

MAT 2379 3X (Spring 2013)

Assignment 4

Deadline: Tuesday, July 9, 2013 (in class)

There are a total of 6 questions.

Part I) Answer the following 4 questions **without** the use of R.

- 1) Water hardness is a traditional measure of the capacity of water to react with soap. Hardness in water is caused by dissolved calcium and magnesium. It is expressed as the equivalent quantity of calcium carbonate. Fifteen measurements were collected from randomly chosen lakes in a particular district. The mean hardness is 103.35 mg/l and the estimated standard error of the mean is 4.755 mg/l.
 - (a) Give the sample standard deviation of the 15 hardness measurements.
 - (b) Assuming that water hardness is normally distributed, compute a 95% confidence interval for the mean water hardness.
 - (c) According to Health Canada, water with a hardness smaller than 100 mg/l is classified as soft and water with a hardness larger than 180 mg/l is classified as hard. If the hardness is between soft and hard, we say that the water is medium/hard. With a level of confidence of 95%, can we classify the mean hardness of the water in this district as medium hard?
- 2) Let X be the number of tumours in a fish living in the Ottawa river. Suppose that it has the following probability mass function

x	0	1	2	3
$f(x)$	0.9	0.07	0.02	0.01

A random sample of size $n = 30$ is selected from this population. Approximate the probability that the mean number of tumours per fish is greater than 0.35.

- 3) Platelet monoamine oxidase (MAO) is an index of brain serotonin activity. Low MAO levels have been found to be related to behaviour disorders. In a particular study, the MAO activity levels of 30 patients with bulimia nervosa were measured. The average level of MAO activity for the 30 bulimic patients was $4.35 \text{ nmol}/10^8 \text{ platelets/hour}$, with a standard deviation of $2.75 \text{ nmol}/10^8 \text{ platelets/hour}$.
- Based on this data, give a 95% confidence interval for the average MAO activity level of bulimic patients. Assume that the level of MAO activity is normally distributed.
 - The normal range for the MAO levels is between 5.5 and 8.5. How does the interval constructed in part 3a compare with the normal range? What conclusions can be drawn?
- 4) A new drug is being tested for its effectiveness to treat a certain type of infection. It was effective in 119 cases out of 170.
- Construct a 95% confidence interval for the rate of effectiveness of the new drug for treating this type of infection.
 - Without constructing the 98% confidence interval for the rate of effectiveness, would you expect the interval to be longer or shorter compared to the 95% confidence interval? Why?
 - Construct a 98% confidence interval for the rate of effectiveness of the new drug for treating this type of infection.

Part II) Answer the following 2 questions **with** the use of R.

Remarks:

- You must provide the R commands and output that were used in answering the question.
- The R output alone is not an answer to a question. The R output is used to support your answer.
- Please do not printout your whole R session. Only provide the R commands and output that are necessary to answer the question.

- 5) A public official believes that the mean household water use is 1,315 liters per day. A study of water usage involved a random sample of twenty five households. The data are found in the file *WATERUSE.txt*.
- (a) Produce a quantile-quantile for the household water use. Is it reasonable to assume that water usage is normally distributed?
 - (b) Construct a 90% confidence interval for the mean household water use per day. Based on the confidence interval, is there evidence against the public official's claim that the mean household water use is 1,315 liters per day.
- 6) pH is the negative logarithm of the hydrogen ion activity. It is a measure of how acid or alkaline a substance is on a scale of 0 to 14. A pH of 7 is neutral, less than 7 is acidic and greater than 7 is alkaline. The ideal pH for soil depends on the crop being grown. Levels between 6.5 and 7 are considered optimal for many plants. Eighteen samples of soil are randomly selected from a field and are sent to a laboratory for pH measurements. The data are found in the file *PH-MEASUREMENTS.txt*.
- (a) Produce a quantile-quantile for this sample. Do the measurements of pH appear to be normally distributed?
 - (b) Construct a 95% confidence interval for the mean pH level.