

**MAT 2377, Probability and statistics for engineers****Assignment 5***Deadline : Before 3 pm on Thursday, April 2**Submit the assignment in the drop box at 585 King Edward*

Solve the following exercises with a TI-30, TI-34, Casio FX-260 or Casio FX-300 calculator.

1. The corrosion loss (in mm) was measured for eight specimens of a certain steel alloy that had been immersed in brine. The measurements were

0.345 0.375 0.356 0.497 0.367 0.389 0.379 0.422.

Assuming that corrosion loss is normally distributed, give a 95% confidence interval for the mean corrosion loss.

2. We are measuring the porosity (in %) in concrete specimens. Assume that the population standard deviation is  $\sigma = 3.2$ . From a random sample of 53 concrete specimens, we measured a mean porosity of 21.6.
  - (a) Find a 90% confidence interval for the mean porosity of specimens of this type of concrete.
  - (b) Find a 95% confidence interval for the mean porosity of specimens of this type of concrete.
  - (c) What is the confidence level of the interval (21.0,22.2)?
  - (d) How many specimens must be sampled so that we are 95% confident that the maximum error in the estimate of the mean porosity of specimens of this type of concrete is less than 0.3?
3. The strength of a certain type of rubber is tested by subjecting pieces of the rubber to an abrasion test. For the rubber to be acceptable, the mean weight loss  $\mu$  must be less than 3.5 mg. Twenty five pieces of rubber that were cured in a certain way were subject to the abrasion test. From these 25 observations, we computed a mean 3.27 mg and a standard deviation of 0.75 mg. Assume that weight loss is normally distributed. Do we have significant evidence that this type of rubber is acceptable at a level of significance of 5%?
  - (a) Use a 95% upper confidence bound for the mean weight loss to answer the question.
  - (b) Use a  $p$ -value to answer the question.
4. Specifications call for the wall thickness of two-liter polycarbonate bottles to be 4 mils on average. (A mil is one thousandth of an inch.) A quality control engineer samples 7 two-liter polycarbonate bottles and measures the wall thickness in each bottle. The results are:

3.990 4.037 4.125 4.101 4.062 3.969 3.955.

Assume that the wall thickness is normally distributed.

- (a) Formulate a null hypothesis against an alternative hypothesis to verify that the wall thickness meets the specifications.
  - (b) Interpret an error of type I in the context of this problem.
  - (c) Interpret an error of type II in the context of this problem.
  - (d) Is there significant evidence at a level of significance of 5% that the wall thickness does not meet the specifications?
5. A particular type of gasoline is supposed to have a mean octane rating greater than 90%. Five measurements (in %) are taken of the octane rating:

90.1 88.8 89.5 91.0 92.1.

We want to verify that the mean octane rating (in %) is greater than 90.

- (a) Formulate the corresponding null and alternative hypotheses.
  - (b) Can you conclude that the mean octane rating (in %) is greater than 90 at a level of significance of 5%? Use a test statistic and critical region to answer the question.
  - (c) Find the  $p$ -value.
6. The mean drying time of a certain paint in a certain application is 12 minutes. A new additive will be tested to see if it reduces the drying time. Specimens will be painted, and the sample mean drying time will be computed. Assume that the drying time is normally distributed with a standard deviation of  $\sigma = 2$  minutes. We want to test  $H_0 : \mu = 12$  against  $H_1 : \mu < 12$ , where  $\mu$  is the mean drying at a level of significance of 5%.
- (a) Compute the probability of committing an error of type II, if  $\mu = 11.5$  and we used  $n = 10$  painted specimens.
  - (b) Compute the probability of committing an error of type II, if  $\mu = 10$  and we used  $n = 10$  painted specimens.
  - (c) Find the required number  $n$  of painted specimens so that our risk of not rejecting the null hypothesis is 1%, if the mean drying is  $\mu = 10$ .