Final Exam

Name:_____

Instructions:

1. This exam is open book. You may use textbooks, notebooks, class notes, and a calculator.

2. Do all your work in the spaces provided. If you need additional space, use the back of the preceding page, indicating *clearly* that you have done so.

3. To get full credit, you must show your work. Partial credit will be awarded.

4. Some partial computations have been provided on some questions. You may find some *but not necessarily all* of these computations useful. You may assume that these computations are correct.

5. Do not dwell too long on any one question. Answer as many questions as you can.

6. Note that some questions have multiple parts. For some questions, these parts are independent; in such cases you can work, for example, on part (b) or (c) separately from part (a).

For graders' use:

Question	Possible Points	Score
1	20	
2	20	
3	24	
4	18	
5	18	
Total	100	

1. (a) A study of 5 drugs, A, B, C, D, and E was conducted to compare the diastolic blood pressure of middle-aged women who use these drugs. Eleven (11) middle-aged women were randomly assigned to each drug and their diastolic blood pressures were measured. The treatment means are $\bar{X}_A$=69.91, $\bar{X}_B$=78.46, $\bar{X}_C$=68.27, $\bar{X}_D$=71.91, and $\bar{X}_E$=73.82. Also, from ANOVA calculations, SSTotal= 3339.7 and SSTreatment=683.3. Verify that the overall F-test leads to rejection at $\alpha = 0.05$ and perform an LSD analysis at $\alpha = 0.05$. Interpret your findings.

   (b) It is known that the use of the pesticide Temik can lead to the contamination of wells. A random sample of wells was conducted in 3 states in the central U.S. In North Dakota, 42 wells were sampled of which 4 were contaminated, in Nebraska 57 wells were sampled with 16 contaminated, and in Oklahoma 60 were sampled with 10 contaminated. Perform and interpret a test of the null hypothesis that the proportion of wells that are contaminated is the same in all three states.

2. A study was undertaken to compare the strength of epoxy-bonded truss joints on wood from three different species of pine: southern, ponderosa, and red. Several joints were constructed from randomly selected wood from each species and the sheer strength (in pounds per square inch) was determined for each. A summary table of results is given here.

species	southern	ponderosa	red
sample size	5	4	7
sample mean	1266.0	855.0	1311.4
sample variance	77006.3	37364.9	34447.4

Also, SSTRT = 580238.

   (a) Compute the ANOVA table. Carry out the test of the null hypothesis that the mean shear strengths are the same for all 3 species of pine. Interpret the results.

   (b) Let μ represent the population mean. Using the Bonferroni idea, test the following null hypotheses (each against the two-sided alternative), report the p-value, and interpret the results.

     i. $\frac{1}{2}(\mu_{southern} + \mu_{ponderosa}) = \mu_{red}$

     ii. $\mu_{southern} = \mu_{ponderosa}$

3. An observational study was conducted to determine how well the number of calories in common food items (for example: Big Mac, club sandwich at Denny's, etc.) can predict the fat content in the food item. The following data were obtained on 8 food items.

x_i	calories	1460	1240	1010	880	700	580	570	420
y_i	fat	74	53	40	57	44	25	39	24

$\sum x_i = 6860$ $\sum y_i = 356$ $\sum x_i^2 = 6791400$ $\sum y_i^2 = 17792$ $\sum x_i y_i = 341930$
$SSTotal = 1950.0$ $SSRegression = 1478.6$.

   (a) Estimate the slope and intercept from a simple linear regression analysis of these data.

   (b) The investigator on this study had hypothesized that the slope of the relationship relating fat to calories was .075 gm/calorie. Test this hypothesis versus the two-sided alternative. Interpret your findings. (Note that SSTot and SSRegr have already been calculated for you to save a few minutes of calculations.)

   (c) The Paul-Rick Food Den has developed a new "Scrumptious Sandwich" which has 1100 calories. Using what you have determined about the relationship between fat and calories, find a 95% prediction interval for the fat content of this sandwich.

4. A plant pathologist designed a study to determine if the application of a certain bactericide affected the number of bacteria on leaves of a certain variety of bean plant compared to leaves on bean plants without the bactericide. The following data (in units of log-base-10 to achieve approximate normality) were obtained from randomly selected leaves from plants with and without bactericide – one leaf per plant.

without bactericide	4.1	3.7	5.8	4.6	3.2	5.0
with bactericide	2.3	4.1	3.5			

   (a) Carry out and interpret a test of the null hypothesis that the bactericide has no effect versus the two-sided alternative.

   (b) Suppose now you were told that there had also originally been 6 observations from leaves with bactericide. However, the number of bacteria on the additional 3 leaves could not be quantified since they were below the limit of experimental sensitivity of 2.0 (on the log-base-10 scale). All you know is that the count on each of those 3 leaves was below 2.0.

     i. Without performing any additional computation, would you modify your interpretation in part (a) given this information about these additional 3 leaves,? If so how?

     ii. Do you have any ideas about how to incorporate this additional information into the analysis? (On this last point, you are *not* asked to perform any additional analysis, only to suggest a possible approach.)

5. You have a red coin and a green coin. You are given the null hypothesis that both coins have a probability of heads of 0.5 versus the alternative that both have a probability of heads greater than 0.5. The red coin is to be tossed (independently) 5 times and the green coin (independently) 4 times. Assume that the two coins are independent of each other. You will reject the null hypothesis if the total number of heads for the two coins is 8 or higher. Find the power of this test if the true probability of heads for the red coin is 0.8 and for the green coin is 0.9. [Hint: Look at the specific outcomes for the two coins that meet the rejection criterion.]