Indian Statistical Institute, Bangalore
M.S. (QMS) First Year
First Semester – Statistical Process Control I

Mid Term Exam Duration: 2 Hrs Date: September 07, 2016 Max Marks: 50

Answer as many questions as you can. Maximum you can score is 50

1. Check whether the following statements are true or false. Justify your answers in not more than 3 sentences. [10]

   a. For *xbar* chart, the quality characteristic *x* need to be normally distributed

   b. The standard deviation of relative range is d_2

   c. In *xbar* and *R* charts, The factor A_2 is used to calculate the distance between the mean and upper and lower control limits in xbar chart

   d. If eight consecutive points in a control chart are steadily increasing or decreasing, then it is an indication of out of control situation

   e. The daily final inspection and testing process of counter gear subassembly is monitored using a u chart with central line 2.5. On a particular day, the inspection team detected 4 defects out of 20 subassemblies inspected and concluded that the process is out of control.

2. The following data were collected from a process manufacturing power supplies. The variable of interest is output voltage and $n = 5$ [15]

Sample Number	*xbar*	*R*	Sample Number	*xbar*	*R*
1	103	4	11	105	4
2	102	5	12	103	2
3	104	2	13	102	3
4	105	11	14	105	4
5	104	4	15	104	5
6	106	3	16	105	3
7	102	7	17	106	5
8	105	2	18	102	2
9	106	4	19	105	4
10	104	3	20	103	2

   a. Compute the control limits for *xbar* and *R* control charts? If required revise the control chart assuming assignable causes for points outside the control limits.

   b. Estimate the process mean and standard deviation?

   c. If the specification limits are 103 ± 4, compute the process capability indices *Cp* & *Cpk*? Give your interpretations on *Cp* and *Cpk* values.

   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 $\mu = 103$, what would be the effect on percent scrap and rework?

3. A of personal computer manufacturing company has set up control chart to monitor the final inspection and testing process. The central line of the control chart (*pbar*) is 0.06. The data on final inspection and testing for 10 days after setting up the control chart is given below. Plot the points in the control chart and check whether the process is in control? [15]

Day	Units Inspected	Nonconforming units
1	80	4
2	110	7
3	90	5
4	75	8
5	130	6
6	120	6
7	70	4
8	125	5
9	105	8
10	95	7

4. A process produces rubber belts in lots of size 2500. From every lot, 1000 items are randomly picked up and inspected. Inspection records on the last 25 lots reveal the following data. Set up a control chart to monitor the number nonconforming belts. If any point goes out of control chart, assume assignable cause and revise the control limits. [15]

Lot Number	Number of nonconforming belts	Lot Number	Number of nonconforming belts
1	23	13	55
2	48	14	39
3	22	15	28
4	34	16	33
5	23	17	19
6	32	18	49
7	28	19	16
8	31	20	26
9	34	21	22
10	30	22	40
11	35	23	35
12	36	24	36