

**Exam 1****PS 306, Fall 2002**

1. Searching for the dangers of caffeine, Dr. Hy Test adds two types of caffeine (those found in coffee and chocolate) to the water supply of groups of laboratory-bred rats. The water supply of a control group of rats was not fortified. This species ordinarily lives about 13 months. The DV is the number of days that the rats lived. Complete the analysis below, interpret the results as completely as you can, and then tell me very specifically what you would do next. [10 pts.]

**ANOVA Table for Days Lived**

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Caffeine	2	33.250	16.625	.084	.9194	.169	.061
Residual	21	4136.375	196.970				

**Means Table for Days Lived****Effect: Caffeine**

	Count	Mean	Std. Dev.	Std. Err.
Chocolate	8	397.750	14.140	4.999
Coffee	8	400.500	16.009	5.660
None	8	399.875	11.606	4.103

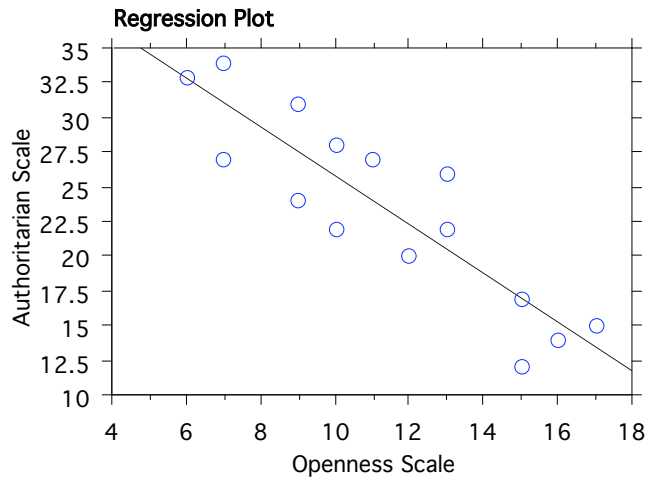
**Because the F-value is small (and the P-Value > .05) you would retain  $H_0$ . Thus, it seems reasonable to conclude that on the basis of this particular study, caffeine (in the forms administered) did not have an impact on the longevity of the rats.**

**Next, of course, you'd need to think about issues of power. How could you make this study more powerful? The most obvious approach would be to increase sample size from 8 to some greater number (30? 50?). You should also consider the treatment level. Could the amount of caffeine added to the water supply be increased? You should also consider how you might decrease  $MS_{Error}$ . One possibility would be to make the rats more similar (litter mates?). Another possibility would be to make sure that the environments of the rats were as close to identical as possible (so that exercise opportunities, type and amount of food provided, etc. were the same).**

2. An interesting psychological trait is openness to experience: a willingness to try new things and to keep an open mind (McCrae, 1996). Another often researched trait is authoritarianism: a general belief that society is better off with strongly enforced laws and punitive parents and bosses to keep people in line. To determine if the two traits are related, a randomly selected group of students was given both scales. Interpret the results of the study seen below as completely as you can. If a person had an Openness to Experience Scale score of 6, what would be your best prediction of that person's Authoritarianism Scale score? What about an Openness to Experience score of 15? What proportion of the variability in Authoritarianism Scale scores is shared with the Openness to Experience Scale? [10 pts.]

**Regression Summary**  
**Authoritarian Scale vs. Openness Scale**

Count	15
Num. Missing	0
R	.885
R Squared	.782
Adjusted R Squared	.766
RMS Residual	3.328



**ANOVA Table**  
**Authoritarian Scale vs. Openness Scale**

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	1	517.722	517.722	46.735	<.0001
Residual	13	144.012	11.078		
Total	14	661.733			

**Regression Coefficients**  
**Authoritarian Scale vs. Openness Scale**

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	43.402	3.040	43.402	14.277	<.0001
Openness Scale	-1.759	.257	-.885	-6.836	<.0001

**There is a significant negative linear relationship between scores on the Authoritarian Scale and the Openness Scale,  $r = -.885$ ,  $p < .0001$ . (Be sure to note how you know that the linear relationship is significant by pointing to the P-Value and even the F-Value of 46.7.) The two scales share about .78 of their variability, which would be a very large amount for psychological research (but characteristic of fabricated data such as these).**

**If a person received a score of 6 on the Openness Scale, you would predict a score on the Authoritarian Scale of:**

$$\hat{y} = 43.402 + (-1.759 * 6)$$

$$\hat{y} = 32.8$$

**If a person received a score of 15 on the Openness Scale, you would predict a score on the Authoritarian Scale of:**

$$\hat{y} = 43.402 + (-1.759 * 15)$$

$$\hat{y} = 17.0$$

3. Drs. Frank Lee and Mai Deere were interested in the impact of time on the nature of romantic relationships (i.e., does familiarity really breed contempt?). To investigate their hypothesis, they recruited 50 people, 10 who had been in a relationship for 6 months, 10 in a relationship for 12 months, 10 in a relationship for 24 months, 10 in a relationship for 48 months, and 10 in a relationship for 120 months. Each participant was asked to rate the quality of his or her relationship on a scale of 1 to 10 (1 = poor and 10 = great). Complete the source table below and interpret the results of this study as completely as you can. [15 pts]

**ANOVA Table for Quality of Rel**

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Length of Rel	4	83.320	20.830	25.063	<.0001	100.251	1.000
Residual	45	37.400	.831				

**Means Table for Quality of Rel**  
Effect: Length of Rel

	Count	Mean	Std. Dev.	Std. Err.
006 mos.	10	8.900	.994	.314
012 mos.	10	9.000	.816	.258
024 mos.	10	7.200	.789	.249
048 mos.	10	5.600	1.075	.340
120 mos.	10	8.500	.850	.269

**First of all, you should note that this study is not a true experiment, in that nothing is manipulated (or that the people are not assigned to the conditions randomly). As a result, the good doctors would not be justified in making any causal claims.**

**There are significant differences among the ratings at different relationship lengths,  $F(4,45) = 25.063$ ,  $p < .0001$ . In order to determine which specific means differed, you would need to compute a post hoc analysis.**

$$HSD = 4.03 \sqrt{\frac{.831}{10}} = 1.16$$

Comparison	Difference
$H_0: \mu_6 = \mu_{12}$	0.1
$H_0: \mu_6 = \mu_{24}$	1.7
$H_0: \mu_6 = \mu_{48}$	3.3
$H_0: \mu_6 = \mu_{120}$	0.4
$H_0: \mu_{12} = \mu_{24}$	1.8
$H_0: \mu_{12} = \mu_{48}$	3.4
$H_0: \mu_{12} = \mu_{120}$	0.5
$H_0: \mu_{24} = \mu_{48}$	1.6
$H_0: \mu_{24} = \mu_{120}$	1.3
$H_0: \mu_{48} = \mu_{120}$	2.9

Thus, it appears that people in a relationship for 6, 12, or 120 months rated the quality of their relationship as significantly higher than people in a relationship for 24 and 48 months. People in a relationship for 24 months rated the quality of their relationship as significantly higher than people in a relationship for 48 months. No other differences were significant.

4. Drs. Dewey, Screwup, & Howe are industrial/organizational psychologists who were interested in the impact of noise levels in the workplace on the productivity of workers. To assess the effect of noise, they went to an automobile factory, where they could study 10 workers under each of 3 different noise levels (Low, Moderate, High). Their DV was level of productivity (1 = Low to 15 = High). Complete the source table below, then interpret the results of this study as completely as you can. [15 pts.]

**ANOVA Table for Noise Level**

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Subject	9	405.500	45.056				
Category for Noise Level	2	84.267	42.133	3.747	.0436	7.494	.604
Category for Noise Level * Subject	18	202.400	11.244				

**Means Table for Noise Level**

Effect: Category for Noise Level

	Count	Mean	Std. Dev.	Std. Err.
Low Noise	10	10.900	5.384	1.703
Mod Noise	10	9.700	4.877	1.542
High Noise	10	6.900	3.843	1.215

First of all, you should note that to appropriately counterbalance this study would require 6 different orders (complete counterbalancing): LMH, LHM, MHL, MLH, HLM, HML. Thus, 10 participants would not be consistent with complete counterbalancing.

It would also be helpful to know what the typical noise level in the factory would be, to determine what level would represent an appropriate control condition.

It appears that there is an impact of noise level on productivity,  $F(2,18) = 3.747, p < .05$ . Thus, you would want to compute post hoc analyses to determine which of the conditions differed.

$$HSD = 3.61 \sqrt{\frac{11.244}{10}} = 3.83$$

Comparison	Difference
$H_0: \mu_{Low} = \mu_{Mod}$	1.2
$H_0: \mu_{Low} = \mu_{High}$	4.0
$H_0: \mu_{Mod} = \mu_{High}$	2.8

You could conclude that the High Noise condition ( $M = 10.9$ ) led to significantly lower productivity than the Low Noise condition ( $M = 6.9$ ), with no other differences significant.

5. Distinguish between the terms *internal validity* and *external validity*. Are they completely independent? (Could you have one without the other?) Which is more important and why? Briefly describe the Higgins & Marlatt (drinking and tension reduction) or the Hecht (dark adaptation) study and articulate the external validity problems. Then tell me why you don't think (or Mook didn't think) that those concerns are sufficiently troublesome that they would negate the value of the study. [10 pts]

**The essay in response to this question would, of course, draw heavily on the Mook article.**

6. You would typically want to use a repeated measures design rather than an independent groups design because it is more powerful and more efficient. First, illustrate the source of power that one typically finds in a repeated measures design, including a brief illustration of circumstances in which the repeated measures design would not be more powerful. Next, illustrate why the repeated measures design is more efficient. Then briefly articulate the reasons that would lead you to use an independent groups design rather than a repeated measures design. (Examples will help your answers here.) [10 pts.]

**The repeated measures design is more powerful because it eliminates the individual differences that contribute to the variability in an independent groups design. Of course, in those rare circumstances in which individual differences are modest, then the power advantage will not be observed. In the two source tables below, which deal with the same 96 numbers, you would expect that the repeated measures analysis would lead to a larger F-ratio. It does not, in this case, because the individual differences are so small.**

Source	df	SS	MS	F
Treatment	3	30	10	5
Error	92	184	2	
Total	95	214		

Source	df	SS	MS	F
Subject	23	11.5		
Treatment	3	30	10	4
Error	69	172.5	2.5	
Total	95	102		

**The above situation would also illustrate the efficiency of the repeated measures design. Note that the same 96 data points would come from 96 participants in an independent groups design. However, in a repeated measures design those same 96 data points would come from 24 people.**

**In spite of the power and efficiency advantages of the repeated measures design, you would use an independent groups design when the treatment produced permanent changes in the participant (physical alterations, like surgeries; permanent changes in mental state, like learning a language) or when deception is used (because it's unlikely that you could fool a participant twice in a row).**