Exam 2 PS 306, Spring 2001

1. A health educator suspects that the "days of discomfort" caused by common colds can be reduced by ingesting large doses of Vitamin C and visiting a sauna every day. Participants with new colds are randomly assigned to one of four different doses of Vitamin C (500, 1000, 1500, or 2000 milligrams) and to one of three different daily exposures to a sauna (0, .5, or 1 hour). The DV is the number of days of discomfort experienced by each of the participants. Complete the source table below and analyze and interpret the results of this study as completely as you can. Then tell me what your next step would be. [10 pts]

ANOVA Table for Days of Discomfort

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Dose of C	3	4.983	1.661	2.492	.0713	7.475	.576
Sauna	2	1.200	.600	.900	.4133	1.800	.190
Dose of C * Sauna	6	3.067	.511	.767	.5998	4.600	.270
Residual	48	32.000	.667				

Means Table for Days of Discomfort
Effect: Dose of C * Sauna

	Count	Mean	Std. Dev.	Std. Err.
1000 mg, .5 Hr	5	3.600	1.140	.510
1000 mg, 0 Hr	5	3.800	.837	.374
1000 mg, 1 Hr	5	3.600	1.140	.510
1500 mg, .5 Hr	5	3.800	.837	.374
1500 mg, 0 Hr	5	3.200	.837	.374
1500 mg, 1 Hr	5	4.200	.837	.374
2000 mg, .5 Hr	5	3.000	.707	.316
2000 mg, 0 Hr	5	3.600	.548	.245
2000 mg, 1 Hr	5	3.600	.548	.245
500 mg, .5 Hr	5	4.200	.837	.374
500 mg, 0 Hr	5	4.000	.707	.316
500 mg, 1 Hr	5	4.400	.548	.245

First of all, you should note that the Dose of C is missing an important control group (0 mg). As you can see in the source table, none of the effects are significant (although the Dosage factor is close). What you should be thinking about is how you might make the study more powerful. One approach would be to add more participants. Another approach would be to increase the treatment effects (which including a 0 mg Dose group would do). You might also consider longer durations in the sauna, but that might be injurious to the health of your participants.

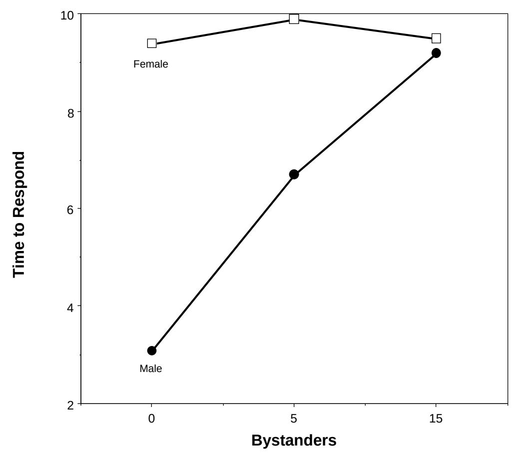
2. A researcher was interested in examining the role of gender in the context of bystander apathy. To that end, she randomly assigned male and female college students to observe a man attacking a woman and the woman yelling, "Stop, I don't know you!" The situation is established so that the participants don't realize that the attack is part of the study. The situation is manipulated so that there are 0, 5, or 15 other people present when the attack takes place. The DV is the time it takes a participant to intervene in the altercation (number of minutes). If the participant hasn't intervened within 10 minutes, that participant receives a score of 10. Complete the analysis below and interpret the results of this study as completely as you can. [20 pts]

ANOVA Table for Time to Intervene

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Gender	1	160.067	160.067	171.500	<.0001	171.500	1.000
Number of Bystanders	2	99.433	49.717	53.268	<.0001	106.536	1.000
Gender * Number of Bystanders	2	90.033	45.017	48.232	<.0001	96.464	1.000
Residual	54	50.400	.933				

Means Table for Time to Intervene
Effect: Number of Bystanders * Gender

	Count	Mean	Std. Dev.	Std. Err.
0, Female	10	9.400	1.075	.340
0, Male	10	3.100	1.197	.379
15, Female	10	9.500	.972	.307
15, Male	10	9.200	.789	.249
5, Female	10	9.900	.316	.100
5, Male	10	6.700	1.160	.367



First of all, note that the interaction is significant ($p < .0001$), so you would need to work to interpret the interaction. I would first create a graph (as seen above). To me, it appears that the Female scores stay roughly the same, regardless of the number of bystanders. On the other hand, the Male scores appear to increase as the number of bystanders increases. Now, to generate some statistical basis for what my eyes tell me, I would need to compute Tukey's HSD. With 6 means and $df_{Error} = 54$, $q = 4.18$. Thus, HSD = 1.28. I could thus conclude:

Women take a long time to respond, regardless of the number of bystanders present (0, 5, or 15). Men, on the other hand, respond quickly when no one else is present (M = 3.1), but respond significantly more slowly when 5 people are present (M = 6.7) and respond more slowly still (M = 9.2) when 15 people are present.

3. Thinking that the type of situation may have influenced the results observed in the preceding study, the researcher changes the situation to another one typically used to study bystander apathy — smoke. In this study, people are in a room and then smoke begins to pour under the door of the room. Of course, when other people are present in the room, they are all confederates of the experimenter (except for the participant). The rest of the study remains essentially unchanged. Complete the analysis, interpret the results as completely as you can, and then try to interpret the results of the two studies together. [20 pts]

ANOVA Table for Time to Intervene

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Gender	1	.067	.067	.080	.7779	.080	.059
Number of Bystanders	2	233.733	116.867	140.866	<.0001	281.732	1.000
Gender * Number of Bystanders	2	2.133	1.067	1.286	.2848	2.571	.257
Residual	54	44.800	.830				

Means Table for Time to Intervene
Effect: Number of Bystanders * Gender

	Count	Mean	Std. Dev.	Std. Err.
0, Female	10	2.100	.738	.233
0, Male	10	1.900	.738	.233
15, Female	10	6.900	1.197	.379
15, Male	10	6.700	.675	.213
5, Female	10	4.600	1.174	.371
5, Male	10	5.200	.789	.249

In this case, the only significant effect is the main effect of Number of Bystanders. The first step is to compute the three means that you'll need to interpret the main effect.

Mean 0	**Mean 5**	**Mean 15**
2.0	4.9	6.8

Next, you need to compute the HSD. With q = 3.42 (3 treatment means and dfError = 54), and n = 20 (each of the 3 means comes from 20 people, 10 Male and 10 Female), HSD = .70. Each of the three means differs by more than .70, so I would conclude:

People (regardless of gender) react significantly more rapidly to smoke pouring under the door of a room if no one else is present compared to situations in which 5 other people are present or 15 other people are present. If 5 people are present, people respond significantly more quickly than if 15 people are present.

4. Suppose that you are interested in studying the effects of a new drug on depression. You decide to conduct a single-factor independent groups experiment with three levels: Placebo, Old Best Drug, and New Drug. You select an equal number of men and women and randomly assign them to the three groups such that there is an equal number of men and women in each group. If you think about it, of course, you could analyze your data with a single-factor ANOVA *or* with a two-factor ANOVA that introduces gender as a variable. Under which circumstances would there be an advantage to analyzing the data with a two-factor ANOVA? When would you be better off sticking to a single-factor ANOVA? Be as explicit as you can in your answer. It may help your thinking if you examine the impact on df of the two approaches. [10 pts]

This question was intended to be a bit of a challenge. First of all, it requires that you are comfortable with the mechanics of computing one-way and two-way ANOVAs. Second, it requires that you have a sense of how variability in the error term affects your analysis. It would actually help you if you thought about a one-way repeated measures design, because some of the logic here parallels that of the one-way repeated measures ANOVA (e.g., removing individual differences). As always, expressing your thoughts in a concrete fashion will help.

When would the two-way ANOVA be helpful? When men and women differ! If you computed a one-way ANOVA on the data *and* men and women differ, you would have a large MS_{Error} and therefore a smaller F-ratio. Imagine a scenario like the one below:

	a1	a2	a3
Male	2 4 1 3 2	4 5 3 7 6	8 7 9 10 9
Female	9 8 10 9 8	10 11 13 12 11	15 18 17 18 17

It should be clear to you that if you computed a one-way ANOVA, the variability within each condition would be fairly large because the scores for males are substantially lower than the scores for females. Of course, I wouldn't expect you to be able to compute an ANOVA on the data, but you should have a good sense of the df in the source table, as well as the notion that the MS_{Error} would be enlarged because of the differences between men and women. The source table would look like this:

ANOVA Table for Score

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
A	2	265.867	132.933	8.636	.0013	17.272	.960
Residual	27	415.600	15.393				

In this example, A turns out to be significant. However, the MS_{Error} is fairly large. If we analyzed the data including Gender as a factor, the source table would look like this:

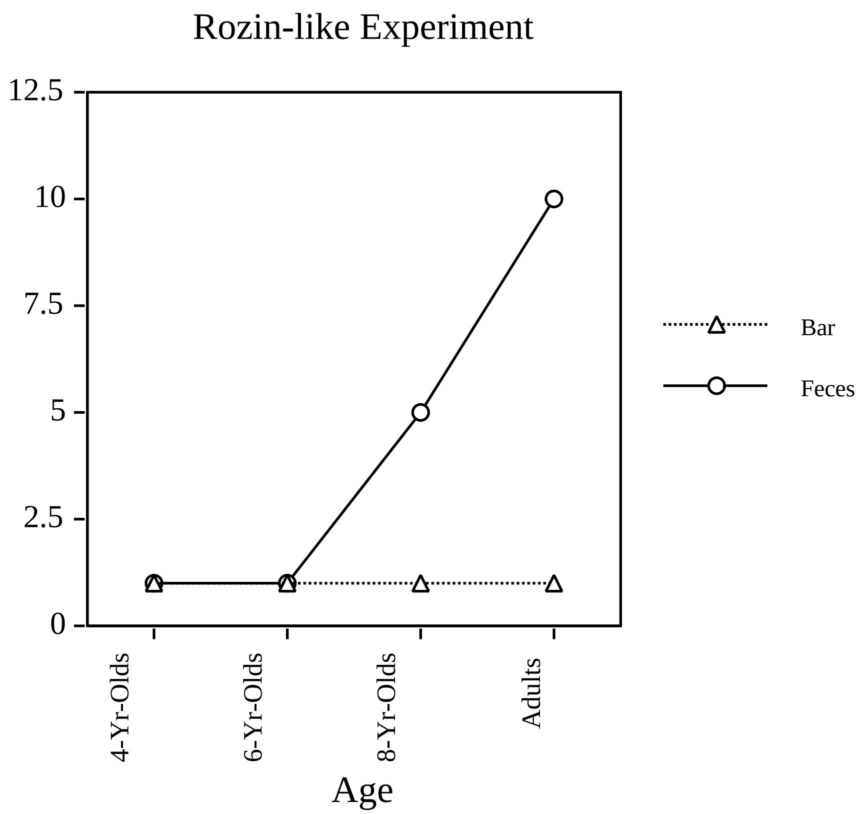
ANOVA Table for Score

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
A	2	265.867	132.933	92.744	<.0001	185.488	1.000
Gender	1	374.533	374.533	261.302	<.0001	261.302	1.000
A * Gender	2	6.667	3.333	2.326	.1194	4.651	.414
Residual	24	34.400	1.433				

Note, first of all, that the df, SS, and MS for A stay the same. (You should be able to tell me why that's so.) However, the F for Treatment A is much larger than it was for the one-way ANOVA. It's now 92.7 (instead of 8.6) because the MS_{Error} is so much smaller (1.43 compared to 15.39). That's the positive benefit of introducing gender as a factor when men and women differ in their responses.

The only time that going the two-way route wouldn't help you is when Males and Females don't differ much. In that case you would lose df in the error term (note that df_{Error} is 27 for the one-way ANOVA and 24 for the two-way ANOVA). Generally speaking, of course, you want your df_{Error} to be as large as possible. (Again, you should be able to explain why that's the case.) Thus, taking the two-way approach to the data loses df where you hate to lose them. However, as long as the men and women differ, you're likely to gain from such a gambit. Again, this discussion should strike you as quite similar to our discussion of repeated measures designs and why they are more powerful than independent groups designs even though the df_{Error} is generally smaller for repeated measures analyses of equivalent data.

5. We had discussed the sort of research that Rozin does on disgust. Suppose that you tested four different age groups (4-, 6-, and 8-year olds as well as adults) to see how long it would take them to eat chocolate when it was shaped like a bar or shaped like dog feces. You used a 4x2 independent groups design with n = 25. Suppose that the results turned out as seen in the graph below. Treating any differences as significant, what effects would you expect to find in the ANOVA for these data? What df would you find in the source table? How would you interpret the outcome? [10 pts]



You should expect to find an interaction between Age and Shape. You should also expect to find a main effect for Shape (Feces > Bar) and Age (Adult > 8 > 6 = 4). In your source table, you would have df as seen below:

Source	**df**
Age	**3**
Shape	**1**
Age x Shape	**3**
Error	**192**

I would interpret the interaction as follows:
When the chocolate is shaped like a bar, no age effects are present (4 = 6 = 8 = Adult). However, when the chocolate is shaped like feces, 4- and 6-yr-olds eat the chocolate as rapidly as when it is shaped like a bar. Eight-yr-olds take longer to eat the feces-shaped chocolate and Adults take longer still.