# Homework 9

1. An electrical firm manufactures light bulbs that have a life span that is approximately normally distributed. The population standard deviation is not known. A sample of 30 bulbs is found to have an average life span of 800 hours and a sample standard deviation of 45 hours.

   a) Find a 90% confidence interval for the population mean, $\mu$.

   b) Would a 99% confidence interval computed from the same sample be wider or narrower than the confidence interval found in part (a)?

   c) Find a 95% confidence lower bound for the population mean.

   d) Repeat part (a) but assume the actual standard deviation, $\sigma$, is known to be 45 hours.

2. To meet the *ISO 4* standard a clean room for semiconductor manufacturing must not have more than 352 particles (size 0.5 microns or larger) per cubic meter. Assume that the number of particles per cubic meter has an approximately normal probability distribution with population standard deviation $\sigma = 28$.

   An engineering working at a CPU manufacturing plant wants to test the hypothesis that $\mu$, the mean for number of particles per cubic meter, is equal to 352 vs the alternative hypothesis that it is greater than 352. She takes air samples on 49 different occasions and finds $\bar{x} = 360$.

   a) State the null and alternative hypothesis.

   b) What is the critical region if the hypothesis test is to be conducted at significance level $\alpha = 0.01$? Is the null hypothesis rejected?

   c) Based on your answer for part (b), can you determine if the null hypothesis would be rejected if the test was performed at a level of significance $\alpha = 0.001$?

   d) What is the probability of a type II error for the critical region computed in the previous part when testing against the specific alternative $\mu = 368$?

3. A DC power supply manufacturer wants to test the hypothesis that the mean output voltage of the supplies is 50 V. Assume that the output voltage has a normal probability distribution.

   A quality control engineer measures the output voltage for nine different supplies and computes a sample mean $\bar{x} = 45.4$ and sample standard deviation $s = 5$.

   a) State the null and alternative hypothesis.

   b) What is the critical region if the hypothesis test is to be conducted at significance level $\alpha = 0.01$? Is the null hypothesis rejected?

4. A new error-correction code for cell phones is reported to be better than the industry standard scheme. The following data represent the measured rates of incorrectly decoded bits with the new code:

$x_1 = 1.0 \cdot 10^{-6}$ $x_2 = 1.5 \cdot 10^{-6}$ $x_3 = 1.1 \cdot 10^{-6}$ $x_4 = 1.5 \cdot 10^{-6}$ $x_5 = 1.4 \cdot 10^{-6}$

$x_6 = 1.7 \cdot 10^{-6}$ $x_7 = 1.4 \cdot 10^{-6}$ $x_8 = 1.5 \cdot 10^{-6}$ $x_9 = 2.4 \cdot 10^{-6}$

a) Using the data, find the one-sided confidence interval for the true mean value at the 0.5 % significance level, (i.e., the 99.5 % confidence interval).

b) Does the mean value for the industry-standard scheme, namely $\mu_o = 1.8 \cdot 10^{-6}$, fall within this confidence interval?

c) What conclusion may be drawn about the relative performance of the two error correcting codes?

5. A small sample of engineers in a large company are found to be earning the following salaries (per year):

$x_1 = \$55{,}500$ $x_2 = \$58{,}500$ $x_3 = \$54{,}500$ $x_4 = \$54{,}000$ $x_5 = \$54{,}500$

$x_6 = \$52{,}000$ $x_7 = \$50{,}000$ $x_8 = \$54{,}500$ $x_9 = \$57{,}000$

The company claims that it pays engineers an average of \$54,000 per year. An engineer wonders whether the true mean value of the engineering salaries is $\mu = \$54{,}000$. Determine whether the hypothesis that $\mu = \$54{,}000$ should be rejected at the 1 % significance level. For the alternative hypothesis, use $\mu \neq \$54{,}000$.

**ANS:**

1. Tasdizen S13 HW 8 prob 3 + part (d) added
2. Tasdizen S13 HW 9 prob 2
3. Tasdizen S13 HW 9 prob 3
4. Cotter S08 HW 8 prob 4
5. Cotter S08 HW 8 prob 5