Laboratory for Two-Way ANOVA: Interactions

For the last lab, we focused on the basics of the Two-Way ANOVA. That is, you learned how to compute a Brown-Forsythe analysis for a Two-Way ANOVA, as well as how to compute the ANOVA itself. We also began to think about the interpretation of interactions. For this lab, we'll focus more explicitly on the analysis and interpretation of interaction effects.

1. Let's assume that we're looking at the effect of sex (M/F) and reward (Low, Med, High) on the performance of rats in a maze. The DV is number of trials to no errors in completing the maze. The data are seen below, with the group means in the last row.

M/Low	M/Med	M/High	F/Low	F/Med	F/High
7	6	4	4	3	3
8	7	5	5	3	3
6	8	3	3	2	4
8	7	4	3	3	4
7	6	5	4	4	3
7.2	6.8	4.2	3.8	3.0	3.4

Here are these data analyzed using SPSS:

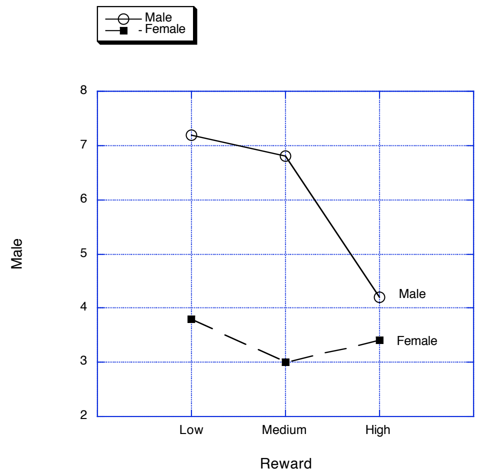
Tests of Between-Subjects Effects
Dependent Variable: TRNOERR

Source	Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power
Corrected Model	81.467	5	16.293	27.156	.000	135.778	1.000
Intercept	672.133	1	672.133	1120.222	.000	1120.222	1.000
SEX	53.333	1	53.333	88.889	.000	88.889	1.000
REWARD	14.867	2	7.433	12.389	.000	24.778	.991
SEX * REWARD	13.267	2	6.633	11.056	.000	22.111	.983
Error	14.400	24	.600				
Total	768.000	30					
Corrected Total	95.867	29					

a Computed using alpha = .05
b R Squared = .850 (Adjusted R Squared = .818)

Descriptive Statistics
Dependent Variable: TRNOERR

SEX	REWARD	Mean	Std. Deviation	N
Female	High	3.40	.548	5
	Low	3.80	.837	5
	Medium	3.00	.707	5
	Total	3.40	.737	15
Male	High	4.20	.837	5
	Low	7.20	.837	5
	Medium	6.80	.837	5
	Total	6.07	1.580	15
Total	High	3.80	.789	10
	Low	5.50	1.958	10
	Medium	4.90	2.132	10
	Total	4.73	1.818	30



First of all, can you remember how to conduct the Brown-Forsythe test on these data? I've placed the necessary data within the file, but could you have figured out how to do the B-F test on your own? Check out the formula for *ztrans* if you need a reminder. Below is the B-F ANOVA. Does it make sense to you?

ANOVA
ZTRANS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.267	5	.053	.178	.968
Within Groups	7.200	24	.300		
Total	7.467	29			

OK, so it appears that we have no concerns about heterogeneity of variance. Now let's approach these data from the perspective of simple effects. Use SPSS to conduct the following simple effects (just to show that you can):

Simple Effect	MS_{Effect}	MS_{Error}	F
Reward for Male			
Reward for Female			
Gender for Low Reward			

What F_{Crit} would you use for these analyses, given that they are post hoc tests?

Now, let's use the critical mean difference approach for the Tukey test. Compute the critical mean difference:

First apply the critical mean difference to test the three simple effects of sex at each level of reward.

Comparison	Difference
M vs. F at Low	
M vs. F at Med	
M vs. F at High	

Given this approach, how would you interpret the results of this study?

Next, let's apply the critical mean difference to test the two simple effects of reward at each level of sex. Note that these are really implicit simple effects tests, because we're skipping ahead to the test of pairs of means.

Comparison	Difference
Low vs. Med at M	
Low vs. High at M	
Med vs. High at M	
Low vs. Med at F	
Low vs. High at F	
Med vs. High at F	

Given this approach, how would you interpret the results of this study?

Which approach/interpretation makes the most sense to you?

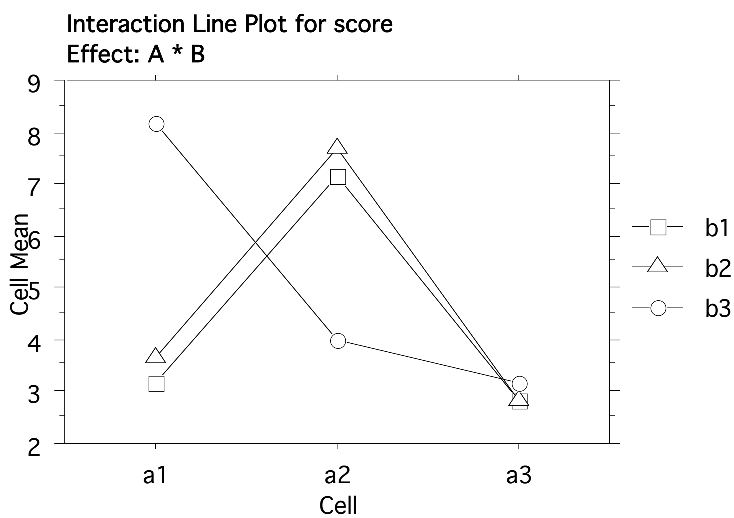
2. Here's a StatView output from some fabricated data from a 3x3 design:

ANOVA Table for score

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
A	2	101.815	50.907	48.059	<.0001	96.119	1.000
B	2	4.704	2.352	2.220	.1203	4.441	.418
A * B	4	134.185	33.546	31.670	<.0001	126.678	1.000
Residual	45	47.667	1.059				

Means Table for score
Effect: A * B

	Count	Mean	Std. Dev.	Std. Err.
a1, b1	6	3.167	.753	.307
a1, b2	6	3.667	1.211	.494
a1, b3	6	8.167	.753	.307
a2, b1	6	7.167	.983	.401
a2, b2	6	7.667	1.033	.422
a2, b3	6	4.000	.894	.365
a3, b1	6	2.833	1.169	.477
a3, b2	6	2.833	.753	.307
a3, b3	6	3.167	1.472	.601



Suppose that the ANOVA had been computed as a one-way ANOVA on A. Complete the source table below to illustrate the outcome of such an ANOVA.

Source	df	SS	MS	F
A				
Error				
Total				

Suppose that the ANOVA had been computed as a one-way ANOVA on B. Complete the source table below.

Source	df	SS	MS	F
B				
Error				
Total				

Can you see how the two-way ANOVA leads to a smaller MS_{Error}? Can you imagine a set of circumstances under which the one-way ANOVA would lead to a larger F-ratio?

Now let's focus on the interaction. Can you determine what has produced this interaction? Use the Tukey Critical Mean Difference approach to disentangle the source of the interaction.
