ID# ___________________________ Final Exam PS217, Fall 1995

Well, here it is...your opportunity to impress me with all that you've learned this semester. As before, the point value for a question is my estimate of how long it should take you to complete the problem. If you're having difficulty with a problem, don't waste time on it...move on to another problem and come back to it if you have time at the end. Answer each question as completely as you can — be thorough. Be sure to *show all your work*! Keep your eyes focused on your own exam. You have exactly 3 hours to complete the exam. No extra time will be allowed, so keep on track.

I hope that you do really well on this exam. I've enjoyed the interactive style of this class — thanks to all of you who remained so inquisitive and involved throughout the semester! Furthermore, I've been really impressed with the diligence that many of you exhibited in attending the weekly review sessions. I look forward to seeing many of you in future courses. Thanks for making my semester a pleasant one. Have a wonderful break. Come back relaxed and refreshed.

Peace,

1. Dr. C. D. Snow is interested in the relationship between loneliness and depression. She collects the data below. Analyze and interpret the data a completely as you can. On the basis of this evidence, would you argue that loneliness causes depression? Why or why not? (Be explicit.) [20 pts.]

Participant	Loneliness Score	Depression Score	**XY**
1	4	16	64
2	27	37	999
3	18	33	594
4	7	23	161
5	30	34	1020
6	12	32	384
7	18	24	432
8	23	29	667
9	19	26	494
10	12	26	312
Sum	170	280	5127
SS	630	352	

To assess the extent of the relationship, you would compute r to test H_0: $\rho = 0$.

$$r = \frac{5127 - \frac{(170)(280)}{10}}{\sqrt{(630)(352)}} = \frac{367}{470.9} = .78$$

Given $r_{Crit}(8) = .632$, this value of r would lead you to reject H_0. Thus, you would conclude that there is a positive linear relationship between the Loneliness Score and the Depression Score.

With a significant value of r, you would next compute the regression equation:

Y = .583X + 18.1

You could not argue that loneliness causes depression because it could be the case that depression causes loneliness or that some third variable (a brain lesion, a poor economic situation, etc.) could produce both loneliness and depression.

2a. In a study of memory processes, animals were presented with a one-trial avoidance task. As soon as they stepped across a line down the center of their cage they were shocked through a grid in the floor of the cage. Learning (avoidance) would be present if the animals took longer to cross over the line on subsequent trials.

One independent variable in this study is the site at which these animals had electrodes implanted in their brains (Neutral Site, Area A, or Area B). After crossing the line and receiving a shock to their feet, a small amount of electrical stimulation was sent to one of these three sites. Each group was further divided based on the second independent variable — the time delay between crossing the line and receiving electrical stimulation to their brain electrodes. A third of each group was given the stimulation 50, 100, or 150 milliseconds after crossing the line and receiving foot shock.

If the brain area stimulated is involved in memory, stimulation would be expected to interfere with consolidation and retard learning of the avoidance response. The dependent variable was the number of seconds it took the animal to cross the line on the second trial. Thus, longer times to cross the line correspond to greater learning and shorter times correspond to lesser learning.

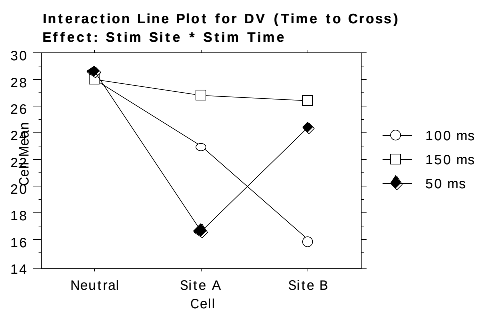
Below are the means, a graph, and a partially completed StatView source table for this experiment. Complete the source table and analyze/interpret the results as completely as possible. [25 pts]

ANOVA Table for DV (Time to Cross)

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Stim Site	2	356.044	178.022	6.074	.0053	12.147	.868
Stim Time	2	188.578	94.289	3.217	.0518	6.434	.571
Stim Site * Stim Time	4	371.956	92.989	3.172	.0248	12.690	.770
Residual	36	1055.200	29.311				

Means Table for DV (Time to Cross)
Effect: Stim Site * Stim Time

	Count	Mean	Std. Dev.	Std. Err.
Neutral, 100 ms	5	28.000	4.690	2.098
Neutral, 150 ms	5	28.000	5.612	2.510
Neutral, 50 ms	5	28.600	7.403	3.311
Site A, 100 ms	5	23.000	4.743	2.121
Site A, 150 ms	5	26.800	5.404	2.417
Site A, 50 ms	5	16.800	5.718	2.557
Site B, 100 ms	5	16.000	5.612	2.510
Site B, 150 ms	5	26.400	4.159	1.860
Site B, 50 ms	5	24.400	4.722	2.112



The interaction is significant, so that's where I would focus my attention.

For Tukey's HSD, I'd obtain a q of 4.7 (k=9, df=36), which would yield a critical mean difference of 11.4. So only those means that differed by 11.4 or more would be different. Therefore, the animals crossed the line significantly faster when Area A is shocked after 50 ms compared to the neutral site. Further, the animals crossed the line significantly faster when Area B was shocked after 100 ms compared to the neutral site. Shocking any area of the brain after 150 ms doesn't appear to disrupt learning, nor does shocking the neutral site.

Remember that lower RTs are indicative of poorer performance (interference with the memory of painful shock, so they are more willing to cross over the line), so it appears that the neutral site is really neutral (not involved in memory for this task). Next, it appears that waiting until 150 ms after they cross the line is too long to disrupt the memory, which makes it equivalent to the neutral site. From the RTs at sites A and B, it appears that memory is disrupted maximally

(sig faster RT than neutral site) for Area A at 50 ms and Area B at 100ms. So my interpretation of the results would be that both Areas A and B are involved in the formation of memory for the shock event, but that the information flows through Area A first and then through Area B. Stimulating Area B before 100 ms (i.e., at 50 ms) is premature, because the info has not arrived at that site by then. Stimulating Area A after 50 ms (i.e., at 100 ms) is too late, as the info has already passed along (possibly to Area B??).

2b. Suppose that you had analyzed the same data as a one-way ANOVA on Site. How would your source table look? [10 pts.]

SOURCE	SS	df	MS	F
Site	**356.04**	**2**	**178**	**4.6**
Error	**1615.73**	**42**	**38.47**	
Total	**1971.77**	**44**		

3. Ordinarily, if you have the ability to compute a two-way ANOVA or a one-way ANOVA on the same data set, you will benefit from computing a two-way ANOVA. Why is that so? Be explicit! (An example with source tables would help your explanation.) [15 pts.]

OR

Ordinarily, a repeated measures ANOVA yields a higher F-ratio than an independent groups ANOVA on the same data. However, in a very specific set of circumstances, that will not be true. Explain those circumstances to me. (An example with source tables would help your explanation.) [15 pts.]

Both of these answers hinge on the same basic concept: smaller error terms lead to larger F-ratios. However, the fact is that in both cases you will end up with a smaller df_{Error}, which would ordinarily lead to a smaller F-ratio. Thus, in both cases, you are banking on the assumption that your SS_{Error} will be substantially smaller. That is, your MS_{Error} is likely to become smaller due to the reduction in the SS_{Error} (given that the df_{Error} is definitely getting smaller). Here are some examples to illustrate the point:

Here's a data set:

1	**4**	**6**
2	**4**	**7**
3	**6**	**7**
3	**7**	**8**
4	**7**	**9**
5	**8**	**11**

Analyzing as aSingle-Factor Independent Groups ANOVA:

Source	**SS**	**df**	**MS**	**F**
Treatment	**76**	**2**	**38**	**14.25**
Error	**40**	**15**	**2.667**	
Total	**116**	**17**		

Analyzing as a Repeated Measures ANOVA (each row of data from same participant):

Source	SS	df	MS	F
Treatment	**76**	**2**	**38**	**142.5**
Subjects	**37.33**	**5**		
Error	**2.667**	**10**	**.267**	
Total	**116**	**17**		

Analyzing as a Two-Factor Independent Groups ANOVA (first three scores in each group are Male and next three scores in each group are Female):

Source	SS	df	MS	F
Treatment	**76**	**2**	**38**	**36.00**
Gender	**26.9**	**1**	**26.9**	**25.474**
Treat x Gend	**.444**	**2**	**.211**	**.211**
Error	**12.667**	**12**	**1.056**	
Total	**116**	**17**		

Note that for both the Repeated Measures ANOVA and the Two-Factor ANOVA you obtain a larger F-ratio than for the Single-Factor Independent Groups ANOVA. Note, also, that in each case the SS, df, and MS for your "Treatment" are unchanged (as the 3 means would not change). Furthermore, in each analysis you have a smaller df in your error term. However, the SS_{Error} is so much smaller that the MS_{Error} is smaller for the Repeated Measures ANOVA and the Two-Factor Independent Groups ANOVA.

4.Below are some summary data from an experiment. On the basis of this information, you can compute an ANOVA. (Trust me, you can!) There's a slightly more time-consuming way to get the source table from these data. A somewhat shorter procedure requires that you use information that you should know about the basis for the $MS_{Between}$ and the MS_{Within}. In fact, you should even be able to find a handout that shows you exactly how to complete the source table in this short fashion. I include this problem because it really gets to the heart of understanding the ANOVA. Analyze the data as completely as possible (i.e., don't simply complete the source table). [30 pts.]

IV = Type of learning strategy (Repetition, Imagery, Make-a-Story, No Instructions)
DV = Number of words recalled out of 30

	Repetition	Imagery	Make-a-Story	No Instructions
Mean	2.6	7.2	7.2	5.7
Variance	1.6	2.4	2.4	.9
n	10	10	10	10

SOURCE	SS	df	MS	F
Between	**141.075**	**3**	**47.025**	**25.77**
Within	**65.7**	**36**	**1.825**	
Total	**206.775**	**39**		

The quickest way to get this answer is to recall that MS_{Error} is the mean of the group variances and that $MS_{Treatment}$ is the variance of the group means times n.

5. Suppose that you are interested in whether or not the nature of a video produces differences in yawning. You have 11 participants first watch an Interesting and then an Uninteresting video. As they watch the videos, you observe the number of times that the participants yawn. Below are the data. Analyze the data as completely as you can. This study has a major flaw that you should notice when you think about the nature of the design. Can you tell me the problem? (Hint: Think about a critical procedure that you must invoke in a design of this sort.) [20 pts.]

Participant	Interesting Video	Uninteresting Video
1	5	7
2	2	1
3	4	7
4	3	8
5	0	2
6	4	5
7	7	6
8	6	9
9	3	3
10	1	4
11	8	9
Sum	43	61
SS	60.9	76.7

Source	**SS**	**df**	**MS**	**F**
Treatment	**14.7**	**1**	**14.7**	**8.5**
Within	**137.6**	**20**		
Subject	**120.3**	**10**		
Error	**17.3**	**10**	**1.73**	
Total	**152.3**	**21**		

The problem, of course, is that this repeated measures design would require counterbalancing. The order of the videos was not appropriately counterbalanced, so that's a major confound.

Nonetheless, you would compare your F_{Obt} = 8.5 with $F_{Crit}(1,10)$ = 4.96 and conclude that people yawn significantly more at either the uninteresting video OR at the second video that they watch. Because of the confound, you couldn't do any better than that.

6. Many tasks require people to be vigilant over a long period, such as an air traffic controller monitoring a radar screen to maintain the proper distance between planes. Thus, psychologists have studied various factors affecting vigilance. As an example, Pfendler and Widdel (1986) had people monitor a simulated display of the dials in the control room of a ship for a 2.5-hour period to see if people became increasingly likely to miss changes in the dials over the 2.5-hour period. Suppose that we were to extend the experiment to a 4-hour period. The dependent variable is the amount of time it takes a person to detect a change in a dial. (Higher numbers mean poorer performance.) People's performance is measured after 1, 2, 3, and 4 hours. Below is a StatView analysis of the data from this experiment. Interpret the results as completely as possible. Be very explicit about the basis for your decisions. Do you have any comments on the design of this study? [15 pts.]

ANOVA Table for Duration

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Subject	12	81.188	6.766				
Category for Duration	3	18.985	6.328	61.122	<.0001	183.367	1.000
Category for Duration * Subject	36	3.727	.104				

Means Table for Duration
Effect: Category for Duration

	Count	Mean	Std. Dev.	Std. Err.
1 hr	13	6.300	1.242	.344
2 hrs	13	6.377	1.339	.371
3 hrs	13	7.077	1.448	.402
4 hrs	13	7.792	1.283	.356

First of all, you would conclude that there is a significant effect of time ($p < .05$). Then, you would need to compute HSD to determine which of the groups came from populations with different means. In this case, HSD = .34 ($q = 3.8$). Thus, people take significantly longer after 4 hours on task compared to 1, 2, or 3 hours on task. People take significantly longer after 3 hours on task compared to 1 or 2 hours on task. Finally, people on task for 1 or 2 hours don't differ.

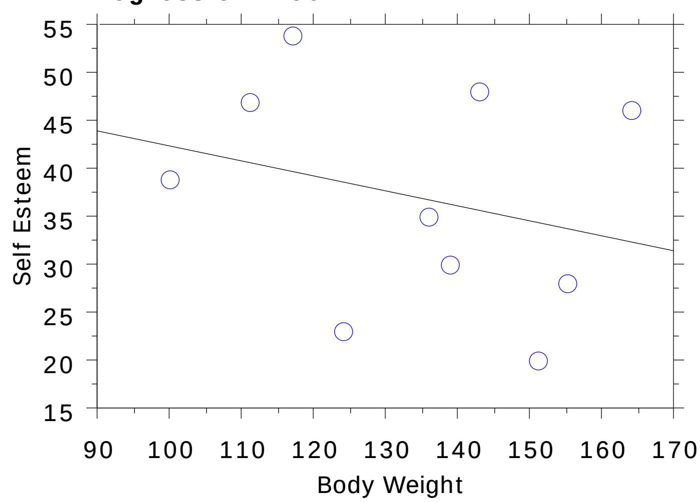
Even though this is a repeated measures design, counterbalancing would not be appropriate. You are actually interested in the cumulative effects of the task, so you wouldn't need to counterbalance the durations.

7. Dr. Rob D. Cash is interested in the relationship between body weight and self esteem in women. He gives 10 women the Alpha Sigma Self-Esteem Test and also measures their body weight. He analyzes the data using StatView, producing the output below. Interpret the output as completely as you can. If a woman weighed 120 lbs., what would be your best prediction of her self-esteem score? Would you have any comments on the design of this study? [10 pts.]

Regression Summary
Self Esteem vs. Body Weight

Count	10
Num. Missing	0
R	.277
R Squared	.076
Adjusted R Squared	•
RMS Residual	11.838

Regression Plot



Y = 57.905 - .156 * X; R^2 = .076

ANOVA Table
Self Esteem vs. Body Weight

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	1	92.822	92.822	.662	.4393
Residual	8	1121.178	140.147		
Total	9	1214.000			

Regression Coefficients
Self Esteem vs. Body Weight

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	57.905	25.958	57.905	2.231	.0562
Body Weight	-.156	.192	-.277	-.814	.4393

The results indicate no significant relationship between Body Weight and Self Esteem ($p > .05$). Thus, you couldn't use the regression equation to predict Self Esteem from Weight. Knowing that a woman weighed 120 pounds would be of no real use to you, so you would simply guess that the woman's Self Esteem was the mean Self Esteem score from the population (or the best estimate you had of that value).

You might note that the non-significant results could have been due to a lack of power. With only 10 participants, the study was likely under-powered. Running the study with more participants would be a good next step.

8. Given Dr. Cash's study, how likely is it that the sample was drawn from a population whose mean weight (μ) was 140? [10 pts.]

H_0: μ = 140

H_1: μ ≠ 140

SS = 3814
s2 = 423.8
s = 20.6

$$t = \frac{134 - 140}{6.5} = -.92$$

$t_{Crit}(9) = 2.262$

Thus, you would retain H_0 and conclude that the sample could well have been drawn from a population with m = 140 pounds.