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

Mid Term Exam Duration: 2 Hrs Date: September 11, 2017 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.
   a. The central limit theorem has no role to play in statistical process control
   b. For monitoring attribute characteristic, control charts need to be constructed for both measure of central tendency and measure of variation
   c. There is no major difference between chance and assignable causes of variation

   [6]

2. Samples of $n = 6$ items are taken from a manufacturing process at regular intervals. A normally distributed quality characteristic is measured and $\bar{x}$ and s values are calculated for each samples. After 50 subgroups have been analyzed, we have

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

   a. Compute the control limit for the $\bar{x}$ 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, compute the process capability indices *Cp* & *Cpk*? What are your conclusions regarding the ability of the process to produce items conforming to specification?
   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?

   [18]

3. The purity of a chemical product is measured on each batch. Purity determinations for 20 batches are given below:
   a. Is purity normally distributed?
   b. Estimate process mean and standard deviation?
   c. If the lower specification limit on purity is 0.77, is the process capable?
   d. Estimate the percentage of batches with purity not confirming to specification?

Batch	Purity	Batch	Purity
1	0.81		0.78
2	0.82		0.83
3	0.80		0.81
4	0.82		0.87
5	0.82		0.81
6	0.83		0.85
7	0.79		0.83
8	0.80		0.84
9	0.81		0.86
10	0.82		0.84

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4. The following data represent the number of nonconformities per 100 meters in the telephonic jumper wire. From the analysis of these data, would you conclude that the process is in statistical control? What control procedure would you recommend for future production?

Sample	Number of nonconformities	Sample	Number of nonconformities
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

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