ELEG 3143 Assignment # 12

1. A very large population of bipolar transistors has a current gain with a mean value of 120 and a standard deviation of 10. The values of current gain may be assumed to be independent Gaussian random variables.

   (a) Find the confidence interval for a confidence level of 90% on the sample mean if it is computed from a sample size of 150.

   (b) Find the confidence interval for a confidence level of 90% on the sample mean if it is computed from a sample size of 21.

2. The resistance of coils manufactured by a certain company is claimed to have a mean value of 100 Ω. A sample of 30 coils is taken an it is found that the sample mean is 115 Ω and the sample standard deviation is 20 Ω.

   (a) Is the claim justified if a 95% confidence level is used?

   (b) Is the claim justified if a 90% confidence level is used?

3. A manufacturer of traveling wave tubes claims the mean lifetime is at leat 4 years. Thirty of these tubes are installed in a communication satellite and a record kept of their performance. It is found that the mean lifetime of this sample is 3.7 years and the standard deviation of the sample is 1 year. For what confidence level would the company's claim be valid?

4. Consider a radar system. When the target is present, the received signal is $X = v + N$, where v is the target voltage, and N is Gaussian noise with zero mean and variance σ_0^2. When the target is not present, the received signal is $X = N$. Define the binary hypothesis as

$$H_0 : X = N$$
$$H_1 : X = v + N$$

If $X \leq x_0$, the radar receiver accepts the null hypothesis; if $X > x_0$, the radar receiver rejects the null hypothesis.

(a) Find the probability of false alarm as a function of v, σ_0^2, and x_0 (type I error)

(b) Find the probability of missed detection as a function of v, σ_0^2, and x_0 (type II error)

(c) Use Matlab to plot the receiver operation characteristics (ROC) curve when $v = 2$ and $\sigma_0^2 = 1$.

(d) Use Matlab to plot the receiver operation characteristics (ROC) curve when $v = 4$ and $\sigma_0^2 = 1$.