Department of ESE **KRP**
Univ. of Connecticut **Spring 2013**

ECE 6161
Problem Set # 4: On-line Quality Control
(Due March 28, 2013)

1. The number of nonconforming switches in samples of 150 switches is shown below. Construct a fraction nonconforming control chart for these data. Does the process appear to be in control? If not, assume that assignable causes can be found for all points outside the control limits and calculate the revised control limits.

Sample Number	Number of nonconforming switches	Sample Number	Number of nonconforming switches
1	8	11	6
2	1	12	0
3	3	13	4
4	0	14	0
5	2	15	3
6	4	16	1
7	0	17	15
8	1	18	2
9	10	19	3
10	6	20	0

2. A high-voltage power supply should have a nominal output voltage of 350V. A sample of four units are selected each day and tested for process control purposes. The data shown below give the difference between the observed reading on each unit and the nominal voltage times ten; that is,

x_i = (observed voltage on unit $i - 350)*10$

Sample Number	x_1	x_2	x_3	x_4	Sample Number	x_1	x_2	x_3	x_4
1	6	9	10	15	11	8	12	14	16
2	10	4	6	11	12	6	13	9	11
3	7	8	10	5	13	16	9	13	15
4	8	9	6	13	14	7	13	10	12
5	9	10	7	13	15	11	7	10	16
6	12	11	10	10	16	15	10	11	14
7	16	10	8	9	17	9	8	12	10
8	7	5	10	4	18	15	7	10	11
9	9	7	8	12	19	8	6	9	12
10	15	16	10	13	20	14	15	12	16

(a) Set up $\bar{x}$ and R charts for this process. Is this process in statistical control?
(b) If specifications are at 350V ±5V, what can you say about process capability?

3. Control charts for $\bar{x}$ and R are maintained for an important quality characteristic. The sample size is $n = 7$. $\bar{x}$ and R are computed for each sample. After 35 samples, it is found that

$$\sum_{i=1}^{35} \bar{x}_i = 7805 \text{ and } \sum_{i=1}^{35} R_i = 1200$$

(a) Set up $\bar{x}$ and R charts for this process. Is this process in statistical control?
(b) Assuming that both charts exhibit control, estimate the process mean and standard deviation.
(c) If the quality characteristic is normally distributed and if specifications are 220 ±35, can the process meet the specifications? Estimate the fraction nonconforming.
(d) Assuming the variance to remain constant, state where the process mean should be located to minimize the fraction nonconforming. What would be the value of the fraction nonconforming under these conditions?

4. Two parts are assembled together. Assume that the dimensions x (of part1) and y (of part 2) are normally distributed with mean μ_x and μ_y and the standard deviations σ_x and σ_y, respectively. The parts are produced on different machines and are assembled at random. Conrtol charts are maintained on each dimension for the range of each sample (n =5). Both range charts are in control.
(a) Given that for 20 samples on the range chart controlling x and 10 samples on the range chart controlling y, we have

$$\sum_{i=1}^{20} R_{xi} = 18.608\, in \text{ and } \sum_{i=1}^{20} R_{yi} = 6.978\, in$$

Estimate σ_x and σ_y.

(b) If it is desired that the probability of a clearance (x-y) smaller than 0.09 inches is 0.006, what distance between the average dimensions (i.e., μ_x -μ_y) should be specified?