SQC & OR Unit

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M.S.(Quality Management Science) (2019-2020)
Semester I-July 2019

Paper :Reliability, Maintainability and Safety

Time: 2 Hours Date: 11 September, 2019 Max. Marks: 50

This paper carries "55" Marks. Answer as many questions as you can but the maximum marks you can score is "50"

1. For each scenario described below, find the range of the random variable. State whether or not the Binomial Distribution is a reasonable model for the random variable and why. State any assumption you make.
   (i) A production process produces thousands of temperature transducers. Random Variable: Number of nonconforming transducers in a sample of size 30 selected at random from the process
   (ii) From a batch of 50 temperature transducers, a sample of size 30 is selected without replacement. Random Variable: Number of nonconforming transducers in the sample
   (iii) Random Variable: Number of accidents along the "NICE road" in Bangalore during a one month period
   (iv) A filling operation attempts to fill detergent packages to the advertised weight. Random Variable: The number of detergent packages that are unfilled.
   (2*4=8)
2. Four bits are transmitted over a digital communication channel. Each bit is either distorted or received without distortion. Let A_i denote the event that "i" th bit is distorted, i=1, 2, 3, 4. Are the A_i's mutually exclusive? Describe the outcome of the events (a) A_1 (b) A_1^c (c) $A_1 \cap A_2 \cap A_3 \cap A_4$ (d) $(A_1 \cap A_2) \cup (A_3 \cap A_4)$ (5)

3. A lot of 50 spacing washers contains 30 washers that are thicker than the target dimension. Suppose that the three washers are selected at random, without replacement, from the lot (i) What is the probability that all three washers are thicker than the target? (ii) What is the probability that the third washer selected is thicker than the target if the first two washers selected are thinner than the target? (iii) What is the probability that the third washer selected is thicker than the target? (2+2+5=9)

4. (a) If A,B,C are any three events, prove that $P(A \cup B|C) = P(A|C)+P(B|C)-P(A \cap B|C)$
   (b) In a bolt factory there are four machines A, B, C, and D manufacturing respectively 20%, 15%, 25%, and 40% of the total production. Out of them 5%, 4%, 3%, 2% are defective. If a bolt drawn at random was found defective what is the probability that it was manufactured by A or D? (4+8=12)

5. If a bank receives on the average "6" bad cheques per day, what is the probability that it will receive "10" bad cheques on any two consecutive days? (4)

6. The random variable “X” is continuously distributed with a density function “f” which is symmetrical about “0” so that f(x) = f (-x) for all x with the range $-\infty < x < +\infty$. Show that (i) F(0) = 0.5 (ii) P[X> a] = 0.5 - $\int f(x)dx$ [Integral from “0” to “a”] , a >0 (5+5=10)
7. (i) State whether “Negative Binomial Random Variable can be represented as a sum of Geometric Random Variables?”
   (ii) Find out the expression of Variance of Hypergeometric Distribution. Which term in the variance is called “Finite Population Correction Factor?”
   (3+4=7)