INDIAN STATISTICAL INSTITUTE

MS in QMS

TEST ON STATISTICAL PROCESS CONTROL

Date: 9 September, 2014 Time: 2 hours Maximum Marks: 50

Answer any five questions

1.

a. Explain the relationship between quality, cost of production and productivity?

b. Consider the manufacture of a mechanical component used in a copier machine. The parts are manufactured in a machining process at the rate of 120 parts per hour. For various reasons the process is operating at 75% quality (75% of the process output is conforming to the specification and 25% is non conforming. 60% of the non conforming can be reworked into acceptable product and the rest must be scraped. The cost of manufacturing a part is $20. The cost of reworking a part is $4. Estimate the cost for producing 100 acceptable parts? How much time is required to produce 100 acceptable items?

c. A new statistical process control procedure implemented reduced the nonconforming % from 25% to 5%. Of the 5% non conforming, 60% can be reworked and 40% scraped. If the manufacturing and rework cost remain as $20 and $4 respectively, compute the cost of manufacturing 100 acceptable parts? How much time is required to produce 100 acceptable items?

[10]

2.

a. Explain variable and attribute type data? Give two examples each

b. Explain chance and assignable causes of variation?

c. Suppose the coating thickness of powder coated industrial enclosures is normally distributed with mean μ and standard deviation σ. Suggest an unbiased estimate for μ and two unbiased estimators forσ?

[10]

3.

a. Explain the role of normal distribution and central limit theorem in control charts?

b. Discuss the issues if the control limits in a control chart is too narrow or too wide?

c. Explain rational sub grouping?

[10]

4. A high voltage power supply should have a nominal output voltage of 350V. A sub group of four units is 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. i.e.

x_i = (observed voltage on unit i – 350) x 10

Sample	x_1	x_2	x_3	x_4	Sample	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	13	14	11	15

a. Set up xbar and R charts on this process. Is the process in statistical control?
b. Estimate the process mean and standard deviation?
c. If specifications are at 350V $\pm$ 5V, What are your conclusions regarding the ability of the process to produce items within these specifications?
d. Assuming that if an item exceeds upper specification limit it can be reworked and if it is below lower specification limit it must be scraped, what is the percentage scrap and rework?

[10]

5. The data on inside diameter (in mm) for automobile engine piston rings are collected in subgroups of 5 and the sample average and standard deviations are computed and given below.

Sample	mean	sd	Sample	mean	sd
1	74.01	0.0148	11	73.994	0.0029
2	74.001	0.0075	12	74.001	0.0042
3	74.008	0.0147	13	73.998	0.0105
4	74.003	0.0091	14	73.99	0.0153
5	74.003	0.0122	15	74.006	0.0073
6	73.996	0.0087	16	73.997	0.0078
7	74	0.0055	17	74.001	0.0106
8	73.997	0.0123	18	74.007	0.0070
9	74.004	0.0055	19	73.998	0.0085
10	73.998	0.0063	20	74.009	0.0080

a. Set up xbar and s chart on this process. I s the process in statistical control?
b. Estimate the process mean and standard deviation?
c. The next five subgroup average and standard deviations are given below. Do these measurements indicate the process is in control?

Sample	mean	sd
1	74	0.0122
2	74.002	0.0074
3	74.002	0.0119
4	74.005	0.0087
5	73.998	0.0162

[10]

6. One-pound coffee cans are filled by a machine, sealed and then weighed automatically. After adjusting for the weight of the can, any package that weighs less than 16 oz is cut out of the conveyor. The weights of 25 successive cans are shown below. Set up a individual x and moving range charts. Estimate the process mean and standard deviation. What % of cans will be under filled?

Can	Weight	Can	Weight
1	16.11	14	16.12
2	16.08	15	16.1
3	16.12	16	16.08
4	16.1	17	16.13
5	16.1	18	16.15
6	16.11	19	16.12
7	16.12	20	16.1
8	16.09	21	16.08
9	16.12	22	16.07
10	16.1	23	16.11
11	16.09	24	16.13
12	16.07	25	16.1
13	16.13		

[10]