64	988
Philadelphia	10.3	44	1,033
Houston	17.6	62	1,411
Chicago	11.6	116	2,009
Los Angeles	20.1	154	2,756

Summary data are as follows. NOTE: $\Sigma Y'$ and $\Sigma Y'^2$ are, respectively, the sum of the predicted (Y') scores and the sum of the squared predicted (Y'^2) scores. You will need them later in this problem.

NOTE: For all parts of this problem, use the equations from lecture/the text, *not* just Excel functions to arrive at your answers. And, of course, be sure to show your work.

$n =$	11
$\Sigma X =$	116.00
$\Sigma X^2 =$	1,640.28
$\Sigma Y =$	805.00
$\Sigma Y^2 =$	71,135.00
$\Sigma XY =$	9,483.30
$\Sigma Y' =$	805.00
$\Sigma Y'^2 =$	61,281.71

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a) Compute the best-fitting values of b and a in the regression equation, Y' = bx + a. (6 points)

b) What are the values of r and r^2 for the relation between number of churches and GLBT? Compute them by first computing r using the standard equation for r and then computing r^2. (8 points)

c) What is the predicted GLBT values for Seattle? (4 points)

d) Re-compute the value of r^2: this time by considering the variances of the observed (Y) and predicted (Y') GLBT scores (NOTE: remember that important information about the Y' scores is provided at the beginning of this problem). (5 points)

e) Suppose you computed the error scores, i.e., the (Y-Y') values for the 11 cities. What is the correlation (either Pearson r or r^2, your choice) between the X scores and the (Y-Y') scores? Briefly justify your answer. (HINT: this should be a very easy question). (4 points)

f) You should have computed a positive correlation between number of churches and GLBT. What extraneous variable might account for this positive correlation? What new statistic might you compute that might prove useful in terms of getting a better sense of the true relation between number of churches and the size of the GLBT? **Be brief. You do not actually to do any calculations for this part of the problem.** (2 points)