Midterm II

Name:_____

For the lecture and discussion sections that you *attend* please indicate:
Instructor:(circle one) Nordheim Rasmussen

TA: (circle one) Cheng Sego Song

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	18	
2	20	
3	18	
4	20	
5	24	
Total	100	

1. A water resource researcher wishes to make a comparison of the average pH levels between rivers in northern Wisconsin and southern Wisconsin. Four rivers were randomly selected from all rivers (meeting certain criteria) in northern WI; similarly, four rivers were randomly selected in southern WI. The resultant pH values are as follows:

northern WI	6.7	7.3	7.0	7.8
southern WI	6.9	6.2	7.2	6.5

   (a) Test the null hypothesis that the mean river pH levels are the same in the two parts of the state versus the two-sided alternative. Interpret the results.

   (b) State the assumptions underlying the test you use in part (a). [Note – You do *not* need to justify these assumptions.]

2. (a) A study was undertaken to compare the summer midday atmospheric ozone concentrations at 6 specific sites (near big cities) in the Midwest. At each site, a random sample of 5 midday readings was obtained during the summer. (Assume that these readings are independent.) The units of concentration are parts per million. Due to equipment error, only 4 readings were available from site 1. The following summary statistics were computed from the data.

site	1	2	3	4	5	6
sample size	4	5	5	5	5	5
sample mean	0.143	0.182	0.092	0.132	0.182	0.116
sample standard dev	0.0714	0.0239	0.0286	0.0497	0.0563	0.0305

Also, SSTRT = 0.0325. Compute the ANOVA table. Carry out the test of the null hypothesis that the mean ozone concentrations are the same at all 6 sites. Interpret the results.

(b) The actual data from the first two sites are:

site 1	0.16	0.06	0.23	0.12	
site 2	0.20	0.17	0.21	0.15	0.18

Using only these values [ignore the data from part (a)], test the null hypothesis that the variances of the two sites are equal versus the two-sided alternative. Interpret the results.

3. For each of the questions below, the *italicized* statement is either True or False. Indicate whether the statement is True or False and provide a justification for your response.

   (a) Assume you have a random sample of size n_1 from a normal distribution. Suppose that you have available summary statistics $\bar{y}$ and s^2. You construct a 95% confidence interval for the underlying mean, μ. Suppose now you have a random sample of size n_2 from the same normal distribution where $n_2 = 4n_1$. Suppose $\bar{y}$ and s^2 are exactly the same as before. *A 95% confidence interval from this second sample will be exactly half as wide as the CI from the first sample.*

   (b) A study was performed to compare the efficacy of two different kinds of antifungal cream on curing a certain fungal foot disease. 40 people were randomly selected and received cream A and another 40 were randomly selected and received cream B. For each person, the cream was applied to both feet. After a fixed period of time, a small piece of skin was obtained from each foot of each person and the amount of fungus on each piece of skin was quantified. Thus, there are available 80 data points for each cream, two data points from each of 40 people. The experimenter thought that since the two data points from each individual were not independent, it would be a good idea to average the fungus amounts for the two feet, thus resulting in 40 data points per treatment. (Then a two-independent-sample method of inference would be applied to these averages.) *The experimenter's idea is a reasonable one.*

4. The reduction in cholesterol level in elderly people due to the use of a certain class of diet supplements is know to be approximately normally distibuted with a variance of 70 ($\sigma^2 = 70$). A new diet supplement from this class is to be evaluated. The null hypothesis is that the true mean cholesterol level reduction is 15 and the alternative is that the true mean reduction is greater than 15. You intend to randomly select n elderly people; you will reject the null hypothesis if the observed sample mean reduction is greater than 18. What sample size should you select if you would like the test to have a power of 0.95 when the true mean reduction is 20?

5. (a) A researcher compared the impact of two distinct environmental chemical stresses on the rate of mutation in mice. The stresses were applied to pregnant mice during the first half of pregnancy. One newborn mouse was randomly selected from each mother for assessing mutation. Stress A was applied to 97 mother mice of which 66 of the newborns responded with mutation; similarly, stress B was applied to 132 mothers of which 67 newborns responded with mutation. Test the null hypothesis that the rates of mutation are the same for both stresses versus the two-sided alternative.

   (b) The researcher now wishes to study the mutation rate in horses due to a given environmental stress during pregnancy. The null hypothesis is that the proportion of newborn horses (again one per mother) with mutation is 0.6 with the alternative that the mutation proportion is greater than 0.6. The researcher wishes to use n mother horses. The null hypothesis will be rejected if all n newborn horses respond with mutation. The researcher wishes the test to have $\alpha = 0.025$. Find the smallest value of n so that it will be possible to reject the null hypothesis. [Hint: – The answer will be $n = 6$ or $n = 7$ or $n = 8$ or $n = 9$].