Unit #2 – Extra Credit

An experiment was carried out on the relation between the size and wall color of a room used for job interviews and the measured anxiety levels of the respondents. Thirty-six subjects were randomly assigned to a color-size combination. All the interviews were conducted one-at-a-time, with independent judges rating each interview. The following results were obtained:

	Red	**Yellow**	**Green**	**Blue**	**Total**
Small	$\overline{X} = 161.7$ $s = 7.6$ $n = 3$	$\overline{X} = 139.0$ $s = 5.0$ $n = 3$	$\overline{X} = 125.0$ $s = 43.5$ $n = 3$	$\overline{X} = 89.7$ $s = 20.7$ $n = 3$	$\overline{X} = 128.8$ $s = 34.4$ $n = 12$
Medium	$\overline{X} = 164.7$ $s = 11.7$ $n = 3$	$\overline{X} = 155.0$ $s = 4.6$ $n = 3$	$\overline{X} = 83.7$ $s = 5.0$ $n = 3$	$\overline{X} = 99.0$ $s = 11.5$ $n = 3$	$\overline{X} = 125.6$ $s = 37.2$ $n = 12$
Large	$\overline{X} = 158.3$ $s = 19.9$ $n = 3$	$\overline{X} = 143.7$ $s = 22.9$ $n = 3$	$\overline{X} = 84.3$ $s = 1.5$ $n = 3$	$\overline{X} = 94.3$ $s = 10.1$ $n = 3$	$\overline{X} = 120.2$ $s = 35.6$ $n = 12$
Total	$\overline{X} = 161.6$ $s = 12.4$ $n = 9$	$\overline{X} = 145.9$ $s = 13.9$ $n = 9$	$\overline{X} = 97.7$ $s = 30.0$ $n = 9$	$\overline{X} = 94.3$ $s = 13.5$ $n = 9$	$M = 124.9$ $s = 34.9$ $n = 36$

1. Assume the data are normally distributed. Will we have any problems with the other two assumptions needed to run an AxB ANOVA? You do not need to run any formal analyses to answer this question.

2. The following ANOVA summary table was created from the data. Fill-in the blanks.

Source	Sums of Squares	Degrees of freedom	Mean Square	Mean Square Ratio
Color	31176.8	_____	_____	_____
Size	453.48	_____	_____	_____
Color x Size	3495.87	_____	_____	_____
Error	7486.96	_____	_____	
Total	42613.1	_____	_____	

3. Sketch an interaction plot to see if you should find a significant interaction? Is there significant interaction? Explain what it means in this case.

4. Explain how you would finish your analysis of this data. For example, if you would analyze the simple effects (or main effects), explain how you would do it. Do not actually conduct the analysis.

The effect of three wage plans on the productivity of industrial workers in an assembly plant was studied. In group #1, assemblers were paid on a combination of hourly wages plus an incentive tied to their personal production of error-free units. In group #2, wages were determined on a combination of hourly rates plus an end-of-year bonus on company profits. In group #3, wages were based entirely on hourly rates. Daily production on an 8-hour shift (averaged over several months) was used as the dependent variable. Years of experience in the job were also considered by including two intervals of this variable as a second factor in the experiment. The results were as follows:

	Incentive	**Yearly Bonus**	**Hourly**	**Total**
1-5 Years Exp.	$\overline{X} = 34.79$ $s^2 = 27.63$ $n = 15$	$\overline{X} = 35.6$ $s^2 = 30.17$ $n = 15$	$\overline{X} = 32.6$ $s^2 = 16.3$ $n = 15$	$\overline{X} = 34.33$ $n = 45$
6-10 years exp.	$\overline{X} = 44.5$ $s^2 = 15.14$ $n = 20$	$\overline{X} = 39.5$ $s^2 = 20.28$ $n = 20$	$\overline{X} = 37.5$ $s^2 = 11.78$ $n = 20$	$\overline{X} = 40.5$ $n = 60$
Total	$\overline{X} = 40.34$ $n = 35$	$\overline{X} = 37.83$ $n = 35$	$\overline{X} = 35.40$ $n = 35$	$M = 37.86$ $n = 105$

1. Sketch an interaction plot to see if you should find a significant interaction? Is there significant interaction? Explain what it means in this case.

2. The following ANOVA summary table was created from the data.

Source	Sums of Squares	Degrees of freedom	Mean Square	Mean Square Ratio
Wage Plan	427.10	2	213.55	10.93*
Experience	978.92	1	978.92	50.10*
WP x Exp	82.58	2	82.58	4.23*
Error	1934.20	99	19.54	
Total	3422.80	104		

4. Complete the analysis & state your conclusions.

In a study of the effects of "assertiveness training" on married women, a researcher obtained a measure of independence and self-confidence before the course, immediately after the course, and two months after the course. The 21 subjects had volunteered for the course in conjunction with a conference on vocational opportunities for women. The data, in part, were as follows:

	Before	**Immediately After**	**Two Months Later**	**Average**
Subject 1	13.7	17.9	21.4	17.7
…	…	…	…	…
Subject 21	16.2	14.9	15.8	15.6
Total	$\overline{X} = 14.6$ $s = 5.2$	$\overline{X} = 18.8$ $s = 7.1$	$\overline{X} = 16.1$ $s = 5.7$	$\overline{X} = 16.5$

5. Complete the following ANOVA summary table.

Source	Sums of Squares	Degrees of freedom	Mean Square	Mean Square Ratio
Time	_____	_____	_____	_____
One-Way ANOVA Error	_____	_____	_____	_____
Subjects	1105.33	_____	_____	_____
Time x Subjects	_____	_____	_____	
Total	2382.79	_____	_____	

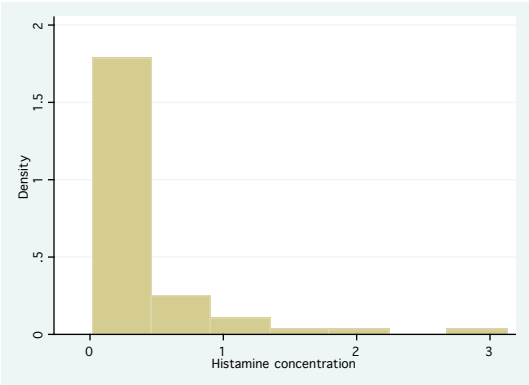
6. What do you conclude based on your ANOVA summary table? Can you conclude there is a "permanent effect" on assertiveness after two months?

7. If we would have run this as a one-way ANOVA, would we still have found a significant differences among the means?

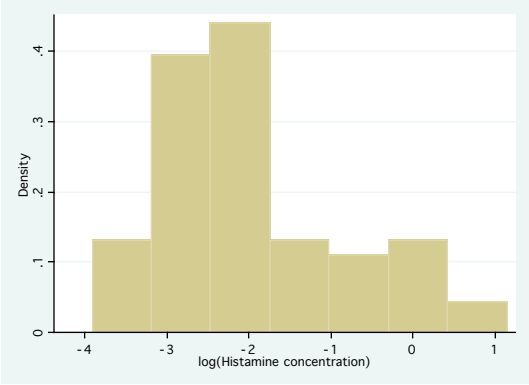
Histamine levels in dogs **Extra Credit Assignment for Unit #2 (AxS and AxB ANOVA)**

Cole and Grizzle (1966) conducted a preclinical drug experiment to study the effect of two drugs on histamine levels in the blood of dogs. Sixteen dogs were randomly assigned to four groups. First, the dogs were classified into 2 groups: 8 dogs had intact histamine levels prior to receiving the drug and the other 8 dogs had depleted histamine levels. Of the 8 dogs with intact histamine levels, 4 dogs received morphine and the other 4 dogs received trimethaphan. Likewise, 4 of the dogs with depleted histamine levels received morphine and the other 4 dogs received trimethaphan.

The dogs were injected with the drug and the blood concentration of histamine was recorded at 0, 1, 3, and 5 minutes after injection. The following graph displays the histamine concentrations for all 16 dogs at all 4 time periods.



This data would obviously fail our assumption of normality. To fix this, the researchers calculated the logarithm of each histamine level. By making a logarithmic transformation, heavily skewed data can become more normal (if you remember that a logarithm is simply an exponent, this should make sense to you). The following histogram displays the logarithm of the histamine concentrations for all 16 dogs at 0, 1, 3, and 5 minutes after being injected with the drug.



Even though I would not made this logarithmic transformation, you can see that the data did, in fact, become more normal. We will assume the normality assumption for our analyses has been met by this data.

The next page displays the data from this study.

			Logarithm of Histamine concentration ___ minutes after injection				
Dog	***Drug***	***Histamine***	0	**1**	**3**	**5**	***Mean***
1	Morphine	Depleted	-3.22	-1.61	-2.30	-2.53	**-2.41**
2	Morphine	Depleted	-3.91	-2.81	-3.91	-3.91	**-3.64**
3	Morphine	Depleted	-2.66	0.34	-0.73	-1.43	**-1.12**
4	Morphine	Depleted	-1.77	-0.56	-1.05	-1.43	**-1.20**
5	Morphine	Intact	-2.30	-2.41	-2.04	-1.97	**-2.18**
6	Morphine	Intact	-2.12	-2.21	-2.30	Missing	**?**
7	Morphine	Intact	-2.66	-2.66	-2.81	-2.66	**-2.70**
8	Morphine	Intact	-3.00	-2.66	-2.81	-2.66	**-2.78**
9	TriMeth	Depleted	-3.51	-0.48	-1.17	-1.51	**-1.67**
10	TriMeth	Depleted	-3.51	0.05	-0.31	-0.51	**-1.07**
11	TriMeth	Depleted	-2.66	-0.19	0.07	-0.22	**-0.75**
12	TriMeth	Depleted	-2.41	1.14	0.72	0.21	**-0.08**
13	TriMeth	Intact	-2.30	-2.41	-2.41	-2.53	**-2.41**
14	TriMeth	Intact	-2.53	-2.41	-2.41	-2.30	**-2.41**
15	TriMeth	Intact	-2.04	-2.30	-2.12	-2.12	**-2.15**
16	TriMeth	Intact	-2.81	-3.00	-3.00	-3.00	**-2.95**
		Mean	**-2.71**	**-1.51**	**-1.79**	**?**	**?**
		Std. Dev	**0.59**	**1.33**	**1.25**	**?**	**?**

The researchers were unable to get an accurate histamine measurement from the 6th dog five minutes after it was injected with morphine (the "Missing" observation).

Your task is to conduct 2 studies on this data.

a) Run an appropriate analysis to determine if histamine levels change at 0, 1, 3, and 5 minutes after injection. Make sure to write out your hypotheses, choose an appropriate alpha-level, show your calculations, and write out your conclusions.

b) There are 2 variables in this study (ignoring the time variable): **Drug** and **Histamine**. Run an AxB ANOVA to determine if the effect of drug type (morphine vs. trimethaphan) and histamine (depleted vs. intact) on the average histamine concentration of dogs. The data have been reformatted on the next page to help you see how this is an AxB ANOVA. Once again, write out your hypotheses, choose an appropriate alpha-level, show your calculations, and write out your conclusions. Remember that you may need to test the simple-effects of this study if you find a significant interaction.

You must decide how you will handle the missing data in this study. Before you begin your analysis, write a sentence or two explaining how you are dealing with the missing observation. Also, explain how your decision will have a negative impact on the study.

		Drug	
		Morphine	TriMeth
Histamine Levels	Depleted	-3.22 -1.61 -2.30 -2.53 -3.91 -2.81 -3.91 -3.91 -2.66 0.34 -0.73 -1.43 -1.77 -0.56 -1.05 -1.43	-3.51 -0.48 -1.17 -1.51 -3.51 0.05 -0.31 -0.51 -2.66 -0.19 0.07 -0.22 -2.41 1.14 0.72 0.21
	Intact	-2.30 -2.41 -2.04 -1.97 -2.12 -2.21 -2.30 Missing -2.66 -2.66 -2.81 -2.66 -3.00 -2.66 -2.81 -2.66	-2.30 -2.41 -2.41 -2.53 -2.53 -2.41 -2.41 -2.30 -2.04 -2.30 -2.12 -2.12 -2.81 -3.00 -3.00 -3.00

This extra credit assignment will be due by the final week of classes (the week before final exams). If you need some help getting started, feel free to stop by my office. You may work with your classmates on this assignment, but please write out your own answers.