

INSTRUCTIONS: Read the questions carefully and completely. Answer the questions and show work in the space provided. This is the only work that I will look at. Partial credit will not be given if work is not shown. Be sure to answer all questions within the context of the problem. Refer to the computer printout and graphs provided when appropriate. **Pace yourself**, do not spend too much time on any one problem. Point values for each problem are given.

1. [10 pts] For each of the following statements indicate whether it is True or False.
 - a) True False A major reason for having replication within an experiment is to be able to estimate the size of chance variation.
 - b) True False An important reason why large samples are better than small ones is that the bigger the sample, the smaller the bias.
 - c) True False An important reason why large samples are better than small ones is that the bigger the sample, the smaller the chance error.
 - d) True False A parameter is a value you compute from a sample.
 - e) True False When bias is present, measurements tend to be off in the same direction, either too low or too high.

2. [8 pts] Confounding occurs when the effects of two factors on the response cannot be separated. For each of the following scenarios identify the response, the conditions and what other factor might be confounded with the conditions.
 - (a) [4] In a 1970s study of oral contraceptives an interesting relationship between number of children and blood pressure of the mother was reported. The average blood pressure of women with two children was about 30 points lower than the average blood pressure of women with four children.

 - (b) [4] In an observational study of climate on health, the average death rate for communities in Alaska was compared to the average death rate for communities in Florida.

3. [35 pts] A study was done using Egyptian skulls from archaeological digs. Male Egyptian skulls from 5 different time periods are identified and measured. For this problem we will only look at the Basialveolar Length, BL (distance between the Basion and the Alveolar Point) of 135 skulls, 27 from each time period. Summary statistics are given below. Also refer to the handout JMP Output for Egyptian Skull Data.

	Time Period				
	-4000	-3300	-1850	-200	150
n	27	27	27	27	27
mean	98.63	99.41	96.22	94.19	93.93
std. dev.	4.71	3.59	3.84	3.67	4.01

- (a) [4] Is this an experiment or an observational study? Explain briefly.
- (b) [3] What are the response, conditions and units?
- (c) [6] Indicate two choices of α , β and $\frac{\Delta}{\sigma}$ that correspond to the sample size in the study. Comment on the pros/cons of each choice.
- (d) [5] Test the null hypothesis $H_o : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$. Be sure to include the value of the appropriate test statistic, the P-value, decision, reason for the decision and what the decision means within the context of the study.

- (e) [4] Compute the value of the LSD. Use an individual comparison error rate of 5% (i.e. 95% confidence).
- (f) [5] Using the LSD in e), indicate which time periods have statistically significant differences in sample means.
- (g) [3] Looking at the plot of residuals versus time period, tell me what you see and what that says about the Fisher conditions.
- (h) [5] Looking at the distribution of residuals, tell me what you see in each plot and what that says about the Fisher conditions.

4. [12 pts] Suppose you have an assignment in a sociology class that asks you to do a study of ISU student attitudes toward under-age alcohol consumption. You decide to survey a sample of 50 ISU students. You could take a random sample or just use your friends as your sample.
- (a) [4] Which sample would give you a more uniform set of subjects, the random sample or the group of friends? Explain briefly.
- (b) [3] Which sample would be more representative? Explain briefly.
- (c) [5] You decide to stand outside the Parks Library at 9 pm on a Thursday night when school is in session and survey students as they walk in the Parks Library. For every student, you flip a coin - heads that student is asked to participate in the survey - tails that student is not asked. Will this procedure result in a random sample of ISU students? Explain briefly.

5. [10 pts] Control of outside variables and randomization are two of the fundamental principles for a well designed study.

(a) [5] Why is control of outside variables important in a well designed study?

(b) [5] How does randomization help when an outside variable is not controlled?