SQC & OR Unit

Indian statistical Institute,8th Mile Mysore Road,Bangalore-59

M.S.(Quality Management Science) (2019-2021)
Semester I-July 2019

Back Paper :Reliability, Maintainability and Safety -I

Time: 3 Hours Date: 1 January 2020 Max. Marks: 100

Answer as many questions as you can

Question (1): Prove that for useful life the MTTF of a two unit standby system(both the units have same failure rate) as a whole is (a) Double that for a single unit
(b) Greater than the MTTF of a system with two units in parallel

(8+7=15)

Question (2): If the sales income in excess of Rs. 4 lacs of a large number of firms can be treated as a random variable having an exponential distribution with mean equal to 2 lacs. What's the probability that 3 out of 4 firms selected have sales income in excess of Rs 5 lacs? (12)

Question (3): Suppose that a system contains a certain type of component whose time in years to failure is given by "T". The random variable "T" is modeled nicely by the exponential distribution with MTTF = 5. If five of these components are installed in different systems, what is the probability that at least two are still functioning at the end of 8 years (10)

Question (4): Fifteen units of a certain automotive component are placed on a life test. The life is measured in Kilocycles. The failures occur at:
90,150,240,340,410,450,510,550,600,670,710,770,790,830,880
(a) Plot the Empirical density function, Hazard Function and Reliability function for the data given
(b) Can you suggest a Reliability Model from the Hazard Plot?

(4+4+4+3=15)

Question (5):

a) Prove that the Normal density function, the hazard rate is monotonically increasing.
b) A DC battery has a time to failure that is normally distributed with a mean of 30 hrs and s.d of 4 hrs
   (i) What's the 25 hrs reliability?
   (ii) When should a battery be replaced to ensure 10% chance of failure prior to replacement ?
   (iii) Two batteries are connected in parallel to power a light. Assuming that the light does not fail, what's the 35 hrs reliability for the power source?
   (iv) A particular battery has been in continuous use for 30 hrs. What's the probability that this battery will last another 4 hrs

(7+2+3+3+3=18)

Question (6): The life in thousands of kilometer, of a certain type of electronic control for locomotives has an approximately lognormal distribution with $\mu = 5.149$ and $\sigma = 0.737$.Find the "b_{10}" life of such an electronic control.

(10)

Question (7): Suppose the hazard function increases or decreases sharply, exhibiting exponential behavior, and the model used is

$h(t) = c.\exp(\alpha.t)$ where c and α are positive constants

Then find the expression for the (a) Failure Density Function (b) Reliability Function (7+6=13)

Question (8): A device has a failure rate characteristic which can be described by a Weibull failure model with Scale Parameter of 14142 hrs and a shape parameter of "2" (i) What % of items are expected to fail in 0 to 1000hrs (ii) Over what design life would the device have an average failure rate (AFR) $4*10^{-6}$ failures per hr.

(7 +5=12)