INDIAN STATISTICAL INSTITUTE

MS in QMS

TEST ON STATISTICAL PROCESS CONTROL

Date: 18 November 2022   Time: 3 hours   Maximum Marks: 50

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

1. Fill in the blanks

    a. In the normal probability plot method, half of the difference between the 97.73rd percentile and 2.28th percentile is approximately equal to --------?
    b. The upper control limit of a modified xbar chart is -----------?
    c. The formula used to compute the interval between resets in a sloping control chart is ----------?
    d. While plotting the control chart using the qcc package of R, *add.stats* = *FALSE* indicate ---------?
    e. In MIL STD 105E standard sampling scheme, the switching from normal inspection to reduced inspection happens when --------?

    [5]

2. The data on the inside diameter of the hole drilled on stiffeners is given below.

19.11	18.00	21.02	21.96
21.94	21.23	21.55	18.98
20.06	19.96	22.47	19.67
20.57	20.42	18.62	18.36
20.05	20.92	21.85	18.00

    a. Check whether the inside diameter is normally distributed or not using the normal probability plot method.
    b. Estimate the process mean and standard deviation using the normal probability plot method
    c. Suppose the specification on the inside diameter is 20 ± 4 mm, compute the process capability indices and comment on the capability of the drilling process.
    d. Assuming that stiffeners with an inside diameter less than the lower specification limit can be reworked and those with a diameter more than the upper specification limit to be scrapped, estimate the % of rework and scrap.

    [10]

3. The data on a hospital emergency room waiting time (in minutes) is given below. Set up an EWMA control chart using λ =0.2, L = 3 and

process target as 4.55 minutes. Does the process seem to be in statistical control?

9	2	10	3
8	3	3	5
6	5	3	2
3	7	4	4
2	8	1	1
5	8	2	6
8	4	2	3
1	11	3	7
1	2	1	5
8	7	2	7

[10]

4.
   a. Describe acceptable quality level (AQL), lot tolerance percent defective (LTPD), producer's risk and consumer's risk.
   b. Suppose a product is shipped in lots of size N = 5000. The receiving sampling inspection procedure is a single sampling plan with n = 50 and c = 1. Construct the OC curve. If AQL and $LTPD$ are respectively 0.015 and 0.095 respectively compute the producer's and consumer's risk

[10]

5.
   a. Describe the average sample number (ASN), rectifying inspection, average outgoing quality (AOQ), average outgoing quality level ($AOQL$) and average total inspection (ATI) of the double sampling plan
   b. Suppose a product is shipped in lots of size N = 8000. The receiving sampling inspection procedure is a double sampling plan with n_1 = 50 and c_1 = 2, n_2 = 40 and c_2 = 4. If the incoming lots have a fraction nonconforming p = 0.04, what is the probability of acceptance on the first sample? What is the probability of final acceptance? What is the probability of rejection in the first sample? Assuming rectifying inspection, compute ASN, AOQ and ATI.

[10]

6. Write a short note on the following:
   a. Pre control charts
   b. MIL STD 105 E sampling schemes.

[10]