Exam 3 PS 217, Spring 2009

1. An industrial-organizational psychologist was interested in whether individuals working in different sectors of a company differed in their attitudes toward the company. A simple 9-point response scale was used, in which 1 indicated a strongly negative attitude toward the company and 9 indicated a strongly positive attitude toward the company. The results from the survey are seen below. Analyze these data as completely as possible for the psychologist and tell the psychologist what management should be told about the results. [15 pts]

	Engineering	Marketing	Accounting	Production	
	9	6	2	5	
	8	4	1	3	
	8	5	3	4	
	8	7	2	5	Sum
Sum	33	22	8	17	80
Sum of squared scores (e.g., ΣX^2)	273	126	18	75	492

Source	*SS*	*df*	*MS*	*F*
Between	81.5	3	27.17	30.9
Within	10.5	12	.88	
Total	92	15		

$F_{Max} = \frac{5}{.75} = 6.7$ **, so with $F_{\text{Max Critical}} > 20.6$, there is no concern about heterogeneity of variance, so test H_0 with $\alpha = .05$.**

$F_{\text{Critical}}(3,12) = 3.49$

$H_0: \mu_{Eng} = \mu_{Mark} = \mu_{Acc} = \mu_{Prod}$
H_1: Not H_0

Decision: Reject H_0, because $F_{Obt} \geq F_{Crit}$.

Post Hoc Test: $HSD = 4.2\sqrt{\frac{.88}{4}} = 1.97$

	Eng	**Mark**	**Acc**	**Prod**
Eng	**---**			
Mark	**2.75***	**---**		
Acc	**6.25***	**3.5***	**---**	
Prod	**4***	**1.25**	**2.25***	**---**

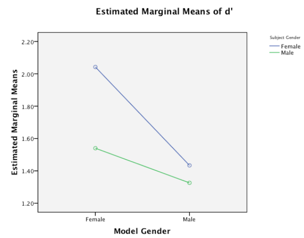
Conclusion: Engineering folks have a more positive attitude (*M* = 8.25) than folks in Marketing (*M* = 5.5), Accounting (*M* = 2), or Production (*M* = 4.25). Folks in Marketing and Production have a more positive attitude than folks in Accounting, but they don't differ from one another. Note, however, that this study is not an experiment, with a random assignment to conditions. Thus, it's entirely possible that the kind of person who is attracted to Engineering may tend to have a more positive attitude toward the company that employs them.

2. Rehnman and Herlitz (2007) examined male and female subjects who viewed faces of both children and adults of either Swedish or Bangladeshi origin. They were later tested on their ability to recognize the faces from among a set of new/distractor faces (all presented in color from a frontal view, but free of facial hair and glasses). The DV in this case is *d'* (remember signal detection, where *d'* is a measure of sensitivity, with higher *d'* meaning more sensitivity, or greater recognition ability). Complete the source table below (slightly modified from SPSS output), then interpret the results as completely as you can. [15 pts]

Descriptive Statistics

Dependent Variable:d'

Model Gen...	Subject Gen...	Mean	Std. Deviation	N
Female	Female	2.0420	.18594	15
	Male	1.5400	.04375	15
	Total	1.7910	.28773	30
Male	Female	1.4340	.14050	15
	Male	1.3260	.09538	15
	Total	1.3800	.13015	30
Total	Female	1.7380	.34903	30
	Male	1.4330	.13099	30
	Total	1.5855	.30326	60



Dependent Variable:d'

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power[b]
Model	2.534	1	2.534	155	.000	.735	1.000
Subject	1.395	1	1.395	87	.000	.604	1.000
Model * Subject	.582	1	.582	36	.000	.389	1.000
Error	.915	56	.016				
Corrected Total	5.426	59					

$F_{Max} = \frac{.0346}{.0019} = 18.1$**, so with $F_{\text{Max Critical}}$ = 4.2, you would conclude that there is likely heterogeneity of variance (i.e., you'd reject H_0: population variances are all identical). Thus, in your overall ANOVA, you'd use α = .01. Alternatively, you could note that with all effects significant at a level below .01, you wouldn't need to compute Hartley's F_{Max}.**

Decision: Main effect for Model Gender is significant (p < .001). Main effect for Subject Gender is significant (p < .001). The interaction is significant (p < .001). As a result, you'd focus your attention on explaining the interaction.

Post Hoc Test: $HSD = 3.75\sqrt{\frac{.016}{15}} = .122$

Conclusion: For male models, the gender of the subject has no impact (*M* = 1.434 for female subjects and *M* = 1.326 for male subjects). However, for female models, female subjects are more sensitive (i.e., significantly higher d', *M* = 2.042) than males (*M* = 1.54).

3. Drs. Yerkes and Dodson were interested in establishing the relationship between arousal and performance. They created a means of determining levels of arousal that fall between 1 (very low arousal) and 10 (very high arousal). They also use a measure of performance that falls between 1 (very low performance) and 10 (very high performance). The data that they collect from 12 subjects are seen below. Analyze the data as completely as you can to tell the good Drs. whether or not their data would allow them to predict levels of performance if they know levels of arousal. For instance, if they knew that a person's arousal level was 5, what would be the best prediction of performance level? What proportion of variance do these two measures share? [10 pts]

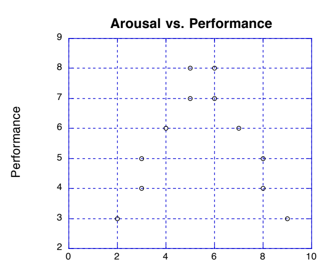
Subject	Arousal	Performance	AP
1	8	5	40
2	2	3	6
3	6	8	48
4	3	5	15
5	9	3	27
6	7	6	42
7	5	8	40
8	3	4	12
9	6	7	42
10	4	6	24
11	8	4	32
12	5	7	35
Sum	66	66	363
Sum of squared scores (e.g., ΣX^2)	418	398	
Mean	5.5	5.5	

H_0: $\rho = 0$ H_1: $\rho \neq 0$
$r_{Crit}(10) = .576$

$$r = \frac{363 - \frac{(66)(66)}{12}}{\sqrt{(55)(35)}} = \frac{0}{43.87} = 0$$ **and $r^2 = 0$ as well (the amount of variance shared).**

Decision: Retain H_0, because $r_{Obt} < r_{Crit}$.

However, this data set provides a good reason for one to plot the data. (The hint was that we'd talked about the Yerkes-Dodson Law in class.) That is, there is a nice relationship between these two variables, but it's not a simple linear one, as seen below. Only if one drew the graph would the relationship be obvious, which would then lead one to say that if the arousal level were 5, you'd predict relatively high performance (8'ish), which you could obtain by computing a separate analysis on the arousal levels from 1-5 (and from 6-10).



4. Suppose that you are interested in the relationship between the time spent studying and the time it takes a person to complete an exam. You collect these data from 11 students and find that the coefficient of determination is .81. Are you justified in computing the regression equation for prediction? Assuming that you are, and given the information from the students seen below, compute the regression equation to predict the time to complete an exam (Y) from the number of hours spent studying (X). (You should assume a positive relationship.) [10 pts]

	Hours Studying	Time to Complete Exam (Mins)
Mean	5	50
Variance	.2	7.2

With $r^2 = .81$, $r = .9$. To test H_0: $\rho = 0$, use $r_{Crit}(9) = .602$. Thus, there is a significant linear relationship between hours studying and time to complete an exam.

Using the variances, we can derive *SP*…and see that it's a positive relationship.

$$.9 = \frac{SP}{\sqrt{(2)(72)}}$$
$$10.8 = SP$$

To determine the regression equation:

$$b = \frac{10.8}{2} = 5.4$$
$$a = 50 - (5.4)(5) = 23$$
$$\hat{Y} = 5.4X + 23$$

5. How are the repeated measures and the two factors analyses of variance similar? How do they differ? The error term for the repeated measures ANOVA is most similar to which term in a two-factor ANOVA? (This question requires no computation.) [5 pts]

The RM ANOVA is actually a kind of two-factor ANOVA, with Treatment (Between) and Subjects as the two factors. However, we can only assess the significance of Treatment (Between), using the Subject effect to remove individual differences and the Treatment x Subject interaction as the error term. So, one similarity is the presence of two "factors" and another is the presence of an interaction. (There are also trivial ways in which they are similar, in that both produce *F*-ratios, etc.) They differ in that one assesses only the effect of treatment in the RM ANOVA, but in the two-way ANOVA one assesses both main effects and the interaction. As indicated above, the error term in the RM ANOVA is actually an interaction term (Treatment x Subjects).

6. Although psychologists do not completely understand the phenomenon of dreaming, it does appear that people need to dream. One experiment demonstrating this fact shows that people who are deprived of dreaming one night will tend to have extra dreams the following night, as if they were trying to make up for the lost dreams. In a typical version of this experiment, the psychologist first records the number of dreams (by monitoring rapid eye movements [REM]) during a normal night's sleep. The next night, each subject is prevented from dreaming by being awakened as soon as she or he begins a dream. During the third night, the psychologist once again records the number of dreams. Hypothetical data from this experiment are as follows:

	First Night	Night After Deprivation
S1	4	7
S2	5	5
S3	4	8
S4	6	7
S5	4	10
S6	5	7
S7	4	7
S8	4	6
Sum	36	57
Sum of squared scores (e.g., ΣX^2)	166	421
SS	**4**	**14.875**

Interpret these data as completely as you can. [15 pts]

Source	***SS***	***df***	***MS***	***F***
Between	$\frac{36^2 + 57^2}{8} - \frac{93^2}{16} = 27.56$	1	27.56	16
Within	4 + 14.875 = 18.875	14		
Subject	$\frac{11^2 + 10^2 + 12^2 + 13^2 + 14^2 + 12^2 + 11^2 + 10^2}{2} - \frac{93^2}{16} = 6.94$	7		
Error	18.875 – 6.94 = 11.9375	7	1.71	
Total	$587 - \frac{93^2}{16} = 46.4375$	15		

$\Sigma X^2 = 587$, $G = 93$

H_0: $\mu_{FirstNight} = \mu_{Night\ After\ Depression}$ **H_1: Not H_0** **$F_{Crit}(1,7) = 5.59$**

Decision: Reject H_0, because $F_{Obt} \geq F_{Crit}$

Interpretation: People had significantly more dreams after deprivation (*M* = 7.125) than on the first night (*M* = 4.5), *F*(1,7) = 16, *MSE* = 1.71, *p* < .05. However, from the description of the study, it wasn't properly counterbalanced. As a result, it could be that the difference is due to people being more familiar with the setting on the second night. It would be important to conduct the properly counterbalanced study to reach a conclusion about the impact of deprivation on dreaming.

7. Below are some summary data from a single-factor independent groups experiment. On the basis of this information, you can compute an ANOVA. (Trust me, you can!) There's a slightly more time-consuming way to get the source table from these data. A somewhat shorter procedure requires that you use information that you should know about the basis for the $MS_{Between}$ and the MS_{Within}. Analyze the data as completely as possible (i.e., don't simply complete the source table). [15 pts.]

IV = Type of learning strategy (Repetition, Imagery, Make-a-Story, No Instructions)
DV = Number of words recalled out of 30

	Repetition	Imagery	Make-a-Story	No Instructions
Mean	2.6	7.2	7.2	5.7
Variance	1.6	2.4	2.4	.9
n	10	10	10	10

Source	***SS***	***df***	***MS***	***F***
Between	141.08	3	47.025	25.767
Within	65.7	36	1.825	
Total	206.775	39		

F_{Max} = 2.4/.9 = 2.67 and $F_{Max\ Crit}$ = 6.31, so there is no reason to be concerned about heterogeneity of variance. Use α = .05 for the ANOVA.

H_0: $\mu_{Repetition} = \mu_{Imagery} = \mu_{Make\text{-}a\text{-}Story} = \mu_{No\ Instructions}$ H_1: Not H_0 $F_{Crit}(3,36) = 2.86$

Decision: Reject H_0, $F_{Obt} \geq F_{Crit}$

	Rep	**Imag**	**Make**	**No Inst**
Rep	**---**			
Imag	**4.6**	**---**		
Make	**4.6**	**0**	**---**	
No Inst	**3.1**	**1.5**	**1.5**	**---**

$$HSD = 3.8\sqrt{\frac{1.825}{10}} = 1.6$$

There is a significant effect of learning strategy on mean number of words recalled, $F(3,36) = 25.767$, $MSE = 1.825$, $p < .05$. Post hoc analysis using Tukey's HSD indicate that the repetition strategy led to significantly lower recall (M = 2.6) than the other three strategies (both Imagery and Make-a-Story M = 7.2, No Instructions M = 5.7), none of which differed.

8a. As part of an analysis of the relationship between smoking and absenteeism, a researcher collected data from 8 randomly selected smokers and 8 randomly selected non-smokers. The number of packs a day that each person smoked was recorded (i.e., 0 for the non-smokers) as was the number of days absent from work in a year. Given the computer output seen below, what would you say about the relationship and the researcher's data? What proportion of the variability in absenteeism is explained by smoking? If a person smoked 1.5 packs a day, what would be your best guess about the number of days that they would be absent? What if the person smoked 7 packs a day? (10 pts)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.793[a]	.629	.603	1.85412

a. Predictors: (Constant), Packs

ANOVA[b]

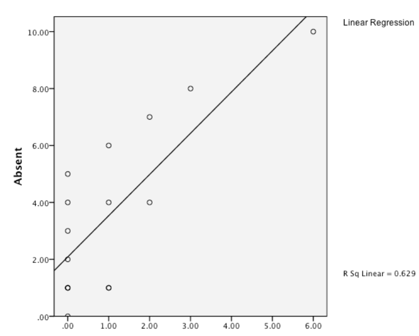
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	81.622	1	81.622	23.743	.000[a]
	Residual	48.128	14	3.438		
	Total	129.750	15			

a. Predictors: (Constant), Packs
b. Dependent Variable: Absent

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.087	.561		3.721	.002
	Packs	1.448	.297	.793	4.873	.000

a. Dependent Variable: Absent



There is a significant positive linear relationship between Absenteeism and Number of Packs smoked, $r(14) = .793$, p < .001. The proportion of shared variability (r^2) is .629. The regression equation is: $\hat{Y} = 1.448X + 2.087$**.**

If a person smoked 1.5 packs per day: $4.259 = 1.448(1.5) + 2.087$ **(so, roughly 4 days)**
If a person smoked 7 packs per day: a. could say that you couldn't predict, because it's outside of observed scores. Or b. $12.2 = 1.448(7) + 2.087$**, but *only* if the trend continues.**

8b. One could also address the question slightly differently, by asking if there was a significant difference in the number of days absent from work as a result of smoking. You can't extract the data points from the graph (some points represent two people), but you should be able to show how you'd set up the data to address this new question. What analysis would you conduct? What does it appear that you'd be likely to find as a result? (5 pts)

You could compute an independent groups ANOVA (or a *t*-test). Your factor (IV) would be number of packs smoked (but it's not a manipulated variable). You could use the exact number of packs as levels of your factor, or you could recode the data as Non-smokers vs. Smokers (lumping together all the people who smoke some number of packs). Your DV would be number of days absent. It does appear that people who smoke (especially larger number of packs) have more days absent than those who don't smoke.

8c. How would you characterize the differences between a research approach that looks for relationships and an approach that looks for differences? Which approach makes more sense to you (and why)? Are there typically problems that confront a researcher looking for relationships that don't confront a researcher looking for differences? (5 pts.)

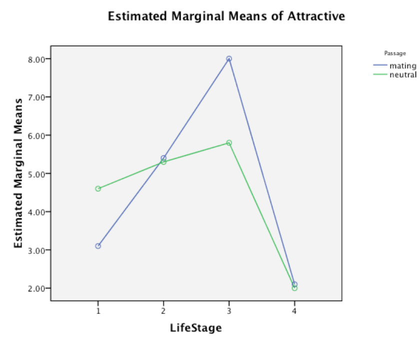
The basic distinction is between a correlational approach and an experimental approach. With correlational designs, nothing is manipulated, so there are problems in making causal claims. With carefully designed experimental designs, causal claims are reasonable. One could make a reasonable claim for either approach, but my own preference is for the experimental approach—probably because I'm a control freak. (And I like to have a sense that I can make an assertion about causal factors.) That said, there are some research areas in which an experiment would be unethical (e.g., does smoking cause lung cancer?). For those areas, the correlational approach makes sense.

9. In one study in their paper *Peak of desire: Activating the mating goal changes life-stage preferences across living kinds*, Huang and Bargh (2008) were interested in the impact of a priming task on ratings of attractiveness. They first had half their participants read a 184-word passage describing a romantic date. The other half of their participants read a neutral passage describing the interior of a building. To keep the analysis consistent with your abilities, let's presume that a quarter of each group rated the attractiveness (on a 10-point scale from 1 = not at all attractive to 10 = extremely attractive) of a photograph of bananas. (Yes…really…bananas…you can't make up something like that!) There were four banana pictures: Life Stage 1 = new, green, Life Stage 2 = developing, yellow-green, Life Stage 3 = peak, completely yellow, and Life Stage 4 = decaying, mottled brown spots. Below are the data in SPSS output form. Analyze these data as completely as you can. [15 pts]

Descriptive Statistics

Dependent Variable:Attractive

Passage	Life Sta...	Mean	Std. Deviation	N
mating	1	3.1000	.56765	10
	2	5.4000	.69921	10
	3	8.0000	.81650	10
	4	2.1000	.56765	10
	Total	4.6500	2.39176	40
neutral	1	4.6000	.84327	10
	2	5.3000	.67495	10
	3	5.8000	1.03280	10
	4	2.0000	.94281	10
	Total	4.4250	1.70801	40
Total	1	3.8500	1.03999	20
	2	5.3500	.67082	20
	3	6.9000	1.44732	20
	4	2.0500	.75915	20
	Total	4.5375	2.06810	80



Tests of Between-Subjects Effects

Dependent Variable:Attractive

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Passage	1.01	1	1.01	1.646	.204	.022	1.646	.244
LifeStage	257.91	3	85.97	139.795	.000	.853	419.384	1.000
Passage * LifeStage	34.53	3	11.51	18.711	.000	.438	56.133	1.000
Error	44.28	72	.615					
Corrected Total	337.888	79						

You could either: **a. compute Hartley's F_{Max} = 1.067/.322 = 3.31 and compare to $F_{Max\ Crit}$ = 8.95, which would lead you to believe that there's no concern about heterogeneity of variance, so, you would use α = .05.**

or

b. say that all significant results were at levels below .01, so there's no need to compute Hartley's $F_{Max.}$

Thus, there is a significant main effect for the Life Stage, $F(3,72) = 139.795$, $MSE = .615$, $p < .001$, $\eta^2 = .853$. There is no main effect for Passage, $F(1,72) = 1.646$, $p = .204$, $\eta^2 = .022$. There is also a significant interaction, $F(3,72) = 18.711$, $p < .001$, $\eta^2 = .438$. To determine the source of the interaction, I'd need to compute Tukey's HSD.

$$HSD = 4.42\sqrt{\frac{.615}{10}} = 1.096$$

One interpretation of the interaction is that people in the Neutral condition rated the Life Stage 1 bananas as more attractive (*M* = 4.6) than did people in the Mating condition (*M* = 3.1). However, people in the Neutral condition rated the Life Stage 3 bananas as *less* attractive (*M* = 5.8) than did people in the Mating condition (*M* = 8.0). People in the Neutral condition didn't differ from people in the Mating condition for ratings of Life Stage 2 bananas (*M*s = 5.3 and 5.4, respectively) or of Life Stage 4 bananas (*M*s = 2.0 and 2.1, respectively).