# SET-"Z"

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

### (Ph.D/URS-EE Jan.2022)

## **STATISTICS**

10025

Sr. No.\_\_

Code

Time: 14 Hours	Total Quest	tions: 100	Max. Marks: 100
Roll No	(in figure)		(in words
Name :		_ Father's Name :	
Mother's Name :		_ Date of Examinatio	n:

(Signature of the candidate)

(Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. All questions are compulsory.

2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by

the candidate.

4. Question Booklet along with answer key of all the A,B,C and D code will be got uploaded on the university website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examinations in writing/through E-Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.

5. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers

MUST NOT be ticked in the Question book-let.

6. There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

. Use only Black or Blue BALL POINT PEN of good quality in the OMR Answer-

Sheet.

8. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.



Question No.	Questions	Question No.
1.	If a random variable X has pdf $f(x) = kx (1-x)$ , $0 \le x \le 1$ then value constant k is:	e of the
	(1) $\frac{1}{2}$ (2) 2	
	(3) 4 (4) 6	
2.	Mean of the random variable X having pdf f (x) = $6x^3 (4 - x)^2$ , 0 is	≤ x ≤ 4
	(1) 9/14 (2) 14/9	
	(3) 9/20 (4) None of these	
3.	If F (x) denote the distribution function of a continuous random X then which one is not true	variable
	(1) $F(-\infty) = 0$ (2) $F(\infty) = 1$	
	(3) F(x) is left continuous (4) None of these	
4.	If X and Y are independent random variables, then	0
	(1) $E(XY) < E(X) \cdot E(Y)$ (2) $E(XY) > E(X) \cdot E(Y)$	
	(3) $E(XY) = E(X) \cdot E(Y)$ (4) None of these	
5.	The skewness of a binomial distribution having probability of $p = 1/2$ is	success
lerror	(1) T-1 pimmo (2) 10 Torn (2) 0 postfimmo (1)	
	(3) 1 None of these	

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Question No.	Questions and
6.	The variance of a distribution having M.G.F. M (t) = $\left(\frac{1}{2} + \frac{1}{2}e^{t}\right)^{4}$ is
	(1) 2 (2) 3/2
	(3) 2/3 (4) None of these
7.	M.G.F. of Poisson distribution is
	(1) $M(t) = e^{\lambda (e^t - 1)}$ (2) $M(t) = e^{-\lambda (e^t - 1)}$
17.	(3) $M(t) = e^{-\lambda e^t} + 1$ (4) $M(t) = e^{-\lambda e^t} - 1$
8.	If X is uniformly distributed over the interval [0, 1] then Var (X) is
	(1) 5/12 (2) 1/3
	(3) 1/12 good to enovi (4) 3/12 good for (2) 4 (8)
9.	If X and Y are random variables such that their expectations exist and $P(X \le Y) = 1$ , then
	$(1)  E(X) \ge E(Y) \qquad (2)  E(X) \le E(Y)$
aesonga 1	(3) $E(X) = E(Y)$ (4) None of these
10.	Level of significance is equal to the probability of
	(1) Not committing Type-I error (2) Committing Type-II error
i i	(3) Not committing Type-II error (4) None of the above

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Question No.	Questions notices
11.	To test $H_0$ : $\mu_0$ against $H_1$ : $\mu > \mu_0$ when the population variance is unknown and sample size is small, the appropriate test is
avi	(1) t-test (2) Z-test
	(3) Chi-square test (4) F-Test
12.	Paired t-test is applicable when the observations in the two samples are
	(1) Independent (2) Mutually independent
sul i	(3) Paired (4) None of these
13.	Association of attributes in a 2×2 contingency table can be tested by
	(1) F-test (2) Z-test
	(3) t-test (4) Fisher Exact test
14.	The $\chi^2$ statistic with usual notations in case of contingency table of order $(m \times n)$ is
	(1) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$ (2) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \frac{O_{ij}^2 - E_{ij}^2}{E_{ij}}$
-24	(3) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \left( \frac{O_{ij} - E_{ij}}{E_{ij}} \right)^2$ (4) None of these

Question No.	anolise Questions	Question No.
15.	If $r_{xy} = 0$ , the two lines of regression  (1) Coincide (2) Are parallel	11
	(3) Are perpendicular to each other (4) None of the ab	ove
16.	Correlation coefficient is independent of change of	
918 89	(1) Origin only (2) Scale only	12.
	(3) Both origin and scale (4) None of these	
17.	Given the two lines of regression as, $3x - 4y + 8 = 0$ and $4x - 3y$ means of x and y are respectively:	= 1, the
. 44	(1) 4 and 5 (2) 5 and 4	FMEI
	(3) $\frac{4}{3}$ and $\frac{5}{4}$ and $\frac{4}{5}$	
18.	Skewness of a frequency curve shows	14.
	(1) Flatness of the frequency curve (2) Lack of symme	etry
	(3) Peakedness of the frequency curve (4) None of these	
19.	For a leptokurtic distribution	
	(1) $\beta_2 > 3$ (2) $\beta_2 < 3$ (3)	
3 . 6	(3) $\beta_2 = 3$ (4) None of these	

Question No.	enon Questions		
20.	If $X_1, X_2, \dots, X_n$ is a random sample from a uniform distribution defined over the interval $0 < x < \theta, \theta > 0$ , then with usual notations MLE of $\theta$ is  (1) $X_{(1)}$ (2) $X_{(n)}$ (3) $(X_{(1)} + X_{(n)})/2$ (4) None of these		
21.	The mean and variance of a chi-square distribution with degrees of freedom 4 are		
	(1) 8 and 4 respectively (2) 4 and 8 respectively		
	(3) 4 and 4 respectively (4) 8 and 8 respectively		
22.	If $X \sim N$ ( $\mu$ , $\sigma^2$ ), the points of inflexion of normal curve are :		
1 ydin	(1) $\mu \pm 2\sigma$ (2) $\sigma \pm 2\mu$		
(X)	(3) $\mu \pm \sigma$ (4) None of these		
23.	If X is a Poisson variates with P $(X = 1) = P (X = 2)$ , then mean of the Poisson variate is equal to		
	(1) 1 (2) 2		
tance an be	(3) 13 0 to the water and with the first of the property of the point		
24.	Which of the following relation is true for the F-distribution:		
	(1) $F_{\alpha}(n_1, n_2) = 1/F_{\alpha}(n_2, n_1)$ (2) $F_{\alpha}(n_1, n_2) = F_{1-\alpha}(n_2, n_1)$ (3) $F_{\alpha}(n_1, n_2) = 1/F_{1-\alpha}(n_2, n_1)$ (4) None of the above		

Question No.	Questions	soiteoi aki
25.	Which of the following true is case of MGF of a random variable X	:03
	(1) MGF may not exist (2) If exists MGF is unique	
	(3) Both (1) and (2) are true (4) None of these	
26.	If $X_1$ , $X_2$ , $X_N$ is a random sample from a multivariate distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then distribution of same mean vector $\overline{X}$ is:	ution
	(1) $N(\mu, \Sigma)$ (2) $N(\mu, N\Sigma)$	
	(3) N ( $\mu$ , $\Sigma$ /N) (4) None of these	
27.	If $X_1, X_2, \dots, X_N$ is a random sample from a p-variate normal distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then MLE of $\Sigma$ is given $(1)  \frac{1}{N} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X})^{t} (X_{\alpha} - \overline{X}) \qquad (2)  \frac{1}{N+1} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X}) (X_{\alpha} - \overline{X})^{t} (X$	n by :
edito	(3) $\frac{1}{N-1} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X})^{t} (X_{\alpha} - \overline{X})$ (4) None of these	.83
28.	If X has p-variate normal distribution with mean vector 0 and covar matrix $\Sigma$ and $ \Sigma  > 0$ , then with usual notations the joint pdf convirten as the product of marginal pdfs of $X_1: q \times 1$ and $X_2: (p-q)$ and only if	an be
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Question No.	Questions 40th and
29.	Let $X_1, X_2, \ldots, X_N$ be a random sample from a p-variate normal distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then which of the following is true
	(1) (N-1) S has Wishart Distribution
	(2) Sample mean and S are independent (2) hour (1) slight (8)
	(3) Sample mean is distributed as $N_p(\mu, \Sigma/N)$
edi gu	(4) All of these
30.	If $Y_1, Y_2, \ldots, Y_n$ dentote the principal components based on correlation matrix (R) and $\lambda_1 > \lambda_2, \ldots > \lambda_p$ are eigenvalues of R, then which of the following is true
	gg. Which of the following is a principle of design of experiments
	(1) $\operatorname{tr}(\Sigma) = \sum_{i=1}^{p} \operatorname{Var}(Y_i)$ (2) $\sum_{i=1}^{p} \lambda_i = \sum_{i=1}^{p} \operatorname{Var}(Y_i)$
	(3) $\operatorname{Var}(Y_p) = p$ (4) All of the above
31.	In a RBD with $v = 5$ and $r = 4$ one treatment is added, the increase in error degrees of freedom will be:
	(1) 1 Visvitesquer e bas 1 (2) 2 Visvitesquer OL bas 8 (1)
	(3) 3 and 36 respectively (4) (4) (4) None of these (6)

Question No.	enoite Questions notices
32.	Which of the following is true about the Principal Component Analysis
lowing	(1) Principal components are ordered linear combinations of the given variables
	(2) First Principal component has maximum variance
	(3) Both (1) and (2) are true debut out 2 but as a semi-significant.
	(4) None of the above (a) Mass best posterior of the above (b)
33.	In experimental designs the experimental error is controlled by using the
· .	(1) Local control (2) Randomization
	(3) Replication (4) None of the above
34.	Which of the following is a principle of design of experiments
	(1) Replication (2) Local Control
	(3) Randomization (4) All of the above
35. ni eass	An investigator randomly assigns 10 patients to each of the 4 different treatments to study their effects of diastolic blood pressure. F test was used to test that the mean response was same between different groups. The numerator and denominator degrees of freedom for F test are
	(1) 3 and 10 respectively (2) 4 and 9 respectively
	(3) 3 and 36 respectively (4) None of these

Question No.	Questions Roots No.
36. 10 evad no	If the overall F test in ANOVA is found to be significant then pair wise comparision between treatment means is made using:
	(1) Chi-square test (2) Two sample t test
	(3) Variance ratio test (4) None of these
37.	A sampling procedure in which the sampling units are selected at a regular interval systematically from the population is known as:
	(1) Systematic sampling (2) Stratified sampling
da -	(3) Systematic random sampling (4) Both (1) and (3)
38.	In RCBD, which of the following principle is adopted?
	(1) Replication (2) Randomization
	(3) Local control (4) All of these
39.	The common device to reduce the block size in experiments studying main effects and interaction is:
	(1) Confounding (2) Block Interaction
	(3) BIBD (4) Asymmetrical factorial design
40.	In designs of experiment. A general rule is to use as many replications which provides at least:
48	(1) 20 error DF (2) 12 error DF
	(3) 30 error DF (4) None of these
	esent to enon (1) (2) both (1) dtod (8) Net reproduct we rate (4) None of these (8)

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uestion No.	anolized Questions	No.
41.	A stratified random sample of size 32 is drawn from three strata of 20, 40 and 100. The samples drawn using proportional allocation sizes:  (1) 6, 10, 16 (2) 4, 8, 20	of sizes n have
referalar	(3) 5, 9, 18 (4) None of these	37.
42.	Non-response in sample surveys means  (1) Non-availability of respondents	
24	<ul> <li>(2) Non-return of questionnaire by the respondents</li> <li>(3) Refusal to give information</li> <li>(4) All of these</li> </ul>	.88.
	to the standard manage and	.09
43.	in a language of the redecided by a charge dainy	differen
44.	Sample survey is advantageous over census because it	
	(1) is less costly (2) has greater scope	
	(3) both (1) and (2) (4) none of these	

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Question No.	Questions	destion No.
45.	Which of these does not match with others	
	(1) Harvit-Thompson estimator	
	(2) Murthy unordered estimator	
1.1	(3) Des Raj ordered estimator	
	(4) Rao, Hartley and Chochran estimator	
46.	Infant mortality rate is defined as the number of deaths under of age in a year:	
88	(1) Per 1000 live births (2) Per 1000 population	
	(3) Per 1000 women (4) None of these	
47.	Which of the following is not a method of collecting vital statist	ics:
0488-1101	(1) Census Method (2) Analytical Method	
011 <del>-</del> 8 <b>9</b> FC	(3) Registration Method (4) None of these	
48.	Total fertility rate is derived from:	
	(1) Age specific birth rate (2) Gross reproduction rate	
	(3) Net reproductive rate (4) None of these	

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Question No.	Questions Questions	.ovi
No.	was a season of the season and the season of	1988
49.	The formula $\sum_{i=1}^{n} p_{0i} q_{1i} \times 100$ represents	70
49.	2 Poi 40i Totamitee nosquod I-divisti (1)	
	(1) Fisher's Index (2) Kelly's Index	
	(4) None of these	
	(a) Dos Pol sedore I self (b)	
50.	Fertility refers to:	
	(1) Actual bearing of children	
	(2) Canacity to bear the child	·
7 2 2 2 2	hinth per woman in the year	46. 10
rea Aneri	(2) Non-Return and Property of the Control of the C	
	(4) None of these	
51.	The region of feasible solution in LPP graphical method is called	
01.	(2) feasible region	
	. Caite morion	
1	1 /2/ 11112/35/11/6 1/61/22	c feasible
52.	In Simplex method, which of the following is correct about the basi	
	solution.  (1) a basic feasible solution is a solution with a maximal set of	non-zer
	(1) a basic feasible solution is a solution with a maximus	
	variables (2) a basic feasible solution is a solution with a minimal set of	f non-zer
	(2) a basic feasible solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution is a solution with a minute of the solution of the solution with a minute of the solution	
1 34	variables  (3) a basic feasible solution does not correspond to a corr	ner of tl
	(3) a basic feasible solution does not correspond polyhedron of feasible solutions	
	(4) None of these star evizouborder teN (8)	
	D/URS-EE-2022 (Statistics) Code-A-shoo (estitation) \$808-33-3	

Question No.	Questions	uestior No.
53.	In transportation models the points of demand are called:	67.
	(1) Origins (2) Supply centres	
	(3) Destinations (4) None of these	
54.	Which of the following are the entities whose values are to be determined the solution of the LPP:	mined
nortulo	(1) objective function (2) decision variables	
	(3) constraints (4) opportunity cost	
55.	A constraint in an LP model restricts	
	(1) Value of the objective function  (2) Values of the decision variables	age to gwidus
	(3) Use of the available resources	
	(4) All of the above to the (b) resignation to reduce (c)	
56.	Operations Research is a very powerful tool for	amh i
	(1) Research (2) Operations (3) (2) Operations	
	(3) Decision Making (4) None of the above	

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Question No.	Questions	Agestion No.
57.	In transportation table every loop has	.51
40.	(1) An even number of cells (2) An odd number of cells	
	(3) An equal number of cells (4) None of the above	
58.	When it is not possible to find solution in LPP, it is called as	
imined	(1) Infeasible solution (2) Unbounded solution	54.
	(3) Improper solution (4) None of the above	
59.	One disadvantage of using North-West Corner Rule to find initial to the transportation problem is that  (1) It is complicated to use	solution
31	(2) It ignores the cost of transportation  (3) It leads to degenerate initial solution	.66
	(4) All of the above	fear la
60.	Game theory models are classified by the	
	(1) Number of players (2) Sum of payoffs	
	(3) Number of strategies (4) All of the above	
61.	When the sum of gains of one player is equal to the sum of lanother player is a game, this situation is known as	osses to
	(1) Biased game (2) Non-zero-sum game	
	(3) Fair game (4) None of these	

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62.	Saddle point exists in game theory when  (1) Maximin and minimax value of the game are same  (2) Maximin value of the game is greater than minimax value  (3) Maximin value of the game is less than minimax value  (4) None of the above	66.
nization	The time over which the inventory level will be controlled is called	ed:
63.	(1) Time Horizon (2) Lead Time (3) Time to take decision (4) None of these	
64.	Which of the following is true about the buffer stock?	**
with a mential iverage	(1) A buffer stock scheme is an attempt to use commodity sto the purposes of Stabilising prices in an entire economy or an in market.	IQI VIQ QQ
	(2) Commodities are bought and stored when a surplus exis economy.	ts in the
	(3) Commodities are sold from the stores when economic shother the economy occur.	
tomers	(4) All of these	08
65.	The variable added to the LHS of a less than or equal to conconvert it into equality is called variable  (1) artificial (2) surplus (3) slack (4) additional	straint to

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Question No.	enoiteer Questions noiteeu Questions
66.	If a customer decides not to enter the queue because of its huge length, he is said to have
	(1) Balked (2) Reneged
58.	(3) Jockey (4) None of these
67. be	When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix.
	(1) cost (2) profit (2) profit (3)
	(3) regret (4) dummy
68.gan	mean rate of 5 per hour. The service time per car follows an exponential
adr (vi e	distribution with a mean of 10 minutes. At the steady state, the average waiting time in the queue is:
edo où e	distribution with a mean of 10 minutes. At the steady state, the average
e in the ng nges in	distribution with a mean of 10 minutes. At the steady state, the average waiting time in the queue is:
69.	distribution with a mean of 10 minutes. At the steady state, the average waiting time in the queue is:  (1) 50 minutes  (2) 25 minutes  (3) 20 minutes  (4) None of these  Efficiency of M/M/C model in terms of the Total Number of Customers (TNC) and Average Number of Customers Served (ANCS) is given by
69.	distribution with a mean of 10 minutes. At the steady state, the average waiting time in the queue is:  (1) 50 minutes  (2) 25 minutes  (3) 20 minutes  (4) None of these

nestion No.	enoite Questions of
70.	Which of the following is true about an evolutionary random process?
	(1) It is not stationary
	(2) Poisson process is an example of evolutionary random process (3) Both (1) and (2) are true
	(3) Both (1) and (2) are true  (4) None of these and a mode and a gain woll of add to do do do
71,900	If a closed set C contains only one state j, then the state is called:
	(1) Non-absorbing state (2) Persistent state
	(3) Transient state (4) None of these
<b>72.</b> woled a	Which of the following is true about an absorbing Markov chain:  (1) A Markov chain is said to be absorbing if it has at least one absorbing state.
	(2) If the state j is absorbing the p <sub>ij</sub> = 1
	(3) It is impossible to leave an absorbing state
	(i) All of those (ii) Mod (iii)
	(4) All of these
73.	Extinction of a stochastic process means that the sequence $\{X_n\}$ consider of
73.	Extinction of a stochastic process means that the sequence {X <sub>n</sub> } consider of
	Extinction of a stochastic process means that the sequence $\{X_n\}$ consist of
	Extinction of a stochastic process means that the sequence {X <sub>n</sub> } consist of  (1) Zeros for all except a finite number of values of n

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Question No.	Questions	No.
74.	For an immigration-emigration process which of the following is	true 07
	(1) $\lambda_n = \lambda$ (2) $\mu_n = \mu$	
88	(3) $\lambda_n = 1$ and $\mu_n = \mu$ (4) None of these surfaces (5) does (6)	
75.	Which of the following is true about a Yule-Furry Process:	
	(1) It is a Pure Birth Process (2) It is a Pure Death F	rocess
	(3) It is a Birth and Death Process (4) None of these	
76.	A matrix is in reduced row-echelon form if it meets the f condition(s):	ollowin
agidaoa	(1) If there is a row where every entry is zero, then this row language any other row that contains a nonzero entry.	
	(2) The leftmost non-zero entry of a row is equal to 1.	
	(3) Both (1) and (2) esent to IIA (4)	
consists	(5) None of these	73.
etalanoo	Extinction of a stochastic process means the seal of (4)	utomer
	Extinction of a stochastic process means the seath to another (4)	utomer
	(4) None of these of easem second of the equation $ A - \lambda I  = 0$ are	utomer

Question No.	anoites Questions noites Questions
78.	A quadratic form is a polynomial with all terms of degree two
	(1) 1 (2) 2 v to sometime at the container of the container.
ans the	(2) Thepans the space 14th (4) et of elements of the sequence (8) space
79.	The index of the quadratic form is equal to
	(1) The difference between the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.
	(2) The sum of the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.
86.	(3) Neither (1) nor (2)
	(4) None of the above
80.	A one-element vector space is an example of a
	(1) Trivial space (2) Universal space
nt a is	(3) Sample space (4) None of these
81.	Angle between the vectors $a = (1, 1, 0)^t$ and $b = (0, 3, 2)^t$ is
	(1) $\arccos\left(\frac{2}{\sqrt{3}\sqrt{13}}\right)$ (2) $\arccos\left(\frac{13}{\sqrt{2}\sqrt{3}}\right)$
	(3) $\arccos\left(\frac{3}{\sqrt{2}\sqrt{13}}\right)$ (4) None of these

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Question No.	Questions	Mession No.
82.	Which of the following is true regarding basis of a vector space	78.
	(1) It is a sequence of vectors	
	(2) It spans the space if the set of elements of the sequence space	ans the
11.	(3) Vectors in basis are linearly independent	79.
orm.	(1) The difference between the number of positive entering All of these transmissions of the transmissions of t	
83.	Which of the following is true about $f(z) = z^2 + 2z$ ?	第.
76.	(1) Continuous and Differentiable	
	(2) Continuous but not Differentiable  ovods edifo enol (1)	
	(3) Neither Continuous Nor Differentiable	
	A one-element vector space is an example of a None of these  (2) Universal space	.08
84.	The radius of convergence of a power series $f$ centered on $a$ point equal to the distance from $a$ to the nearest point where $f$	nt a is
	(1) Can not be defined in a way that makes it holomorphic.	81.
77.	(2) Can be defined in a way that makes it holomorphic.	
	(3) Can not be defined in a way that does not make it holomorphi	c
	(4) None of these seeds to enough (4) None (5) ecoors (6)	

Question No.	Questions
85.	Which of the following is true about the radius of convergence of a power series:
	(1) is the radius of the largest disk at the center of the series in which the series converges
20.	(2) is the radius of the smallest disk at the center of the series in which the series converges
	(3) is the radius of the largest disk at the center of the series in which the series diverges
	(4) None of these
86.	The Cauchy integral theorem in complex analysis is  (1) the fundamental theorem of circular integrals
	(2) an important statement about line integrals for holomorphic functions in the complex plane
	(3) an important statement about line integrals for homomorphic functions in the real plane
1	(4) None of these
87.	A sequence $\left\{\frac{1}{n}\right\}$ (is 0) = (1) 1 and (111 -) = 0 has $x = (x)$ 1 jed
	(1) Bounded (2) Unbounded
	(3) Divergent (4) None of these

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Ph.D

Question No.	Questions	nestion No.
88.	Which of the following is true about a closed set?	.68
Í doldw	(1) Contains all its limit points	
	(2) Does not contains all of its limit points	
which	(2) Is the radius of the smallest disk at the behavior of the series converges	
Holdw	(4) None of these and as daily segrel end to surber end at (8)	
89.	Let $A = [0, 1]$ and $B = [2, 3]$ , then which of the following is correct	
	(1) Both A and B are connected (2) $A \cup B$ is not connected	1
	(3) Both (1) and (2) are correct (4) None of these	88
90.	Let $U = (-1, 0)$ and $V = (0, 1)$ , then which of the following is not tr	ue
Ecorina	(1) U and V are disjoint open sets	
oidgro	(2) U and V are disjoint closed sets	
	(3) Distance between U and V is 0	
	(4) None of these	, ex
91.	Let $f(x) = x^2$ and $U = (-1, 1)$ , then $f(U) = [0, 1)$ is	87.
	(1) Bounded open set (2) Unbounded open set	6
	(3) Not an open set (4) None of these	

nestion No.	No. Sections
92.	A point at which an analytical function ceases to possess a derivative is called
	(1) Stagnation Point (2) Saddle Point
	(3) Critical Point (4) Singular Point
93.	The Newton-Raphson Method fails if
	(1) $f(x0) = 0$ (2) $f'(x0) = 0$
erators	(3) $f''(x0) = 0$ (4) None of these
94.	If f(z) is analytic within and on a closed curve and if a is any poin within C, then $f(a) = \frac{1}{2\pi i} \int_C \frac{f(z) dz}{z-a}$ represents
olation	(1) Cauchy's Theorem (2) Residue Theorem (3) Morera's Theorem (4) Cauchy's Integral Formula
95.	Which of the following is not a method of Numerical Integration
	(1) Runges's method (2) Weddle's rule
	(3) Simpson's one-third rule (4) Trapezoidal rule
96.	Which of the following is true in relation to the Regula-Falsi method:  (1) Is method of finding real roots of an equation $f(x) = 0$
182	(2) Closely resembles the bisection method
	(3) Both (1) and (2) are true body Mathie Hammy (1)
	(4) None of these (4) body body (8)

Gode-A

Question No.	Questions	milan sk
97.	The formula used for solving the equation using Regula Falsi met	1.
0	The formula used for solving the equation using Regula Falsi met.	nod is
	$\int_{a}^{b} bf(a) - af(b)$ af (a) - bf(b)	
	(1) $x = \frac{bf(a) - af(b)}{f(a) - f(b)}$ (2) $x = \frac{af(a) - bf(b)}{f(a) - f(b)}$	
	(3) Critical Point strion 1 (4) Singular Point to seed .	
	(3) $x = \frac{bf(a) - af(b)}{a - b}$ (4) None of these	8/
	$a = 0$ $0 = (0x)^{1}$ $0 = (0x)^{1}$ $0 = (0x)^{2}$	
98.	With usual notations, which of the following relations between ope	erator
	is correct:	
garied A	(1) $\delta = E^{1/2} - E^{-1/2}$ (2) $\delta = E^{1/2} + E^{-1/2}$	
	becomes the first trace of the representation of the representatio	
	(3) $\delta = E - E^{-1/2}$ (4) None of these	
99.	Which of the following is true about the Newton's Forward Interpo	1.4:
	formula: sayedal a vilous (A)	Diation
THE STREET STREET, STREET STREET, STREET STREET, STREE	(1) Is used for interpolating y values near the and of a set of the	-1-4
	(1) Is used for interpolating y values near the end of a set of tab values	ulate
	values bodiem a sopring (1)	ulate
	values  (2) Is used for extrapolating y values a little ahead of y <sub>n</sub>	ulate
hod	values  (2) Is used for extrapolating y values a little ahead of y <sub>n</sub> (3) Both (1) and (2) are true	ulate
: hos	values  (2) Is used for extrapolating y values a little ahead of y <sub>n</sub> (3) Both (1) and (2) are true	ulate
: hor	values  (2) Is used for extrapolating y values a little ahead of y <sub>n</sub> (3) Both (1) and (2) are true  (4) None of these	.00
100.	values  (2) Is used for extrapolating y values a little ahead of y <sub>n</sub> (3) Both (1) and (2) are true	.00
: hor	values  (2) Is used for extrapolating y values a little ahead of y <sub>n</sub> (3) Both (1) and (2) are true  (4) None of these  Which of the following is a method for a numerical solution of ODE	.00
: hor	values  (2) Is used for extrapolating y values a little ahead of y <sub>n</sub> (3) Both (1) and (2) are true  (4) None of these  Which of the following is a method for a numerical solution of ODI	.00

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

### (Ph.D/URS-EE Jan. 2022)

## **STATISTICS**

10022

Sr. No.\_\_\_

Code

Time: 11/4 Hours	Total Quest	ions: 100	Max. Marks: 100
Roll No.	(in figure)		(in words)
Name:		_ Father's Name:	
Mother's Name:		_ Date of Examination	on:

(Signature of the candidate)

(Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

All questions are compulsory.

The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by

the candidate.

Question Booklet along with answer key of all the A,B,C and D code will be got uploaded on the university website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examinations in writing/through E-Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.

The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers

MUST NOT be ticked in the Question book-let.

There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

Use only Black or Blue BALL POINT PEN of good quality in the OMR Answer-

Sheet.

BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.



Question No.	enoise	Questions	
1.	and sample size is small, the lettering 2.4. (1) t-test	μ <sub>0</sub> when the population variance is unknown appropriate test is  (2) Z-test	wn
9700	(3) Chi-square test	(4) F-Test	
2.		nen the observations in the two samples a	re
	(1) Independent	(2) Mutually independent	*
= 1 the	(3) Paired	(4) None of these	
3.	Association of attributes in a	2×2 contingency table can be tested by	
	(1) F-test	(2) Z-test	
13.	(3) t-test	(4) Fisher Exact test	
4.	The $\chi^2$ statistic with usual new $(m \times n)$ is	otations in case of contingency table of ord	der
14.	(1) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$	(2) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \frac{O_{ij}^2 - E_{ij}^2}{E_{ij}}$	
	(3) $\chi^2 = \sum_{i=1}^{m} \sum_{j=1}^{n} \left( \frac{O_{ij} - E_{ij}}{E_{ij}} \right)^2$		

Question No.	empitesu Questions	Question No.
a 5. a a	If $r_{xy} = 0$ , the two lines of regression  (1) Coincide  (2) Are parallel  (3) Are perpendicular to each other  (4) None of the area o	bove
6.	Correlation coefficient is independent of change of	
ples are	(1) Origin only (2) Scale only	2.
	(3) Both origin and scale (4) None of these	
7. vd l	Given the two lines of regression as, $3x - 4y + 8 = 0$ and $4x - 3y$ means of x and y are respectively:	
	(1) $4$ and $5$ (2) $5$ and $4$ (3) $\frac{4}{3}$ and $\frac{5}{4}$ and $\frac{5}{4}$ (4) $\frac{3}{4}$ and $\frac{4}{5}$ (5)	•
ne 8.0 lo	Skewness of a frequency curve shows  (1) Flatness of the frequency curve  (2) Lack of symm	netry
	(3) Peakedness of the frequency curve (4) None of these	
9.	For a leptokurtic distribution	
	(1) $\beta_2 > 3$ (2) $\beta_2 < 3$ (3) $X = \frac{\pi}{2}$ (8)	
	(3) $\beta_2 = 3$ (4) None of these	

Question No.	anoides Questions Holisen
10.	If $X_1, X_2, \dots, X_n$ is a random sample from a uniform distribution defined over the interval $0 < x < \theta, \theta > 0$ , then with usual notations MLE of $\theta$ is
	(1) $X_{(1)}$ (2) $X_{(n)}$
	(3) $(X_{(1)} + X_{(n)})/2$ (4) None of these
hod : RE	Which of the tollowing is true an relation to the degree belsi me
11.	Let $f(x) = x^2$ and $U = (-1, 1)$ , then $f(U) = [0, 1)$ is
	(1) Bounded open set (2) Unbounded open set
20.	(3) Not an open set (4) None of these
12.	A point at which an analytical function ceases to possess a derivative is called
ai-borld	(1) Stagnation Point (2) Saddle Point
	(3) Critical Point (4) Singular Point
13.	The Newton-Raphson Method fails if
	(1) $f(x0) = 0$ (2) $f'(x0) = 0$
	(3) $f''(x0) = 0$ (4) None of these
14.	If f(z) is analytic within and on a closed curve and if a is any point
perators	within C, then $f(a) = \frac{1}{2\pi i} \int_{C} \frac{f(z) dz}{z-a}$ represents
	(1) Cauchy's Theorem (2) Residue Theorem
	(3) Morera's Theorem (4) Cauchy's Integral Formula

Question No.	enolized Questions	Question No.
	Which of the following is not a method of Numerical Integration  (1) Runges's method  (2) Weddle's rule  (3) Simpson's one-third rule  (4) Trapezoidal rule	.01 bove
16.	Which of the following is true in relation to the Regula-Falsi me	thod:
10.	(1) Is method of finding real roots of an equation f (x) = 0  tea nego behanoda U (2)  (2) Closely resembles the bisection method	.11
	(3) Both (1) and (2) are true	
vative is	(4) None of these . believe the second of th	12.
17.	The formula used for solving the equation using Regula Falsi me	ethod is
	(1) $x = \frac{bf(a) - af(b)}{f(a) - f(b)}$ (2) $x = \frac{af(a) - bf(b)}{f(a) - f(b)}$	13.
	(3) $x = \frac{bf(a) - af(b)}{a - b}$ (4) None of these	
ny point	If f (z) is analytic within and on a closed curve and if a is a	
18.	With usual notations, which of the following relations between 0 is correct:  (1) $\delta = E^{1/2} - E^{-1/2}$ (2) $\delta = E^{1/2} + E^{-1/2}$	perators
	(1) $\delta = E^{1/2} - E^{-1/2}$ (2) $\delta = E^{-1/2} + E^{-1/2}$ (3) $\delta = E - E^{-1/2}$ (4) None of these	

Code-B

	No.
19.	Which of the following is true about the Newton's Forward Interpolation formula:
	(1) Is used for interpolating y values near the end of a set of tabulated values
	(2) Is used for extrapolating y values a little ahead of y <sub>n</sub>
	(3) Both (1) and (2) are true
	(4) None of these
20.	Which of the following is a method for a numerical solution of ODEs:
29	(1) Runge-Kutta Method (2) Picard's Method
	(3) Euler's Method (4) All of these
21.	If a closed set C contains only one state j, then the state is called:
100001	(1) Non-absorbing state (2) Persistent state
	(3) Transient state (4) None of these
22.	Which of the following is true about an absorbing Markov chain:
died eai	(1) A Markov chain is said to be absorbing if it has at least one absorbing state.
30.	(2) If the state j is absorbing the $p_{ij} = 1$
	(3) It is impossible to leave an absorbing state
	(4) All of these

Question No.	Questions
23.	Extinction of a stochastic process means that the sequence {X <sub>n</sub> } consists of  (1) Zeros for all except a finite number of values of n  (2) Zeros for all values of n  (3) Zeros for at least one value of n  (4) None of these
24.	For an immigration-emigration process which of the following is true $(1)  \lambda_n = \lambda \qquad \qquad (2)  \mu_n = \mu \qquad \qquad (3)  \lambda_n = 1 \text{ and } \mu_n = \mu \qquad \qquad (4)  \text{None of these}$ Which of the following is true about a Yule-Furry Process: $(1)  \text{It is a Pure Birth Process} \qquad (2)  \text{It is a Pure Death Process}$ $(3)  \text{It is a Birth and Death Process} \qquad (4)  \text{None of these}$
26.	A matrix is in reduced row-echelon form if it meets the following condition(s):

Question No.	Questions
27.	If A is square matrix, then roots of the equation $ A - \lambda I  = 0$ are called
	ever the interval $0 < x < 0.0 > 0$ , then with usual notations MLE of 0 is
	(1) Latent roots (2) Eigenvalues
	(3) Both (1) and (2) are true (4) None of these
28.	A quadratic form is a polynomial with all terms of degree two
on-zero	(1) 1 underdopentrische Julie au notinbounded open set.
	(3) 3 to an open set (4) 4 one of these set
marian made	
29.	The index of the quadratic form is equal to
29.	The index of the quadratic form is equal to
29.	(1) The difference between the number of positive Eigen values and th number of negative Eigen values of the matrix of quadratic form.
29.  9d) 10.3	(1) The difference between the number of positive Eigen values and th
29.	<ol> <li>The difference between the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>The sum of the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>Neither (1) nor (2)</li> </ol>
29. and to a	<ol> <li>The difference between the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>The sum of the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> </ol>
edi the	<ol> <li>The difference between the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>The sum of the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>Neither (1) nor (2)</li> <li>None of the above</li> </ol> A one-element vector space is an example of a
edi to a	<ol> <li>The difference between the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>The sum of the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>Neither (1) nor (2)</li> <li>None of the above</li> </ol>

B

Question No.	Questions
31.	The region of feasible solution in LPP graphical method is called
	(1) unbounded region (2) feasible region (1)
	(3) infeasible region (4) infinite region (8)
32.	In Simplex method, which of the following is correct about the basic feasible solution.
	(1) a basic feasible solution is a solution with a maximal set of non-zero variables
	(2) a basic feasible solution is a solution with a minimal set of non-zero
	variables of laupe at most outstoaup ent to xebri ent 1980.
	variables  (3) a basic feasible solution does not correspond to a corner of the
	variables  (3) a basic feasible solution does not correspond to a corner of the polyhedron of feasible solutions  (4) None of these
.m.to	variables  (3) a basic feasible solution does not correspond to a corner of the polyhedron of feasible solutions
orm.	variables  (3) a basic feasible solution does not correspond to a corner of the polyhedron of feasible solutions  (4) None of these
orm.	variables  (3) a basic feasible solution does not correspond to a corner of the polyhedron of feasible solutions  (4) None of these  In transportation models the points of demand are called:  (1) Origins  (2) Supply centres  (3) Destinations  (4) None of these
orm.	(3) a basic feasible solution does not correspond to a corner of the polyhedron of feasible solutions  (4) None of these  In transportation models the points of demand are called:  (1) Origins  (2) Supply centres  (3) Destinations  (4) None of these  Which of the following are the entities whose values are to be determined from the solution of the LPP:
mber of	(3) a basic feasible solution does not correspond to a corner of the polyhedron of feasible solutions  (4) None of these  In transportation models the points of demand are called:  (1) Origins  (2) Supply centres  (3) Destinations  (4) None of these  Which of the following are the entities whose values are to be determined

Question No.	angites Questions	Question
35.	A constraint in an LP model restricts	some for
	(1) Value of the objective function	
	(2) Values of the decision variables	
	(3) Use of the available resources	
	(4) All of the above	40
36.	Operations Research is a very powerful tool for	
	(1) Research (2) Operations	
ri easern 1	(3) Decision Making (4) None of the above	- 28 0
37.	In transportation table every loop has	ali wie
	(1) An even number of cells (2) An odd number of cells	
nalysie the given	(3) An equal number of cells (4) None of the above	12. Pre-19.44
38.	When it is not possible to find solution in LPP, it is called as	a regulat
	(1) Infeasible solution (2) Unbounded solution	
	(3) Improper solution (4) None of the above	

Question No.	anoisen Questions	Question No.
39.	One disadvantage of using North-West Corner Rule to find initia to the transportation problem is that	l solution
1.0	(1) It is complicated to use (1)	
	(2) It ignores the cost of transportation of transportation (2)	
	(3) It leads to degenerate initial solution	
	(4) All of the above	TO MAKE
40.	Game theory models are classified by the	W *.
	(1) Number of players (2) Sum of payoffs	2008
	(3) Number of strategies (4) All of the above	
41.	In a RBD with $v = 5$ and $r = 4$ one treatment is added, the in error degrees of freedom will be:	icrease in
	(1) 1 sed qool (2) 2 sides noitetrogeners al	4.87.
	(1) An even number of cells (2) An odd number of cells	
42.	Which of the following is true about the Principal Component A	nalysis
	(1) Principal components are ordered linear combinations of	
	<ul> <li>(1) Principal components are ordered linear combinations of variables</li> <li>(2) First Principal component has maximum variance</li> </ul>	
	(1) Principal components are ordered linear combinations of variables	

Code B

No.	anoiseen Questions			
43.	In experimental designs the experim	In experimental designs the experimental error is controlled by using the		
	(1) Local control (2)	Randomization (1)		
	(3) Replication of the IIA (4)	None of the above		
44.	Which of the following is a principle of design of experiments			
	(1) Replication (2)	Local Control		
ign	(3) Randomization (4)	All of the above		
45.	An investigator randomly assigns 10 patients to each of the 4 di- treatments to study their effects of diastolic blood pressure. F te used to test that the mean response was same between different g The numerator and denominator degrees of freedom for F test are			
	The state of the s			
	(1) 3 and 10 respectively (2)	4 and 9 respectively		
moheed.	(4) None of these	4 and 9 respectively  None of these		
mobeen'	(3) 3 and 36 respectively (4)	None of these ound to be significant then pair wise		
mobern'	(3) 3 and 36 respectively (4)  If the overall F test in ANOVA is f comparision between treatment me	None of these		
mobseri	(3) 3 and 36 respectively (4)  If the overall F test in ANOVA is f comparision between treatment me	None of these ound to be significant then pair wise ans is made using: Two sample t test		
46. 47.	(3) 3 and 36 respectively (4)  If the overall F test in ANOVA is f comparision between treatment me  (1) Chi-square test (2)  (3) Variance ratio test (4)	None of these ound to be significant then pair wise ans is made using:  Two sample t test  None of these ampling units are selected at a regular		
	(3) 3 and 36 respectively (4)  If the overall F test in ANOVA is f comparision between treatment me  (1) Chi-square test (2)  (3) Variance ratio test (4)  A sampling procedure in which the s	None of these ound to be significant then pair wise ans is made using:  Two sample t test  None of these ampling units are selected at a regular		

В

Question No.	ano	Ques	destions and	
48.	In RCBD, which of the following principle is adopted?			
	(1) Replication	(2)	Randomization and (1)	
	(3) Local control	(A) (4)	All of these	
49.	The common device to reduce the block size in experiments studying main effects and interaction is:			
	(1) Confounding	(2)	된 사람들이 본지 않는 사람들은 것이 많은 사람들이 되었다. 그 사람들은 사람들은 사람들이 되었다면 하는 것이 되었다면 하는데 그렇게 되었다면 하는데 그렇게 되었다면 하는데 없었다.	
	(3) BIBD	(4)	Asymmetrical factorial design	
50.	In designs of experiment. A general rule is to use as many replications which provides at least:			
	(1) 20 error DF	(2)	12 error DF	
135	(3) 30 error DF	(4)		
51.	The mean and variance of a chi-square distribution with degrees of freedom  4 are			
	(1) 8 and 4 respectively		4 and 8 respectively	
182	(3) 4 and 4 respectively	(4)	8 and 8 respectively	
52.	If $X \sim N$ ( $\mu$ , $\sigma^2$ ), the points of inflexion of normal curve are :			
	(1) $\mu \pm 2\sigma$	(2)	$\sigma \pm 2\mu$	
		(4)	None of these	
	(AC) MONEY WHAT ADD (8)		(3) Systematic candemas	

Code-B

Question No.	anoite of Questions and anoite of Questions		
<b>53.</b> 13	If X is a Poisson variates with P $(X = 1) = P (X = 2)$ , then mean of the Poisson variate is equal to		
$^{\circ}(\overline{X}{\wp}$	(1) 1 (2) 2 (X X X X X X X X X X X X X X X X X X		
	(3) 3 (4) 4 (3) 13 All of the above 1		
54.	Which of the following relation is true for the F-distribution:		
orarianc	(1) $F_{\alpha}(n_1, n_2) = 1/F_{\alpha}(n_2, n_1)$ (2) $F_{\alpha}(n_1, n_2) = F_{1-\alpha}(n_2, n_1)$		
Ex(p-	(3) $F_{\alpha}(n_1, n_2) = 1/F_{1-\alpha}(n_2, n_1)$ (4) None of the above		
55.	Which of the following true is case of MGF of a random variable X		
	(1) MGF may not exist (2) If exists MGF is unique		
olindist niwolloi	(3) Both (1) and (2) are true (4) None of these		
56.	If $X_1$ , $X_2$ , $X_N$ is a random sample from a multivariate distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then distribution of sample mean vector $\overline{X}$ is:		
365.	(1) $N(\mu, \Sigma)$ (2) $N(\mu, N\Sigma)$		
	(3) N ( $\mu$ , $\Sigma$ /N) (4) None of these		

Question No.	Questions enoits Questions	
57.	If $X_1, X_2, \ldots, X_N$ is a random sample from a p-variate normal distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then MLE of $\Sigma$ is given by:  (1) $\frac{1}{N} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X})^t (X_{\alpha} - \overline{X})$ (2) $\frac{1}{N+1} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X}) (X_{\alpha} - \overline{X})^t$	
49.	(3) $\frac{1}{N-1} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X})^{t} (X_{\alpha} - \overline{X})$ (4) None of these	
58.	If X has p-variate normal distribution with mean vector 0 and covariance matrix $\Sigma$ and $ \Sigma  > 0$ , then with usual notations the joint pdf can be written as the product of marginal pdfs of $X_1: q \times 1$ and $X_2: (p-q) \times 1$ if and only if	
X e	(1) $\Sigma_{12} = 0$ (2) $\Sigma_{11} = 0$ (3) $\Sigma_{22} = 0$ (4) None of these	
59.	Let $X_1, X_2,, X_N$ be a random sample from a p-variate normal distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then which of the following is true  (1) $(N-1)$ S has Wishart Distribution	
52	(2) Sample mean and S are independent	
	<ul> <li>(3) Sample mean is distributed as N<sub>p</sub> (μ, Σ/N)</li> <li>(4) All of these</li> </ul>	

Question No.	anotteon Questions notteon on	
60.	If $Y_1, Y_2, \ldots, Y_n$ denote the principal components based on correlation matrix (R) and $\lambda_1 > \lambda_2, \ldots > \lambda_p$ are eigenvalues of R, then which of the following is true	
	(1) $\operatorname{tr}(\Sigma) = \sum_{i=1}^{p} \operatorname{Var}(Y_i)$ (2) $\sum_{i=1}^{p} \lambda_i = \sum_{i=1}^{p} \operatorname{Var}(Y_i)$	
	(3) $Var(Y_p) = p$ (4) All of the above	
61.	A stratified random sample of size 32 is drawn from three strata of sizes 20, 40 and 100. The samples drawn using proportional allocation have sizes:	
	(1) 6, 10, 16 (2) 4, 8, 20	
	(3) 5, 9, 18 (4) None of these	
62.	Non-response in sample surveys means	
c one ver	(1) Non-availability of respondents	
	(2) Non-return of questionnaire by the respondents	
	(3) Refusal to give information	
72.	(4) All of these and the second (4)	
63.	Which of the following is an example of a non-random sampling technique?	
	(1) Purposive (2) Quota	
	(3) Convenience (4) All of these	

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Question No.	on arroitses Questions	
64.	Sample survey is advantageous over census because it	
	(1) is less costly (2) has greater scope	
	(3) both (1) and (2) (4) none of these	
65.	Which of these does not match with others	
ta of size	(1) Harvit-Thompson estimator	
	(2) Murthy unordered estimator	
7	(3) Des Raj ordered estimator	
	(4) Rao, Hartley and Chochran estimator	
66.	Infant mortality rate is defined as the number of deaths under one year of age in a year:	
	(1) Per 1000 live births (2) Per 1000 population	
	(3) Per 1000 women (4) None of these	
67.	Which of the following is not a method of collecting vital statistics:	
	(1) Census Method (2) Analytical Method	
	(3) Registration Method (4) None of these	

Question No.	Questions	Question No.
68.	Total fertility rate is derived from:	IVEST F
	(1) Age specific birth rate (2) Gross reproduction rate	
	(3) Net reproductive rate (4) None of these	
69.	The formula $\frac{\sum p_{0i} q_{1i}}{\sum p_{0i} q_{0i}} \times 100$ represents	74.
phylba	(1) Fisher's Index (2) Kelly's Index	
	(3) Paasche's Index (4) None of these	
70.	Fertility refers to:	- T
r sees in	(1) Actual bearing of children	
	(2) Capacity to bear the child	
	(3) Average No. of live birth per woman in the year	
	(4) None of these	stateess
71.	When the sum of gains of one player is equal to the sum of another player is a game, this situation is known as	losses t
	(1) Biased game (2) Non-zero-sum game	
	(3) Fair game (4) None of these	0.17
	I do the to any open decrease the street but any many represent a second of the second	25
72.	Saddle point exists in game theory when	
72.	Saddle point exists in game theory when  (1) Maximin and minimax value of the game are same	988
72.	A CANADA SALAM SAL	999
72.	(1) Maximin and minimax value of the game are same	1998 / -  -  - 

Question No.	enoitesu Questions .ou			
73.	The time over which the inventory level will be controlled is called:  (1) Time Horizon  (2) Lead Time  (3) Time to take decision  (4) None of these			
74.	Which of the following is true about the buffer stock?			
	<ol> <li>A buffer stock scheme is an attempt to use commodity storage for the purposes of Stabilising prices in an entire economy or an individual market.</li> <li>Commodities are bought and stored when a surplus exists in the economy.</li> <li>Commodities are sold from the stores when economic shortages in the economy occur.</li> </ol>			
*	(4) All of these a demonstrated distribution of agreevA (8)			
<b>75.</b>	The variable added to the LHS of a less than or equal to constraint to convert it into equality is called variable  (1) artificial  (2) surplus  (3) slack  (4) additional			
76.	If a customer decides not to enter the queue because of its huge length, he is said to have  (1) Balked (2) Reneged (3) Jockey (4) None of these			

Question No.	anoiteen Questions . doiteon9		
77. eu	When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:		
	(1) cost (2) profit		
	(3) regret (4) dummy (6)		
78.	Cars arrive at a service station according to Poisson distribution with a mean rate of 5 per hour. The service time per car follows an exponential distribution with a mean of 10 minutes. At the steady state, the average waiting time in the queue is:		
	(1) 50 minutes (2) 25 minutes		
Pidamav	(3) 20 minutes (4) None of these		
79.	Efficiency of M/M/C model in terms of the Total Number of Customers (TNC) and Average Number of Customers Served (ANCS) is given by		
	(1) TNC/ANCS (2) ANCS/TN		
	(3) ANCS × TNC (4) None of these		
80. Which of the following is true about an evolutionary random			
##9000# 1	(1) It is not stationary		
	(2) Poisson process is an example of evolutionary random process		
	(3) Both (1) and (2) are true		
1	(4) None of these		

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Question No.	Questions goitzen Q
81.	If a random variable X has pdf f (x) = $kx (1-x)$ , $0 \le x \le 1$ then value of the constant k is:
	(1) $\frac{1}{2}$ (2) (2) 2 . The entropy (1)
	(3) 4 he tollowymmab (4) 6 ferger (8)
82.	Mean of the random variable X having pdf f (x) = $6x^3$ (4 - x) <sup>2</sup> , $0 \le x \le 4$ is
Vaareva :	(1) 9/14 (2) 14/9 (3) (4/9)
	(3) 9/20 (4) None of these
83.	If F (x) denote the distribution function of a continuous random variable X then which one is not true
section to	(1) $F(-\infty) = 0$ (2) $F(\infty) = 1$
en by	(3) F (x) is left continuous (4) None of these
84.	If X and Y are independent random variables, then
	(1) $E(XY) < E(X) \cdot E(Y)$ (2) $E(XY) > E(X) \cdot E(Y)$
S ee oog	(3) $E(XY) = E(X) \cdot E(Y)$ (4) None of these
85.	The skewness of a binomial distribution having probability of success $p=1/2$ is
eass	(2) Poisson process is on (2) imple of evolutionary random (1)
•	(3) 1 (4) None of these (6)
	(4) None of these

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westion No.	Questions Questions		
86.	The variance of a distribution having M.G.F. M (t) = $\left(\frac{1}{2} + \frac{1}{2}e^{t}\right)^{4}$ is		
	(1) 2 (2) 3/2 (1)		
461-	(3) 2/3 (4) None of these		
87.	M.G.F. of Poisson distribution is		
	(1) $M(t) = e^{\lambda (e^t - 1)}$ (2) $M(t) = e^{-\lambda (e^t - 1)}$		
	(3) $M(t) = e^{-\lambda e^t} + 1$ (4) $M(t) = e^{-\lambda e^t} - 1$		
88.	If X is uniformly distributed over the interval [0, 1] then Var (X) is		
	(1) 5/12 (2) 1/3		
	(3) 1/12 (4) 3/12		
89.	If X and Y are random variables such that their expectations exist and $P(X \le Y) = 1$ , then		
8.9	$(1)  E(X) \ge E(Y) \qquad (2)  E(X) \le E(Y)$		
	(3) $E(X) = E(Y)$ (4) None of these		
90.	Level of significance is equal to the probability of		
	(1) Not committing Type-I error (2) Committing Type-II error		
	(3) Not committing Type-II error (4) None of the above		

Question No.	, anomas Questions	Question No.
91.	Angle between the vectors $a = (1, 1, 0)^t$ and $b = (0, 3, 2)^t$ is  (1) $\arccos\left(\frac{2}{\sqrt{3}\sqrt{13}}\right)$ (2) $\arccos\left(\frac{13}{\sqrt{2}\sqrt{3}}\right)$	.86.
	(3) $\arccos\left(\frac{3}{\sqrt{2}\sqrt{13}}\right)$ (4) None of these	
92.	Which of the following is true regarding basis of a vector space  (1) It is a sequence of vectors  (2) It spans the space if the set of elements of the sequence space	pans the
3933	(3) Vectors in basis are linearly independent (4) All of these	
93.	Which of the following is true about f (z) = z2 + 2z?  (1) Continuous and Differentiable  (2) Continuous but not Differentiable	89.
l error	(3) Neither Continuous Nor Differentiable  (4) None of these  (5) None of these  (6) None of these  (7) None of these  (8) None of these	

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Question No.	anoites Questions anoites Questions
94.	The radius of convergence of a power series f centered on a point a is equal to the distance from a to the nearest point where f  (1) Can not be defined in a way that makes it holomorphic.  (2) Can be defined in a way that makes it holomorphic.  (3) Can not be defined in a way that does not make it holomorphic  (4) None of these
95.	Which of the following is true about the radius of convergence of a power series:
	(1) is the radius of the largest disk at the center of the series in which the series converges
	(2) is the radius of the smallest disk at the center of the series in which the series converges
	(3) is the radius of the largest disk at the center of the series in which the series diverges
	(4) None of these
96.	The Cauchy integral theorem in complex analysis is
ent	(1) the fundamental theorem of circular integrals
	(2) an important statement about line integrals for holomorphic functions in the complex plane
	(3) an important statement about line integrals for homomorphic functions in the real plane
	(4) None of these

Question No.	anolize Questions	guestion No.
97.	A sequence $\left\{\frac{1}{n}\right\}$ is the sequence of the sequence of the sequence $\left\{\frac{1}{n}\right\}$ is the sequence of the	ree ate
	(1) Bounded (2) Unbounded (3)	
Sie	(3) Divergent (4) None of these	
98.	Which of the following is true about a closed set?	
a power	(1) Contains all its limit points	
	(2) Does not contains all of its limit points	
	(3) Is unbounded	ane the
n which	(4) None of these (2)	
99.	Let $A = [0, 1]$ and $B = [2, 3]$ , then which of the following is correct	;
	(1) Both A and B are connected (2) $A \cup B$ is not connected	ed
	(3) Both (1) and (2) are correct (4) None of these	.86
100.	Let $U = (-1, 0)$ and $V = (0, 1)$ , then which of the following is not t	rue
(unetions	(1) U and V are disjoint open sets	
billaton	(2) U and V are disjoint closed sets	
	(3) Distance between U and V is 0	
	(4) None of these	

Ph.D/URS-EE-2022 (Statistics) Code-B about (2014) 2002-3312-2314-2314-3

## SET-"Z"

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

(Ph.D/URS-EE Jan. 2022)

## **STATISTICS**

10023

Sr. No.\_\_\_\_

Code

 Time: 1¼ Hours
 Total Questions: 100
 Max. Marks: 100

 Roll No.
 (in figure)
 (in words)

 Name:
 Father's Name:
 Date of Examination:

(Signature of the candidate)

(Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. All questions are compulsory.

2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by

the candidate.

4. Question Booklet along with answer key of all the A,B,C and D code will be got uploaded on the university website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examinations in writing/through E-Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.

5. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers

MUST NOT be ticked in the Question book-let.

6. There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

Use only Black or Blue BALL POINT PEN of good quality in the OMR Answer-

Sheet.

8. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.



Question No.	and the Questions no its off
A stratified random sample of size 32 is drawn from three str 20, 40 and 100. The samples drawn using proportional alloc sizes:	
	(1) 6, 10, 16 (2) 4, 8, 20
	(3) 5, 9, 18 (4) None of these
2.	Non-response in sample surveys means
	(1) Non-availability of respondents
ne year	(2) Non-return of questionnaire by the respondents
	(3) Refusal to give information
	(4) All of these
3.	Which of the following is an example of a non-random sampling technique?
12.	(1) Purposive (2) Quota
	(3) Convenience (4) All of these
4.	Sample survey is advantageous over census because it
	(1) is less costly (2) has greater scope
	(3) both (1) and (2) (4) none of these

Code-C

Question No.	Questions	No.
5. evad n	Which of these does not match with others	.1
	(1) Harvit-Thompson estimator	
	(2) Murthy unordered estimator	
	(3) Des Raj ordered estimator	
	(4) Rao, Hartley and Chochran estimator	2.
6.	Infant mortality rate is defined as the number of deaths under of age in a year:	one year
	(1) Per 1000 live births (2) Per 1000 population (3) Per 1000 women (4) None of these	
7.	Which of the following is not a method of collecting vital statistic	cs:
	(1) Census Method (2) Analytical Method	
	(3) Registration Method (4) None of these	
8.	Total fertility rate is derived from:	- 4
	(1) Age specific birth rate (2) Gross reproduction rate	
	(3) Net reproductive rate (4) None of these	

Question No.	anoise Questions	guestion No.
9.	The formula $\frac{\sum p_{0i} q_{1i}}{\sum p_{0i} q_{0i}} \times 100$ represents	can be
	(1) Fisher's Index (2) Kelly's Index	
	(3) Paasche's Index (4) None of these	
10.	Fertility refers to:	15.
	(1) Actual bearing of children	
	(2) Capacity to bear the child	
	(3) Average No. of live birth per woman in the year	
noitiidi	(4) None of these	91
11.	11. The mean and variance of a chi-square distribution with degrees of free 4 are	
	(1) 8 and 4 respectively (2) 4 and 8 respectively	
	(3) 4 and 4 respectively (4) 8 and 8 respectively	
12.	If $X \sim N$ ( $\mu$ , $\sigma^2$ ), the points of inflexion of normal curve are :	
. vadrav	(1) $\mu \pm 2\sigma$ (2) $\sigma \pm 2\mu$	
(X +	(3) $\mu \pm \sigma$ (4) None of these	
13.	If X is a Poisson variates with P $(X = 1) = P (X = 2)$ , then mean Poisson variate is equal to	of the
	(1) 1 seed to enov (A) (2) 2 (X	
	(3) 3 (4) 4	

Code-C

Question No.	anoitas Que	stions
14.	Which of the following relation is t	rue for the F-distribution:
	(1) $F_{\alpha}(n_1, n_2) = 1/F_{\alpha}(n_2, n_1)$	(2) $F_{\alpha}(n_1, n_2) = F_{1-\alpha}(n_2, n_1)$
	(3) $F_{\alpha}(n_1, n_2) = 1/F_{1-\alpha}(n_2, n_1)$	(4) None of the above
15.	Which of the following true is case	of MGF of a random variable X
		2) If exists MGF is unique
		1) None of these
mobee	with mean vector $\mu$ and covariance	mple from a multivariate distribution $\alpha$ matrix $\Sigma$ , then distribution of sample $\alpha$ .
		2) 1 (Maria Masa a mis o (1)
		4) None of these
17.	(3) N ( $\mu$ , $\Sigma$ /N) (4)  If X., X., X. is a random samp	4) None of these
17.	(3) N ( $\mu$ , $\Sigma$ /N) (4)  If X <sub>1</sub> , X <sub>2</sub> , X <sub>N</sub> is a random samp with mean vector $\mu$ and covariance	

No.	enolise Questions noticent
18.	If X has p-variate normal distribution with mean vector 0 and covariance matrix $\Sigma$ and $ \Sigma  > 0$ , then with usual notations the joint pdf can be written as the product of marginal pdfs of $X_1: q \times 1$ and $X_2: (p-q) \times 1$ if and only if
	(1) $\Sigma_{12} = 0$ (2) $\Sigma_{11} = 0$
12 x 2	(3) $\Sigma_{22} = 0$ (4) None of these
19.	Let $X_1, X_2,, X_N$ be a random sample from a p-variate normal distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then which of the following is true
variable	(1) (N-1) S has Wishart Distribution
	(2) Sample mean and S are independent
	(3) Sample mean is distributed as $N_p$ ( $\mu$ , $\Sigma/N$ )
29.	(4) All of these
20.	If $Y_1, Y_2, \ldots, Y_n$ dentote the principal components based on correlation matrix (R) and $\lambda_1 > \lambda_2, \ldots > \lambda_p$ are eigenvalues of R, then which of the following is true
success	gs. The skowness of a bromial distribution having probability d
io.	(1) $\operatorname{tr}(\Sigma) = \sum_{i=1}^{p} \operatorname{Var}(Y_i)$ (2) $\sum_{i=1}^{p} \lambda_i = \sum_{i=1}^{p} \operatorname{Var}(Y_i)$
	(3) $Var(Y_p) = p$ (4) All of the above

Code-C

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Question No.	another Questions nother of .oM
21.	If a random variable X has pdf f (x) = $kx (1-x)$ , $0 \le x \le 1$ then value of the constant k is:
	(1) $\frac{1}{2}$ (2) 2 hylmobias
	(3) 4 (2) (4) 6 (4) 6
22.	Mean of the random variable X having pdf f (x) = $6x^3 (4 - x)^2$ , $0 \le x \le 4$ is
notudra	(1) 19/14 de matrix 3 zintam son (2) 14/9 a motore de matrix 2 zintam son (2) 14/9 a motore de matrix 2 zintam son (2) 14/9 a motore de matrix 2 zintam son (2) 14/9 a motore de matrix 2 zintam son (2) 2 zintam
	(3) 9/20 (4) None of these
23.	If F (x) denote the distribution function of a continuous random variable X then which one is not true
clarifie Door or property	(2) For a substant $f(x) = 0$ (2) For a substant $f(x) = 0$ (2) $f(x) = 0$
	(3) F(x) is left continuous (4) None of these
24.	If X and Y are independent random variables, then
rosyktavia	(1) $E(XY) < E(X) \cdot E(Y)$ (2) $E(XY) > E(X) \cdot E(Y)$
ch of the	(3) $E(XY) = E(X) \cdot E(Y)$ (4) None of these
25.	The skewness of a binomial distribution having probability of success $p = 1/2$ is
	(1) -1   (2) 0
	(3) 1 Production (4) None of these (8)

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Question No.	anoitan Questions noitean Q
26.	The variance of a distribution having M.G.F. M (t) = $\left(\frac{1}{2} + \frac{1}{2}e^{t}\right)^{4}$ is
	(1) 2 seeds to ego (2) 3/2 see dego as told (8)
ei evije	(3) 2/3 (4) None of these
27.	M.G.F. of Poisson distribution is
	(1) $M(t) = e^{\lambda (e^t - 1)}$ (2) $M(t) = e^{-\lambda (e^t - 1)}$
	(3) $M(t) = e^{-\lambda e^t + 1}$ (4) $M(t) = e^{-\lambda e^t} - 1$
28.	If X is uniformly distributed over the interval [0, 1] then Var (X) is
	(1) 5/12
niog yn	(3) 1/12 a symp baselo a go b (4) 3/12
29.	If X and Y are random variables such that their expectations exist and $P(X \le Y) = 1$ , then
26	$(1)  E(X) \ge E(Y) \qquad (2)  E(X) \le E(Y)$
	(3) $E(X) = E(Y)$ (4) None of these
20	Level of significance is equal to the probability of
30.	- (1) Rimman and a second of the second of t
	(1) Not committing Type-I error (2) Committing Type-II error
	(3) Not committing Type-II error (4) None of the above

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Question No.	Questions	question No.
31.	Let $f(x) = x^2$ and $U = (-1, 1)$ , then $f(U) = [0, 1]$	
	(1) Bounded open set (2) Unbound	
	(3) Not an open set (4) None of	these (1)
32.	A point at which an analytical function cease called	
ř	(1) Stagnation Point (2) Saddle P	27. M.G.F. of Poisson trio
	(3) Critical Point (4) Singular	Point (1) M V(1)
33.	The Newton-Raphson Method fails if	200 = (3) M = (0)
23. 4.1	(1) $f(x0) = 0$ (2) $f'(x0) =$	O morning et XIII AT 189
	(3) $f''(x0) = 0$ (4) None of	these SNa (I)
34.	If f (z) is analytic within and on a closed c	
me zelze	within C, then $f(a) = \frac{1}{2\pi i} \int_{C} \frac{f(z) dz}{z - a}$ represents	29. 'H X and Y and Z an
	(1) Cauchy's Theorem (2) Residue	Theorem
	(3) Morera's Theorem (4) Cauchy's	s Integral Formula
35.		
rorre Il	(1) Runges's method (2) Weddle'	
	(3) Simpson's one-third rule (4) Trapezo	

Question No.	v anotta Questions
36.	Which of the following is true in relation to the Regula-Falsi method:
00.	(1) Is method of finding real roots of an equation $f(x) = 0$
	(2) Closely resembles the bisection method
	(3) Both (1) and (2) are true
oj 8988	(4) None of these
37.	The formula used for solving the equation using Regula Falsi method is
	(1) $x = \frac{bf(a) - af(b)}{f(a) - f(b)}$ (2) $x = \frac{af(a) - bf(b)}{f(a) - f(b)}$
	(3) $x = \frac{bf(a) - af(b)}{a - b}$ (4) None of these
38.	With usual notations, which of the following relations between operator is correct:
35.	(1) $\delta = E^{1/2} - E^{-1/2}$ (2) $\delta = E^{1/2} + E^{-1/2}$
	(3) $\delta = E - E^{-1/2}$ (4) None of these
39.	Which of the following is true about the Newton's Forward Interpolation formula:  (1) Is used for interpolating y values near the end of a set of tabulate
	(2) Is used for extrapolating y values a little ahead of y <sub>n</sub>
	(3) Both (1) and (2) are true  (4) None of these (3)

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Ph.D

Question No.	Questions			
40.	Which of the following is a method for a numerical solution of OD	Es:		
	(1) Runge-Kutta Method (2) Picard's Method			
	(3) Euler's Method (4) All of these			
41.	When the sum of gains of one player is equal to the sum of loanother player is a game, this situation is known as	osses to		
	(1) Biased game (2) Non-zero-sum game	€.		
	(3) Fair game (4) None of these			
42.	Saddle point exists in game theory when			
erotoreo 34.	(1) Maximin and minimax value of the game are same	.88 nioq ya		
	(2) Maximin value of the game is greater than minimax value			
	(3) Maximin value of the game is less than minimax value			
polation abulated	(4) None of the above			
43.	The time over which the inventory level will be controlled is called	ed :		
	(1) Time Horizon (2) Lead Time			
	(3) Time to take decision (4) None of these (4)			

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the purposes of Stabilising prices in an entire economy or an individue market.  (2) Commodities are bought and stored when a surplus exists in the economy.  (3) Commodities are sold from the stores when economic shortages the economy occur.  (4) All of these  45. The variable added to the LHS of a less than or equal to constraint convert it into equality is called variable  (1) artificial (2) surplus  (3) slack (4) additional	Question No.	enoises Questions noises Questions			
the purposes of Stabilising prices in an entire economy or an individus market.  (2) Commodities are bought and stored when a surplus exists in the economy.  (3) Commodities are sold from the stores when economic shortages the economy occur.  (4) All of these  45. The variable added to the LHS of a less than or equal to constraint convert it into equality is called variable  (1) artificial  (2) surplus  (3) slack  (4) additional  46. If a customer decides not to enter the queue because of its huge lengthe is said to have  (1) Balked  (2) Reneged  (3) Jockey  (4) None of these  47. When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost  (2) profit	44.	Which of the following is true about the buffer stock?			
economy.  (3) Commodities are sold from the stores when economic shortages the economy occur.  (4) All of these  45. The variable added to the LHS of a less than or equal to constraint convert it into equality is called variable  (1) artificial  (2) surplus  (3) slack  (4) additional  46. If a customer decides not to enter the queue because of its huge lengthe is said to have  (1) Balked  (2) Reneged  (3) Jockey  (4) None of these  47. When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost  (2) profit	93819VS	(1) A buffer stock scheme is an attempt to use commodity storage for the purposes of Stabilising prices in an entire economy or an individual market.			
the economy occur.  (4) All of these  45. The variable added to the LHS of a less than or equal to constraint convert it into equality is called variable  (1) artificial (2) surplus (3) slack (4) additional  46. If a customer decides not to enter the queue because of its huge length he is said to have  (1) Balked (2) Reneged (3) Jockey (4) None of these  47. When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost (2) profit					
The variable added to the LHS of a less than or equal to constraint convert it into equality is called variable  (1) artificial (2) surplus (3) slack (4) additional  46. If a customer decides not to enter the queue because of its huge lengthe is said to have  (1) Balked (2) Reneged (3) Jockey (4) None of these  47. When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost (2) profit	atomera	the economy occur.			
convert it into equality is called variable  (1) artificial (2) surplus (3) slack (4) additional  46. If a customer decides not to enter the queue because of its huge length he is said to have  (1) Balked (2) Reneged (3) Jockey (4) None of these  47. When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost (2) profit	en by	(4) All of these			
(3) slack (4) additional  46. If a customer decides not to enter the queue because of its huge length he is said to have  (1) Balked (2) Reneged  (3) Jockey (4) None of these  47. When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost (2) profit	45.				
46. If a customer decides not to enter the queue because of its huge length he is said to have  (1) Balked (2) Reneged (3) Jockey (4) None of these  When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost (2) profit		(1) artificial (2) surplus			
he is said to have  (1) Balked (2) Reneged  (3) Jockey (4) None of these  When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost (2) profit	5 88900	(3) slack removement (4) additional			
(1) Balked (2) Reneged (3) Jockey (4) None of these  When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:  (1) cost (2) profit	46.	If a customer decides not to enter the queue because of its huge length, he is said to have			
When a maximization assignment problem is converted in minimizati problem, the resulting matrix is called matrix:  (1) cost (2) profit					
problem, the resulting matrix is called matrix:  (1) cost (2) profit	1-156	(3) Jockey (4) None of these			
	47.939				
图:2018年1月 1918年					
(3) regret (4) dummy					

Question No.	Rections Questions .				
48.	Cars arrive at a service station according to Poisson distribution with mean rate of 5 per hour. The service time per car follows an exponent distribution with a mean of 10 minutes. At the steady state, the averwaiting time in the queue is:				
od) ni a	(1) 50 minutes (2) 25 minutes				
ni eoga)	(3) 20 minutes (4) None of these				
49.	Efficiency of M/M/C model in terms of the Total Number of Customers (TNC) and Average Number of Customers Served (ANCS) is given by				
or misu	(1) TNC/ANCS (2) ANCS/TN				
40	(3) ANCS × TNC (4) None of these (1)				
50.	Which of the following is true about an evolutionary random process?				
dtanel	(1) It is not stationary of refus of for sebiseb remoters all				
24	(2) Poisson process is an example of evolutionary random process				
	(3) Both (1) and (2) are true				
	(4) None of these (A) vertical (B)				
51.	In a RBD with $v = 5$ and $r = 4$ one treatment is added, the increase in error degrees of freedom will be:				
	(1) 1 (2) 2 Time tao (1)				
	(3) 3				

Which of the following is true about the Principal Component And (1) Principal components are ordered linear combinations of the variables  (2) First Principal component has maximum variance  (3) Both (1) and (2) are true  (4) None of the above  53. In experimental designs the experimental error is controlled by use (1) Local control (2) Randomization  (3) Replication (4) None of the above  54. Which of the following is a principle of design of experiments  (1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 control treatments to study their effects of diastolic blood pressure. Fused to test that the mean response was same between different The numerator and denominator degrees of freedom for F test and (1) 3 and 10 respectively (2) 4 and 9 respectively	No.		)restions	Quest	ions	
variables  (2) First Principal component has maximum variance  (3) Both (1) and (2) are true  (4) None of the above  53. In experimental designs the experimental error is controlled by use (1) Local control (2) Randomization  (3) Replication (4) None of the above  54. Which of the following is a principle of design of experiments  (1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 of treatments to study their effects of diastolic blood pressure. Fused to test that the mean response was same between different The numerator and denominator degrees of freedom for F test and the state of	52.	Whi	ch of the following is true al	oout	the Principal Component Ar	nalysis
(3) Both (1) and (2) are true  (4) None of the above  53. In experimental designs the experimental error is controlled by u  (1) Local control (2) Randomization  (3) Replication (4) None of the above  54. Which of the following is a principle of design of experiments  (1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 of treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different and denominator degrees of freedom for F test and the same property of the		(1)	아마스 하다 그 사람들은 아니라 살아왔다면 하는데 아니라	ordei	red linear combinations of t	the given
(4) None of the above  53. In experimental designs the experimental error is controlled by u  (1) Local control (2) Randomization  (3) Replication (4) None of the above  54. Which of the following is a principle of design of experiments  (1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 of treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different to runmerator and denominator degrees of freedom for F test and the state of t		(2)	First Principal component	has n	naximum variance	
53. In experimental designs the experimental error is controlled by u  (1) Local control (2) Randomization  (3) Replication (4) None of the above  54. Which of the following is a principle of design of experiments  (1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different The numerator and denominator degrees of freedom for F test as	aluger a	(3)	Both (1) and (2) are true	i dok H9 k	A sampling procedure in what serval systematically tro	sorbing
(1) Local control (2) Randomization  (3) Replication (4) None of the above  54. Which of the following is a principle of design of experiments  (1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 of treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different The numerator and denominator degrees of freedom for F test and the state of the	3	(4)	None of the above		d) Systematic sampling	
(3) Replication (4) None of the above  54. Which of the following is a principle of design of experiments  (1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 control treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different to numerator and denominator degrees of freedom for F test and the state of the state o	53.	Ine	xperimental designs the exp	perim	ental error is controlled by	using the
54. Which of the following is a principle of design of experiments  (1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 of treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different and denominator degrees of freedom for F test and the state of the		(1)	Local control	(2)	Randomization	24.88
(1) Replication (2) Local Control  (3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 of treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different The numerator and denominator degrees of freedom for F test and the statements of the statement of th	63.	(3)	Replication	(4)	None of the above	
(3) Randomization (4) All of the above  55. An investigator randomly assigns 10 patients to each of the 4 of treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different The numerator and denominator degrees of freedom for F test and denominator degrees degre	54.	Which of the following is a principle of design of experiments				
An investigator randomly assigns 10 patients to each of the 4 contract treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different to the numerator and denominator degrees of freedom for F test and denominator degrees degr	atudyii **	(1)	Replication	(2)	Local Control	-59*
treatments to study their effects of diastolic blood pressure. For used to test that the mean response was same between different The numerator and denominator degrees of freedom for F test and denominator degrees de		(3)	Randomization	(4)	All of the above	
(1) 3 and 10 respectively (2) 4 and 9 respectively	55.	treatments to study their effects of diastolic blood pressure. I used to test that the mean response was same between differe				test was at groups
		(1)	3 and 10 respectively	(2)	4 and 9 respectively	
(3) 3 and 36 respectively (4) None of these		(3)	3 and 36 respectively	(4)	None of these	

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Question No.	enolise Questions	luestion No.				
56.	If the overall F test in ANOVA is found to be significant then pair comparision between treatment means is made using:					
	(1) Chi-square test (2) Two sample t test					
	(3) Variance ratio test (4) None of these					
57.	A sampling procedure in which the sampling units are selected at a interval systematically from the population is known as:	regular				
	(1) Systematic sampling (2) Stratified sampling	mersi				
nsing the	(3) Systematic random sampling (4) Both (1) and (3)	3) Systematic random sampling (4) Both (1) and (3)				
58.	In RCBD, which of the following principle is adopted?					
	(1) Replication to anoth (1) (2) Randomization					
50.	(3) Local control (4) All of these	es la				
59.	The common device to reduce the block size in experiments so main effects and interaction is:	tudying				
	(1) Confounding (2) Block Interaction					
different Lest wa	(3) BIBD of a trouter (1) Asymmetrical factorial designment of the state of the sta	gn .đđ				
60.	In designs of experiment. A general rule is to use as many replications which provides at least:					
	(1) 20 error DF (2) 12 error DF					
	(3) 30 error DF (4) None of these					

Question No.	Questions goldson Questions goldson Questions				
61.	If a closed set C contains only one state j, then the state is called:				
rocess	(1) Non-absorbing state (2) Persistent state				
	(3) Transient state (4) None of these				
62.	Which of the following is true about an absorbing Markov chain:				
entwolld	(1) A Markov chain is said to be absorbing if it has at least one absorbing state.				
es below	(2) If the state j is absorbing the $p_{ij} = 1$				
2334	(3) It is impossible to leave an absorbing state				
	(4) All of these				
63.	Extinction of a stochastic process means that the sequence $\{X_n\}$ consists of				
	(1) Zeros for all except a finite number of values of n				
re called	(2) Zeros for all values of n				
	(3) Zeros for at least one value of n				
	(4) None of these				
0.4	Which of the following (4) and (2) hand (3) white age of				
64.	For an immigration-emigration process which of the following is true				
	(1) $\lambda_n = \lambda$ (2) $\mu_n = \mu$ (3) $\mu_n = \mu$ (1)				
	(3) $\lambda_n = 1$ and $\mu_n = \mu$ (4) None of these				
	(4) All of these				

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Question No.	Questions noitang noitang
65.	Which of the following is true about a Yule-Furry Process:  (1) It is a Pure Birth Process  (2) It is a Pure Death Process  (3) It is a Birth and Death Process (4) None of these
66.	A matrix is in reduced row-echelon form if it meets the following condition(s):  (1) If there is a row where every entry is zero, then this row lies below any other row that contains a nonzero entry.  (2) The leftmost non-zero entry of a row is equal to 1.
or statenco	(3) Both (1) and (2) Assem assessed an analysis in the mile of these mile souls violated and a second of the secon
67.	<ul> <li>If A is square matrix, then roots of the equation  A - λI  = 0 are called:</li> <li>(1) Latent roots</li> <li>(2) Eigenvalues</li> <li>(3) Both (1) and (2) are true</li> <li>(4) None of these</li> </ul>
68.	A quadratic form is a polynomial with all terms of degree two  (1) 1 (2) 2  (3) 3 (4) 4

Question No.	anoltseu Questions aoitseu Questions
69.	<ul> <li>The index of the quadratic form is equal to</li> <li>(1) The difference between the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>(2) The sum of the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.</li> <li>(3) Neither (1) nor (2)</li> </ul>
r s fnio	(4) None of the above
70.	A one-element vector space is an example of a  (1) Trivial space (2) Universal space  (3) Sample space (4) None of these
71. do	Angle between the vectors $\mathbf{a} = (1, 1, 0)^t$ and $\mathbf{b} = (0, 3, 2)^t$ is $(1)  \arccos\left(\frac{2}{\sqrt{3}\sqrt{13}}\right) \qquad (2)  \arccos\left(\frac{13}{\sqrt{2}\sqrt{3}}\right)$
ın whic	(3) $\arccos\left(\frac{3}{\sqrt{2}\sqrt{13}}\right)$ (4) None of these
72.	Which of the following is true regarding basis of a vector space
	(1) It is a sequence of vectors
bidw ai	<ul> <li>(2) It spans the space if the set of elements of the sequence spans the space</li> <li>(3) Vectors in basis are linearly independent</li> <li>(4) All of these</li> </ul>

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Question No.	enoise Questions	Question No.
73.	Which of the following is true about $f(z) = z^2 + 2z$ ?	-69
and the form.	(1) Continuous and Differentiable	
amber ol	(2) Continuous but not Differentiable	
	(3) Neither Continuous Nor Differentiable	
62,	(4) None of these (5) Hou (1) Today (8)	
74.	The radius of convergence of a power series f centered on a poequal to the distance from a to the nearest point where f	oint a is
	(1) Can not be defined in a way that makes it holomorphic.	
	(2) Can be defined in a way that makes it holomorphic.	
	(3) Can not be defined in a way that does not make it holomorp	hic
	(4) None of these	
75.	Which of the following is true about the radius of convergence of series:	a power
	(1) is the radius of the largest disk at the center of the series in the series converges	n which
Na.	(2) is the radius of the smallest disk at the center of the series in the series converges	n which
surds (	(3) is the radius of the largest disk at the center of the series in the series diverges	n which
	(4) None of these	

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76.	<ul> <li>The Cauchy integral theorem in complex analysis is</li> <li>(1) the fundamental theorem of circular integrals</li> <li>(2) an important statement about line integrals for holomorphic functions in the complex plane</li> <li>(3) an important statement about line integrals for homomorphic functions in the real plane</li> <li>(4) None of these</li> </ul>
77.	A sequence $\left\{\frac{1}{n}\right\}$ is  (1) Bounded (2) Unbounded (3) Divergent (4) None of these
78.	Which of the following is true about a closed set?
ples are	<ul> <li>(1) Contains all its limit points</li> <li>(2) Does not contains all of its limit points</li> <li>(3) Is unbounded</li> <li>(4) None of these</li> </ul>
79.	Let $A = [0, 1]$ and $B = [2, 3]$ , then which of the following is correct  (1) Both A and B are connected  (2) $A \cup B$ is not connected  (3) Both (1) and (2) are correct  (4) None of these

Question No.	Questions	nortegi,
80.	Let $U = (-1, 0)$ and $V = (0, 1)$ , then which of the following is not tr	, A) E)
		76.90
anotton	(1) U and V are disjoint open sets	
oldere e	(2) Cand vare disjoint closed sets	
	(3) Distance between U and V is 0	
74	(4) None of these	
81.	To test $H_0: \mu_0$ against $H_1: \mu > \mu_0$ when the population variance is unknown	nowr
	and sample size is small, the appropriate test is	-11
	Unbounded (2) Unbounded	
	(1) t-test (2) Z-test (3) (3) (4)	
	(3) Chi-square test (4) F-Tost	
	• Which of the following is true about a closed set	
82.	Paired t-test is applicable when the observations in the two sample	s are
	(1) Independent (2) Mutually independent	
	(a) D: 1	
	(3) Paired (4) None of these	
99	the series converges and these (4) None of these	
83.	Association of attributes in a 2×2 contingency table can be tested by	7
betek	(1) F-test (2) Z-test (2)	
	(4) Indeed the second (4) None (1) these	
Control of the Contro	(3) t-test (4) Fisher Exact test	

Question No.	anoite Questions	Juestion No.
84.	The $\chi^2$ statistic with usual notations in case of contingency table (m × n) is  (1) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$ (2) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \frac{O_{ij}^2 - E_{ij}^2}{E_{ij}}$	of order
defined of 6 is	(3) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \left( \frac{O_{ij} - E_{ij}}{E_{ij}} \right)^2$ (4) None of these	08
85.	If $r_{xy} = 0$ , the two lines of regression  (1) Coincide (2) Are parallel	
gr.	(1) Coincide (2) Are parallel (3) Are perpendicular to each other (4) None of the ab	ove
86.	Correlation coefficient is independent of change of  (1) Origin only  (2) Scale only	•
feasible	(3) Both origin and scale (4) None of these	.92.
87.	Given the two lines of regression as, $3x - 4y + 8 = 0$ and $4x - 3y$ means of x and y are respectively:	= 1, the
96.	(1) 4 and 5 (2) 5 and 4	
er of the	(3) $\frac{4}{3}$ and $\frac{5}{4}$ and $\frac{1}{4}$ and $\frac{3}{4}$ and $\frac{4}{5}$ beginning (a)	•

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Question No.	anoitse Questions noitsei
88.	Skewness of a frequency curve shows
	(1) Flatness of the frequency curve (2) Lack of symmetry
	(3) Peakedness of the frequency curve (4) None of these
89.	For a leptokurtic distribution
	(1) $\beta_2 > 3$ (2) $\beta_2 < 3$
	(3) $\beta_2 = 3$ (4) None of these
90.	If $X_1, X_2, \dots, X_n$ is a random sample from a uniform distribution defined over the interval $0 < x < \theta, \theta > 0$ , then with usual notations MLE of $\theta$ is
	(1) $X_{(1)}$ (2) $X_{(n)}$
	(3) $(X_{(1)} + X_{(n)})/2$ (4) None of these
91.	The region of feasible solution in LPP graphical method is called
	(1) unbounded region (2) feasible region
8.3	(3) infeasible region (4) infinite region
92.	In Simplex method, which of the following is correct about the basic feasible solution.
da . l = 4	(1) a basic feasible solution is a solution with a maximal set of non-zero variables
83	(2) a basic feasible solution is a solution with a minimal set of non-zero variables
	(3) a basic feasible solution does not correspond to a corner of the polyhedron of feasible solutions
	(4) None of these

No.	enoites Questions	Question No.
93.	In transportation models the points of demand are called:	.70
	(1) Origins (2) Supply centres (1)	
	(3) Destinations (4) None of these (8)	
94.	Which of the following are the entities whose values are to be defined the solution of the LPP:	termined
	(1) objective function (2) decision variables	<b>*</b>
	(3) constraints (4) opportunity cost	
restudos.	One dist avantage of using North-West Corner Rule to find initia	.00
95.	A constraint in an LP model restricts	
	(1) Value of the objective function	
	(2) Values of the decision variables	
	(3) Use of the available resources	
	(4) All of the above	
0.0	Operations Research is a very powerful tool for	.001
96.	operations Research is a very powerful cost for a grant and more affected and a grant and	
	(1) Research (2) Operations	
	(3) Decision Making (4) None of the above	

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Question No.	, anoilso Questions	Question No.
97.	In transportation table every loop has	93.71
	(1) An even number of cells (2) An odd number of cells	
20	(3) An equal number of cells (4) None of the above	
98.	When it is not possible to find solution in LPP, it is called as	.50
	(1) Infeasible solution (2) Unbounded solution	
	(3) Improper solution (4) None of the above	
99.	One disadvantage of using North-West Corner Rule to find initia to the transportation problem is that	l solution
91.	(1) It is complicated to use	
	(2) It ignores the cost of transportation	
92.	(3) It leads to degenerate initial solution	
	(4) All of the above evode and to IIA (4)	
100.	Game theory models are classified by the	36.
	(1) Number of players (2) Sum of payoffs	
	(3) Number of strategies (4) All of the above	

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(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

## (Ph.D/URS-EE Jan. 2022)

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## STATISTICS

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Total Questions: 100	Max. Marks: 100
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Time: 11/4 Hours	Total Questi	ons: 100	(in words)
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Koli No.		Father's Name:	N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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Mother's Name:		Date of E	

(Signature of the candidate)

(Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

All questions are compulsory.

The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by

Question Booklet along with answer key of all the A,B,C and D code will be got uploaded on the university website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examinations in writing/through E-Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.

The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers

MUST NOT be ticked in the Question book-let.

There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

Use only Black or Blue BALL POINT PEN of good quality in the OMR Answer-7.

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Question No.	Questions notices Questions
1.	If a closed set C contains only one state j, then the state is called:
aeeoo	(1) Non-absorbing state (2) Persistent state
	(3) Transient state (4) None of these
2.	Which of the following is true about an absorbing Markov chain:
es below	(1) A Markov chain is said to be absorbing if it has at least one absorbing state.
	(2) If the state j is absorbing the $p_{ij} = 1$
	(3) It is impossible to leave an absorbing state
	(4) All of these (5) has (1) Alot (8)
3.	Extinction of a stochastic process means that the sequence $\{X_n\}$ consists of
bellee e	(1) Zeros for all except a finite number of values of n
12.	(2) Zeros for all values of n
	(3) Zeros for at least one value of n
	(4) None of these
4.	For an immigration-emigration process which of the following is true
	$(1)  \lambda_n = \lambda \qquad (2)  \mu_n = \mu$
	(3) $\lambda_n = 1$ and $\mu_n = \mu$ (4) None of these

Question No.	anoitseuQuestions	Question No.
5.	Which of the following is true about a Yule-Furry Process:	1.
	(1) It is a Pure Birth Process (2) It is a Pure Death P	rocess
	(3) It is a Birth and Death Process (4) None of these	
	Which of the following is true about an absorbing Markov chain	- 8
6.	A matrix is in reduced row-echelon form if it meets the f	ollowing
bsorbing	(1) A Markov chain is said to be absorbing if it has (a) noitibnos	
	state.	
	(1) If there is a row where every entry is zero, then this row l	
	any other row that contains a nonzero entry.	
	(2) The leftmost non-zero entry of a row is equal to 1.	
	(3) Both (1) and (2)	
consists	(4) None of these	
	lo	
	If A is square matrix, then roots of the equation $ A - \lambda I  = 0$ as	re called:
7.	If A is square matrix, then roots of the equation (12)	
	(1) Latent roots (2) Eigenvalues	
	(1) Latent roots (2) Eigenvalues	
	(1) None of these	
	(3) Both (1) and (2) are true (4) None of these	
	two	
8.	A quadratic form is a polynomial with all terms of degree two	
euri	(1) 1	
	(3) 3 (4) 4	
	(3) A = ( and u = n	

Question No.	anoises Questions aotasos of		
9.	The index of the quadratic form is equal to		
	(1) The difference between the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.		
	(2) The sum of the number of positive Eigen values and the number of negative Eigen values of the matrix of quadratic form.		
bearings	(3) Neither (1) nor (2)		
	(4) None of the above		
10.	A one-element vector space is an example of a		
	(1) Trivial space (2) Universal space		
	(3) Sample space (4) None of these		
11.	The region of feasible solution in LPP graphical method is called		
	(1) unbounded region (2) feasible region		
	(3) infeasible region (4) infinite region		
12.	In Simplex method, which of the following is correct about the basic feasible solution.		
	(1) a basic feasible solution is a solution with a maximal set of non-zero variables		
21,	(2) a basic feasible solution is a solution with a minimal set of non-zero variables		
	(3) a basic feasible solution does not correspond to a corner of the polyhedron of feasible solutions		
	(4) None of these move the second (8)		

Question No.	anoilse Questions	Juestion No.
13.	In transportation models the points of demand are called:	9.
end the form.	(1) Origins (2) Supply centres	bcesa
mber of	(3) Destinations (4) None of these (4) None of these (5)	
14.	Which of the following are the entities whose values are to be det from the solution of the LPP:	ermined
	(1) objective function (2) decision variables	s below
	(3) constraints (3) (4) opportunity cost	
15.	A constraint in an LP model restricts	
	The region of feasible solution in LPP graphical method is called	
	(1) Value of the objective function	
7	(2) Values of the decision variables	collect.
DENBEST O	(3) Use of the available resources	
non-zero	(4) All of the above entire a armortule address of the above entire address of the abo	
16.	Operations Research is a very powerful tool for	
er of the	(1) Research (2) Operations class (8)	
	(3) Decision Making (4) None of the above	

Code-D

No.	Questions
17.	In transportation table every loop has
	(1) An even number of cells (2) An odd number of cells
	(3) An equal number of cells (4) None of the above
18.	When it is not possible to find solution in LPP, it is called as
	(1) Infeasible solution (2) Unbounded solution
	(3) Improper solution (4) None of the above
19.	One disadvantage of using North-West Corner Rule to find initial solution to the transportation problem is that
	(1) It is complicated to use
	(2) It ignores the cost of transportation
	(3) It leads to degenerate initial solution
	(4) All of the above
20.	Game theory models are classified by the
A CLASS	(1) Number of players (2) Sum of payoffs
	(3) Number of strategies (4) All of the above
21.	In a RBD with $v = 5$ and $r = 4$ one treatment is added, the increase in error degrees of freedom will be:
	(1) 1 (2) 2
	(3) 3

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Question No.	Questions
22.	Which of the following is true about the Principal Component Analysis
31.	and sample size is small, the appropriate test is  (1) Principal components are ordered linear combinations of the given  variables  (2) Z-test
	(2) First Principal component has maximum variance (3) Chi-square test
	(3) Both (1) and (2) are true
32.	Paired t-test is applicable when the observations in the two samples are  (4) None of the above
	(1) Independent (2) Mutually independent
23.	In experimental designs the experimental error is controlled by using the
	(3) Paired (4) None of these
	(1) Local control (2) Randomization
33.	(3) Replication (4) None of the above
24.	Which of the following is a principle of design of experiments
	(1) Replication (2) Local Control
34.	(3) Randomization usual notat (4) s All of the above gency table of order $(m \times n)$ is
25.	An investigator randomly assigns 10 patients to each of the 4 different treatments to study their effects of diastolic blood pressure. F test was used to test that the mean response was same between different groups. The numerator and denominator degrees of freedom for F test are
	(1) 3 and 10 respectively (2) 4 and 9 respectively
	(3) 3 and 36 respectively (4) None of these

Question No.	Questions
26.	If the overall F test in ANOVA is found to be significant then pair wise comparision between treatment means is made using:  (1) An even number of cells (2) An odd number of cells (3) An equal number of cells (4) None of the above (5) Variance ratio test (6) None of these
18.	When it is not possible to find solution in LPP, it is called as
27.	A sampling procedure in which the sampling units are selected at a regular
	interval systematically from the population is known as:  (1) Systematic sampling (2) Stratified sampling
19.	(3) Systematic random sampling (4) or Both (1) and (3) tial solution to the transportation problem is that
28.	In RCBD, which of the following principle is adopted?  (1) It is complicated to use (1) Replication (2) Randomization (3) Local control (4) All of these (3) It leads to degenerate initial solution
29.	The common device to reduce the block size in experiments studying main effects and interaction is:
20.	(1) Confounding els are classifi (2) Block Interaction (3) BIBD er of players (4) Asymmetrical factorial design
30.	In designs of experiment. A general rule is to use as many replications which provides at least:
21.	In a RBD with v = 5 and r = 4 one treatment is added, the increase in (1) 20 error DF freedom will be (2) 12 error DF
	(3) 30 error DF (4) None of these
	(3) 3 (4) 4

Question No.		Questions
31.		$H_1: \mu > \mu_0$ when the population variance is unknowall, the appropriate test is
	(1) t-test	(2) Z-test
	(3) Chi-square test	(4) F-Test
32.	Paired t-test is applica	ble when the observations in the two samples ar
	(1) Independent	(2) Mutually independent
	(3) Paired	(4) None of these
33.	Association of attribut	es in a 2×2 contingency table can be tested by
	(1) F-test	(2) Z-test
	(3) t-test	(4) Fisher Exact test
34.	The $\chi^2$ statistic with u (m × n) is	sual notations in case of contingency table of orde
	(1) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \frac{(O_{ij} - E)}{E_{ij}}$	(2) $\chi^2 = \sum_{i=1}^m \sum_{j=1}^n \frac{O_{ij}^2 - E_{ij}^2}{E_{ij}}$
	(3) $\chi^2 = \sum_{i=1}^{m} \sum_{j=1}^{n} \left( \frac{O_{ij} - E_{ij}}{E_{ij}} \right)$	$\left(\frac{ij}{2}\right)^2$ (4) None of these

Question No.	Questions
35.	If $r_{xy} = 0$ , the two lines of regression  (1) Coincide (2) Are parallel
	(3) Are perpendicular to each other (4) None of the above
36.	Correlation coefficient is independent of change of
	(1) Origin only (2) Scale only
	(3) Both origin and scale (4) None of these
37.	Given the two lines of regression as, $3x - 4y + 8 = 0$ and $4x - 3y = 1$ , the means of x and y are respectively:
	(1) 4 and 5 (2) 5 and 4
90	(3) $\frac{4}{3}$ and $\frac{5}{4}$ (4) $\frac{3}{4}$ and $\frac{4}{5}$
	plain effects and interaction is
38.	Skewness of a frequency curve shows
	(1) Flatness of the frequency curve (2) Lack of symmetry
no.	(3) Peakedness of the frequency curve (4) None of these
39.	For a leptokurtic distribution
	(1) $\beta_2 > 3$ (2) $\beta_2 < 3$
	(3) $\beta_2 = 3$ (4) None of these

Question	
No.	Questions
10	
40.	If X <sub>1</sub> , X <sub>2</sub> , X <sub>n</sub> is a random sample from a uniform distribution defined
	over the interval $0 < x < \theta$ , $\theta > 0$ , then with usual notations MLE of $\theta$ is
	(1) $X_{(1)}$ (2) $X_{(n)}$
	(II)
	(3) $(X_{(1)} + X_{(n)})/2$ (4) None of these
41.	Let $f(x) = x^2$ and $U = (-1, 1)$ , then $f(U) = [0, 1)$ is
	= 1, 1), then 1 (0) = [0, 1) is
	(1) Bounded open set (2) Unbounded open set
1 - F	(3) Not an open set (4) None of these
42.	A point at which an analytical function ceases to possess a derivative is
	called
	(1) Stagnation Point (2) Saddle Point
	(a) C:: 1D::
	(3) Critical Point (4) Singular Point
43.	The Newton-Raphson Method fails if
	(1) $f(x0) = 0$ (2) $f'(x0) = 0$
	(2) (11 ( 0) 0
	(2) Trolle of these
44.	If f (z) is analytic within and on a closed curve and if a is any point
***	within C, then $f(a) = \frac{1}{2\pi i} \int_{C} \frac{f(z) dz}{z-a}$ represents
	$2\pi i \int_{C}^{T} z - a$
	(1) Cauchy's Theorem (2) Residue Theorem
	(3) Morera's Theorem (4) Cauchy's Integral Formula
	(1) Caucity stitlegral Formula

Question No.	Questions
45.	Which of the following is not a method of Numerical Integration
	(1) Runges's method (2) Weddle's rule
	(3) Simpson's one-third rule (4) Trapezoidal rule
46.	Which of the following is true in relation to the Regula-Falsi method:
	(1) Is method of finding real roots of an equation $f(x) = 0$
	(2) Closely resembles the bisection method
	(3) Both (1) and (2) are true
	(4) None of these
47.	The formula used for solving the equation using Regula Falsi method is
	(1) $x = \frac{bf(a) - af(b)}{f(a) - f(b)}$ (2) $x = \frac{af(a) - bf(b)}{f(a) - f(b)}$
	(3) $x = \frac{bf(a) - af(b)}{a - b}$ (4) None of these
48.	With usual notations, which of the following relations between operators is correct:
	(1) $\delta = E^{1/2} - E^{-1/2}$ (2) $\delta = E^{1/2} + E^{-1/2}$
	(3) $\delta = E - E^{-1/2}$ (4) None of these

Question No.	Questions	
49.	Which of the following is true about the Newton's Forward Interpolation formula:  (1) Is used for interpolating y values near the end of a set of tabulation values  (2) Is used for extrapolating y values a little ahead of y <sub>n</sub> (3) Both (1) and (2) are true  (4) None of these	
50.	Which of the following is a method for a numerical solution of ODEs:  (1) Runge-Kutta Method (2) Picard's Method (3) Euler's Method (4) All of these	
51.	When the sum of gains of one player is equal to the sum of losses to another player is a game, this situation is known as	
	(1) Biased game (2) Non-zero-sum game (3) Fair game (4) None of these	
52.	Saddle point exists in game theory when  (1) Maximin and minimax value of the game are same  (2) Maximin value of the game is greater than minimax value  (3) Maximin value of the game is less than minimax value  (4) None of the above	

Question	Questions	
No.		
53.	The time over which the inventory level will be controlled is called:	
	(1) Time Horizon (2) Lead Time	
	(3) Time to take decision (4) None of these	
54.	Which of the following is true about the buffer stock?	
	(1) A buffer stock scheme is an attempt to use commodity storage for the purposes of Stabilising prices in an entire economy or an individual market.	
	(2) Commodities are bought and stored when a surplus exists in the economy.	
	(3) Commodities are sold from the stores when economic shortages in the economy occur.	
	(4) All of these	
55.	The variable added to the LHS of a less than or equal to constraint to convert it into equality is called variable	
	(1) artificial (2) surplus	
	(3) slack (4) additional	
56.	If a customer decides not to enter the queue because of its huge length, he is said to have	
	(1) Balked (2) Reneged	
	(3) Jockey (4) None of these	

Questio No.	Questions
57.	When a maximization assignment problem is converted in minimization problem, the resulting matrix is called matrix:
	(1) cost (2) profit
	(3) regret (4) dummy
58.	Cars arrive at a service station according to Poisson distribution with a mean rate of 5 per hour. The service time per car follows an exponential distribution with a mean of 10 minutes. At the steady state, the average waiting time in the queue is:
	(1) 50 minutes (2) 25 minutes
	(3) 20 minutes (4) None of these
59.	Efficiency of M/M/C model in terms of the Total Number of Customers (TNC) and Average Number of Customers Served (ANCS) is given by
	(1) TNC/ANCS (2) ANCS/TN
	(3) ANCS × TNC (4) None of these
60.	Which of the following is true about an evolutionary random process?
	(1) It is not stationary
	(2) Poisson process is an example of evolutionary random process
	(3) Both (1) and (2) are true
	(4) None of these

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Questions
Angle between the vectors $a = (1, 1, 0)^t$ and $b = (0, 3, 2)^t$ is
(1) $\arccos\left(\frac{2}{\sqrt{3}\sqrt{13}}\right)$ (2) $\arccos\left(\frac{13}{\sqrt{2}\sqrt{3}}\right)$
(3) $\arccos\left(\frac{3}{\sqrt{2}\sqrt{13}}\right)$ (4) None of these
Which of the following is true regarding basis of a vector space
(1) It is a sequence of vectors
(2) It spans the space if the set of elements of the sequence spans the space
(3) Vectors in basis are linearly independent
(4) All of these
Which of the following is true about $f(z) = z^2 + 2z$ ?
(1) Continuous and Differentiable
(2) Continuous but not Differentiable
(3) Neither Continuous Nor Differentiable
(4) None of these

Question No.	Questions
2.1	
64.	The radius of convergence of a power series f centered on a point a equal to the distance from a to the nearest point where f
	(1) Can not be defined in a way that makes it holomorphic.
	(2) Can be defined in a way that makes it holomorphic.
	(3) Can not be defined in a way that does not make it holomorphic
	(4) None of these
65.	Which of the following is true about the radius of convergence of a power series:
	(1) is the radius of the largest disk at the center of the series in which the series converges
	(2) is the radius of the smallest disk at the center of the series in which the series converges
	(3) is the radius of the largest disk at the center of the series in which the series diverges
	(4) None of these
66.	The Cauchy integral theorem in complex analysis is
	(1) the fundamental theorem of circular integrals
	(2) an important statement about line integrals for holomorphic functions in the complex plane
	(3) an important statement about line integrals for homomorphic functions in the real plane
(4	4) None of these
1,700	

Question No.	Questions
67.	A sequence $\left\{\frac{1}{n}\right\}$ is
	(1) Bounded (2) Unbounded
	(3) Divergent (4) None of these
68.	Which of the following is true about a closed set?
	(1) Contains all its limit points
	(2) Does not contains all of its limit points
	(3) Is unbounded
	(4) None of these
69.	Let A = [0, 1] and B = [2, 3], then which of the following is correct
	(1) Both A and B are connected (2) $A \cup B$ is not connected
	(3) Both (1) and (2) are correct (4) None of these
70.	Let $U = (-1, 0)$ and $V = (0, 1)$ , then which of the following is not true
	(1) U and V are disjoint open sets
	(2) U and V are disjoint closed sets
	(3) Distance between U and V is 0
	(4) None of these

of at a

Question No.	Questions
71.	A stratified random sample of size 32 is drawn from three strata of sizes 20, 40 and 100. The samples drawn using proportional allocation have sizes:
	(1) 6, 10, 16 (2) 4, 8, 20
	(3) 5, 9, 18 (4) None of these
72.	Non-response in sample surveys means
	(1) Non-availability of respondents
	(2) Non-return of questionnaire by the respondents
	(3) Refusal to give information
	(4) All of these
73.	Which of the following is an example of a non-random sampling technique?
	(1) Purposive (2) Quota
	(3) Convenience (4) All of these
74.	Sample survey is advantageous over census because it
	(1) is less costly (2) has greater scope
	(3) both (1) and (2) (4) none of these

Question No.	Questions								
75.	Which of these does not match with others								
	(1) Harvit-Thompson estimator								
3	(2) Murthy unordered estimator								
	(3) Des Raj ordered estimator								
	(4) Rao, Hartley and Chochran estimator								
76.	Infant mortality rate is defined as the number of deaths under one year of age in a year:								
	(1) Per 1000 live births (2) Per 1000 population								
	(3) Per 1000 women (4) None of these								
77.	Which of the following is not a method of collecting vital statistics:								
	(1) Census Method (2) Analytical Method								
	(3) Registration Method (4) None of these								
78.	Total fertility rate is derived from:								
	(1) Age specific birth rate (2) Gross reproduction rate								
	(3) Net reproductive rate (4) None of these								

Questio No.	Questions							
79.	The formula $\frac{\sum p_{0i} q_{1i}}{\sum p_{0i} q_{0i}} \times 100$ represents							
	(1) Fisher's Index (2) Kelly's Index							
	(3) Paasche's Index (4) None of these							
80.	Fertility refers to:							
	(1) Actual bearing of children							
	(2) Capacity to bear the child							
	(3) Average No. of live birth per woman in the year							
	(4) None of these							
81.	The mean and variance of a chi-square distribution with degrees of freedom 4 are							
	(1) 8 and 4 respectively (2) 4 and 8 respectively							
er mann e i inger skipt	(3) 4 and 4 respectively (4) 8 and 8 respectively							
82.	If $X \sim N$ ( $\mu$ , $\sigma^2$ ), the points of inflexion of normal curve are :							
	(1) $\mu \pm 2\sigma$ (2) $\sigma \pm 2\mu$							
	(3) $\mu \pm \sigma$ (4) None of these							
83.	If X is a Poisson variates with $P(X = 1) = P(X = 2)$ , then mean of the Poisson variate is equal to							
	(1) 1 (2) 2							
	(3) 3							

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Question No.	Questions  Which of the following relation is true for the F-distribution:						
84.							
	(1) $F_{\alpha}(n_1, n_2) = 1/F_{\alpha}(n_2, n_1)$ (2) $F_{\alpha}(n_1, n_2) = F_{1-\alpha}(n_2, n_1)$						
	(3) $F_{\alpha}(n_1, n_2) = 1/F_{1-\alpha}(n_2, n_1)$ (4) None of the above						
85.	Which of the following true is case of MGF of a random variable X						
	(1) MGF may not exist (2) If exists MGF is unique						
	(3) Both (1) and (2) are true (4) None of these						
86.	If $X_1, X_2, \ldots, X_N$ is a random sample from a multivariate distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then distribution of sample mean vector $\overline{X}$ is:						
50.	(1) $N(\mu, \Sigma)$ (2) $N(\mu, N\Sigma)$						
	(3) N ( $\mu$ , $\Sigma$ /N) (4) None of these						
87.	If $X_1, X_2, \ldots, X_N$ is a random sample from a p-variate normal distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then MLE of $\Sigma$ is given by						
	(1) $\frac{1}{N} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X})^{t} (X_{\alpha} - \overline{X})$ (2) $\frac{1}{N+1} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X}) (X_{\alpha} - \overline{X})^{t}$ (3) $\frac{1}{N-1} \sum_{\alpha=1}^{N} (X_{\alpha} - \overline{X})^{t} (X_{\alpha} - \overline{X})$ (4) None of these						

Question No.	Questions  If X has p-variate normal distribution with mean vector 0 and covariance matrix $\Sigma$ and $ \Sigma  > 0$ , then with usual notations the joint pdf can be written as the product of marginal pdfs of $X_1: q \times 1$ and $X_2: (p-q) \times 1$ if and only if						
88.							
	(1) $\Sigma_{12} = 0$ (2) $\Sigma_{11} = 0$						
	(3) $\Sigma_{22} = 0$ (4) None of these						
89.	Let $X_1, X_2, \ldots, X_N$ be a random sample from a p-variate normal distribution with mean vector $\mu$ and covariance matrix $\Sigma$ , then which of the following is true  (1) $(N-1)$ S has Wishart Distribution  (2) Sample mean and S are independent  (3) Sample mean is distributed as $N_p$ ( $\mu$ , $\Sigma/N$ )						
90.	If $Y_1$ , $Y_2$ ,, $Y_n$ dentote the principal components based on correlation matrix (R) and $\lambda_1 > \lambda_2$ , $\lambda_p$ are eigenvalues of R, then which of the						
	following is true  (1) $\operatorname{tr}(\Sigma) = \sum_{i=1}^{p} \operatorname{Var}(Y_i)$ (2) $\sum_{i=1}^{p} \lambda_i = \sum_{i=1}^{p} \operatorname{Var}(Y_i)$ (3) $\operatorname{Var}(Y_p) = p$ (4) All of the above						

Question No.	Questions						
91.	If a random variable X has pdf f (x) = $kx (1-x)$ , $0 \le x \le 1$ then value of the constant k is:						
	(1) $\frac{1}{2}$ (2) 2						
	(3) 4						
92.	Mean of the random variable X having pdf f (x) = $6x^3$ (4 - x) <sup>2</sup> , $0 \le x \le 4$ is						
	(1) 9/14 (2) 14/9						
	(3) 9/20 (4) None of these						
93.	If F (x) denote the distribution function of a continuous random variable X then which one is not true						
	(1) $F(-\infty) = 0$ (2) $F(\infty) = 1$						
	(3) F(x) is left continuous (4) None of these						
94.	If X and Y are independent random variables, then						
	(1) $E(XY) < E(X) \cdot E(Y)$ (2) $E(XY) > E(X) \cdot E(Y)$						
	(3) $E(XY) = E(X) \cdot E(Y)$ (4) None of these						
95.	The skewness of a binomial distribution having probability of success $p=1/2$ is						
	(1) -1 (2) 0						
	(3) 1 (4) None of these						

Question No.	Questions							
96.	The variance of a distribution having M.G.F. M (t) = $\left(\frac{1}{2} + \frac{1}{2}e^{t}\right)^{4}$ is							
and the second s	(1) 2 (2) 3/2							
3. Comp.	(3) 2/3 (4) None of these							
97.	M.G.F. of Poisson distribution is							
The second secon	(1) $M(t) = e^{\lambda (e^t - 1)}$ (2) $M(t) = e^{-\lambda (e^t - 1)}$ (3) $M(t) = e^{-\lambda e^t + 1}$ (4) $M(t) = e^{-\lambda e^t} - 1$							
The state of the s	(3) $M(t) = e^{-\lambda e^t} + 1$ (4) $M(t) = e^{-\lambda e^t} - 1$							
98.	If X is uniformly distributed over the interval [0, 1] then Var (X) is							
	(1) 5/12 (2) 1/3							
	(3) 1/12 (4) 3/12							
99.	If X and Y are random variables such that their expectations exist and $P(X \le Y) = 1$ , then							
	(1) $-E(X) \ge E(Y)$ (2) $E(X) \le E(Y)$							
	(3) $E(X) = E(Y)$ (4) None of these							
100.	Level of significance is equal to the probability of							
	(1) Not committing Type-I error (2) Committing Type-II error							
	(3) Not committing Type-II error (4) None of the above							

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1	4	-	1	2	4
2	1	+-	3	4	4
3	3	-	4	4	1
4	3	-	1	3	3
5		-	3	1	1
6		+	3	1	3
7		-	1	1	
		_	2	1	
8		_	1	4	
10		1	2	1	
7,014000		1	3	2	
11		3	4	3	
12		1	2	2	
13		-	4	3	
14		1 3	1	3	
15		3	3	3	
16		1	1	4	
17		2	1	1	
18		_	4	4	
19		2	4	4	
20		_	4	4	
21		2		1	
22		3	4	3	
23		2	3	3	
24		3		2	
25		3	3		
26		3	3	1	
27		4		3	
28		1	2		
29		4	1		
30		4	1	4	
31		3	2		1
32			2		
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34		4	2		
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36		2	3		3
3		4	1		1
38		4	1		1
39		1	3		4
40		2	4		4
4		2	3	1	4
4.		4	3		1
4.		4	1		1
4		3	4		4
4		1	3		3
4		1	2		1
4		1	4		3
	8	1	4		1
	9	4	1		2
	0	1	2		3
5	1	2	2		3

(s.c.macile)

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ED	3	2	1	1
53 54	2	3	4	4
55	3	3	3	3
56	3	3	2	1
57	1	4	4	3
58	1	1	4	1
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67	3	1	3	1
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83	1	3	4	2
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93	2	1	2	3
94	4	1	3	2
95	3	2	3	4
96 97	1	3	1	1
98	1	1	1	
99	4	3	3	3 2 4
100	4	2	4	4

S.c. Maril

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