MATHEMATICS 150

(2001-2002)

PROBLEM SET 7

Solutions may be submitted **in class on Monday, March 11** or may be submitted to the Instructor's office (CC F30) **by 3:00 pm Tuesday, March 12** . ***Print your name on the upper right-hand corner of the front page***.

1. In Problem 4 of problem Set 6, a polling agency was commissioned to conduct a simple random sample of households in an area with $N = 8734$ households in order to estimate the percentage of households in which at least one adult was aware (to an arbitrarily set level) of the site selection process for determining waste disposal sites. Suppose that the sample size was chosen to be $n = 225$ and that, in the sample, there were $x = 48$ of the households in which at least one adult was aware of the process. Determine 95% confidence limits for the ***number*** of households in the area with at least one adult aware of the process.

2. Although defective signal relays can be identified, it is not known what proportion of times they will fail to function correctly "in the long run". A study consisted of 70 trials with defective relays and the relays failed to function correctly in 18 of these trials.

a) Estimate the long run proportion of times that a defective relay will fail to function correctly; i.e. estimate the probability that a defective relay will fail to function correctly in an individual use.

b) Determine 95% confidence limits for the probability that a defective relay will fail to function correctly in an individual use.

3. Determine a lower 95% confidence limit for the proportion of times that a an attempt to connect to a modem pool will result in a busy signal if a busy signal was encountered in 43 of 200 sample attempts (distributed over various times on different days.)

4. Natural tissue variation and measurement error are such that measurements on sodium content for any given tissue section are assumed to follow a normal distribution with mean μ_X equal to the 'true' mean tissue sodium content and with standard deviation $\sigma_X = 0.008$. The mean of 12 sample measurements was used to produce a 95% confidence interval for the 'true' content for a particular tissue section. The confidence interval was

$$0.0155 \le \mu_X \le 0.0245$$

On the basis of this sample, indicate whether to accept or reject the null hypothesis or reserve judgement in each of the following tests. In each case, use a nominal level of significance $\alpha = 0.05$

a) H_0: $\mu_X = 0.0150$ vs H_A: $\mu_X \neq 0.0150$

b) H_0: $\mu_X = 0.0260$ vs H_A: $\mu_X \neq 0.0260$

c) H_0: $\mu_X = 0.0180$ vs H_A: $\mu_X \neq 0.0180$

d) H_0: $\mu_X = 0.0160$ vs H_A: $\mu_X \neq 0.0160$

5. An arthritis treatment capsule is suppose to be such that each capsule contains 500 mg of the main ingredient, a form of glucosamine. Natural variation is such that the amount in any given capsule may not be ***exactly*** 500 mg, but the process should produce capsules with a mean of 500 mg and with individual capsules varying from that by no more than 0.5% (i.e by no more than 2.5 mg.) It is assumed that a process producing individual capsule amounts with a mean of 500 mg and a standard deviation of at most 1.0 mg will keep almost all capsules in the proper range Sample capsules are assessed from time to time to check the mean level and the consistency of the values (i.e. the variation.)

a) If the process produces individual capsule amounts that are normally distributed with a mean of 500 mg and a standard deviation of 1.0 mg, what percentage of all capsules will have amounts within 0.5% of 500 mg?

b) If the process produces individual capsule amounts that are normally distributed with a mean of 500 mg and a standard deviation of 1.0 mg, what percentage of all capsules will have amounts within 0.75% of 500 mg?

c) Measured amounts in capsules selected in random samples from four weeks were as in the following table (overleaf.) If you wish to use computer software to work with these data, you may obtain these data electronically in the usual way from a link at

http://www.trentu.ca/academic/math/courses/stat/files

The full data set is in a data file capsule.dat. Alternatively, data sets for the individual weeks are in data files capsule1.dat, capsule2.dat, capsule3.dat and capsule4.dat. To use these data with MINITAB, you may enter the data into MINITAB with COPY/PASTE operations or with the READ statement or with menu choices. For the full file use the format 4(3x,f5.1) to enter the data into four separate columns (do not be concerned by the 'missing' values.) No format is needed for the individual data set files.

OVER

5. c) (Continued)

Sample capsule glucosamine amounts (mg)

week 1	week 2	week 3	week 4
499.4	498.9	500.7	499.8
500.1	500.6	500.9	499.5
498.9	499.6	498.7	500.6
499.9	499.9	500.1	500.1
500.4	500.3	502.3	498.6
502.2	499.9	499.8	500.7
502.4	499.6	499.9	502.9
499.0	499.0	500.7	500.7
498.9	499.2	498.4	499.4
501.6	499.7	500.3	499.5
501.7	501.4	500.3	496.9
500.8	499.7	498.0	500.9
	500.0	500.7	499.9
	500.9	499.3	499.4
	499.7	498.5	499.0
	499.8	500.4	499.8
	499.4	499.8	498.8
	500.6	498.1	500.6
		498.7	501.0
		499.4	501.3
		499.5	500.6
		499.6	500.8
		499.7	500.8
		498.4	499.7
		499.5	498.4
		500.5	501.8
		499.4	500.9
		499.1	499.8
		500.2	500.3
		498.7	500.9
		501.7	500.4
		498.7	501.0
		501.6	498.5
		499.4	501.5
		498.7	497.2
		498.4	499.5
		499.7	
		499.5	
		499.7	
		499.6	
		499.0	
		500.1	
		499.2	
		499.5	
		499.1	
		500.3	
		500.2	
		500.7	

Display the data with four box plots all together in one plot with reference lines at 497.5 mg, 500 mg and 502.5 mg.

d) For each week individually, determine whether there is sufficient evidence at the 5% level of significance that the process mean (for that week) differed from 500 mg. ***If*** there is sufficient evidence, indicate the *P*-value.

e) For each week individually, determine whether there is sufficient evidence at the 5% level of significance that the process standard deviation (for that week) exceeds 1.00 mg. ***If*** there is sufficient evidence, indicate the *P*-value.