Indian Statistical Institute, Bangalore

M.S (QMS) First Year
First Semester - Statistical Process Control I

Mid Term Exam Time: 2 hours Maximum Marks: 50 Date: 8 Sept, 2015

Answer as many questions as you can.

1. [10]

   a. Explain chance and assignable causes of variation?

   b. Explain the step by step details of carrying out process capability analysis using normal probability plot method?

2. The net weight (in oz) of a dry bleach product is to be monitored by xbar and R control charts using subgroup size of n = 5. Data for 20 samples are shown below: [12]

Sample Number	xbar	R	Sample Number	xbar	R
1	16.20	0.8	11	16.24	0.5
2	16.14	0.5	12	16.38	0.8
3	16.30	0.4	13	16.32	0.5
4	16.20	0.5	14	16.34	0.3
5	16.22	0.5	15	16.24	0.3
6	16.32	0.9	16	16.20	0.3
7	16.30	0.4	17	16.30	0.2
8	16.18	0.2	18	16.24	0.5
9	16.34	0.3	19	16.30	0.4
10	16.38	0.5	20	16.22	0.7

   a. Set up xbar and R charts on this process. Does the process exhibit statistical control?
   b. Estimate the process mean and standard deviation?
   c. If specifications are at 16.2 ± 0.5, compute Cp & Cpk? What conclusions would you draw about process capability?
   d. What fraction of containers produced by this process is likely to be beyond the specification limit?

3. Subgroups of n = 4 are taken from a process at regular intervals. A normally distributed quality characteristic is measured and xbar and s values are calculated for each subgroup. After 50 subgroups have been analyzed, we have [13]

$$\sum_{i=1}^{50} \bar{x}_i = 1000 \qquad \sum_{i=1}^{50} s_i = 72$$

   a. Compute the control limits for xbar and s control charts?

b. Assume that all points on both charts plot within the control limits, estimate the process mean and standard deviation?

c. If the specification limits are 19 ± 4.0, what are your conclusions regarding the ability of the process to produce items conforming to specifications?

d. Assuming that if an item exceeds the upper specification limit it can be reworked, and if it is below the lower specification limit it must be scrapped, what percent scrap and rework is the process now producing?

e. If the process were centered at $\mu = 19.0$, what would be the effect on percent scrap and rework?

4. The number of nonconforming switches in samples of size 150 is shown below. Construct a number non conforming control chart for this 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 limits [10]

Sample Number	Number of Nonconforming switches	Sample Number	Number of Nonconforming switches
1	5	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

5. The number of defects found on final inspection of a tape deck is shown below. Can you conclude the process is in statistical control? What center line and control limits would you recommend for controlling future production? [10]

Deck Number	Number of defects	Deck Number	Number of defects
2412	0	2421	1
2413	1	2422	0
2414	1	2423	3
2415	0	2424	2
2416	2	2425	5
2417	1	2426	1
2418	1	2427	2
2419	3	2428	1
2420	2	2429	1