ID# ___________________________ Exam 2 PS217, Fall 1996

OK, good luck on this exam. Keep your attention focused on your own exam. Work carefully and quickly through the exam, showing all your work on all problems. The point value for each question is indicated, which should give you some clue as to how long to spend on a question (e.g., you should only spend about 5 minutes on a 5-point question).

1. Since the last exam, we've covered t-tests (single-sample and independent groups) and analysis of variance (independent groups and repeated measures). Briefly sketch out the situations in which you'd use each of these statistics. (In other words, what is the purpose of each statistic?) [5 pts]

You would use a single-sample t-test when you wanted to determine the likelihood that a sample mean was drawn from a population with a particular μ. That is, you would test H_0: μ = X.

You would use an independent groups t-test when you wanted to determine if two sample means were drawn from populations with identical μ's. Most often you would do so in an experimental situation. That is, you would have treated the two samples differently, expecting that your manipulation will have changed the two samples such that they are now drawn from populations with different μ's. Your H_0: $\mu_1 = \mu_2$.

The independent groups ANOVA is much like the independent groups t-test, with the important difference that the ANOVA allows you to test hypotheses about two or more sample means. Thus, your H_0: $\mu_1 = \mu_2 = \ldots$

The repeated measures ANOVA is much like the independent groups ANOVA, with the important difference that the design collects data from each participant under each treatment level. H_0 would look just like that for the independent groups ANOVA.

2. Below is the output from a StatView analysis of an experiment. Tell me as much as you can about the experiment (what sort of design, how many treatment levels, how many people participated, what you could conclude, etc.). [5 pts]

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Between subjects	7	19338.625	2762.661		
treatments	2	11260.583	5630.292	4.665	.028
residual	14	16896.75	1206.911		
Total	23	47495.958			

[I've modified the output a bit to make it look more like what you'd see in the new version of StatView.]
This is a single-factor repeated measures ANOVA with 3 levels. You had a total of 8 participants. As you can see, the F is significant ($p < .05$), so you would reject H_0. The next step would be to compute HSD to see which of the means (not given) differed.

3. First-born children tend to develop language skills faster than their younger siblings. One possible explanation for the phenomenon is that first-borns have undivided attention from their parents. If this explanation is correct, then it is also reasonable that twins should show slower language development than single children and that triplets should learn even slower. Davis (1937) found exactly this result. The following hypothetical data demonstrate the effect. The dependent variable is the measure of language skill at age three for each child. Analyze the data as completely as you can. Tell me what you would conclude, especially in light of the original hypothesis. [25 pts]

Single Child	Twin	Triplet
8	4	4
7	6	4
10	7	7
6	4	2
9	9	3

F_{Max} = 1.8 and $F_{MaxCrit}$ = 15.5, so you' d have no concern about heterogeneity of variance.
Your source table should look like:

ANOVA Table for Lang Skill

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Num Sibs	2	40.000	20.000	5.714	.0181	11.429	.765
Residual	12	42.000	3.500				

Means Table for Lang Skill
Effect: Num Sibs

	Count	Mean	Std. Dev.	Std. Err.
Single	5	8.000	1.581	.707
Triplet	5	4.000	1.871	.837
Twin	5	6.000	2.121	.949

H_0: $\mu_{Sing} = \mu_{Tw} = \mu_{Tr}$
H_1: Not H_0

With $F_{Crit}(2,12) = 3.88$, you would reject H_0. (Of course, if you could actually generate a StatView analysis, you wouldn't need to look up the critical value of F, but would simply look at the P-Value and determine that it's less than .05.)

The next step would be to compute HSD to determine which of the three means differs. With q = 3.77, HSD = 3.15. Thus, a participant who is a member of a triplet scores significantly lower on language development than an only child, but no other differences are significant.

4. Given the data from the earlier problem (#3), test the hypothesis that the triplets were sampled from a population with a mean language skill score of 7 (i.e., $\mu = 7$). [10 pts]

The mean for twins was 6. The standard deviation for twins was 2.12 and the standard error for twins was .949. Thus, your single-sample t-test would be t = 1.05. With t_{Crit} = 2.776, you would retain H_0. The language score for your twins may have come from a population with μ = 7.

5. Below is a partially completed source table for an experiment with 6 levels of the factor and sample size (n) of 20. First, complete the source table. Then, tell me explicitly how you would interpret the results and what you would do next. [10 pts]

Source	SS	df	MS	F
Between	100	5	20	2.0
Within	1140	114	10	
Total	1240	119		

Because F_{Crit} = 2.3, I would retain H_0. Thus, the next step would involve trying to re-design the study so that it had more power. I would look to adding participants, increasing the treatment effect, and increasing the sensitivity of the DV.