Exam 2 PS 306, Fall 2001

1. Suppose that you are interested in learning which factors lead to better performance on exams. Thus, you decide to use test performance (% correct) as your dependent variable. You will have a group of participants study in preparation for a test in an obscure area of knowledge for the typical person (that is, a topic about which people are unlikely to know a lot of information). [Why would you want an obscure content area for your experiment?] You decide that you want to use two independent variables: number of hours spent studying and the extent to which the material being learned is inherently interesting. Prior to beginning the study, you have an independent group of students rate the extent to which 10 topics are interesting. From the 10 topics, you choose 3 to use in your study (the topic rated least interesting, the topic rated most interesting, and a topic rated in the middle in terms of interest). Thus, the *Interest* factor has 3 levels, which I would like you to treat as a repeated measures factor. The number of hours spent studying that you assess is up to you, except that the factor must contain at least 3 levels and it must be an independent groups (between groups) factor. Therefore, the experiment you are about to design is at least a 3x3 mixed design (though it could have more than 3 levels of the *Hours Studying* factor if you so choose). Think carefully. What I want you to do is to lay out for me in fairly explicit detail how you would design/conduct this experiment. Be sure to address all the issues that we have discussed that would be important in designing experiments of this sort. I want you to provide sufficient detail so that I can tell that you've thought through the experiment in concrete terms. Be explicit!! [25 pts]
You would want obscure content areas to minimize the possibility that participants will come to the experiment with prior knowledge of the topic. After the selection process (from 10 possibilities) you would choose 3 content areas of Low, Medium, and High Interest. Because you're treating interest as a repeated variable, you would need to counterbalance the order in which the three content areas are studied. With only 3 levels, complete counterbalancing would make the most sense, so you would need 6 orders (LMH, LHM, MLH, MHL, HLM, HML). If the person studies all 3 at one sitting, you'd have to be careful to keep the maximum amount of study time reasonable (e.g., less than .5 hour per topic). If you decided to spread the study time over three separate days, you could use longer study times, but you should recognize that you might run into attrition problems. Even with the use of presumably obscure topics, of course, you would need to include a 0 hours study condition as a control for prior knowledge.
So, one possible set of study times might be 0, .5, and 1 hour (if you conducted the study over a few days). That is, one group would study L from .5 hour on Day1, M for .5 hour on Day2, and H for .5 hours on Day3 (with 5 other groups getting the other 5 orders). Of course, one group wouldn't study at all, but would just take the test. (Although you might consider bringing them to the lab for some time to study something different, to ensure that their performance isn't adversely affected just by being uncomfortable in the lab.) To achieve sufficient power, I might shoot for 30 pieces of data in each condition, so I'd need to run a total of 90 participants (30 in the 0 hour, 30 in the .5 hour, and 30 in the 1 hour study conditions).

2. Most adolescents experience a growth spurt when they are between 12 and 15 years old. A psychologist studying the physical development of adolescents recorded the gain in height (in centimeters) over a 1-year period for boys and girls ranging in age from 11 to 15. Thus, the *Age*

factor has 5 levels. The other factor of interest is *Gender*. The partially completed source table for this 2x5 design is seen below. Complete the source table and then interpret the study as completely as you can. [20 pts]

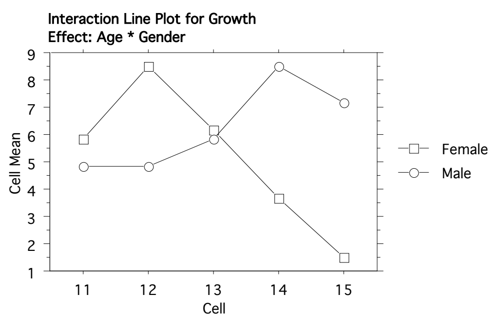
ANOVA Table for Growth

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Age	4	38.067	9.517	10.160	<.0001	40.641	1.000
Gender	1	18.150	18.150	19.377	<.0001	19.377	.996
Age * Gender	4	191.933	47.983	51.228	<.0001	204.911	1.000
Residual	50	46.833	.937				

Means Table for Growth
Effect: Age * Gender

	Count	Mean	Std. Dev.	Std. Err.
11, Female	6	5.833	.753	.307
11, Male	6	4.833	.753	.307
12, Female	6	8.500	1.049	.428
12, Male	6	4.833	.983	.401
13, Female	6	6.167	.753	.307
13, Male	6	5.833	1.169	.477
14, Female	6	3.667	.816	.333
14, Male	6	8.500	1.378	.563
15, Female	6	1.500	.548	.224
15, Male	6	7.167	1.169	.477

Because the interaction is significant, that's where you should focus your attention.



A graph of the data helps clarify the nature of the interaction. To determine which specific means differed, you would need to compute HSD.

$HSD = q\sqrt{\frac{MS_{Error}}{n}} = 4.69\sqrt{\frac{.937}{6}} = 1.85$ **Thus, at Age 11 and at Age 13, Males and Females have equivalent growth rates. However, at Age 12 Females have a significantly larger growth rate than Males. Furthermore, at Ages 14 and 15, Males have significantly larger growth rates than Females.**

3. A researcher interested in group dynamics hypothesizes that when groups of people are given a problem to solve, they will reach a unanimous consensus more quickly if the group is composed of members of the same gender than if the group is composed of people of both genders. She proposes the following independent groups design (3 levels): a group of 6 males, a group of 6 females, or a group of 6 males and 6 females will meet in a conference room. (Thus, there are three different types of groups defined by gender composition.) The researcher will give the participants biographies of three people who are being considered for an advisory position in a shipping company. The group's task is to select one of the applicants for the position through discussion and deliberation. The experimenter will be present to act as a moderator, but she will not attempt to sway the decision in one way or another. The amount of time needed to reach a decision will be the dependent variable. Are there any problems with this procedure? [10 pts]

You should notice right away that the group sizes differ (as well as the group composition). Thus, one way to fix that problem would be to have 12 females, 12 males, and a group of 6 males and 6 females. You should also notice that the female experimenter may well have an impact on the process (she's studying gender issues, so she should be aware of that possibility!!). Thus, you'd either need to remove the moderator from the process, or else introduce gender of moderator into the study (with half of each group getting a male moderator and the other half getting a female moderator).

4. The Yerkes-Dodson Law asserts that performance is lower with low and high arousal levels and higher with medium levels of arousal (an inverted-U-shaped function). Dr. Lance Boyle decides to conduct a 2x5 independent groups design with two levels of reward ($1 for each correct answer and $5 for each correct answer) and five levels of arousal (Very Low, Low, Moderate, High, and Very High). (Levels of arousal were determined by amount of caffeine ingested.) The dependent variable is number of problems correctly solved in a 10-minute period. Complete the source table below and interpret the results of this study as completely as you can. [15 pts]

ANOVA Table for Problems Solved

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Reward	1	216.090	216.090	134.775	<.0001	134.775	1.000
Arousal	4	510.560	127.640	79.609	<.0001	318.437	1.000
Reward * Arousal	4	.360	.090	.056	.9940	.225	.061
Residual	90	144.300	1.603				

Means Table for Problems Solved
Effect: Reward * Arousal

	Count	Mean	Std. Dev.	Std. Err.
$1, High	10	4.100	1.370	.433
$1, Low	10	4.100	1.197	.379
$1, Moderate	10	9.000	1.247	.394
$1, Very High	10	3.000	1.247	.394
$1, Very Low	10	3.100	1.197	.379
$5, High	10	6.900	1.197	.379
$5, Low	10	7.100	1.197	.379
$5, Moderate	10	12.100	1.370	.433
$5, Very High	10	6.000	1.247	.394
$5, Very Low	10	5.900	1.370	.433

Because the interaction is not significant, you would focus your attention on the two main effects, both of which are significant in this study. Because Reward has only two levels, you wouldn't need a post hoc test, so you could directly compare the two means ($1 = 4.7 and $5 = 7.6). Thus, you could conclude that people paid $5 perform significantly better (solve more problems correctly in a 10-minute period) than people paid $1. To determine the impact of Arousal, you would need to compute a post hoc test.

$$HSD = q\sqrt{\frac{MS_{Error}}{n}} = 3.95\sqrt{\frac{1.603}{20}} = 1.12$$

Thus, you could conclude that performance under Very Low (*M* = 4.5) and Very High (*M* = 4.5) arousal was equal and significantly lower than performance under High (*M* = 5.5) and Low (*M* = 5.6) arousal, neither of which differed. And the best performance, compared to all other arousal conditions, occurred under Moderate arousal (*M* = 10.55).