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No.	

M.Sc. (Part – II) (Semester – IV) (CGPA) Examination, 2016 STATISTICS (Paper – XVIII) Reliability and Survival Analysis (New)

•	,
Day and Date : Monday, 4-4-2016	Total Marks : 70
Time: 2.30 p.m. to 5.00 p.m.	
Instructions: 1) Attempt five questions. 2) Q. No. 1 and Q. No. 2 at 3) Attempt any three from 4) Figures to the right indi	Q. No. 3 to Q. No. 7.
1. A) Choose the correct alternative :	
1) The total time on test corresponding to	a complete sample is
a) x _(n)	b) $nx_{(n)}$
c) n x	d) none of these
2) Log-rank test for equality of two distrib	utions is based on data.
a) type I censoring	b) type II censoring
c) left censored	d) right censored
 For a parallel system of two independer each, then the reliability of system is a) 0.4 	nt components having reliability 0.6 b) 0.6
c) 0.84	d) 0.16
4) Parallel system of n components has _	minimal path set.
a) 1	b) n
c) 2 ⁿ	d) 2 ⁿ⁻¹
5) Which of the following is coherent syst	em?
a) parallel	b) series
c) k-out-of n	d) all the above



- B) Fill in the blanks:
 - DFRA class is preserved under _____
 - 2) A function is star shaped if _____
 - 3) K-M estimator of survival function S(t) when there are no ties in an experiment is given by _____
 - 4) The number of minimal paths in 2 out of 3 system is _____
 - 5) The i^{th} component is said to be irrelevant to structure function $\, \varphi \,$ if
- C) State whether the following statements are true or false:
 - 1) The dual of K out of n system is (n-k) out of n system.
 - 2) The subset of minimal cut set is cut set.
 - 3) Type I censoring is a particular case of random censoring.
 - 4) Kaplan-Meier estimator is nonparametric in nature. (5+5+4)
- 2. a) Define:
 - i) Mean Time To Failure (MTTF).
 - ii) Mean Residual Life (MRL) function.
 - iii) Failure rate function.
 - b) Write short note on the following:
 - i) Gehan's test.
 - ii) NBU and MBUE class of life distributions. (6+8)
- 3. a) Define coherent structure for a coherent structure with n components.

Prove that $\prod_{i=1}^{n} x_i \le \phi(\underline{x}) \le \prod_{i=1}^{n} x_i$.

b) If $x_1, x_2, \dots x_n$ are associated binary random variables, then prove that

$$P\left[\prod_{j=1}^{n} x_{j} = 1\right] \ge \prod_{j=1}^{n} P(x_{j} = 1).$$
 (7+7)



- 4. a) Define Polya function of order 2 (PF₂). If $f \in PF_2$, then prove that $F \in IFR$.
 - b) Define IFR and IFRA class of distributions. If $F \in IFR$ then prove that

F ∈ IFRA. (7+7)

- 5. a) Describe each of the following with one simple illustration.
 - i) Type I censoring.
 - ii) Type II censoring.
 - iii) Random censoring.
 - b) Describe acturial method of estimation of survival function. (7+7)
- 6. a) Describe Deshpande's test for exponentiality against IFRA.
 - b) Discuss maximum likelihood estimation of parameters of gamma distribution based on complete sample. (7+7)
- 7. a) Explain Mantel's technique of computing Gehan's statistic for a two sample problem for testing equality of two life distributions.
 - b) Obtain MLE of mean of exponential distribution under type II censoring. (7+7)

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M.Sc. (Semester - IV) (New) (CBCS) Examination Oct/Nov-2019 Statistics

		Statistics RELIABILITY AND SURVI	VAI	L ANALYSIS	
•		e: Friday, 08-11-2019 O PM To 05:30 PM		Max. Marks	: 70
Instr	uction	ns: 1) All questions are compulsory. 2) Figures to the right indicate full mar	ks.		
Q.1	Fill ir 1)	the blanks by choosing correct alternates The number of minimal paths in 2 out of a) 0 c) 2			14
	2)	Which of the following failure rate function a) $h(t) = e^t$ c) t	b)	presponds to IFR distribution? $h(t) = t e^t$ all of above	
	3)	IFRA class is preserved under a) convolution c) mixture	b) d)	coherent all the above	
	4)		b)	e structure \emptyset if $\emptyset(1_i, x_i) > \emptyset(0_i, x_i)$ none of these	
	5)	The dual of K out of n structure is a) n-k out of n c) k-1 out of n-1	b)	n-k+1 out of n n-k-1 out of n	
	6)	A parallel system of n components has _ a) 1 c) 2 ⁿ		minimal path sets. n 2 ⁿ⁻¹	
	7)	A function $p(x) \ge 0$ for all x is a polya function $p(x) \ge 0$ for all x is a polya function $p(x)$ is convex c) for fixed Δ , $\frac{P(x+\Delta)}{P(x)}$ is increasing in x	b)	$\log p(x)$ is concave	
	8)	Reliability of a system always lies between a) $-\infty$ and ∞ c) 0 and 1	en _ b) d)		
	9)	Scaled TTT transform for exponential disa) θt c) t/θ	stribi b) d)		
	10)	In type II censoring a) duration of experiment is fixed b) number of failures is fixed c) both number and time of failure are to d) none of these	ixec	j	

	11)	rate?					
		,	exponential Weibull		log-normal Gamma		
	12)	exp	$X_{(r)}$ be the r^{th} order statistic in a rando conential distribution with mean θ . The	en E	$[X_{(n)}] =$		
		a)	$\theta[n-r+1]^{-1}$	b)	$\sum_{i=1}^{r} [n-i+1]^{-1}$		
		c)	$\sum_{i=1}^{r} \theta \ [n-i+1]^{-1}$	d)	$\sum_{i=1}^{r} [n-i+1]^{-1}$ $\frac{1}{\theta} \sum_{i=1}^{r} [n-i+1]$		
	13)	a) b) c)	rich one of the following is not true? When there is no censoring K-M est function K-M estimator always exists K-M estimator is self consistent K-M estimator is also known as proc		·		
	14)	cer a)	e censoring time for every censored on soring. type I	b)	type II		
~ ^	• >	c)	random	,	both in a and b	00	
Q. 2	A)	1) 2) 3) 4) 5)	Define IFR and IFRA class of distribed Define IFR and IFRA class of distribed Define associated random variables associated random variables. Give two definitions of star shaped for Describe random censoring with suit Define Kaplan-Meier estimator.	utior and uncti	state any two properties of	08	
	B)	Writ 1) 2) 3)	te notes. (Any Two) Getian's two sampling test under ce Burnham's measure of structural imp Star shaped function			06	
Q.3	A)	Ans 1) 2) 3)	wer the following questions. (Any Define minimal path set and minimal Show that if F is IFR then F is IFRA Discuss maximum likelihood estimated distribution based on a complete sar	l cut	set. of parameters of Weibull	80	
	B)	1) 2)	ower the following questions. (Any Obtain MLE for mean of exponential For a coherent system with n composition $\emptyset(0)=0$ and $\emptyset(1)=1$ ii) $\prod_{i=1}^{n} x_i \leq \emptyset(x) \leq \prod_{i=1}^{n} x_i$	distr	bution under type II censoring.	06	
Q.4	A)	Ans 1) 2)	wer the following questions. (Any Define mean residual life function ar distribution. Obtain the likelihood function under abservations some from a distribution.	nd ob rand	om censoring setup, when the	10	
			observations come from a distribution	ווי ר	with density F.		

3) G	ive two	real life	examples	where	both	left and	right	censoring	occurs.
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B) Answer the following questions. (Any One)

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- Describe Kaplan-Meier estimator and derive an expression for the same.
- 2) Define K-out-of-n system. Obtain the reliability function of the system.

Q.5 Answer the following questions. (Any Two)

- a) Explain Mantel's technique of computing Gehan's statistic for a two-sample problem for testing equality of two life distributions.
- **b)** Define mean time to failure (MTTF) and mean residual life (MRL) function. Obtain the same for exponential distribution.
- c) Show that IFR class of life distributions is closed under convolution.

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M.Sc. (Part – II) (Semester – IV) Examination, 2015 STATISTICS (Paper – XVIII) Reliability and Survival Analysis

Day and Date: Tuesday, 21-4-2015 Total Marks: 70

Time: 3.00 p.m. to 6.00 p.m.

Instructions: 1) Attempt five questions.

- 2) Q. No. (1) and Q. No. (2) are compulsory.
- 3) Attempt any three from Q. No. (3) to Q. No. (7).
- 4) Figures to the right indicate full marks.

1.	A)	Choose the correct alternative
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- 1) For which of the following family each member has non-monotone failure rate?
 - a) Exponential

b) Weibull

c) Gamma

- d) Lognormal
- 2) For Weibull distribution _____ parameter decides whether distribution belongs to the IFR class or the DFR class.
 - a) Location

b) Shape

c) Scale

- d) All the above
- 3) In censored data actuarial estimator of survival function is _____

a)
$$\sum_{i=1}^{k} \hat{P}_i$$

b)
$$\frac{1}{k} \sum_{i=1}^{k} \hat{P}_i$$

c)
$$\prod_{i=1}^{k} \hat{p}_{i}$$

d)
$$\prod_{i=1}^{k} (\hat{p}_i)^{\frac{1}{2}}$$

4) The ith component of a system is relevant if _____

a)
$$\phi(1_i, \underline{x}) = 1$$
 and $\phi(0_i, \underline{x}) = 1$

b)
$$\phi(1_i, \underline{x}) = 1$$
 and $\phi(0_i, \underline{x}) = 0$

c)
$$\phi(1_i, \underline{x}) = 0$$
 and $\phi(0_i, \underline{x}) = 0$

d)
$$\phi(1_i, \underline{x}) = 0$$
 and $\phi(0_i, \underline{x}) = 1$



		5)	A function $g(x)$ defined on $[0, \infty)$ is s	star shaped function	if for $0 \le \alpha \le$	1,
			a) $g(\alpha x) \leq [g(x)]^{\alpha}$	b) $g(\alpha x) \ge [g(x)]^{\alpha}$		
			c) $g(\alpha x) \le \alpha g(x)$	d) $g(\alpha x) \ge \alpha g(x)$		
	B)	Filli	in the blanks :			5
		1)	IFR property is preserved under			
		2)	$F \in IFRA$ if and only if $-\log R(t)$ is			
		3)	A sequence of (2×2) contingency ta	bles is used in		
		4)	In type II censoring is	fixed.		
		5)	The minimal path sets for a structure	e φ are	_ for its dual.	
	C)	Stat	te whether the following statements a	re True or False :		4
		1)	The dual of a parallel system is not a	a parallel.		
		2)	For exponential distribution failure ra	ate is constant.		
		3)	Weibull distribution is IFR for all para	ameter values.		
		4)	IFRA property is preserved under co	nvolution.		
2.	a)	Ans	swer the following :			6
		1)	Define minimal path sets and minimal co	ut sets. Illustrate the sa	me by examp	le.
		2)	Define k out of n system. Obtain the	reliability function of	this system.	
	b)	Wri	rite short notes on the following :			8
		1)	Empirical survival function and its pr	operties.		
		2)	Log-rank test.			
3.	a)		fine NBU and NBUE classes of distril IFRA \Rightarrow F \in NBU.	outions. Prove that		
	b)	Give	e two definitions of star shaped functi	on and prove their eq	ιuivalence.	(7+7)
4.	a)	Des	scribe various censoring schemes.			
	b)		tain MLE of the mean (θ) of an expond type II censoring.	ential distribution bas	ed on type I	(7+7)



- 5. a) Describe situations where random censoring occurs naturally. Obtain actuarial estimate of survival function and derive Greenwood's formula for the estimate of variance of the estimator.
 - b) Define associated random variables. If $X_1, X_2, ..., X_n$ are binary associated random variables then prove that $P\left[\coprod_{j=1}^n X_j = 1\right] \le \coprod_{j=1}^n P(X_j = 1)$. (7+7)
- 6. a) Let $F(x) = \int F_{\alpha}(x) dG(\alpha)$ be a mixture of $\{F_{\alpha}\}$ with mixing distribution $G(\alpha)$. Prove that $^{\alpha}$ f each F_{α} is DFR then F is DFR.
 - b) Obtain the actuarial estimator of the survival function. Clearly state the assumption that you need to make. State Greenwood's formula for the variance of the estimator.
- 7. a) Show that Kaplan-Meier estimator of survival function is the generalized likelihood estimator of the survival function.
 - b) Define structure function of a system. Obtain structure function of a system in terms of minimal path sets. (7+7)

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M.Sc. (Part – II) (Semester – IV) Examination, 2015 STATISTICS (Paper – XVIII) Reliability and Survival Analysis

Day and Date: Tuesday, 21-4-2015 Total Marks: 70

Time: 3.00 p.m. to 6.00 p.m.

Instructions: 1) Attempt five questions.

- 2) Q. No. (1) and Q. No. (2) are compulsory.
- 3) Attempt any three from Q. No. (3) to Q. No. (7).
- 4) Figures to the right indicate full marks.

1.	A)	Choose the correct alternative
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5

- 1) For which of the following family each member has non-monotone failure rate?
 - a) Exponential

b) Weibull

c) Gamma

- d) Lognormal
- 2) For Weibull distribution _____ parameter decides whether distribution belongs to the IFR class or the DFR class.
 - a) Location

b) Shape

c) Scale

- d) All the above
- 3) In censored data actuarial estimator of survival function is _____

a)
$$\sum_{i=1}^{k} \hat{P}_i$$

b)
$$\frac{1}{k} \sum_{i=1}^{k} \hat{P}_i$$

c)
$$\prod_{i=1}^{k} \hat{p}_{i}$$

d)
$$\prod_{i=1}^{k} (\hat{p}_i)^{\frac{1}{2}}$$

4) The ith component of a system is relevant if _____

a)
$$\phi(1_i, \underline{x}) = 1$$
 and $\phi(0_i, \underline{x}) = 1$

b)
$$\phi(1_i, \underline{x}) = 1$$
 and $\phi(0_i, \underline{x}) = 0$

c)
$$\phi(1_i, \underline{x}) = 0$$
 and $\phi(0_i, \underline{x}) = 0$

d)
$$\phi(1_i, \underline{x}) = 0$$
 and $\phi(0_i, \underline{x}) = 1$



		5)	A function $g(x)$ defined on $[0, \infty)$ is s	star shaped function	if for $0 \le \alpha \le$	1,
			a) $g(\alpha x) \leq [g(x)]^{\alpha}$	b) $g(\alpha x) \ge [g(x)]^{\alpha}$		
			c) $g(\alpha x) \le \alpha g(x)$	d) $g(\alpha x) \ge \alpha g(x)$		
	B)	Filli	in the blanks :			5
		1)	IFR property is preserved under			
		2)	$F \in IFRA$ if and only if $-\log R(t)$ is			
		3)	A sequence of (2×2) contingency ta	bles is used in		
		4)	In type II censoring is	fixed.		
		5)	The minimal path sets for a structure	e φ are	_ for its dual.	
	C)	Stat	te whether the following statements a	re True or False :		4
		1)	The dual of a parallel system is not a	a parallel.		
		2)	For exponential distribution failure ra	ate is constant.		
		3)	Weibull distribution is IFR for all para	ameter values.		
		4)	IFRA property is preserved under co	nvolution.		
2.	a)	Ans	swer the following :			6
		1)	Define minimal path sets and minimal co	ut sets. Illustrate the sa	me by examp	le.
		2)	Define k out of n system. Obtain the	reliability function of	this system.	
	b)	Wri	rite short notes on the following :			8
		1)	Empirical survival function and its pr	operties.		
		2)	Log-rank test.			
3.	a)		fine NBU and NBUE classes of distril IFRA \Rightarrow F \in NBU.	outions. Prove that		
	b)	Give	e two definitions of star shaped functi	on and prove their eq	ιuivalence.	(7+7)
4.	a)	Des	scribe various censoring schemes.			
	b)		tain MLE of the mean (θ) of an expond type II censoring.	ential distribution bas	ed on type I	(7+7)



- 5. a) Describe situations where random censoring occurs naturally. Obtain actuarial estimate of survival function and derive Greenwood's formula for the estimate of variance of the estimator.
 - b) Define associated random variables. If $X_1, X_2, ..., X_n$ are binary associated random variables then prove that $P\left[\coprod_{j=1}^n X_j = 1\right] \le \coprod_{j=1}^n P(X_j = 1)$. (7+7)
- 6. a) Let $F(x) = \int F_{\alpha}(x) dG(\alpha)$ be a mixture of $\{F_{\alpha}\}$ with mixing distribution $G(\alpha)$. Prove that $^{\alpha}$ f each F_{α} is DFR then F is DFR.
 - b) Obtain the actuarial estimator of the survival function. Clearly state the assumption that you need to make. State Greenwood's formula for the variance of the estimator.
- 7. a) Show that Kaplan-Meier estimator of survival function is the generalized likelihood estimator of the survival function.
 - b) Define structure function of a system. Obtain structure function of a system in terms of minimal path sets. (7+7)

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M.Sc. (Part - II) (Semester - IV) Examination, 2014

		TISTICS (Pap ity and Surv	er – XVIII) ival Analysis	
Day and Date: Satu	•	14		Total Marks : 70
Time: 3.00 p.m. to 6	6.00 p.m.			
Instructions:	2) Q. No. (1) 3) Attempt a	` ,	are compulsory . Q. No. (3) to Q. No. (7).
1. A) Choose the	correct altern	ative :		5
1) In type II	censoring			
a) durat	ion of experim	ent is fixed		
b) numb	per of failures i	is fixed		
c) both	time and numl	oer of failures a	re fixed	
d) none	of these			
2) For whic rate ?	h of the follow	ing family, each	member has non-mo	onotonic failure
а) ехрог	nential b)	weibull	c) lognormal	d) gamma
3) IFRA pro	perty is prese	rved under		
a) cohe	rent b)	mixture	c) convolution	d) none of these
4) Birnbaur	m's measure o	of structural imp	ortance of compone	nt i is
a) $\frac{n_{\phi(i)}}{n^2}$	b)	$\frac{n_{\phi(i)}}{(n-1)^2}$	c) $\frac{n_{\phi(i)}}{2^{n-1}}$	d) $\frac{n_{\phi(i)}}{2^n}$
5) The i th c	omponent of a	a system is rele	vant if	

a) $\phi(1_i, \underline{x}) = 1$

b) $\phi(0_i, \underline{x}) = 0$

c) both (a) and (b)

d) neither (a) nor (b)



	B)	Fill in the blanks :	5
		1) If p _i is the reliability of the i th component, then the reliability of parallel system of n independent components is	el
		2) A function is star shaped if	
		3) A distribution F is said to be NBU if	
		4) Mantel derived variance of Gehan's statistic under the hypothes	is
		5) Kaplan-Meier estimator is also called estimator.	
	C)	State whether the following statements are True or False :	4
		1) Weibull distribution has monotone failure rate.	
		2) Non-decreasing function of associated random variables is not associated	d.
		3) Log-rank test is based in left censored data.	
		4) Type I censoring is a particular case of random censoring.	
2.	a)	Answer the following:	6
		1) Define dual of structure function. Obtain dual of 2-out-of-3 system.	
		2) Describe type I censoring.	
	b)	Write short notes on the following:	8
		1) Star shaped function.	
		2) Log-rank test.	
3.	a)	If h(p) is the reliability function of coherent system of n independent component	ts
		then show that $h(p^{\alpha}) \ge [h(p)]^{\alpha}$.	
	b)	Define IFR and IFRA class of distributions. If $F \in IFR$ then show that $F \in IFRA$.	(6+8)
4.	a)	Define (i) NBU (ii) NBUE class of distributions. Prove or disprove : NBU ⇒ NBUE	Ξ.
	b)	If failure time of item has the Pareto distribution. Obtain failure rate function and show that the distribution belongs to DFR.	n
	c)	Define reliability function. Obtain it for series and parallel system of n independent components. (5	+4+5)



- 5. a) Discuss maximum likelihood estimation of parameters of weibull distribution based on a complete sample.
 - b) Define acturial estimator and obtain an estimate of variance of acturial estimator.
- 6. a) Describe each of the following with one simple illustration:
 - i) Type I censoring
 - ii) Type II censoring
 - iii) Random censoring.
 - b) Describe two sample problem under randomly censored set up and develop Gehan's test for the same. (6+8)
- 7. a) Obtain m.l.e. for mean of the exponential distribution under Type II censoring.
 - b) Describe the Kaplan-Meier estimator.
 - c) Define mean residual life function and obtain the same for exponential distribution. (5+5+4)

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M.Sc. (Semester - IV) (New) (CBCS) Examination March/April-2019

	Statisti RELIABILITY AND SUR	
•	& Date: Wednesday, 24-04-2019 03:30 PM To 06:00 PM	Max. Marks: 70
Instru	uctions: 1) All questions are compulsory. 2) Figures to the right side indicate	e full marks.
Q.1	Choose the correct alternative:1) Which of the following is coherent systema:a) Seriesc) K out of n	em? b) Parallel d) All the above
	2) IFR class is preserved undera) coherentc) mixture	b) convectiond) all the above
	3) A function $g(x)$ defined on $[0, \infty]$ is star a) $\frac{g(x)}{x} \uparrow x$ c) $g(\propto x) \geq \propto g(x)$	shaped if b) $\frac{g(x)}{x} \downarrow x$ d) $g(\propto x) = \propto g(x)$
	4) If P_i is the reliability of i^{th} component the independent components is a) $\sum_{i=1}^{n} P_i$ c) $\prod_{i=1}^{n} (1 - P_i)$	en reliability of series system of n b) $\prod_{i=1}^{n} P_i$ d) $1 - \prod_{i=1}^{n} (1 - P_i)$ responds in DFR distribution? b) $h(t) = te^t$
	5) Which of the following rate function corn a) $h(t) = t$ c) $h(t) = e^{-t}$	responds in DFR distribution? b) $h(t) = te^t$ d) None of these
	6) In a system of n components, total numa) nc) 2ⁿ⁻¹	ber of path and cut vectors is b) 2 ⁿ d) ⁿ C ₂
	7) In a K out of n system there are a) n c) ${}^{n}C_{k}$	minimal path sets. b) k d) n ^k
	8) An experiment is terminated after a fixe scheme.a) Type Ic) Both (a) and (b)	b) Type II d) Neither (a) nor (b)
	9) Logrank test for equality of two distributa) Type I censoringc) Left censoring	tions is based on data. b) Type II censoring d) Right censoring
	10) The TTT transforms of an IFR distributa) Convexc) Linear	ion is b) Concave d) Neither concave nor convex

		Let $X_1, X_2,,X_n$ be iid exponential with mean θ . The MLE of survival function is	
	(a) $\frac{e^{-t}}{X}$ b) $\frac{e^{-t}}{X_{(1)}}$ c) $\frac{e^{-t}}{X_{(n)}}$ d) $\frac{e^{-t}}{M}$, M is median	
		A vector <i>X</i> is called path vector if	
	ŧ	a) $\emptyset(\underline{X}) = 1$ b) $\emptyset(\underline{X}) = 0$	
	(c) $0 \le \emptyset(\underline{X}) \le 1$ d) $\emptyset(X) = \frac{1}{2}$	
	; 	K-M estimator of survival function a) always exist b) is generalized MLE c) is different from the empirical survival under no censoring d) none of the above	
	14)	Gehan's test is an extension of a) Mann - Whitney test b) Wilcoxon's test c) Mantel - Haenzel test d) Chi – square test	
Q.2	A)	 Answer any four of the following questions. 1) Define coherent system. Give an illustration of a system which is not coherent. 2) Define irrelavent component. Give an illustration. 3) Describe the need of censoring experiment. 4) Describe type I censoring with suitable example. 5) State the Greenwood Formula. 	08
	B)	Write short note on any two of the following.1) Mean residual life function.2) Pivotal decomposition of structure function.3) Empirical survival function.	06
Q.3	A)	 Answer any two of the following: 1) Give two definitions of star shaped function and prove their equivalence. 2) Define dual of a structure function. Show that dual of dual is primal. 3) Discuss maximum likelihood estimation of parameters of gamma distribution based on a complete sample. 	80
	B)	 Answer any one of the following: 1) Obtain the MLE for mean of the exponential distribution under random sampling. 2) If X₁, X₂,, X_n are associated random variables of a coherent system. Prove that \[\int_{i=1}^n P(X_i = 1) \leq P[\varphi(X) = 1] \leq \int_{i=1}^n P(X_i = 1) \] 	06
Q.4	A)	Attempt any two of the following: 1) If failure time of item has Weibull distribution with distribution function $F(t) = \begin{cases} 1 - e^{-(\lambda t)^{\alpha}}, & t > 0 \\ 0, & \text{Otherwise} \end{cases}$	10
		Examine whether it belongs to IFR or DFR. 2) Describe actuarial method of estimation of survival function with suitable illustration.	

3) Develop a test for testing exponentiality against NBU.

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B)	Attempt any one of the following:	U
	1) Derive the likelihood function of observed data under type I censoring.	
	Obtain the structure function of a coherent system using minimal path sets. Illustrate the same by an example.	

Q.5 Answer any two of the following:

- a) Define NBU and NBUE class of distributions. Prove or disprove : NBU => NBUE
- **b)** Define associated random variables. If X_1, X_2, \ldots, X_n are binary associated random variables then prove that $1-X_1, 1-X_2, \ldots, 1-X_n$ are associated.
- c) Define TTT transform. Show that for an IFR distribution TTT transform is a convex function