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SARDAR PATEL UNIVERSITY

M.Sc Examination, 3rd Semister

Friday Date : 26-10-2018 Time : 2.00 p.m. to 5.00 p.m.

Subject/Course Code : PS03ESTA021 PS03ESTA21

Reliability and Life Testing

Q-1 Answer following. 8

(1) In usual notation for i^{th} component, $\phi(1_i, X) = \phi(0_i, X)$ then i^{th} component is

(a) irrelevant.

(b) relatively important.

(c) critical.

(d) Non-of-above.

(2) In usual notation for i^{th} component $[\phi(1_i, X) - \phi(0_i, X)] \neq 1$ then i^{th} component is

(a) irrelevant.

(b) relatively important.

(c) critical.

(d) Non-of-above.

(3) Reliability importance of i^{th} component is denoted by

(a) $\eta_\phi(i)$

(b) $I_\phi(i)$.

(c) $I_h(i)$

(d) Non-of-above.

(4) For two types of failure, real system fail and safety and monitoring system fail

(a) we use series structure.

(b) we use parallel structure.

(c) we use coherent structure.

(d) we use dual structure.

(5) In usual notation total time on test till k^{th} failure, for with replacement is

(a) $nX_{1:n}$.

(b) $(n-1)(X_{2:n} - X_{1:n})$.

(PTO)

(c) $(n-k)(t-X_{k:n})$.

(d) Non-of-above.

(6) In usual notation total test time observed between $x_{k:n}$ to t for with out replacement is

(a) $nX_{1:n}$.

(b) $(n-1)(X_{2:n}-X_{1:n})$.

(c) $(n-k)(t-X_{k:n})$.

(d) Non-of-above.

(7) In usual notation # of components in hi-fy system are

(a) 5.

(b) 4.

(c) 3.

(d) 2.

(8) In usual notation mean life is $e^{\mu+\frac{\sigma^2}{2}}$. The life model is

(a) exponential.

(b) negative exponential.

(c) gamma.

(d) Non-of-above.

Q-2 Answer following. 14

(1) Give two definition of DFR.

(2) Derive reliability function for life model $f(x;\theta)=(1+x\theta)^{-1-\frac{1}{\theta}}; 0 < X$

(3) Given hazard rate, $\lambda(t)=\frac{1}{1+t\theta}$ derive life model.

(4) In usual notation interpret : (1) Minimal path set (2) Minimal cut set

(5) In usual notation derive unbiased estimator of reliability for life model $F(X)$.

(6) In usual notation interpret :

For any coherent structure $\phi(X \coprod Y) \geq \phi(X) \coprod \phi(Y)$.

(7) In usual notation deriving structure function of two component series structure using $\phi(X) = \sum_y \sum_{j=1}^{n} X_j^{y_j}(1 - X_j)^{1-y_j}\phi(y)$; sum is extended over all y of order n.

(8) Write inclusion-exclusion probability law.

(9) In usual notation interpret :
For any coherent structure $\prod_{i=1}^{n} X_i \leq \phi(X) \leq \coprod_{i=1}^{n} X_i$

Q-3 A React and justify : Chain is as strong as it's weakest link. 6

Q-3 B In usual notation interpret and prove : For coherent structure $\phi(X \prod Y) \leq \phi(X) \prod \phi(Y)$ and equality holds if ϕ is series structure. 6

OR

Q-3 B Show that dual of k-out-of-n system is (n-k + 1)-out-of-n system.

Q-4 A In usual notation the $\theta_r^* = (nx_{r:n}/r) \sim GAM(\theta/r, r)$, where θ_r^* is complete sufficient statistics of θ. Show that $E(1 - t/r\theta_r^*)^{r-1} = e^{-\left(\frac{t}{\theta}\right)}$. 6

Q-4 B In usual notation derive marginal posture pdf $\Pi(\eta/x)$, when joint posture pdf $\Pi(\theta, \eta/x) = (nS^{r+c-2}/\theta^{r+c}\Gamma r + c - 2)e^{-[S + n(x_{1:n} - \eta)]/\theta}$. 6

OR

Q-4 B In usual notation state and prove Greenwood's formula use in life table.

Q-5 A Express bridge structure as : 6

(1) parallel arrangement in minimal path series structure.

(2) series arrangement in minimal cut parallel structure.

Q-5 B Derive bound on reliability function using second method. 6

OR

Q-5 B Consider type-II censored sample (without replacement) of size n from $EXP[\theta]$. Derive test procedure for testing $H_0 : \theta = \theta_0$ V.S $H_1 : \theta = \theta_1$.

Q-6 A In usual notation define D_k, k^{th} spacing between order statistics. For uncensored sample of size n from life model $EXP[\theta]$ and show that $\forall\ D_k \sim EXP(\frac{\theta}{n-k+1})$; for k = 1, 2, . . . ,n. 6

B In usual notation define reliability importance of component and show that Improvement in component reliability Δp_j leads to a corresponding improvement in Δh in system. 6

OR

B In usual notation for 2-out-of-3 system with structure $\phi(X) = X_1(X_2 \amalg X_3)$ compute relative importance for component-1.

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