INDIAN STATISTICAL INSTITUTE

MS in QMS

TEST ON STATISTICAL PROCESS CONTROL

Date: 29 December 2021 Time: 3 hours Maximum Marks: 50

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

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1. A high-voltage power supply should have a nominal output voltage of 350 V. A sample of four units is selected each day and tested for process-control purposes. Kindly simulate 20 samples of power supply voltage with a subgroup size of four each from a normal distribution with mean 350V and standard deviation of 1.5V
    a. Set up xbar and R chart on this process. Is the process in statistical control?
    b. Estimate the process mean and standard deviation?
    c. If specifications are at 350 ± 5V, Compute the process capability indices and give your interpretation
    d. Calculate the % of rejection?
    e. By undertaking some improvement activities if the process standard deviation is reduced to 1.25 V, how much will be the % of rejection?

    [15]

2. Fifteen successive heats of a steel alloy are tested for hardness. The analysis showed that the hardness is normally distributed with a mean of 54 HRC and a standard deviation of 1.5 HRC. Simulate fifteen hardness values from the aforementioned distribution
    a. Set up a control chart for the moving range and a control chart for individual hardness measurements. Is it reasonable to assume that process is in control?
    a. Confirm whether the hardness is normally distributed using the normal probability plot method. Estimate the process mean and standard deviation using the normal probability plot method
    b. Suppose the specification on hardness is 55 ± 5 HRC, compute the process capability indices and comment on the capability of the process.
    c. Assuming that a part with hardness below the lower specification limit can be reworked and those with hardness above the upper specification limit to be scrapped, estimate the % of rework and scrap?

    [15]

3. A company uses the double sampling scheme with $n_1 = 40$, $c_1 = 2$, $n_2 = 50$ and $c_2 = 4$ for incoming inspection of goods. The goods are shipped in lots of size

5000. Assume that the fraction defective p is equal to the last two digits in your roll number divided by 100

a. Compute the probability acceptance *Pa*? How much is the probability of rejection at the first sample inspection itself?
b. Compute the average sample number ASN?
c. Assuming rectifying inspection, compute average outgoing quality AOQ?
d. Assuming rectifying inspection, compute average total inspection ATI?

[15]

4.

a. What are chance and assignable causes of variation? What part do they play in the operation and interpretation of Shewhart control charts?
b. What is meant by the statement that a process is in a state of statistical control?
c. If a process is in a state of statistical control, does it necessarily follow that all or nearly all of the units of product produced will be within the specification limits? Justify?
d. Describe the logic underlying the use of three-sigma limits on Shewhart control charts? How will the chart respond if narrower limits are chosen? How will it respond if wider limits are chosen?
e. Describe the rational subgroup concept? What part does it play in the control chart analysis?

[10]