Indian Statistical Institute, Bangalore
MS (QMS) First Year
Second Semester - Advanced Statistical Process Control

Midterm Exam   Date: March 17, 2022
Maximum marks: 50   Duration: 3 hours

1. Define the suitable process control method in detail with justification.   [3 x 5 = 15]

a) The continuous product characteristic is dependent on the input Raw Material quality.

b) The discrete product characteristic quality depends on the quality of setting and monitoring of significant process characteristic thereafter.

c) The critical product quality parameter cannot be inspected for quality during manufacturing.

d) The total spread of a continuous product characteristic just meet the given tolerance under stable condition.

e) The cp value of a normally distributed continuous product characteristics <1 under stability.

2. Using the following data setup short run $\bar{x}$ and R chart, assuming that the standard deviation of the measured characteristic for each part is not same. The nominal dimension of the parts are TA = 50, TB = 75.   [10]

Sample No.	Part No.	S1	S2	S3
1	A	48	51	50
2	A	47	49	53
3	A	50	52	54
4	A	52	53	49
5	A	48	47	52
6	B	71	70	72
7	B	73	77	75
8	B	79	80	82
9	B	74	78	80
10	B	80	81	84

3. A plastic component used to manufacture, a durable product is checked 100% for all visual defects. The batch size for each part is relatively small. Establish a suitable SPC method to control the no. of defects.   [10]

Sl. No.	Product	#Defects	Sl. No.	Product	#Defects
1	A	16	7	B	24
2	A	10	8	B	21
3	A	15	9	B	28
4	A	8	10	B	35
5	A	12	11	B	21
6	A	14	12	B	20

4.   [6]

a) A normally distributed continuous product characteristic is having CPK = 1.33. Develop a setup control chart limit for the given specification 500 ± 12ml.

b) The CPK value of a normally distributed continuous product characteristic is >2. Calculate the modified limit of $\bar{x}$ chart with min CPK = 2.

5.   [2 + 3 + 4 = 9]

a) State the need of joint control for multiple continuous product characteristics.

b) Define the Phase I and Phase II limits of T^2 control chart (n>1).

c) Two continuous product characteristics follow bivariate normal distribution under control. The mean vector and covariance matrix are estimated as follows.

$$\bar{x} = \begin{bmatrix} 3.2 \\ 2.5 \end{bmatrix} \quad s = \begin{bmatrix} 1.4 & 2.1 \\ 2.1 & 1.8 \end{bmatrix}$$

The data were collected by using a subgroup of 10 pieces for 15 such subgroups. Check whether the following sample is in control [3.1 2.7].