

1a. In each of the chapters we've covered for this exam, there has been some discussion of effect size. First of all, tell me how you would measure effect size (i.e., tell me the statistic you would use). Then, tell me how effect size and power are related. [3 pts]

**The measure of effect size that we've been using for ANOVAs is  $\eta^2$ . In general, with smaller effect sizes, you'd need more power to detect the effect.**

1b. If researchers work to achieve a level of power of .80, what does that say about their tolerance for Type II Error relative to Type I Error, given the usual  $\alpha$ -level used in research? [2 pts]

**Given the complementary nature of power and Type II Error, power (1- $\beta$ ) of .80 would mean that Type II Error was .20. That means that people are willing to tolerate four times as much Type II Error as Type I Error (assuming  $\alpha = .05$ ).**

2. Pelton (1983) reported that Olympic-level marksmen shoot much better if they fire between heartbeats rather than squeezing the trigger during a heartbeat. The small vibration caused by a heartbeat seems to affect the marksmen's aim. Suppose that Pelton had obtained the following hypothetical data from a sample of  $n = 6$  Olympic marksmen. The dependent variable is an accuracy score (larger scores are better). Do these data indicate a significant difference? [15 pts]

	During Heartbeats	Between Heartbeats	P
	93	98	191
	90	94	184
	95	96	191
	92	91	183
	95	97	192
	91	97	188
( $\Sigma X$ ) or T	556	573	1129
$\Sigma X^2$	51544	54755	106299
SS	21.33	33.5	54.83

Source	SS	df	MS	F
Treatment	24.08	1	24.08	6.92
Within	54.83	10		
Subject	37.42	5		
Error	17.41	5	3.48	
Total	78.92	11		

$$H_0: \mu_{\text{During}} = \mu_{\text{Between}}$$

$$H_1: \text{Not } H_0$$

**For this repeated measures design,  $F_{\text{crit}}(1,5) = 6.61$ . Thus, you'd reject  $H_0$  because  $F_{\text{obt}} > F_{\text{crit}}$ . Because there are only two levels, no post hoc test is necessary, so you could conclude that accuracy was significantly better between heartbeats ( $M = 95.5$ ) than during heartbeats ( $M = 92.67$ ).**

3. A scientist tests two drugs for their effects on insomnia. A sample of insomniacs is pre-tested with a placebo before bedtime, and the latency to onset of sleep is measured to serve as a baseline. A week later, the participants receive the first drug (Drug A) before bedtime, and the time that lapses between drug administration and sleep onset is measured again. Finally, a week later the second drug (Drug B) is tested in the same fashion. The latency to sleep onset in minutes is measured for each participant on every test. Complete the StatView output for this study and then interpret the results as completely as you can. [15 pts]

**ANOVA Table for Drug**

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Subject	10	24587.879	2458.788				
Category for Drug	2	40418.182	20209.091	49.001	<.0001	98.001	1.000
Category for Drug * Subject	20	8248.485	412.424				

**Means Table for Drug**

**Effect: Category for Drug**

	Count	Mean	Std. Dev.	Std. Err.
Placebo	11	219.091	39.104	11.790
Drug A	11	164.545	31.738	9.569
Drug B	11	134.545	27.336	8.242

Well, first of all you should note that the order of the treatments is constant (not counterbalanced). That is, all participants first receive the placebo, then Drug A, and then Drug B. You might also get a clue from the number of participants, because to properly counterbalance a study with 3 levels, you'd use complete counterbalancing and that means 6 orders, so you'd need a multiple of 6 participants. Eleven doesn't work. So, the study is confounded.

You would reject  $H_0 (\mu_{\text{Plac}} = \mu_A = \mu_B)$ , because  $p < .05$ . To determine which conditions differed, you would compute Tukey's HSD post hoc test:

$$HSD = 3.58 \sqrt{\frac{412.424}{11}} = 21.92$$

The latency to sleep onset was significantly less with Drug B than Drug A and Placebo. Drug A had significantly shorter sleep onset than Placebo. But, of course, it could also be that the third position led to significantly shorter sleep onset times than the second or first positions. Hence, the inherent confound due to lack of counterbalancing.

4. A psychologist would like to examine the relative effectiveness of three therapy techniques for treating mild phobias. A group of 15 individuals who display a moderate fear of spiders is obtained. These individuals are randomly assigned to each of the three therapies with  $n = 5$ . The dependent variable is a measure of the reported fear of spiders, with higher numbers indicating greater fear. Analyze these data as completely as you can. [20 pts]

	Therapy A	Therapy B	Therapy C	
	8	3	1	
	5	3	0	
	5	0	1	
	7	2	2	
	5	2	1	
( $\Sigma X$ ) or T	30	10	5	45
$\Sigma X^2$	188	26	7	221
SS	8	6	2	

Source	Computation	SS	df	MS	F
Treatment	$\frac{30^2 + 10^2 + 5^2}{5} - \frac{45^2}{15} = 205 - 135$	70	2	35	26.3
Error	$8 + 6 + 2$	16	12	1.33	
Total	$221 - \frac{45^2}{15}$	86	14		

$$F_{\text{Crit}}(2,12) = 3.88$$

Reject  $H_0$  ( $\mu_A = \mu_B = \mu_C$ ) because  $F_{\text{Obs}} > F_{\text{Crit}}$ .

$$\text{Compute HSD: } HSD = 3.77 \sqrt{\frac{1.33}{5}} = 1.94$$

Therapy A left the people with greater fear of spiders ( $M = 6$ ) than people given Therapy B ( $M = 2$ ) or Therapy C ( $M = 1$ ). Thus, Therapies B and C appear to leave people with significantly less fear than Therapy A. A Placebo control group would make a lot of sense, because it would allow the researcher to know what the level of fear would be in the absence of actual treatment.