ID# ___________________________ Exam 2 PS217, Spring 1995

Okay, here's the second installment in the continuing saga of "What have you learned in your statistics course?" You should work quickly and carefully through the questions. Remember to show all your work, otherwise you will not receive partial credit if you make a mathematical error. Try to be as neat as possible. I've indicated the point value of each question, which should give you a clue as to the amount of time I expect that question to take you (1 pt = 1 min).

1. A psychologist is asked by a dog food manufacturer to determine if animals show a preference among three new food mixes recently developed. The psychologist takes a sample of 6 dogs. They are deprived of food overnight and presented simultaneously with three bowls of the mixes on the next morning. After 10 minutes, the bowls are removed, and the amount of food (in ounces) consumed is determined for each type of mix. The data are as follows: [25 points]

| Mix1 | Mix2 | Mix3 |
|---|---|---|
| 3 | 7 | 5 |
| 0 | 0 | 1 |
| 2 | 2 | 3 |
| 1 | 6 | 3 |
| 1 | 2 | 1 |
| 3 | 5 | 3 |

What is the independent variable? **The food mixes.**

What is the dependent variable? **The amount of food consumed (in ounces).**

What are the null and alternative hypotheses? $\mathbf{H_0: \mu_{Mix1} = \mu_{Mix2} = \mu_{Mix3}}$
$\mathbf{H_1: \text{Not } H_0}$

Determine fully and completely what one could conclude from an experiment such as this. In other words, if you were asked to make recommendations about the 3 mixes based on these results, what would you tell the dog food manufacturer?

**ANOVA Table for Mix**

| | DF | Sum of Squares | Mean Square | F-Value | P-Value | Lambda | Power |
|---|---|---|---|---|---|---|---|
| Subject | 5 | 42.667 | 8.533 | | | | |
| Category for Mix | 2 | 12.000 | 6.000 | 4.500 | .0404 | 9.000 | .627 |
| Category for Mix * Subject | 10 | 13.333 | 1.333 | | | | |

**Means Table for Mix**
**Effect: Category for Mix**

| | Count | Mean | Std. Dev. | Std. Err. |
|---|---|---|---|---|
| Mix I | 6 | 1.667 | 1.211 | .494 |
| Mix II | 6 | 3.667 | 2.733 | 1.116 |
| Mix III | 6 | 2.667 | 1.506 | .615 |

**Reject $H_0$, because p < .05. With HSD = 1.83, I would conclude that dogs ate significantly more Mix II than Mix I, but no other differences were significant.**

$$HSD = 3.88\sqrt{\frac{1.33}{6}} = 1.83$$

2. Suppose that in the not-too-distant future you conduct a single factor experiment using a repeated measures design, but you can't remember how to perform a repeated measures ANOVA. All you can remember from your PS217 class is how to conduct an independent groups ANOVA, so you go ahead and analyze the data from the repeated measures design using an independent groups ANOVA. Your analysis is significant (you can reject $H_0$). Even though you've conducted an inappropriate analysis, would you be inclined to believe the results of your analysis? Why or why not? [5 pts]

**If you recall that the repeated measures analysis is typically more powerful than the independent group analysis, then this question should make sense to you. If you are interested in being conservative (because you don't know which analysis to conduct), then the independent groups ANOVA makes more sense. If the results are significant with the independent groups ANOVA, then they should certainly be significant if analyzed with a repeated measures ANOVA. Of course, you should also be able to articulate the rare instances in which that would not be true (very little in the way of individual differences).**

3a. Sure, you can tell me the formula for computing the $MS_{Between}$ (i.e., $MS_{Treatment}$), but what is it *really*? In other words, we know that the $MS_{Between}$ assesses Treatment Effects + Random Effects (+ Individual Differences in an independent groups design). We also know that MS is just another term for a variance. But what is the $MS_{Between}$ estimating? (Be explicit.) [3 pts]

**$MS_{Between}$ is really assessing the variance of the means of the conditions (multiplied by sample size, n). Those means would vary because of Treatment Effects + Random Effects in a repeated measures design and Treatment Effects + Individual Differences + Random Effects in an independent groups design.**

3b. In an independent groups design, what is estimated by $MS_{Within}$ (i.e., $MS_{Error}$)? In other words, we know that the $MS_{Within}$ assesses Random Effects + Individual Differences. We also know that MS is just another term for variance. But what is the $MS_{Within}$ estimating? (Be explicit.) [2 pts]

**$MS_{Within}$ is estimating $\sigma^2$ (population variance).**

4. Suppose that you've analyzed an experiment as a repeated measures ANOVA. You've obtained an F(3,12) = 5. Your $MS_{Error}$ = 1 and there are 5 scores in each group. Now, however, you find out that you *should have* computed an independent groups ANOVA. Fill in the source table below as it should appear with the appropriate analysis (i.e., assuming that all the scores are the same). [5 pts]

| SOURCE | SS | df | MS | F |
|---|---|---|---|---|
| Between | **15** | **3** | **5** | **2.5** |
| Within | **32** | **16** | **2** | |
| Total | 47 | **19** | | |

**You should be able to figure out that your source table for the RM ANOVA would have looked something like this:**

| **SOURCE** | **SS** | **df** | **MS** | **F** |
|---|---|---|---|---|
| **Between** | **15** | **3** | **5** | **5** |
| **Subject** | **20** | **4** | | |
| **Error** | **12** | **12** | **1** | |
| **Total** | **47** | **19** | | |

**Then all that you'd need to do is to combine the SS and df for Subject and Error to get to the Within values you'd need for the independent groups ANOVA.**

5. In the first problem (dog food mixes), how likely is it that Mix 1 was drawn from a population with $\mu$ = 2.5 ounces of food consumed? [10 pts]

**For this single-sample t-test, you would need the mean for Mix 1 (1.667) and the standard error for Mix 1 (.494). You would get the standard error by dividing the standard deviation for Mix 1 (1.211) by the square root of the sample size (6). Thus, your t = 1.69. With $t_{Crit}(5) = 2.571$ you would retain $H_0$ and conclude that it is possible that the sample mean was drawn from a population with $\mu = 2.5$.**