UNIVERSITY OF ILLINOIS AT CHICAGO
Mechanical Engineering

IE 446
Problem Set #1

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Spring 2000

Issued: 12 Jan 2000
Due: 21 Jan 2000

Reading: Montgomery, Ch. 2

1. (Montgomery 2-6) The time to failure in hours of an electronic component subjected to an accelerated life test is shown below (read down, then across):

127	124	121	118
125	123	136	131
131	120	140	125
124	119	137	133
129	128	125	141
121	133	124	125
142	137	128	140
151	124	129	131
160	142	130	129
125	123	122	126

   (a) Calculate the sample average and standard deviation of the data.
   (b) Construct a histogram of the data.
   (c) Construct a stem-and-leaf plot of the data.
   (d) Construct a box plot of the data. Be sure to label the sample median and the upper and lower quartiles.

2. (Montgomery 2-18) The probability distribution of x is $f(x) = ke^{-x}$, $0 \leq x \leq \infty$. Find the appropriate value of k. Find the mean and variance of x.

3. (Montgomery 2-24) A random sample of 100 units is drawn from a production process every half hour. The fraction of nonconforming product manufactured is "known" to be 0.03. What is the probability that $\hat{p} \leq 0.04$, where $\hat{p}$ is the number of nonconforming units in the sample?

4. (Montgomery 2-34) The tensile strength of a metal part is normally distributed with mean 40 lb and standard deviation 8 lb. If 50,000 parts are produced, how many would fail to meet a minimum specification limit of 34-lb tensile strength? How many would have a tensile strength in excess of 48 lb?

5. (Montgomery 2-41) If x is a discrete random variable with probability distribution $p(x)$, then the mean of the distribution is defined as

$$\mu = \sum_{i=1}^{\infty} x_i p(x_i)$$

and the variance of the distribution is defined as

$$\sigma^2 = \sum_{i=1}^{\infty} (x_i - \mu)^2 p(x_i)$$

Use this result to derive the mean and variance of the Poisson distribution

$$p(x) = \frac{e^{-\lambda}\lambda^x}{x!}, \quad x = 0, 1, \ldots$$