Name_____

Ψ 420
Ainsworth

Psy 420 – Midterm 1
Part 1 – In class (50 points total)

**True or False (circle T or F) (1 point each)**

1. T F With more than 2-groups, performing multiple T-tests would be the same as doing a one-way ANOVA.

2. T F In a one-way ANOVA, total variance is the sum of within and between groups variance.

3. T F In ANOVA, your sample must have a normal distribution?

**Multiple Choice (circle the best answer) (1 points each)**

4. If an IV has no effect on subject scores you would expect the F-ratio for that effect in an ANOVA to be:

   A) 0 B) 1

   C) 1.96 D) cannot be determined

5. An effect you're studying has a Cohen's D of .5. According to Cohen, the size of this effect is:

   A) Large B) Moderate

   C) Small D) not worth studying

6. IV A and IV B interact significantly, what does this mean?

   A) A causes B B) A and B have the same effect on the DV

   C) The effect of A depends on B D) Subjects in A got to know subjects in B

7. If you have a 2 x 2 x 2 ANOVA, this means that:

   A) You have 2 IVs with 3 levels each B) You have 2 IVs and 3 DVs

   C) You have 3 IVs with 2 levels each D) You have 3 IVs and 2 subjects in each IV

8. $\sum(Y_i - Y_{GM})^2$ is the deviation form of:

   A) $SS_T$ B) $SS_{BG}$

   C) $SS_{WG}$ D) $MS_{WG}$

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**Fill in the blank and short-answer**

9. According to the simplest form of the GLM, a subject's score is said to be the sum of μ (grand mean), α (effect of the IV) and ε (error). (3 points)

10. In regression terms, the residual is the difference between _____Y____ and ____Y'_____. (2 points)

11. When performing an ANOVA, why do we assume homogeneity of variance? (2 points)

Because we are assuming that all of the subjects in each sample come from the same population.

Because we need to calculate an average within groups variance using each of the samples and you can't do that if the variances are way off.

12. Describe 1 scenario where the assumption of independence of errors would be violated. (2 points)

Repeated measures
Grouped data

13. Under what circumstance is trend analysis recommended? (2 points)

Anytime you have an IV that increases quantitatively (in amount)

14. You have an IV with four groups (groups 1, 2, 3 and 4) and there is a significant quadratic trend; what might your data look like (draw a graph) (2 points)?

Any picture that looks like a bowl or a mound with labels for the four groups across the bottom.

15. If you have a three-way ANOVA (IVs A, B and C), the between groups sums of squares is broken down into what effects (just list the labels of the effects, not the formulas)? (1 point each)

A
B
C
AB
AC
BC
ABC
If they put anything else, deduct half a point each

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One-Way ANOVA

| | Square | BNL | DMB | John Mayer |
|---|---|---|---|---|
| | 9 | 7 | 5 | 3 |
| | 10 | 5 | 6 | 4 |
| | 9 | 7 | 3 | 4 |
| | 8 | 8 | 3 | 4 |
| | 8 | 6 | 5 | 5 |
| Sum | 44 | 33 | 22 | 20 |
| Mean | 8.8 | 6.6 | 4.4 | 4 |
| SD | 0.84 | 1.14 | 1.34 | 0.71 |

T = 119

$\sum Y^2 = 799$

20 subjects were randomly selected to rate 4 different recording artists (Square, Bare Naked Ladies, Dave Mathews Band and John Mayer) on a ten point scale (higher scores mean they liked the artist more).

16. Do an omnibus ANOVA (show your work) and decide if there is a significant difference between groups (5 points):

$$SS_A = \frac{44^2 + 33^2 + 22^2 + 20^2}{5} - \frac{119^2}{20} = 781.8 - 708.05 = 73.75$$

$$SS_{S/A} = 799 - 781.8 = 17.2$$

$$SS_T = 799 - 708.05 = 90.95$$

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Band | 73.75 | 3 | 24.58 | 22.76 |
| S/Band | 17.2 | 16 | 1.08 | |
| Total | 90.95 | 19 | | |

$F_{crit}(3, 16) = 3.24$

17. Test for the homogeneity of variance assumption (2 points).

$1.34^2 / 1.14^2 = 1.7956 / 1.2996 = 1.38$ It's less than 10 so it's fine.

18. Calculate $\eta^2$ for the effect (2 points):

73.75/90.95=.81

19. Do a single test comparing Square to all the other artists combined and test the comparison using a Scheffé adjustment (3 points):

$$F = \frac{5[3(8.8) - 1(6.6) - 1(4.4) - 1(4)]^2 \Big/ 3^2 + (-1)^2 + (-1)^2 + (-1)^2}{1.08} = \frac{54.15}{1.08} = 50.14$$

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3-way ANOVA

| | $c_1$ | | | $c_2$ | | | $c_3$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | $a_1$ | $a_2$ | $a_3$ | $a_1$ | $a_2$ | $a_3$ | $a_1$ | $a_2$ | $a_3$ |
| $b_1$ | 6 | 7 | 6 | 6 | 6 | 6 | 7 | 6 | 7 |
| | 6 | 6 | 7 | 7 | 6 | 7 | 7 | 6 | 7 |
| | 6 | 7 | 7 | 7 | 6 | 6 | 7 | 6 | 6 |
| $b_2$ | 6 | 7 | 10 | 6 | 7 | 6 | 6 | 6 | 7 |
| | 7 | 9 | 11 | 6 | 6 | 7 | 7 | 6 | 6 |
| | 6 | 8 | 12 | 6 | 7 | 7 | 7 | 7 | 8 |
| $b_3$ | 7 | 11 | 14 | 6 | 11 | 13 | 6 | 7 | 7 |
| | 6 | 11 | 13 | 6 | 10 | 15 | 7 | 7 | 6 |
| | 6 | 11 | 14 | 6 | 10 | 14 | 7 | 8 | 6 |

$A_1 = 173$ $A_2 = 205$ $A_3 = 235$

$B_1 = 174$ $B_2 = 194$ $B_3 = 245$

$C_1 = 227$ $C_2 = 206$ $C_3 = 180$

$T = 613$

$\Sigma Y^2 = 5069$

A x B x C cell totals

| | $c_1$ | | | $c_2$ | | | $c_3$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | $a_1$ | $a_2$ | $a_3$ | $a_1$ | $a_2$ | $a_3$ | $a_1$ | $a_2$ | $a_3$ |
| $b_1$ | 18 | 20 | 20 | 20 | 18 | 19 | 21 | 18 | 20 |
| $b_2$ | 19 | 24 | 33 | 18 | 20 | 20 | 20 | 19 | 21 |
| $b_3$ | 19 | 33 | 41 | 18 | 31 | 42 | 20 | 22 | 19 |

2-way interaction totals

| | $a_1$ | $a_2$ | $a_3$ |
|---|---|---|---|
| $b_1$ | 59 | 56 | 59 |
| $b_2$ | 57 | 63 | 74 |
| $b_3$ | 57 | 86 | 102 |

| | $a_1$ | $a_2$ | $a_3$ |
|---|---|---|---|
| $c_1$ | 56 | 77 | 94 |
| $c_2$ | 56 | 69 | 81 |
| $c_3$ | 61 | 59 | 60 |

| | $c_1$ | $c_2$ | $c_3$ |
|---|---|---|---|
| $b_1$ | 58 | 57 | 59 |
| $b_2$ | 76 | 58 | 60 |
| $b_3$ | 93 | 91 | 61 |

20. Based on the data above, fill in the missing pieces of the source table on the next page (6 points). Use the space below for calculations, make sure you show all work.

$$SS_{AC} = \frac{56^2+56^2+61^2+77^2+69^2+59^2+94^2+81^2+60^2}{9} - \frac{173^2+205^2+235^2}{27} - \frac{227^2+206^2+180^2}{27} + \frac{613^2}{81} =$$

$$4,795.67 - 4,710.33 - 4,680.19 + 4,639.12 = 44.27$$

Or they can figure out the S/ABC and subtract everything to get $SS_{AC}$

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**Source Table**

| Source | SS | df | MS | F |
|---|---|---|---|---|
| A | 71.21 | 2 | 35.61 | 103.00 |
| B | 99.28 | 2 | 49.64 | 143.61 |
| C | 41.06 | 2 | 20.53 | 59.39 |
| AB | 61.61 | 4 | 15.40 | 44.55 |
| AC | | | | |
| BC | 52.20 | 4 | 13.05 | 37.75 |
| ABC | 41.58 | 8 | 5.20 | 15.04 |
| S/ABC | | 54 | .35 | |
| Total | 430.11 | 80 | | |

21. Calculate partial Omega squared for the AB effect (3 points):

$$Partial\ \hat{\omega}^2 = \frac{4(15.4-.35)/81}{\left[4(15.4-.35)/81\right]+.35} = \frac{4(15.05)/81}{\left[4(15.05)/81\right]+.35} = \frac{.743}{.743+.35} = \frac{.743}{1.093} \approx .68$$

22. If you were to do this ANOVA through regression how many predictors (Xs) would you need to code the ABC interaction? (1 point)
You'd need 8