Stat 401 **MIDTERM 2** **May 4, 2006**

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1. A pilot study was carried out in 1991 at the Northwestern Memorial Hospital in Chicago to compare two different methods of care management of geriatric patients. The two methods were " usual care " and "geriatric care". The hospital costs for five patients treated by the "usual care " method (in thousands of dollars) were $528, 620, 912, 1130, and$ 1289 whereas the hospital costs of five patients treated by the "geriatric care" method (in thousands of dollars) were $478, 605, 626, 714, and$ 818. Perform a one-sided two-sample t-test to decide whether the "geriatric care" method is more cost-effective than the "usual care" method. Take $\alpha = .05$. First do a test for equality of variances to see whether or not you can pool the sample variances. Explain why you decided whether to pool or not to pool the sample variances.

(10 points)

2. The salinity of water samples from three separate sites in the Bimini Lagoon, Bahamas, was measured. The data are tabulated below.

A	37.54	37.01	36.71
B	40.17	40.80	39.76
C	39.04	39.21	39.05

Test whether there are significant differences in levels in salinity at the three sites, take $\alpha = .05$.

(10 points)

3. The following problem concerns the the material in §9.4 in the text (you are not expected to have looked at this before).

A random sample of 5726 telephone numbers from a certain region taken in March 2002 yielded 1105 that were unlisted and 1 year later a sample of 5384 yielded 980 unlisted numbers.

(a) Test at level $\alpha = .1$ whether there is a difference in true proportion of unlisted numbers between the two years. (Use your calculator - use the 2-PropZTest, test number 6 on your calculator. In your answer record the p-value and compare it to $\alpha = .1$.)

(b) Use the 2-PropZinterval (number B) on your calculator to compute a two-sided 90 percent confidence interval for the difference $p_1 - p_2$.

(c) Use your result in (b) to do the confidence interval test to test $H_0 : p_1 - p_2 = 0$ against $H_a : p_1 - p_2 \neq 0$ at level .1. Compare your result to what you got in part (a).

(d) Use the formula (9.7) (see below) in your text for the required sample size to get a given β for given p_1 and p_2 to do the following. If $p_1 = .20$ and $p_2 = .18$ what sample size $m = n$ would be necessary to detect such a difference with probability .9.

Warning: $\beta \neq .9$ here.

Here is the sample size formula (9.7).

$$m = n = \frac{(z_{\alpha/2}\sqrt{(p_1 + p_2)(q_1 + q_2)/2} + z_\beta\sqrt{p_1q_1 + p_2q_2})^2}{(p_1 - p_2)^2}.$$

Here $q_1 = 1 - p_1$ and $q_2 = 1 - p_2$.

(10 points)

4. A laboratory tested tires for tread wear by running the following experiment. Tires of a certain brand were mounted on a car. The tires were rotated every thousand miles and the groove depth was measured in mils (.001 in). The results are tabulated in the following table

Mileage (in 1000 miles)	Groove depth (in mils)
0	394.33
4	329.50
8	291.00
12	255.17
16	229.33
20	204.83
24	179.00

(a) Find the least squares line corresponding the above data (y is the groove depth (in mils)) and x is the mileage (in units of 1000 miles)).

(b) Find r^2, the coefficient of determination.

(c) Suppose the objective of the experiment is to evaluate a new tire design. The tread wear rate for the old tire design is -8 mils for every 1000 miles. Assume the data tabulated above are for the new design. Do a one-sided test to see if the new design has a significantly *less* wear rate than the old design (take $\alpha = .05$). Watch out here: less wear rate means β_1 is *less negative* than $-8 \Leftrightarrow \beta_1 > -8$.
Test

$$H_0 : \beta_1 = -8 \; against \; H_a : \beta_1 > -8$$

.
(Hint: Your calculator will not do the above test because $(\beta_1)_0 \neq 0$ so you have to use the formula in the text, page 516 in Edition 5 and page 526 in Edition 6 with $(\beta_1)_0 = -8$.)
One way to minimize computation is to procede as follows.

First do the linear regression t-test on your calculator with $(\beta_1)_0 = 0$ to get s and $\widehat{\beta_1}$.

But the denominator of the t-statistic is $s_{\widehat{\beta_1}}$ *not* s. To convert s to $s_{\widehat{\beta_1}}$ go to 1–Var Stats to find s_X then use the formula

$$S_{xx} = (n-1)s_X^2.$$

Then use the formula

$$s_{\widehat{\beta_1}} = s/\sqrt{S_{xx}}.$$

Now compute

$$t = \frac{\widehat{\beta_1} - (\beta_1)_0}{s_{\widehat{\beta_1}}}$$

and do the linear regression t-test.

(d) Estimate the groove depth in mils for a tire (with the new design) which has been driven $25,000$ miles.
(20 points)