Name_____________________________ Please circle your TA: Adam Suzanne Yiyu

Psychology 318 Final Exam
June 6, 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. Unless told otherwise, use α = .05 and use 95% for computing confidence intervals.

Grading

Problem	Points	Grader
1a-c	/20	Adam
2a-g	/40	Yiyu
3a-d	/30	Adam
4	/10	Suzanne
Bonus	/2.5	Suzanne
Total	/100	

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1. The following table shows two variables—first, X = age in years, and second Y = puzzle-solving time in minutes—for three children.

Child	X = Age (years)	Y = time (minute)
Adam	4	6
Yiyu	2	10
Suzanne	9	5

For your information…

$n = 3$

$\Sigma X = 15$ $\Sigma Y = 21$

$\Sigma X^2 = 101$ $\Sigma Y^2 = 161$

$\Sigma XY = 89$

NOTE: Be sure to show your work in all parts of this question.

a) Assuming a linear relation between age and problem-solving time, what is Yiyu's *predicted* puzzle-solving time? (8 points)

b) What percent of variance in the **X-scores** is accounted for by variation in the **Y-scores**? (7 points)

c) Compute a Pearson r between X and Y. Now either compute an 80% confidence interval around the Pearson r or explain why you couldn't compute such a confidence interval.

(5 points)

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2. Krispy Kracker Inc. is considering adding salt to its crackers. In anticipation of this, Krispy Kracker plans to evaluate the degree to which people actually *like* salt on their Krispy Krackers. To investigate this issue, Krispy Kracker devises an experiment in which people are given Krispy Krackers with added salt. There are three groups of $n = 6$ subjects per group. The three groups are given Krispy Krackers with differing amounts of salt: either 0.05 ounces (Group 1), 0.10 ounces (Group 2), or 0.18 ounces (Group 3).

The plan is to have subjects eat the Krackers and then provide ratings of how much they like the flavor ranging from 1 ("hate it") to 25 ("love it"). However, by the end of the experiment, some of the subjects have disappeared. Data (rating) for the remaining subjects are summarized in the table below.

	Amount of Salt (ounces)		
Statistic	0.05	0.10	0.18
n_j's	$n_1 = 1$	$n_2 =$	$n_3 = 5$
df_j's	$df_1 =$	$df_2 = 2$	$df_3 =$
T_j's	$T_1 = 30$	$T_2 =$	$T_3 =$
M_j's	$M_1 =$	$M_2 = 22.0$	$M_3 = 15.0$
Σx_{ij}^2's	$\Sigma x_{i1}^2 =$	$\Sigma x_{i2}^2 =$	$\Sigma x_{i3}^2 =$
SS_j's	$SS_1 =$	$SS_2 = 24.0$	$SS_3 =$
$est_j\, \sigma^2$'s	$est_1\, \sigma^2 =$	$est_2\, \sigma^2 =$	$est_3\, \sigma^2 =$
S_j^2's	$S_1^2 =$	$S_2^2 =$	$S_3^2 =$
$est_j\, \sigma_M^2$'s	$est_1\, \sigma_M^2 =$	$est_2\, \sigma_M^2 =$	$est_3\, \sigma_M^2 = 1.5$

a) Fill in the information in the unshaded cells of the table. If any cell value(s) is/are uncomputable write "can't do" in the cell and explain in the space below *why* the cell is uncomputable.

NOTE: if you do not know how to compute the value of some cell, a TA will sell you the value for 0.5 points.

Be sure to show your work. (10 points)

b) For your information

$\Sigma T_j^2/n_j =$ 3,477
$T^2/N =$ 3,249

Carry out a standard ANOVA. Include all possible sums of squares and degrees of freedom, but include only the mean squares that you need for the ANOVA (7 points)

c) For this part and for the next part (i.e., for Parts c and d) ***only***, suppose that the population variance were *known* to be 16.0. Re-do the F-test from the ANOVA of Part (b). (3 points)

d) Under the known-population-variance assumption of Part (c) compute the 80% confidence interval magnitude around M_2. (5 points)

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e) Consider the hypothesis that flavor ratings *decrease* linearly with amount of salt. What would be the weights corresponding to this hypothesis? Use the smallest weights that are integers. Put these weights in the table below. (6 points)

Group 1: 0.05	Group 2: 0.10	Group 3: 0.18
$w_1 =$	$w_2 =$	$w_3 =$

f) Carry out a two-tailed t-test between Groups 1 and 2. Assume that Groups 1 and 2 have the same population variance, but that this variance is not necessarily the same as the Group-3 population variance. (6 points)

g) Compute the **50%** confidence interval magnitude around (M_1 - M_2) assuming complete homogeneity of variance, i.e., homogeneity of variance across all three groups. (3 points)

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3. Continuing its testing of adding salt, Krispy Kracker Inc. again carries out an experiment of the sort described in Question 2. This time, however, it has four levels of salt addition, ranging from zero (control) to 0.10 ounces.

In addition, a second factor is added, that of age type: elementary-school students, high-school students, and college students are tested. There are **n = 13** subjects in each condition, i.e., each cell. Data (mean rating) are provided in the table below.

Amount of added salt (ounces)

		0.00	0.01	0.05	0.10	M_{Rk}'s
Age Group	Elementary	30	27	25	22	26.00
	High School	19	18	17	10	16.00
	College	20	18	17	13	17.00
	M_{Cj}'s:	23.00	21.00	19.67	15.00	19.67 = M

Note that: $\Sigma\Sigma T_{jk}^2 =$ 843,986

$\Sigma T_{Cj}^2 =$ 2,405,884

$\Sigma T_{Rk}^2 =$ 3,301,584

$T^2 =$ 9,412,624

Assume that: $\Sigma\Sigma\Sigma x_{ijk}^2 =$ 70,682

Caution! that these sums haven't been divided by anything yet!

a) Compute n_C, n_R, and N (3 points)

b) Carry out a two-way ANOVA on these data. (12 points)

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c) Assume homogeneity of variance throughout. Compute 90% confidence interval magnitudes suitable for going around the M_{jk}'s, and the M_{Rk}'s. (6 points)

d) Make up weights for the following two ***independent*** hypotheses and place the weights in the tables that are provided for you. Choose weights that are as small as possible but that are integers. Prove that that your two hypotheses are independent.

Hypothesis 1: Flavor ratings are greater for Elementary school students than for the other two age groups

Hypothesis 2: Flavor ratings decreases linearly with amount of added salt.

(9 points)

Weights for H1:

Amount of Added Salt (ounces)

		0.00	0.01	0.05	0.10
	Elementary	W_{11} =	W_{21} =	W_{31} =	W_{41} =
Age Group	**High School**	W_{12} =	W_{22} =	W_{32} =	W_{42} =
	College	W_{13} =	W_{23} =	W_{33} =	W_{43} =

Weights for H2:

Amount of Added Salt (ounces)

		0.00	0.01	0.05	0.10
	Elementary	W_{11} =	W_{21} =	W_{31} =	W_{41} =
Age Group	**High School**	W_{12} =	W_{22} =	W_{32} =	W_{42} =
	College	W_{13} =	W_{23} =	W_{33} =	W_{43} =

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4. Bartleson, who is Research Chief for the Fitzo soda-pop company, assigns his deputy, Dudley, to carry out an experiment designed to determine whether people prefer the taste of **FitzoClassic**, the company's traditional soft drink, or **FitzoNeuveau**, a newly developed version of their soft drink.

Dudley returns several weeks later. He explains to Bartleson that the experiment was run as follows. A total of N = 12 subjects had been randomly divided into two groups of n = 6 subjects per group. Group 1 subjects were provided FitzoClassic to drink, while Group 2 subjects were provided FitzoNeuveau. All subjects were then asked to rate, on a scale from 0-30, how much they liked what they were drinking. The 12 ratings from the (alleged) N = 12 subjects are shown in the table below

FitzoClassic (x_{i1})	FitzoNeuveau (x_{i2})
28	30
26	27
24	26
10	12
8	9
4	7

Bartleson, upon looking at these data, is suspicious that they had come from a within-subjects design, not a between-subjects design and that each row actually represented the data from a single subject.

What very simple measure—a single number—could Bartleson have computed from the data that would have provided evidence for or against his suspicion? (You don't have to compute such a measure, just explain what you think it might be).

HINT: Don't bother looking at the text for clues as to how to answer this. But *do* carefully consider the pattern of the scores.

(10 points)

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BONUS points: The answer to this question will not be immediately evident. Do not spend much time on it. But if you get it, you will get an extra 2.5 points.

Consider the design from Question 3. Suppose the data had come up like this (data are in terms of flavor ratings):

		Amount of Added Salt (ounces)			
		0.00	0.01	0.05	0.10
Age Group	Elem.	$M_{11} = 6$	$M_{21} = 5$	$M_{31} = 4$	$M_{41} = 4$
	HS	$M_{12} = 3$	$M_{22} = 3$	$M_{32} = 1$	$M_{42} = 1$
	College	$M_{13} = 2$	$M_{23} = 2$	$M_{33} = 1$	$M_{43} = 1$

Generate a single hypothesis whose sum of squares *is guaranteed to take up the entire sum of squares between*. Put these weights in the table below.

		Amount of Added Salt (ounces)			
		0.00	0.01	0.05	0.10
Age Group	Elem.	$W_{11} =$	$W_{21} =$	$W_{31} =$	$W_{41} =$
	HS	$W_{12} =$	$W_{22} =$	$W_{32} =$	$W_{42} =$
	College	$W_{13} =$	$W_{23} =$	$W_{33} =$	$W_{43} =$