Name_____

Ψ 420
Ainsworth

Psy 420 – Midterm 2
Part 1 – In class (50 points total)
Key

Name_____

True or False (circle T or F) (2 points each)

1. T F Homogeneity of covariance and sphericity are the same thing.

2. T F Any comparison on WS variables requires a separate error term.

3. T F A matched randomized design is treated the same as a WS design.

Multiple Choice (3 points each)

4. When performing an ANOVA through regression, the number of columns for coding is equal to:
   a. df_T.
   b. df_{effect}
   c. df_{error}
   d. not enough information.

5. Controlling for everything else, BG designs are _____ powerful than WS designs.
   a. more
   b. less
   c. just as
   d. Not enough information.

Short Answer Question (8 points)

6. You have a study with 4 IVs (A, B, C, D). A is a BG variable, while B, C and D are WS variables. What are the sources of variance and which error terms go with which effects?

BG	WS	error
A		S/A
	B, AxB	BxS/A
	C, AxC	CxS/A
	D, AxD	DxS/A
	BC, ABC	BxCxS/A
	BD, ABD	BxDxS/A
	CD, ACD	CxDxS/A
	BCD, ABCD	BxCxDxS/A

Name_____

A cookie company is interested in whether the amount of butter in a batch of cookies makes them "yummier". Five people were randomly selected to taste test three different batches of sugar cookies; one used only one stick of butter, the second used two sticks of butter and the third batch used three sticks of butter. Ratings of "yumminess" were measured by the number of cookies that each person ate from each batch.

	One Stick	Two Sticks	Three Sticks	Case Totals
S_1	13	22	24	$S_1 = 59$
S_2	7	16	17	$S_2 = 40$
S_3	2	10	13	$S_3 = 25$
S_4	9	17	19	$S_4 = 45$
S_5	5	13	15	$S_5 = 33$
	1 stick = 36	2 sticks = 78	3 sticks = 88	T = 202

7. Does amount of butter affect the ratings of "yumminess"? Create a summary table of all effects and perform the appropriate significance test (5 points). Show all work.

$\Sigma Y^2 = 3246$, A = # of stick of butter

$$SS_{\text{Butter}} = \frac{\Sigma(\Sigma A)^2}{s} - \frac{T^2}{as} = \frac{36^2 + 78^2 + 88^2}{5} - \frac{202^2}{3(5)} = \frac{15{,}124}{5} - \frac{40{,}804}{15} = 3{,}024.8 - 2{,}720.267 = 304.534$$

$$SS_S = \frac{\Sigma(\Sigma S)^2}{a} - \frac{T^2}{as} = \frac{59^2 + 40^2 + 25^2 + 45^2 + 33^2}{3} - 2{,}720.27 = \frac{8{,}820}{3} - 2{,}720.27 = 2{,}940 - 2{,}720.27 = 219.733$$

$$SS_{AxS} = \sum Y^2 - \frac{\Sigma(\Sigma A)^2}{s} - \frac{\Sigma(\Sigma S)^2}{a} + \frac{T^2}{as} = 3246 - 3{,}024.8 - 2{,}940 + 2{,}720.267 = 1.467$$

$$SS_{Total} = \sum Y^2 - \frac{T^2}{as} = 3246 - 2{,}720.267 = 525.733$$

Source	**SS**	**df**	**MS**	**F**
Butter	304.534	2	152.267	832.060
S	219.733	4	54.933	
Butter x S	1.467	8	0.183	
Total	525.733	14		

Fcrit (2, 8) = 4.46, since 832.060 > 4.46, reject h_0.

8. What is the relative efficiency of this design? (2 points)

$MS_{S/A} = (219.733 + 1.467)/(8+4) = 221.2/12 = 18.433$

$$Efficiency = \frac{MS_{S/A}}{MS_{AS}}\left(\frac{df_{AS}+1}{df_{AS}+3}\right)\left(\frac{df_{S/A}+3}{df_{S/A}+1}\right) = \frac{18.433}{0.183}\left(\frac{9}{11}\right)\left(\frac{15}{13}\right) = 100.726 \;\; 0.818 \;\; 1.154 \;\; = 95.083$$

Name_____

A researcher is interested in finding out who is cuter, his nephew or his niece. So he randomly selects 5 people to rate pictures taken of both kids; one when each is 1-year old, 2 years old and 3 years old. Results of the rating are shown below.

	Nephew			Niece			
	1 year	2 year	3 year	1 year	2 year	3 year	Case Totals
S_1	10	9	5	12	16	17	S1 = 69
S_2	12	12	8	16	20	20	S2 = 88
S_3	10	9	5	14	18	19	S3 = 75
S_4	13	12	9	16	20	21	S4 = 91
S_5	8	7	3	12	17	17	S5 = 64
	NephY1 = 30	NephY2 = 49	NephY3 = 53	NieceY1 = 70	NieceY2 = 91	NieceY3 = 94	T = 387
	Nephew = 132			Niece = 255			
	1 year = 123		2 year = 140		3 year = 124		

9. Create a summary table of all effects and perform the appropriate significance tests (8 points). Show all work.

$\Sigma Y^2 = 5725$, Nephew/Niece = A, Year of Picture = B

$$SS_A = \frac{\Sigma(\Sigma A)^2}{bs} - \frac{T^2}{abs} = \frac{132^2 + 255^2}{3(5)} - \frac{387^2}{2(3)(5)} = \frac{82{,}449}{15} - \frac{149{,}769}{30} = 5{,}496.6 - 4{,}992.3 = 504.3$$

$$SS_B = \frac{\Sigma(\Sigma B)^2}{as} - \frac{T^2}{abs} = \frac{123^2 + 140^2 + 124^2}{2(5)} - 4{,}992.3 = \frac{50{,}105}{10} - 4{,}992.3 = 5{,}010.5 - 4{,}992.3 = 18.20$$

$$SS_{AB} = \frac{\Sigma(\Sigma AB)^2}{s} - \frac{\Sigma(\Sigma A)^2}{bs} - \frac{\Sigma(\Sigma B)^2}{as} + \frac{T^2}{abs} = \frac{30^2 + 49^2 + 53^2 + 70^2 + 91^2 + 94^2}{5} - 5{,}496.6 - 5{,}010.5 + 4{,}992.3 =$$

$$\frac{28{,}127}{5} - 5{,}496.6 - 5{,}010.5 + 4{,}992.3 = 5{,}625.4 - 5{,}496.6 - 5{,}010.5 + 4{,}992.3 = 110.6$$

$$SS_S = \frac{\Sigma(\Sigma S)^2}{ab} - \frac{T^2}{abs} = \frac{69^2 + 88^2 + 75^2 + 91^2 + 64^2}{6} - 4{,}992.3 = \frac{30{,}507}{6} - 4{,}992.3 = 5{,}084.5 - 4{,}992.3 = 92.20$$

$$SS_{AxS} = \frac{\Sigma(\Sigma AS)^2}{b} - \frac{\Sigma(\Sigma A)^2}{bs} - \frac{\Sigma(\Sigma S)^2}{ab} + \frac{T^2}{abs} = \frac{24^2 + 32^2 + \cdots + 57^2 + 46^2}{3} - 5{,}496.6 - 5{,}084.5 + 4{,}992.3 =$$

$$\frac{16783}{3} - 5{,}496.6 - 5{,}084.5 + 4{,}992.3 = 5{,}594.333 - 5{,}496.6 - 5{,}084.5 + 4{,}992.3 = 5.533$$

$$SS_{BxS} = \frac{\Sigma(\Sigma BS)^2}{a} - \frac{\Sigma(\Sigma B)^2}{as} - \frac{\Sigma(\Sigma S)^2}{ab} + \frac{T^2}{abs} = \frac{22^2 + 28^2 + \cdots + 30^2 + 20^2}{2} - 5{,}010.5 - 5{,}084.5 + 4{,}992.3 =$$

$$\frac{10207}{2} - 5{,}010.5 - 5{,}084.5 + 4{,}992.3 = 5{,}103.5 - 5{,}010.5 - 5{,}084.5 + 4{,}992.3 = 0.800$$

$$SS_{AxBxS} = \sum Y^2 - \frac{\Sigma(\Sigma AB)^2}{s} - \frac{\Sigma(\Sigma AS)^2}{b} - \frac{\Sigma(\Sigma BS)^2}{a} + \frac{\Sigma(\Sigma A)^2}{bs} + \frac{\Sigma(\Sigma B)^2}{as} + \frac{\Sigma(\Sigma S)^2}{ab} - \frac{T^2}{abs} =$$

$$5725 - 5{,}625.4 - 5{,}594.333 - 5{,}103.5 + 5{,}496.6 + 5{,}010.5 + 5{,}084.5 - 4{,}992.3 = 1.067$$

$$SS_{Total} = \sum Y^2 - \frac{T^2}{abs} = 5725 - 4{,}992.3 = 732.7$$

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Source	SS	df	MS	F
A	504.3	1	504.3	364.642
B	18.20	2	9.1	91
AB	110.6	2	55.3	415.789
S	92.2	4	23.05	
AS	5.533	4	1.383	
BS	.8	8	.1	
ABS	1.067	8	.133	
Total	759.7	29		

Fcrit (1,4) = 7.71, since 364.642 > 7.71, reject h_0 for A
Fcrit (2,8) = 4.46, since both 91 and 415.789 are greater than 4.46, reject h_0 for both B and AB.

10. Briefly, describe what you would need to do in order to perform a linear contrast on pictures, no computations (2 points).

11. What are the lower and upper limit eta squared values for nephew/niece effect? (3 points)

Lower = 504.3/759.7 = 0.66
Upper = 504.3/(504.3 + 1.383) = 0.997

Name_____

A researcher wants to reassess the effects that Electroconvulsive (ECT) therapy has on various psychological disorders. The researcher randomly selects three patients with depression (D), three with schizophrenia (S) and three with dissociative identity disorder (I) and exposes each to three levels of ECT (100 volts, 200 volts and 300 volts) during different sessions (all subjects were exposed to all treatments). Results are measured by the amount of improvement in the disorder as designated by their doctors.

		100 volts	200 volts	300 volts	
Depression	S_1	1	4	6	S1 = 11
	S_2	2	5	7	S2 = 14
	S_3	3	7	9	S3 = 19
		D100 =6	D200 =16	D300 =22	Depression = 44
Schizophrenia	S_4	11	13	6	S4 = 30
	S_5	8	11	5	S5 = 24
	S_6	9	12	5	S6 = 26
		S100 =28	S200 =36	S300 =16	Schiz = 80
DID	S_7	9	12	14	S7 = 35
	S_8	5	9	11	S8 = 25
	S_9	5	9	11	S9 = 25
		I100 =19	I200 =30	I300 =36	DID = 85
		100v = 53	200v = 82	300v = 74	T = 209

12. Create a summary table of all effects and perform the appropriate significance tests (10 points). Show all work.

$\Sigma Y^2 = 1931$, A = disorder, B = voltage

$$SS_A = \frac{\Sigma(\Sigma A)^2}{bs} - \frac{T^2}{abs} = \frac{44^2+80^2+85^2}{3(3)} - \frac{209^2}{3(3)(3)} = \frac{15{,}561}{9} - \frac{43{,}681}{27} = 1{,}729 - 1{,}617.815 = 111.185$$

$$SS_{S/A} = \frac{\Sigma(\Sigma AS)^2}{b} - \frac{\Sigma(\Sigma A)^2}{bs} = \frac{11^2+14^2+19^2+30^2+24^2+26^2+35^2+25^2+25^2}{3} - 1729 =$$

$$\frac{5{,}305}{3} - 1729 = 1{,}768.333 - 1617.815 = 39.333$$

$$SS_B = \frac{\Sigma(\Sigma B)^2}{as} - \frac{T^2}{abs} = \frac{53^2+82^2+74^2}{3(3)} - 1{,}617.815 = \frac{15{,}009}{9} - 1{,}617.815 = 1{,}667.667 - 1{,}617.815 = 49.852$$

$$SS_{AB} = \frac{\Sigma(\Sigma AB)^2}{s} - \frac{\Sigma(\Sigma A)^2}{bs} - \frac{\Sigma(\Sigma B)^2}{as} + \frac{T^2}{abs} = \frac{6^2+16^2+22^2+28^2+36^2+16^2+19^2+30^2+36^2}{3} - 1729 - 1667.667 + 1617.815 =$$

$$\frac{5{,}669}{3} - 1729 - 1667.667 + 1617.815 = 1{,}889.667 - 1729 - 1667.667 + 1617.815 = 110.815$$

$$SS_{BxS/A} = \Sigma Y^2 - \frac{\Sigma(\Sigma AB)^2}{s} - \frac{\Sigma(\Sigma AS)^2}{b} + \frac{\Sigma(\Sigma A)^2}{bs} = 1931 - 1889.667 - 1768.333 + 1729 = 2.000$$

$$SS_{Total} = \sum Y^2 - \frac{T^2}{abs} = 1931 - 1617.815 = 313.185$$

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Source	SS	df	MS	F
A	111.185	2	55.593	8.480
S/A	39.333	6	6.556	
B	49.852	2	24.926	149.556
AB	110.815	4	27.704	166.223
BxS/A	2.000	12	0.167	
Total	313.185	26	12.046	

Fcrit (2,6) = 5.14, since 8.480 > 5.14, reject h_0 for A
Fcrit (2,12) = 3.88, since 149.556 > 3.88, reject h_0 for B
Fcrit (4,12) = 3.26, since 166.223 > 3.26, reject h_0 for AB