INDIAN STATISTICAL INSTITUTE

MS in QMS

TEST ON STATISTICAL PROCESS CONTROL

Date: 15 September, 2023   Time: 2 hours   Maximum Marks: 50

Answer as many questions as you can. The maximum you can score is 50

1. Check whether the following statements are true or false. Provide brief justification for your answers
   a. The capability of a process can be evaluated by calculating the *Cp* value.
   b. The presence of nine consecutive points on one side of the center line in a control chart is indicative of an out-of-control situation.
   c. When monitoring attribute characteristics to ensure process stability, separate control charts for measures of central tendency and dispersion are not necessary.
   d. If a data point plotted on a *u* chart falls below the lower control limit, it is imperative to conduct an investigation, identify the assignable cause, and take corrective actions to eliminate it.
   e. The occurrence of six consecutive points, all either increasing or decreasing, on a control chart is an indication of an out-of-control situation.
   f. In a fraction defective control chart used to assess whether a process is in control, it is not necessary to calculate control limits individually for each data point.

[12]

2. The data given below were collected from a process manufacturing power supplies. The variable of interest is the output voltage, and $n = 5$.

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	8	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. Set up appropriate control charts and plot the points on the charts. Give your insights on the stability of the process.
   b. Suggest center lines and control limits suitable for controlling future production.
   c. Assume that the quality characteristic is normally distributed. Estimate the process standard deviation.
   d. What would be your estimate of the process fraction nonconforming if the specifications on the characteristic were 103 ± 4?
   e. What approaches to reducing the fraction nonconforming can you suggest?

[15]

3.

a. An automobile manufacturer wishes to control the number of defects in a subassembly area producing manual transmissions. The inspection unit is defined as four transmissions and data from sixteen samples (each of size 4) are given below. Set up a control chart for monitoring the defects and plot the points on the chart.

Sample	Defects	Sample	Defects	Sample	Defects	Sample	Defects
1	1	5	0	9	2	13	1
2	3	6	2	10	1	14	1
3	2	7	1	11	0	15	2
4	1	8	5	12	2	16	3

b. Suppose the center line of a fraction nonconforming control chart is 0.06. Kindly plot the fraction nonconforming of the following data on the control chart with the aforementioned center line. Is the process in control? Give your insights.

Number Checked	Number Nonconforming
45	3
50	5
55	3
45	1
50	6
60	12
50	5

[15]

4. Fifteen heats of a steel alloy are tested for hardness. The resulting data are shown in the table below:

Heat	Hardness	Heat	Hardness
1	52	9	58
2	51	10	51
3	54	11	54
4	55	12	59
5	50	13	53
6	52	14	54
7	50	15	55
8	51		

a. Is it justifiable to assume that the hardness is normally distributed? (Use probability plot method)
b. Estimate the process mean and standard deviation.
c. Assuming specification on Hardness as 55 ± 5, calculate process capability indices Cp and Cpk, and offer insights on capability of the process.
d. Estimate the total % non confirming units.

[12]