1. What is the probability of getting a sum of 9 from two throws of a dice ?

(1) 1/6 (2) 1/8 (3) 1/9 (4) 1/2

2. If P(A) = 0.8, P(B) = 0.3 and P(A/B) = 0.6. What is P(A and B) ?

(1) 0.18 (2) 0.24 (3) 0.03 (4) 0.30

3. If P(A/B) = 1/4, P(B/A) = 1/3, then P(A)/P(B) is equal to :

(1) 3/4 (2) 7/12 (3) 4/3 (4) 1/12

4. What should be the value of *K* for $f(x)=\begin{cases} kx, & 0 \le x \le 1 \\ k, & 1 \le x \le 2 \\ -kx+3a, 2 \le x \le 3 & \\ 0 & \text{elsewhere} \end{cases}$

(1) 1/4 (2) 1/2 (3) 1/8 (4) 2

5. The expected value of the random variable X whose probability density is given by

$$f(x)=\begin{cases} \frac{x+1}{8}, & 2 < x < 4 \\ 0, & \text{otherwise} \end{cases}$$

(1) 37/6 (2) 37/12

(3) 37/18 (4) 37/24

6. The relationship between mean μ, variance σ^2 and second moment about the origin μ_2^1 is :

(1) $\sigma^2 = \mu_2^1 - \mu^2$ (2) $\sigma^2 = \mu - \mu_2^1$

(3) $\sigma^2 = \mu_2^1 + \mu$ (4) None of these

7. The joint probability density function of a two dimensional random variable (*X*, *Y*) is given by $f(x, y) = 2, 0 < x < 1, 0\ 2y < x = 0$ elsewhere then :

(1) WLLN holds (2) WLLN does not hold

(3) SLLN holds (4) SLLN does not hold

8. Let $X_1, X_2, ...X_n$ be *n* independent and identically distributed random variable each with mean μ and variance σ^2, and let $\overline{X}_n$ be the sample mean, i.e., $\overline{X}_n = (X_1 + X_2 + ... + X_n)/n$ then for any $\alpha > 0$, as $n \to \infty$ $P(\mu - \alpha \le \overline{X}_n \le \mu + \alpha)$ tends to :

(1) 0 (2) 1 (3) μ (4) σ

9. A random variable X has Poisson distribution. If $2P(X = 2) = P(X = 1) + 2P(X = 0)$, then variance of X is :

(1) 3/2 (2) 2 (3) 1 (4) 1/2

10. For a positive skewed distribution which of the following inequality does not hold :

(1) Median > Mode (2) Mode > Mean

(3) Mean > Median (4) Mean > Mode

11. The relation between the mean and variance of χ^2 with nd.f is :

(1) mean = 2 variance (2) 2 mean = variance

(3) mean = variance (4) none of these

12. If $X \sim B(n, p)$, $Y \sim P(\lambda)$ and $E(X) = E(Y)$:

(1) Var(X) < VarY (2) Var(X) > Var(Y)

(3) Var(X) = Var Y (4) Var(X) can't estimate

13. If the sum of squares of the difference between ten ranks of two series is 33, then the rank correlation co-efficient is :

(1) 0.967 (2) 0.80 (3) 0.725 (4) =0.67

14. The Binomial distribution have number of parameters :

(1) one (2) two (3) three (4) four

15. Given the two lines of regression as $3X - 4Y + 8 = 0$ and $4X - 3Y = 1$, the mean of X and Y are :

(1) $\overline{X} = 4, \overline{Y} = 5$ (2) $\overline{X} = 3, \overline{Y} = 4$

(3) $\overline{X} = 4/3, \overline{Y} = 5/4$ (4) None of these

16. The area under the standard normal curve beyond the lines $Z = \pm 1.96$ is :

(1) 95 percent (2) 90 percent

(3) 5 percent (4) 10 percent

17. If $X \sim N(0, 1)$ and $Y \sim \chi^2/n$, the distribution of the variate $X/\sqrt{Y}$ follows :

(1) Cauchy's distribution (2) Fisher's t-distribution

(3) Student's t-distribution (4) none of the above

18. Mean of the F-distribution with d.f. u_1 and u_2 for $u_2 \geq 3$ is :

(1) $\frac{u_2}{u_1 - 2}$ (2) $\frac{u_1}{u_2 - 2}$

(3) $\frac{u_1}{u_1 - 2}$ (4) $\frac{u_2}{u_2 - 2}$

19. If an estimator T_n of population parameter θ converges in probability to θ as n tends to infinity is said to be :

(1) Sufficient (2) Efficient

(3) Consistent (4) Unbiased

20. For a random sample from a Poisson population $P(\lambda)$, the maximum likelihood estimate of λ is :

(1) median (2) mode

(3) mean (4) geometric mean

21. The diameter of cylindrical rods is assumed to be normally distributed with a variance of 0.04 cm. A sample of 25 rods has a mean diameter of 4.5 cm. 95% confidence limits for population mean are :

(1) 4.5 ∓ 0.004 (2) 4.5 ∓ 0.0016

(3) 4.5 ∓ 0.078 (4) 4.5 ∓ 0.2

22. Let $x_1, x_2, ... x_n$ be a random sample from a Bernoulli population $p^x (1-p)^{n-x}$. A sufficient statistics for p is :

(1) $\sum x_i$ (2) πx_i

(3) $\text{Max}(x_1, x_2, ... x_n)$ (4) $\text{Min}(x_1, x_2, ..., x_n)$

23. Size of the critical region is known as :

(1) Power of the test

(2) Size of type II error

(3) Critical value of the test statistics

(4) Size of the test

24. If $x \geq 1$ is the critical region for testing $H_0 : \theta = 2$ against the alternative $\theta = 1$ on the basis of the single observation from the population :

$f(x, \theta) = \theta \exp(-\theta x), 0 \leq x < \infty$, then size of type II error is :

(1) $1/e$ (2) $1-(1/e)$ (3) e (4) $1-e$

25. Let $X_1, X_2, ... X_n$ be a random sample from a population with *pdf*

$f(x, \theta) = \theta x^{\theta-1}, 0 < x < 1, \theta > 0$, then $t = \underset{i=1}{\overset{n}{\pi}} X_i$ is :

(1) sufficient estimate of θ

(2) not sufficient estimate for θ

(3) sufficient estimate for nθ

(4) not sufficient estimate for nθ

26. How many types of optimum allocation are in common use ?

(1) one (2) two (3) three (4) four

27. Each contrast among K treatments has :

(1) (K – 1) d.f (2) one d.f

(3) K d.f (4) none of these

28. Variance of $\overline{x}_{st}$ under random sampling, proportional allocation and optimum allocation hold the correct inequality as :

(1) $V_{ran}(\overline{x}_{st}) \leq V_{prop}(\overline{x}_{st}) \leq V_{opt}(\overline{x}_{st})$

(2) $V_{ran}(\overline{x}_{st}) \geq V_{opt}(\overline{x}_{st}) \geq V_{prop}(\overline{x}_{st})$

(3) $V_{ran}(\overline{x}_{st}) \geq V_{prop}(\overline{x}_{st}) \geq V_{opt}(\overline{x}_{st})$

(4) all of the above

29. If the sample values are 1, 3, 5, 7, 9 the standard error of sample mean is :

(1) S. E. $= \sqrt{2}$ (2) S. E. $= 1/\sqrt{2}$

(3) S. E. = 2.0 (4) S. E. = 1/2

30. Under proportional allocation, the size of sample from each stratum depends on :

(1) total sample size (2) size of stratum

(3) population size (4) all of the above

31. For estimating the population proportion P in a class of a population having N units, the variance of the estimator p of P based on sample for size n is :

(1) $\frac{N}{N-1} \cdot \frac{PQ}{n}$ (2) $\frac{N}{N-1} \cdot \frac{PQ}{N}$

(3) $\frac{N-n}{N-1} \cdot \frac{PQ}{n}$ (4) $\frac{N-1}{N-n} \cdot \frac{PQ}{n}$

32. Two stage sampling design is more efficient than single stage sampling if the correlation between units in the first stage is :

(1) negative (2) positive

(3) zero (4) none of the above

33. The consumer price index in 1990 increases by 80 percent as compared to the base year 1980. A person in 1980 getting Rs. 60,000 per annum should now get :

(1) Rs. 1,08,000 per annum (2) Rs. 72,000 per annum

(3) Rs. 54,000 per annum (4) Rs. 96,000 per annum

34. The condition for the time reversal test to hold good with usual notations are :

(1) $P_{01} \times P_{10} = 1$ (2) $P_{10} \times P_{01} = 0$

(3) $P_{01} / P_{10} = 1$ (4) $P_{01} + P_{10} = 1$

35. If Laspeyre's price index is 324 and Paasche's price index is 144, then Fisher's ideal index is :

(1) 234 (2) 180 (3) 216 (4) 196

36. For the given five values 17, 26, 20, 35, 44 the three years moving averages are :

(1) 21, 27, 33 (2) 21, 24, 33,

(3) 21, 25, 33 (4) 21, 27, 31

37. A linear trend shows the business movement to a time series towards :

(1) growth (2) decline

(3) stagnation (4) all of the above

38. Given the annual trend with 1981 as origin and X unit = 1 year and Y = annual demand as Y = 148.8 + 7.2X, the monthly trend equation is :

(1) Y = 12.4 + 7.2 X (2) Y = 12.4 + 0.05 X

(3) Y = 12.4 + 0.6 X (4) Y = 148.8 + 0.6 X

39. The central mortality rate m_x in terms of q_x is given by the formula :

(1) $2q_x/(2 + q_x)$ (2) $2q_x/(2 - q_x)$

(3) $q_x/(2 + q_x)$ (4) $q_x/(2 - q_x)$

40. The relation between NRR and GRR is :

(1) NRR and GRR are usually equal

(2) NRR can never exceed GRR

(3) NRR is generally greater than GRR

(4) None of the above

41. The ratio of birth to the total deaths in a year is called :

(1) survival rate (2) total fertility rate

(3) vital index (4) population death rate

42. The following layout stands for :

A	B	C	D
A	C	B	D
B	A	C	C
A	A	B	C

meets the requirement of a :

(1) Completely randomized design

(2) Randomized block design

(3) Latin square design

(4) None of these

43. In the analysis of data of a randomized block design with b blocks and x treatments, the error degrees of freedom are :

(1) $b(x-1)$ (2) $x(b-1)$

(3) $(b-1)(x-1)$ (4) none of these

44. The ratio of the number of replications required in CRD and RBD for the same amount of information is :

(1) 6 : 4 (2) 10 : 6 (3) 10 : 8 (4) 6 : 10

45. If K effects are confounded in a 2^n factorial to have 2^k blocks of size 2^{n-k} units, the number of automatically confounded effect is :

(1) $2^k - k$ (2) $k^2 - k - 1$

(3) $2^k - k - 1$ (4) $2^k - k + 1$

46. The contrast representing the quadratic effect among four treatments is :

(1) $-3T_1 - T_2 + T_3 + 3T_4$

(2) $-T_1 + 3T_2 - 3T_3 + T_4$

(3) $-T_1 - T_2 - T_3 + T_4$

(4) None of these

47. If X is K variate normal with mean μ and covariance matrix $\Sigma = [\sigma_{ij}]$ which is non-singular, then X has a pdf given by :

(1) $f_x(X) = \dfrac{1}{(2\pi)^K |\Sigma|^{1/2}} e^{-\frac{1}{2}(x-\mu)\Sigma(x-\mu)}$

(2) $f_x(X) = \dfrac{1}{(\sqrt{2\pi})^K |\Sigma|^{1-2}} e^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

(3) $f_x(X) = \dfrac{1}{(2\pi)^{K/2} |\Sigma|} e^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

(4) $f_x(X) = \dfrac{1}{(2\pi)^{K/2} |\Sigma|^{K/2}} \exp^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

48. If the joint density of X_1, X_2 and X_3 is given by :

$$f(x_1, x_2, x_3) = \begin{cases} (x_1 + x_2)e^{-x_3} & \text{for } 0 < x_1 < 1; 0 < x_2 < 1;\ x_3 > 0 \\ 0 & , \quad \text{elsewhere} \end{cases}$$

then the regression equation of X_2 on X_1 and X_3 is :

(1) $\left(x_1 + \frac{2}{3}\right) \Big/ (2x_1 + 1)$

(2) $x_1 / (x_1 + 1)$

(3) $(x_1 + x_2)$

(4) $(x_1 + x_2) / x_3$

49. If A be the Wishart matrix following Wishart (Σ, N − 1), which of the following statement is incorrect ?

(1) $\phi_A(\theta) = |I - 2i\Sigma\theta|^{-n/2}; n = N - 1$

(2) If $A = \underset{\begin{array}{cc} q & p-q \end{array}}{\begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix}}{}^{q}_{q-p}$ and $\Sigma = \underset{\begin{array}{cc} q & p-q \end{array}}{\begin{bmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{bmatrix}}{}^{q}_{p-q}$

(3) $E(|A|) = (N-1)|\Sigma|$

(4) $\phi_A(\theta) = |I + 2i\Sigma\theta|^{-n/2}; n = N - 1$

50. If σ_1^2 is the error variance of design - 1 and σ_2^2 of design 2 utilizing the same experiment materials the efficiency of design 1 over 2 is :

(1) $\frac{1}{\sigma_1^2} \Big/ \frac{1}{\sigma_2^2}$

(2) $\frac{1}{\sigma_2^2} \Big/ \frac{1}{\sigma_1^2}$

(3) $\frac{\sigma_1^2 + \sigma_2^2}{\sigma_2^2}$

(4) none of the above

51. In M | M | 1 queueing system, the expected number of customers in the system are :

(1) $L_s = \frac{\lambda}{\mu - \lambda}$

(2) $L_s = \frac{\lambda - \mu}{\lambda}$

(3) $L_s = \frac{\mu}{\mu - \lambda}$

(4) $L_s = \frac{\mu - \lambda}{\mu}$

52. Let N = 10, arrival rate $\lambda = 2$ then for M | M | 1 | N system the expected waiting time in the system for P = 1 is :

(1) $W_s = 10/3$

(2) $W_s = 5/2$

(3) $W_s = 3$

(4) $W_s = 5$

53. A TV repairman finds that the time spent on his job has an exponential distribution with mean 30 min. He repairs sets in the order in which they came in and the arrival of sets is approximately Poisson with an average rate of 10 per 8 hours a day. What is repairman's expected idle time each day ?

(1) 2 hours (2) 3 hours (3) 4 hours (4) 5 hours

54. In M | M | C queueing model the expected number of customers in the system are :

(1) $L_q + \frac{\rho}{C}$ (2) $L_q + \frac{\lambda}{C}$ (3) $L_q + \frac{C}{\rho}$ (4) $L_q + \frac{\mu}{C}$

55. Little formula states the relationship :

(1) W_s, W_q and λ

(2) L_s, L_q and λ

(3) W_s, L_s and λ

(4) None of these

56. Let W_s and W_q be the expected and waiting time in system and queue and L_s and L_q be the expected no. of customers in the system and queue, then :

(1) $\frac{L_s}{W_s} < \frac{L_q}{W_q}$

(2) $\frac{L_s}{W_s} > \frac{L_q}{W_q}$

(3) $\frac{L_s}{W_s} = \frac{L_q}{W_q}$

(4) none of these

57. In linear programming problem :

(1) Objective function, constraints and variables are all linear

(2) Only objective function is linear

(3) Only constraints are to be linear

(4) Variables and constraints are to be linear

58. The maximum value of $Z = 4x + 2y$ subject to $2x + 3y \leq 18$, $x + y \geq 10$, $x, y \geq 0$ is :

(1) 36 (2) 40

(3) 20 (4) None of these

59. If in LPP the number of variable in primal are n and number of constraints in its dual are m, then :

(1) $m \geq n$ (2) $m \leq n$

(3) $m = n$ (4) none of these

60. If the primal has no feasible solution, then its dual has :

(1) unbounded solution

(2) either unbounded or no feasible solution

(3) no feasible solution

(4) feasible solution but not optimal

61. Consider the LPP

$$\text{Maximize } Z = x_1 + x_2 \text{ subject to}$$

$$x_1 - 2x_2 \leq 10$$

$$x_2 - 2x_1 \leq 10$$

$$x_1, x_2 \geq 0$$

then,

(1) the LPP admits an optimal solution

(2) the LPP is unbounded

(3) the LPP admits no feasible solution

(4) the LPP admits a unique feasible solution

62. An assignment problem is a special form of transportation problem where all supply and demand values equal :

(1) 0 (2) 1 (3) 2 (4) 3

63. What happens when maxmin and minimax values of the game are same :

(1) no solution exists
(2) solution is mixed
(3) saddle point-exists
(4) none of these

64. The solution to a transportation problem with m-rows (supplies) and n-columns (destination) is feasible if number of positive allocations are :

(1) $m + n$
(2) $m \times n$
(3) $m + n - 1$
(4) $m + n + 1$

65. A department of a company has three employees with five jobs to be performed. The time that each man takes to perform each is given in the effective matrix :

Employees

Jobs	A	B	C
1	12	10	8
2	8	9	11
3	11	14	12

How should the jobs be allocated one per employee, so as to minimize the total man hours :

(1) $1 \rightarrow C$
$2 \rightarrow B$
$3 \rightarrow A$

(2) $1 \rightarrow B$
$2 \rightarrow C$
$3 \rightarrow A$

(3) $1 \rightarrow C$
$2 \rightarrow A$
$3 \rightarrow B$

(4) $1 \rightarrow A$
$2 \rightarrow B$
$3 \rightarrow C$

66. If the unit cost rises, then optimal order quantity :

(1) increases
(2) decreases
(3) either increase or decrease
(4) none of the above

67. A newspaper –boy buys papers for Rs. 2.60 each and sells them for Rs. 3.60 each. He cannot return unsold newspapers. Daily demand has the following distribution :

No. of outcomes	:	23	24	25	26	27
Probability	:	.01	.03	.06	.10	.20
No. of outcomes	:	28	29	30	31	32
Probability	:	.25	.15	.1	.05	.05

If each day's demand is independent of the previous day's, how many papers should be ordered each day ?

(1) 24 (2) 30 (3) 25 (4) 27

68. A baking company sells cake by one Kg weight. It makes a profit of Rs. 5.00 a Kg on each Kg sold on the day it is baked. If disposes of all cakes not sold on the date it is baked at a loss of Rs. 1.20 a Kg. If demand is known to be rectangular between 2000 to 3000 Kg, then what is the optimal daily amount baked ?

(1) 2807 Kg (2) 2702 Kg

(3) 2608 Kg (4) 2859 Kg

69. Let $[X_n, n \geq 0]$ be a Markov chain with three states 0, 1, 2 and with transition matrix

$$\begin{array}{c|ccc} & 0 & 1 & 2 \\ \hline 0 & 3/4 & 1/4 & 0 \\ 1 & 1/4 & 1/2 & 1/4 \\ 2 & 0 & 3/4 & 1/4 \end{array}$$

and the initial distribution $\Pr[X_0 = i] = 1/3$ for $i = 0, 1, 2$, then $\Pr[X_2 / X_1 = 1]$ is :

(1) $3/4$ (2) $1/4$ (3) $1/2$ (4) $=0$

70. Suppose that the prob. of a dry day (state 0) following a rainy day (state 1) is $1/3$ and the prob. of rainy day following a dry day is $1/2$. Then the prob. that May 3 is a dry day given that May 1 is a dry day is :

(1) $5/12$ (2) $7/12$ (3) $2/3$ (4) $7/18$

71. Which one of the following is incorrect ?

(1) If K is a transient state and j is an arbitrary state then $\overset{(n)}{\Sigma} p_{jk}$ converges and $\lim_{n\to\infty} p_{jk}^{(n)} \to 0$

(2) State j is persistent iff $\sum_{n=0}^{\infty} p_{jj}^{(n)} \neq \infty$

(3) Infinite irreducible Markov chain all states are non-null persistent

(4) If state K is persistent null, then for every j $\lim_{n\to\infty} p_{jk}^{(n)} \to 0$

72. Suppose the customers arrive at a service counter in accordance with a Poisson process with mean rate of 2 per minute. Then the probability that the interval between two successive arrivals is more than 1 minute is :

(1) e^{-2} (2) $e^{-1/2}$ (3) e^{-1} (4) none of these

73. If $N(t)$ is a Poisson process then the autocorrelation (correlation) l co-efficient between $N(t)$ and $N(t + s)$ is :

(1) $t/(t+s)^{½}$ (2) $t^{½}/(t+s)$

(3) $t/(t+s)$ (4) $[t/(t+s)]^{½}$

74. If the intervals between successive occurrences of an event E are independently distributed with a common exponential distribution with mean $1/\lambda$, then the events E form a Poisson process with mean :

(1) λ/t (2) λ (3) λt (4) $1/\lambda$

75. Which one of the following is incorrect statement ?

(1) The sum of two Poisson process is a Poisson process

(2) Time dependent Poisson process is also called Non-homogeneous Poisson process

(3) The difference of two Poisson process is a Poisson process

(4) The mean number of occurrences in an interval of length t in case of Poisson Process is λt

76. The order of convergence in Newton Raphson method is :

(1) 2 (2) 3

(3) 0 (4) None of these

77. The second order Runge-Kutta method is applied to the initial value problem $y' = -y, y(0) = y_0$, with step size h, then, $y(h)$ is :

(1) $y_0(h-1)^2$
(2) $\frac{1}{2}y_0(h^2-2h+2)$
(3) $\frac{y_0}{6}(h^2-2h+2)$
(4) $y_0\left(1-h+\frac{h}{2}+\frac{h^3}{6}\right)$

78. The Newton divided difference polynomial which interpolate $f(0) = 1, f(1) = 3, f(3) = 55$ is :

(1) $8x^2+6x+1$
(2) $8x^2-6x+1$
(3) $8x^2-6x-1$
(4) $8x^2+6x-1$

79. In Simpson's one-third rule the curve $y = f(x)$ is assumed to be a :

(1) circle
(2) parabola
(3) hyperbola
(4) straight line

80. Consider the series $x_{n+1} = \frac{x_n}{2} + \frac{9}{8}x_n, x_0 = 0.5$ obtained from the Newton-Raphson method. The series converges to :

(1) 1.5
(2) $\sqrt{2}$
(3) 1.6
(4) 1.4

81. If Δ and ∇ are the forward and the backward difference operators respectively, then $\Delta - \nabla$ is equal to :

(1) $-\Delta\nabla$
(2) $\Delta\nabla$
(3) $\Delta + \nabla$
(4) $\frac{\Delta}{\nabla}$

82. By Euler's method to initial value problem $\frac{dy}{dx} = x + y, y_0 = y(0) = 0$, the value of y_2 by taking h = 0.2 is :

(1) $y_2 = 0.04$
(2) $y_2 = 0.08$
(3) $y_3 = 0.01$
(4) $y_2 = 0.06$

83. The residue of $f(z) = \frac{z^3}{(z-1)^4(z-2)(z-3)}$ at z = 3 is :

(1) 0
(2) 8
(3) –8
(4) 27/16

84. For the function $f(z) = \frac{z - \sin z}{z^3}, z = 0$ is :

(1) essential singularity
(2) pole
(3) removal singularity
(4) none of these

85. If $f(z) = u + iv$ is a analytic function in a finite region and $u = x^3 - 3xy^2$, the v is equal to :

(1) $3x^2y - y^3 + c$ (2) $3x^2y^2 - y^3$

(3) $3x^2y - y^2 + c$ (4) $3x^2y^2 - y^3$

86. The value of $\int_L Z^n dZ, n \neq 1,$ where $L : |Z| = r$ is :

(1) $2\pi i$ (2) 2π (3) i (4) 0

87. Which of the following function $f(z)$ satisfies Cauch-Riemann equations ?

(1) $f(z) = \overline{z} = x - iy$ at $z = 1 + i$

(2) $f(z) = |z|^2$ at $z\ (z \neq 0)$

(3) $f(z) = \sqrt{|xy|}$ at $z = 0$

(4) $f(z) = \dfrac{x^3(1+i) - y^3(1-i)}{x^2 + y^2}, z \neq 0, f(0) = 0$

88. Which of the following is not analytic ?

(1) sin z (2) cos z

(3) $az^2 + bz + c$ (4) $1/(z-1)$

89. If V and W are subspace of R^n, then :

(1) $V \cup W$ is necessarily a subspace of R^n

(2) $V \cup W$ is never a subspace of R^n

(3) $V \cup W$ is a subspace of R^n if and only if one of V, W is contained in the other

(4) $V \cup W$ is a subspace of R^n if and only if one of V, W is $\{0\}$

90. All the eigen value of the matrix $\begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ lie in the disc :

(1) $|\lambda + 1| \leq 1$ (2) $|\lambda - 1| \leq 1$

(3) $|\lambda + 1| \leq 0$ (4) $|\lambda - 1| \leq 2$

91. A linear transformation $T : R^2 \rightarrow R^2$ such that $T(3, 1) = (2, -4)$ and $T(1, 1) = (0, 2)$. Then $T(7, 8)$ is :

(1) (–1, 3) (2) (–1, 19) (3) (2, –3) (4) (–3, 2)

92. If $A\begin{bmatrix}2 & 1\\3 & -1\end{bmatrix}$ and $I=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$ which of the following is zero matrix :

(1) A^2-A-5I

(2) A^2+A-5I

(3) A^2+A-I

(4) $A^2-3A+5I$

93. Which one of the following quadratic forms is positive definite :

(1) $-x_1^2-x_2^2-x_3^2$

(2) $x_1^2-x_2^2+x_3^2$

(3) $x_1^2+x_2^2+2x_3^2-x_1x_3-2x_2x_3$

(4) $6x_1^2+3x_1^2+3x_1^2-4x_1x_2-2x_2x_3+4x_2x_3$

94. The non-zero vector which is orthogonal to $u_1=(1,2,1)$ and $u_2=(2,5,4)$ in R^3 is :

(1) (1, 3, 2)

(2) (3, –2, 1)

(3) (3, 2, –1)

(4) None of these

95. Ever open set of real numbers is the union of :

(1) Countable collection of disjoint open intervals.

(2) Uncountable collection of disjoint open intervals.

(3) Countable collection of disjoint closed intervals.

(4) Uncountable collection of disjoint closed intervals.

96. The series $1+\frac{3}{\lfloor 1}+\frac{5}{\lfloor 3}+\frac{7}{\lfloor 5}+......$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory

(4) None of these

97. The sequence $\{x_n\}$, where $x_n=\left[1+\frac{1}{n+1}\right]^n$ converges to :

(1) e

(2) 0

(3) 1

(4) None of these

98. Which one of the following statement is ***true*** ?

(1) A constant function is not Riemann integrable

(2) A constant function is Riemann integrable

(3) A constant function may or may not be Riemann integrable

(4) None of these

99. Which of the following real valued function on (0, 1) is uniformly continuous :

(1) $f(x) = 1/x$

(2) $f(x) = \frac{\sin x}{x}$

(3) $f(x) = \sin\frac{1}{x}$

(4) $f(x) = \frac{\cos x}{x}$

100. If $u + iv$ is analytic, the dv is equal to :

(1) $\frac{\partial v}{\partial x}dx - \frac{\partial v}{\partial y}dy$

(2) $-\frac{\partial u}{\partial y}dx + \frac{\partial u}{\partial x}dy$

(3) $\frac{\partial u}{\partial x}dx - \frac{\partial u}{\partial y}dy$

(4) $\frac{\partial u}{\partial y}dx + \frac{\partial u}{\partial x}dy$

1. Which one of the following is incorrect ?

(1) If K is a transient state and j is an arbitrary state then $\overset{(n)}{\Sigma} p_{jk}$ converges and $\lim_{n\to\infty} p_{jk}^{(n)} \to 0$

(2) State j is persistent iff $\sum_{n=0}^{\infty} p_{jj}^{(n)} \neq \infty$

(3) Infinite irreducible Markov chain all states are non-null persistent

(4) If state K is persistent null, then for every j $\lim_{n\to\infty} p_{jk}^{(n)} \to 0$

2. Suppose the customers arrive at a service counter in accordance with a Poisson process with mean rate of 2 per minute. Then the probability that the interval between two successive arrivals is more than 1 minute is :

(1) e^{-2} (2) $e^{-1/2}$ (3) e^{-1} (4) none of these

3. If $N(t)$ is a Poisson process then the autocorrelation (correlation) l co-efficient between $N(t)$ and $N(t+s)$ is :

(1) $t/(t+s)^{1/2}$ (2) $t^{1/2}/(t+s)$

(3) $t/(t+s)$ (4) $[t/(t+s)]^{1/2}$

4. If the intervals between successive occurrences of an event E are independently distributed with a common exponential distribution with mean $1/\lambda$, then the events E form a Poisson process with mean :

(1) λ/t (2) λ (3) λt (4) $1/\lambda$

5. Which one of the following is incorrect statement ?

(1) The sum of two Poisson process is a Poisson process

(2) Time dependent Poisson process is also called Non-homogeneous Poisson process

(3) The difference of two Poisson process is a Poisson process

(4) The mean number of occurrences in an interval of length t in case of Poisson Process is λt

6. The order of convergence in Newton Raphson method is :

(1) 2 (2) 3

(3) 0 (4) None of these

7. The second order Runge-Kutta method is applied to the initial value problem $y' = -y, y(0) = y_0$, with step size h, then, $y(h)$ is :

(1) $y_0(h-1)^2$ (2) $\frac{1}{2}y_0(h^2-2h+2)$

(3) $\frac{y_0}{6}(h^2-2h+2)$ (4) $y_0\left(1-h+\frac{h}{2}+\frac{h^3}{6}\right)$

8. The Newton divided difference polynomial which interpolate $f(0) = 1, f(1) = 3, f(3) = 55$ is :

(1) $8x^2+6x+1$ (2) $8x^2-6x+1$

(3) $8x^2-6x-1$ (4) $8x^2+6x-1$

9. In Simpson's one-third rule the curve $y = f(x)$ is assumed to be a :

(1) circle (2) parabola

(3) hyperbola (4) straight line

10. Consider the series $x_{n+1} = \frac{x_n}{2} + \frac{9}{8}x_n, x_0 = 0.5$ obtained from the Newton-Raphson method. The series converges to :

(1) 1.5 (2) $\sqrt{2}$ (3) 1.6 (4) 1.4

11. In M | M | 1 queueing system, the expected number of customers in the system are :

(1) $L_s = \frac{\lambda}{\mu-\lambda}$ (2) $L_s = \frac{\lambda-\mu}{\lambda}$ (3) $L_s = \frac{\mu}{\mu-\lambda}$ (4) $L_s = \frac{\mu-\lambda}{\mu}$

12. Let N = 10, arrival rate $\lambda = 2$ then for M | M | 1 | N system the expected waiting time in the system for P = 1 is :

(1) $W_s = 10/3$ (2) $W_s = 5/2$

(3) $W_s = 3$ (4) $W_s = 5$

13. A TV repairman finds that the time spent on his job has an exponential distribution with mean 30 min. He repairs sets in the order in which they came in and the arrival of sets is approximately Poisson with an average rate of 10 per 8 hours a day. What is repairman's expected idle time each day ?

(1) 2 hours (2) 3 hours (3) 4 hours (4) 5 hours

14. In M | M | C queueing model the expected number of customers in the system are :

(1) $L_q + \frac{\rho}{C}$ (2) $L_q + \frac{\lambda}{C}$ (3) $L_q + \frac{C}{\rho}$ (4) $L_q + \frac{\mu}{C}$

15. Little formula states the relationship :

(1) W_s, W_q and λ (2) L_s, L_q and λ

(3) W_s, L_s and λ (4) None of these

16. Let W_s and W_q be the expected and waiting time in system and queue and L_s and L_q be the expected no. of customers in the system and queue, then :

(1) $\frac{L_s}{W_s} < \frac{L_q}{W_q}$ (2) $\frac{L_s}{W_s} > \frac{L_q}{W_q}$

(3) $\frac{L_s}{W_s} = \frac{L_q}{W_q}$ (4) none of these

17. In linear programming problem :

(1) Objective function, constraints and variables are all linear

(2) Only objective function is linear

(3) Only constraints are to be linear

(4) Variables and constraints are to be linear

18. The maximum value of $Z = 4x + 2y$ subject to $2x + 3y \leq 18$, $x + y \geq 10$, $x, y \geq 0$ is :

(1) 36 (2) 40

(3) 20 (4) None of these

19. If in LPP the number of variable in primal are n and number of constraints in its dual are m, then :

(1) $m \geq n$ (2) $m \leq n$

(3) $m = n$ (4) none of these

20. If the primal has no feasible solution, then its dual has :

(1) unbounded solution

(2) either unbounded or no feasible solution

(3) no feasible solution

(4) feasible solution but not optimal

21. For estimating the population proportion P in a class of a population having N units, the variance of the estimator p of P based on sample for size n is :

(1) $\frac{N}{N-1}\cdot\frac{PQ}{n}$ (2) $\frac{N}{N-1}\cdot\frac{PQ}{N}$

(3) $\frac{N-n}{N-1}\cdot\frac{PQ}{n}$ (4) $\frac{N-1}{N-n}\cdot\frac{PQ}{n}$

22. Two stage sampling design is more efficient than single stage sampling if the correlation between units in the first stage is :

(1) negative (2) positive

(3) zero (4) none of the above

23. The consumer price index in 1990 increases by 80 percent as compared to the base year 1980. A person in 1980 getting Rs. 60,000 per annum should now get :

(1) Rs. 1,08,000 per annum (2) Rs. 72,000 per annum

(3) Rs. 54,000 per annum (4) Rs. 96,000 per annum

24. The condition for the time reversal test to hold good with usual notations are :

(1) $P_{01} \times P_{10} = 1$ (2) $P_{10} \times P_{01} = 0$

(3) $P_{01} / P_{10} = 1$ (4) $P_{01} + P_{10} = 1$

25. If Laspeyre's price index is 324 and Paasche's price index is 144, then Fisher's ideal index is :

(1) 234 (2) 180 (3) 216 (4) 196

26. For the given five values 17, 26, 20, 35, 44 the three years moving averages are :

(1) 21, 27, 33 (2) 21, 24, 33,

(3) 21, 25, 33 (4) 21, 27, 31

27. A linear trend shows the business movement to a time series towards :

(1) growth (2) decline

(3) stagnation (4) all of the above

28. Given the annual trend with 1981 as origin and X unit = 1 year and Y = annual demand as Y = 148.8 + 7.2X, the monthly trend equation is :

(1) $Y = 12.4 + 7.2\ X$ (2) $Y = 12.4 + 0.05\ X$

(3) $Y = 12.4 + 0.6\ X$ (4) $Y = 148.8 + 0.6\ X$

29. The central mortality rate m_x in terms of q_x is given by the formula :

(1) $2q_x/(2 + q_x)$ (2) $2q_x/(2 - q_x)$

(3) $q_x/(2 + q_x)$ (4) $q_x/(2 - q_x)$

30. The relation between NRR and GRR is :

(1) NRR and GRR are usually equal

(2) NRR can never exceed GRR

(3) NRR is generally greater than GRR

(4) None of the above

31. The relation between the mean and variance of χ^2 with nd.f is :

(1) mean = 2 variance (2) 2 mean = variance

(3) mean = variance (4) none of these

32. If $X \sim B(n, p)$, $Y \sim P(\lambda)$ and $E(X) = E(Y)$:

(1) $Var(X) < VarY$ (2) $Var(X) > Var(Y)$

(3) $Var(X) = Var\ Y$ (4) Var(X) can't estimate

33. If the sum of squares of the difference between ten ranks of two series is 33, then the rank correlation co-efficient is :

(1) 0.967 (2) 0.80 (3) 0.725 (4) =0.67

34. The Binomial distribution have number of parameters :

(1) one (2) two (3) three (4) four

35. Given the two lines of regression as $3X - 4Y + 8 = 0$ and $4X - 3Y = 1$, the mean of X and Y are :

(1) $\overline{X} = 4, \overline{Y} = 5$ (2) $\overline{X} = 3, \overline{Y} = 4$

(3) $\overline{X} = 4/3, \overline{Y} = 5/4$ (4) None of these

36. The area under the standard normal curve beyond the lines Z = ±1.96 is :

(1) 95 percent
(2) 90 percent
(3) 5 percent
(4) 10 percent

37. If $X \sim N(0, 1)$ and $Y \sim \chi^2/n$, the distribution of the variate $X/\sqrt{Y}$ follows :

(1) Cauchy's distribution
(2) Fisher's t-distribution
(3) Student's t-distribution
(4) none of the above

38. Mean of the F-distribution with d. f. u_1 and u_2 for $u_2 \geq 3$ is :

(1) $\frac{u_2}{u_1 - 2}$
(2) $\frac{u_1}{u_2 - 2}$
(3) $\frac{u_1}{u_1 - 2}$
(4) $\frac{u_2}{u_2 - 2}$

39. If an estimator T_n of population parameter θ converges in probability to θ as n tends to infinity is said to be :

(1) Sufficient (2) Efficient (3) Consistent (4) Unbiased

40. For a random sample from a Poisson population $P(\lambda)$, the maximum likelihood estimate of λ is :

(1) median
(2) mode
(3) mean
(4) geometric mean

41. A linear transformation $T : R^2 \rightarrow R^2$ such that $T(3, 1) = (2, -4)$ and $T(1, 1) = (0, 2)$. Then $T(7, 8)$ is :

(1) (–1, 3) (2) (–1, 19) (3) (2, –3) (4) (–3, 2)

42. If $A\begin{bmatrix} 2 & 1 \\ 3 & -1 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ which of the following is zero matrix :

(1) $A^2 - A - 5I$
(2) $A^2 + A - 5I$
(3) $A^2 + A - I$
(4) $A^2 - 3A + 5I$

43. Which one of the following quadratic forms is positive definite :

(1) $-x_1^2 - x_2^2 - x_3^2$

(2) $x_1^2 - x_2^2 + x_3^2$

(3) $x_1^2 + x_2^2 + 2x_3^2 - x_1x_3 - 2x_2x_3$

(4) $6x_1^2 + 3x_2^2 + 3x_3^2 - 4x_1x_2 - 2x_2x_3 + 4x_2x_3$

44. The non-zero vector which is orthogonal to $u_1 = (1,2,1)$ and $u_2 = (2,5,4)$ in R^3 is :

(1) (1, 3, 2)
(2) (3, –2, 1)
(3) (3, 2, –1)
(4) None of these

45. Ever open set of real numbers is the union of :

(1) Countable collection of disjoint open intervals.

(2) Uncountable collection of disjoint open intervals.

(3) Countable collection of disjoint closed intervals.

(4) Uncountable collection of disjoint closed intervals.

46. The series $1+\frac{3}{\underline{|1}}+\frac{5}{\underline{|3}}+\frac{7}{\underline{|5}}+......$ is :

(1) Convergent
(2) Divergent
(3) Oscillatory
(4) None of these

47. The sequence $\{x_n\}$, where $x_n = \left[1+\frac{1}{n+1}\right]^n$ converges to :

(1) e
(2) 0
(3) 1
(4) None of these

48. Which one of the following statement is *true* ?

(1) A constant function is not Riemann integrable

(2) A constant function is Riemann integrable

(3) A constant function may or may not be Riemann integrable

(4) None of these

49. Which of the following real valued function on (0, 1) is uniformly continuous :

(1) $f(x) = 1/x$
(2) $f(x) = \frac{\sin x}{x}$
(3) $f(x) = \sin\frac{1}{x}$
(4) $f(x) = \frac{\cos x}{x}$

50. If $u + iv$ is analytic, the dv is equal to :

(1) $\frac{\partial v}{\partial x}dx - \frac{\partial v}{\partial y}dy$
(2) $-\frac{\partial u}{\partial y}dx + \frac{\partial u}{\partial x}dy$
(3) $\frac{\partial u}{\partial x}dx - \frac{\partial u}{\partial y}dy$
(4) $\frac{\partial u}{\partial y}dx + \frac{\partial u}{\partial x}dy$

51. Consider the LPP

$$\text{Maximize } Z = x_1 + x_2 \text{ subject to}$$

$$x_1 - 2x_2 \le 10$$

$$x_2 - 2x_1 \le 10$$

$$x_1, x_2 \ge 0$$

then,

(1) the LPP admits an optimal solution

(2) the LPP is unbounded

(3) the LPP admits no feasible solution

(4) the LPP admits a unique feasible solution

52. An assignment problem is a special form of transportation problem where all supply and demand values equal :

(1) 0 (2) 1 (3) 2 (4) 3

53. What happens when maxmin and minimax values of the game are same :

(1) no solution exists (2) solution is mixed

(3) saddle point-exists (4) none of these

54. The solution to a transportation problem with m-rows (supplies) and n-columns (destination) is feasible if number of positive allocations are :

(1) m + n (2) m × n (3) m + n − 1 (4) m + n + 1

55. A department of a company has three employees with five jobs to be performed. The time that each man takes to perform each is given in the effective matrix :

		Employees		
		A	**B**	**C**
Jobs	1	12	10	8
	2	8	9	11
	3	11	14	12

How should the jobs be allocated one per employee, so as to minimize the total man hours :

(1) 1 → C, 2 → B, 3 → A

(2) 1 → B, 2 → C, 3 → A

(3) 1 → C, 2 → A, 3 → B

(4) 1 → A, 2 → B, 3 → C

56. If the unit cost rises, then optimal order quantity :

(1) increases

(2) decreases

(3) either increase or decrease

(4) none of the above

57. A newspaper –boy buys papers for Rs. 2.60 each and sells them for Rs. 3.60 each. He cannot return unsold newspapers. Daily demand has the following distribution :

No. of outcomes	:	23	24	25	26	27
Probability	:	.01	.03	.06	.10	.20
No. of outcomes	:	28	29	30	31	32
Probability	:	.25	.15	.1	.05	.05

If each day's demand is independent of the previous day's, how many papers should be ordered each day ?

(1) 24 (2) 30 (3) 25 (4) 27

58. A baking company sells cake by one Kg weight. It makes a profit of Rs. 5.00 a Kg on each Kg sold on the day it is baked. If disposes of all cakes not sold on the date it is baked at a loss of Rs. 1.20 a Kg. If demand is known to be rectangular between 2000 to 3000 Kg, then what is the optimal daily amount baked ?

(1) 2807 Kg (2) 2702 Kg

(3) 2608 Kg (4) 2859 Kg

59. Let $[X_n, n \geq 0]$ be a Markov chain with three states 0, 1, 2 and with transition matrix

$$\begin{array}{c|ccc} & 0 & 1 & 2 \\ \hline 0 & 3/4 & 1/4 & 0 \\ 1 & 1/4 & 1/2 & 1/4 \\ 2 & 0 & 3/4 & 1/4 \end{array}$$

and the initial distribution $\Pr[X_0 = i] = 1/3$ for $i = 0, 1, 2$, then $\Pr[X_2 / X_1 = 1]$ is :

(1) 3/4 (2) 1/4 (3) 1/2 (4) =0

60. Suppose that the prob. of a dry day (state 0) following a rainy day (state 1) is 1/3 and the prob. of rainy day following a dry day is 1/2. Then the prob. that May 3 is a dry day given that May 1 is a dry day is :

(1) 5/12
(2) 7/12
(3) 2/3
(4) 7/18

61. If Δ and ∇ are the forward and the backward difference operators respectively, then $\Delta - \nabla$ is equal to :

(1) $-\Delta\nabla$
(2) $\Delta\nabla$
(3) $\Delta + \nabla$
(4) $\frac{\Delta}{\nabla}$

62. By Euler's method to initial value problem $\frac{dy}{dx} = x + y, y_0 = y(0) = 0$, the value of y_2 by taking h = 0.2 is :

(1) $y_2 = 0.04$
(2) $y_2 = 0.08$
(3) $y_3 = 0.01$
(4) $y_2 = 0.06$

63. The residue of $f(z) = \frac{z^3}{(z-1)^4(z-2)(z-3)}$ at z = 3 is :

(1) 0
(2) 8
(3) –8
(4) 27/16

64. For the function $f(z) = \frac{z - \sin z}{z^3}, z = 0$ is :

(1) essential singularity
(2) pole
(3) removal singularity
(4) none of these

65. If $f(z) = u + iv$ is a analytic function in a finite region and $u = x^3 - 3xy^2$, the v is equal to :

(1) $3x^2y - y^3 + c$
(2) $3x^2y^2 - y^3$
(3) $3x^2y - y^2 + c$
(4) $3x^2y^2 - y^3$

66. The value of $\int_L Z^n dZ, n \neq 1,$ where $L: |Z| = r$ is :

(1) $2\pi i$
(2) 2π
(3) i
(4) 0

67. Which of the following function $f(z)$ satisfies Cauch-Riemann equations ?

(1) $f(z)=\overline{z}=x-iy$ at $z=1+i$

(2) $f(z)=|z|^2$ at z $(z\neq 0)$

(3) $f(z)=\sqrt{|xy|}$ at $z=0$

(4) $f(z)=\dfrac{x^3(1+i)-y^3(1-i)}{x^2+y^2}, z\neq 0,\ f(0)=0$

68. Which of the following is not analytic ?

(1) $\sin z$

(2) $\cos z$

(3) az^2+bz+c

(4) $1/(z-1)$

69. If V and W are subspace of R^n, then :

(1) $V\cup W$ is necessarily a subspace of R^n

(2) $V\cup W$ is never a subspace of R^n

(3) $V\cup W$ is a subspace of R^n if and only if one of V, W is contained in the other

(4) $V\cup W$ is a subspace of R^n if and only if one of V, W is $\{0\}$

70. All the eigen value of the matrix $\begin{bmatrix}1 & 2 & 0\\ 2 & 1 & 0\\ 0 & 0 & -1\end{bmatrix}$ lie in the disc :

(1) $|\lambda+1|\leq 1$

(2) $|\lambda-1|\leq 1$

(3) $|\lambda+1|\leq 0$

(4) $|\lambda-1|\leq 2$

71. The ratio of birth to the total deaths in a year is called :

(1) survival rate

(2) total fertility rate

(3) vital index

(4) population death rate

72. The following layout stands for :

A	B	C	D
A	C	B	D
B	A	C	C
A	A	B	C

meets the requirement of a :

(1) Completely randomized design

(2) Randomized block design

(3) Latin square design

(4) None of these

73. In the analysis of data of a randomized block design with b blocks and x treatments, the error degrees of freedom are :

(1) $b(x-1)$

(2) $x(b-1)$

(3) $(b-1)(x-1)$

(4) none of these

74. The ratio of the number of replications required in CRD and RBD for the same amount of information is :

(1) 6 : 4

(2) 10 : 6

(3) 10 : 8

(4) 6 : 10

75. If K effects are confounded in a 2^n factorial to have 2^k blocks of size 2^{n-k} units, the number of automatically confounded effect is :

(1) $2^k - k$

(2) $k^2 - k - 1$

(3) $2^k - k - 1$

(4) $2^k - k + 1$

76. The contrast representing the quadratic effect among four treatments is :

(1) $-3T_1 - T_2 + T_3 + 3T_4$

(2) $-T_1 + 3T_2 - 3T_3 + T_4$

(3) $-T_1 - T_2 - T_3 + T_4$

(4) None of these

77. If X is K variate normal with mean μ and covariance matrix $\Sigma = [\sigma_{ij}]$ which is non-singular, then X has a pdf given by :

(1) $f_x(X) = \dfrac{1}{(2\pi)^K |\Sigma|^{1/2}} e^{-\frac{1}{2}(x-\mu)\Sigma(x-\mu)}$

(2) $f_x(X) = \dfrac{1}{(\sqrt{2\pi})^K |\Sigma|^{1-2}} e^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

(3) $f_x(X) = \dfrac{1}{(2\pi)^{K/2} |\Sigma|} e^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

(4) $f_x(X) = \dfrac{1}{(2\pi)^{K/2} |\Sigma|^{K/2}} \exp^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

78. If the joint density of X_1, X_2 and X_3 is given by :

$$f(x_1, x_2, x_3) = \begin{cases} (x_1 + x_2)e^{-x_3} & \text{for } 0 < x_1 < 1; 0 < x_2 < 1; x_3 > 0 \\ 0 & , \quad \text{elsewhere} \end{cases}$$

then the regression equation of X_2 on X_1 and X_3 is :

(1) $\left(x_1 + \frac{2}{3}\right) \Big/ (2x_1 + 1)$ (2) $x_1/(x_1 + 1)$

(3) $(x_1 + x_2)$ (4) $(x_1 + x_2)/x_3$

79. If A be the Wishart matrix following Wishart (Σ, N − 1), which of the following statement is incorrect ?

(1) $\phi_A(\theta) = |I - 2i\Sigma\theta|^{-n/2}; n = N - 1$

(2) If $A = \begin{array}{c} \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \begin{matrix} q \\ q-p \end{matrix} \\ \begin{matrix} q & \quad p-q \end{matrix} \end{array}$ and $\Sigma = \begin{array}{c} \begin{bmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{bmatrix} \begin{matrix} q \\ p-q \end{matrix} \\ \begin{matrix} q & \quad p-q \end{matrix} \end{array}$

(3) $E(|A|) = (N-1)|\Sigma|$

(4) $\phi_A(\theta) = |I + 2i\Sigma\theta|^{-n/2}; n = N - 1$

80. If σ_1^2 is the error variance of design - 1 and σ_2^2 of design 2 utilizing the same experiment materials the efficiency of design 1 over 2 is :

(1) $\dfrac{1}{\sigma_1^2} \Big/ \dfrac{1}{\sigma_2^2}$ (2) $\dfrac{1}{\sigma_2^2} \Big/ \dfrac{1}{\sigma_1^2}$ (3) $\dfrac{\sigma_1^2 + \sigma_2^2}{\sigma_2^2}$ (4) none of the above

81. The diameter of cylindrical rods is assumed to be normally distributed with a variance of 0.04 cm. A sample of 25 rods has a mean diameter of 4.5 cm. 95% confidence limits for population mean are :

(1) 4.5 ∓ 0.004 (2) 4.5 ∓ 0.0016

(3) 4.5 ∓ 0.078 (4) 4.5 ∓ 0.2

82. Let $x_1, x_2, \ldots x_n$ be a random sample from a Bernoulli population $p^x(1-p)^{n-x}$. A sufficient statistics for p is :

(1) $\sum x_i$ (2) πx_i

(3) $\text{Max}(x_1, x_2, \ldots . x_n)$ (4) $\text{Min}(x_1, x_2, \ldots ., x_n)$

83. Size of the critical region is known as :

(1) Power of the test

(2) Size of type II error

(3) Critical value of the test statistics

(4) Size of the test

84. If $x \geq 1$ is the critical region for testing $H_0 : \theta = 2$ against the alternative $\theta = 1$ on the basis of the single observation from the population :

$f(x, \theta) = \theta \exp(-\theta x), 0 \leq x < \infty$, then size of type II error is :

(1) $1/e$ (2) $1-(1/e)$

(3) e (4) $1-e$

85. Let $X_1, X_2, \ldots X_n$ be a random sample from a population with *pdf*

$f(x, \theta) = \theta x^{\theta-1}, 0 < x < 1, \theta > 0$, then $t = \underset{i=1}{\overset{n}{\pi}} X_i$ is :

(1) sufficient estimate of θ

(2) not sufficient estimate for θ

(3) sufficient estimate for nθ

(4) not sufficient estimate for nθ

86. How many types of optimum allocation are in common use ?

(1) one (2) two (3) three (4) four

87. Each contrast among K treatments has :

(1) (K – 1) d.f (2) one d.f

(3) K d.f (4) none of these

88. Variance of $\overline{x}_{st}$ under random sampling, proportional allocation and optimum allocation hold the correct inequality as :

(1) $V_{ran}(\overline{x}_{st}) \leq V_{prop}(\overline{x}_{st}) \leq V_{opt}(\overline{x}_{st})$

(2) $V_{ran}(\overline{x}_{st}) \geq V_{opt}(\overline{x}_{st}) \geq V_{prop}(\overline{x}_{st})$

(3) $V_{ran}(\overline{x}_{st}) \geq V_{prop}(\overline{x}_{st}) \geq V_{opt}(\overline{x}_{st})$

(4) all of the above

89. If the sample values are 1, 3, 5, 7, 9 the standard error of sample mean is :

(1) S. E. $=\sqrt{2}$ (2) S. E. $= 1/\sqrt{2}$

(3) S. E. = 2.0 (4) S. E. = 1/2

90. Under proportional allocation, the size of sample from each stratum depends on :

(1) total sample size (2) size of stratum

(3) population size (4) all of the above

91. What is the probability of getting a sum of 9 from two throws of a dice ?

(1) 1/6 (2) 1/8 (3) 1/9 (4) 1/2

92. If P(A) = 0.8, P(B) = 0.3 and P(A/B) = 0.6. What is P(A and B) ?

(1) 0.18 (2) 0.24 (3) 0.03 (4) 0.30

93. If P(A/B) = 1/4, P(B/A) = 1/3, then P(A)/P(B) is equal to :

(1) 3/4 (2) 7/12 (3) 4/3 (4) 1/12

94. What should be the value of K for $f(x)=\begin{cases} kx, & 0 \leq x \leq 1 \\ k, & 1 \leq x \leq 2 \\ -kx+3a, & 2 \leq x \leq 3 \\ 0 & \text{elsewhere} \end{cases}$

(1) 1/4 (2) 1/2 (3) 1/8 (4) 2

95. The expected value of the random variable X whose probability density is given by

$$f(x)=\begin{cases} \frac{x+1}{8}, & 2 < x < 4 \\ 0, & \text{otherwise} \end{cases}$$

(1) 37/6 (2) 37/12

(3) 37/18 (4) 37/24

96. The relationship between mean μ, variance σ^2 and second moment about the origin μ_2^1 is :

(1) $\sigma^2 = \mu_2^1 - \mu^2$
(2) $\sigma^2 = \mu - \mu_2^1$
(3) $\sigma^2 = \mu_2^1 + \mu$
(4) None of these

97. The joint probability density function of a two dimensional random variable (X, Y) is given by $f(x, y) = 2, 0 < x < 1, 0\ 2y < x = 0$ elsewhere then :

(1) WLLN holds
(2) WLLN does not hold
(3) SLLN holds
(4) SLLN does not hold

98. Let $X_1, X_2, ...X_n$ be n independent and identically distributed random variable each with mean μ and variance σ^2, and let $\overline{X}_n$ be the sample mean, i.e., $\overline{X}_n = (X_1 + X_2 + ... + X_n)/n$ then for any $\alpha > 0$, as $n \to \infty$ $P(\mu - \alpha \leq \overline{X}_n \leq \mu + \alpha)$ tends to :

(1) 0
(2) 1
(3) μ
(4) σ

99. A random variable X has Poisson distribution. If $2P(X = 2) = P(X = 1) + 2P(X = 0)$, then variance of X is :

(1) 3/2
(2) 2
(3) 1
(4) 1/2

100. For a positive skewed distribution which of the following inequality does not hold :

(1) Median > Mode
(2) Mode > Mean
(3) Mean > Median
(4) Mean > Mode

1. The ratio of birth to the total deaths in a year is called :

   (1) survival rate (2) total fertility rate

   (3) vital index (4) population death rate

2. The following layout stands for :

A	B	C	D
A	C	B	D
B	A	C	C
A	A	B	C

   meets the requirement of a :

   (1) Completely randomized design

   (2) Randomized block design

   (3) Latin square design

   (4) None of these

3. In the analysis of data of a randomized block design with b blocks and x treatments, the error degrees of freedom are :

   (1) $b(x-1)$ (2) $x(b-1)$

   (3) $(b-1)(x-1)$ (4) none of these

4. The ratio of the number of replications required in CRD and RBD for the same amount of information is :

   (1) 6 : 4 (2) 10 : 6

   (3) 10 : 8 (4) 6 : 10

5. If K effects are confounded in a 2^n factorial to have 2^k blocks of size 2^{n-k} units, the number of automatically confounded effect is :

   (1) $2^k - k$ (2) $k^2 - k - 1$

   (3) $2^k - k - 1$ (4) $2^k - k + 1$

6. The contrast representing the quadratic effect among four treatments is :

   (1) $-3T_1 - T_2 + T_3 + 3T_4$ (2) $-T_1 + 3T_2 - 3T_3 + T_4$

   (3) $-T_1 - T_2 - T_3 + T_4$ (4) None of these

7. If X is K variate normal with mean μ and covariance matrix $\Sigma = [\sigma_{ij}]$ which is non-singular, then X has a pdf given by :

(1) $f_x(X) = \dfrac{1}{(2\pi)^K |\Sigma|^{1/2}} e^{-\frac{1}{2}(x-\mu)\Sigma(x-\mu)}$

(2) $f_x(X) = \dfrac{1}{(\sqrt{2\pi})^K |\Sigma|^{1-2}} e^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

(3) $f_x(X) = \dfrac{1}{(2\pi)^{K/2} |\Sigma|} e^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

(4) $f_x(X) = \dfrac{1}{(2\pi)^{K/2} |\Sigma|^{K/2}} \exp^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

8. If the joint density of X_1, X_2 and X_3 is given by :

$$f(x_1, x_2, x_3) = \begin{cases} (x_1 + x_2)e^{-x_3} & \text{for } 0 < x_1 < 1; 0 < x_2 < 1;\ x_3 > 0 \\ 0 & , \quad \text{elsewhere} \end{cases}$$

then the regression equation of X_2 on X_1 and X_3 is :

(1) $\left(x_1 + \frac{2}{3}\right) \Big/ (2x_1 + 1)$

(2) $x_1 / (x_1 + 1)$

(3) $(x_1 + x_2)$

(4) $(x_1 + x_2) / x_3$

9. If A be the Wishart matrix following Wishart (Σ, N – 1), which of the following statement is incorrect ?

(1) $\phi_A(\theta) = |I - 2i\Sigma\theta|^{-n/2}; n = N - 1$

(2) If $A = \begin{array}{cc} \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} & \begin{array}{l} q \\ q-p \end{array} \\ \begin{array}{cc} q & \quad p-q \end{array} & \end{array}$ and $\Sigma = \begin{array}{cc} \begin{bmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{bmatrix} & \begin{array}{l} q \\ p-q \end{array} \\ \begin{array}{cc} q & \quad p-q \end{array} & \end{array}$

(3) $E(|A|) = (N-1)|\Sigma|$

(4) $\phi_A(\theta) = |I + 2i\Sigma\theta|^{-n/2}; n = N - 1$

10. If σ_1^2 is the error variance of design - 1 and σ_2^2 of design 2 utilizing the same experiment materials the efficiency of design 1 over 2 is :

(1) $\frac{1}{\sigma_1^2} \Big/ \frac{1}{\sigma_2^2}$ (2) $\frac{1}{\sigma_2^2} \Big/ \frac{1}{\sigma_1^2}$

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(1) Power of the test

(2) Size of type II error

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$f(x, \theta) = \theta \exp(-\theta x), 0 \leq x < \infty$, then size of type II error is :

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15. Let $X_1, X_2, ... X_n$ be a random sample from a population with *pdf*

$f(x, \theta) = \theta x^{\theta-1}, 0 < x < 1, \theta > 0$, then $t = \overset{n}{\underset{i=1}{\pi}} X_i$ is :

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16. How many types of optimum allocation are in common use ?

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17. Each contrast among K treatments has :

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(3) $V_{ran}(\overline{x}_{st}) \geq V_{prop}(\overline{x}_{st}) \geq V_{opt}(\overline{x}_{st})$

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19. If the sample values are 1, 3, 5, 7, 9 the standard error of sample mean is :

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22. If P(A) = 0.8, P(B) = 0.3 and P(A/B) = 0.6. What is P(A and B) ?

(1) 0.18 (2) 0.24 (3) 0.03 (4) 0.30

23. If P(A/B) = 1/4, P(B/A) = 1/3, then P(A)/P(B) is equal to :

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24. What should be the value of K for $f(x) = \begin{cases} kx, & 0 \leq x \leq 1 \\ k, & 1 \leq x \leq 2 \\ -kx+3a, & 2 \leq x \leq 3 \\ 0 & \text{elsewhere} \end{cases}$

(1) 1/4 (2) 1/2 (3) 1/8 (4) 2

25. The expected value of the random variable X whose probability density is given by

$$f(x)=\begin{cases}\frac{x+1}{8}, & 2<x<4\\ 0, & \text{otherwise}\end{cases}$$

(1) 37/6 (2) 37/12

(3) 37/18 (4) 37/24

26. The relationship between mean μ, variance σ^2 and second moment about the origin μ_2^1 is :

(1) $\sigma^2=\mu_2^1-\mu^2$ (2) $\sigma^2=\mu-\mu_2^1$

(3) $\sigma^2=\mu_2^1+\mu$ (4) None of these

27. The joint probability density function of a two dimensional random variable (*X*, *Y*) is given by $f(x, y) = 2, 0 < x < 1, 0\ 2y < x = 0$ elsewhere then :

(1) WLLN holds (2) WLLN does not hold

(3) SLLN holds (4) SLLN does not hold

28. Let $X_1, X_2, ...X_n$ be *n* independent and identically distributed random variable each with mean μ and variance σ^2, and let $\overline{X}_n$ be the sample mean, i.e., $\overline{X}_n=(X_1+X_2+....+X_n)/n$ then for any $\alpha>0$, as $n\to\infty$ $P(\mu-\alpha\le\overline{X}_n\le\mu+\alpha)$ tends to :

(1) 0 (2) 1 (3) μ (4) σ

29. A random variable X has Poisson distribution. If 2P(X = 2) = P(X = 1) + 2P(X = 0), then variance of X is :

(1) 3/2 (2) 2 (3) 1 (4) 1/2

30. For a positive skewed distribution which of the following inequality does not hold :

(1) Median > Mode (2) Mode > Mean

(3) Mean > Median (4) Mean > Mode

31. A linear transformation $T:R^2\to R^2$ such that $T(3, 1) = (2, -4)$ and $T(1, 1) = (0, 2)$. Then $T(7, 8)$ is :

(1) (–1, 3) (2) (–1, 19)

(3) (2, –3) (4) (–3, 2)

32. If $A\begin{bmatrix}2 & 1\\ 3 & -1\end{bmatrix}$ and $I=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ which of the following is zero matrix :

(1) A^2-A-5I (2) A^2+A-5I

(3) A^2+A-I (4) $A^2-3A+5I$

33. Which one of the following quadratic forms is positive definite :

(1) $-x_1{}^2-x_2{}^2-x_3{}^2$

(2) $x_1{}^2-x_2{}^2+x_3{}^2$

(3) $x_1{}^2+x_2{}^2+2x_3{}^2-x_1x_3-2x_2x_3$

(4) $6x_1{}^2+3x_2{}^2+3x_3{}^2-4x_1x_2-2x_2x_3+4x_2x_3$

34. The non-zero vector which is orthogonal to $u_1=(1,2,1)$ and $u_2=(2,5,4)$ in R^3 is :

(1) (1, 3, 2) (2) (3, –2, 1)

(3) (3, 2, –1) (4) None of these

35. Ever open set of real numbers is the union of :

(1) Countable collection of disjoint open intervals.

(2) Uncountable collection of disjoint open intervals.

(3) Countable collection of disjoint closed intervals.

(4) Uncountable collection of disjoint closed intervals.

36. The series $1+\frac{3}{\underline{|1}}+\frac{5}{\underline{|3}}+\frac{7}{\underline{|5}}+\ldots\ldots$ is :

(1) Convergent (2) Divergent

(3) Oscillatory (4) None of these

37. The sequence $\{x_n\}$, where $x_n=\left[1+\frac{1}{n+1}\right]^n$ converges to :

(1) e (2) 0 (3) 1 (4) None of these

38. Which one of the following statement is ***true*** ?

(1) A constant function is not Riemann integrable

(2) A constant function is Riemann integrable

(3) A constant function may or may not be Riemann integrable

(4) None of these

39. Which of the following real valued function on (0, 1) is uniformly continuous :

(1) $f(x)=1/x$

(2) $f(x)=\frac{\sin x}{x}$

(3) $f(x)=\sin\frac{1}{x}$

(4) $f(x)=\frac{\cos x}{x}$

40. If $u + iv$ is analytic, the dv is equal to :

(1) $\frac{\partial v}{\partial x}dx-\frac{\partial v}{\partial y}dy$

(2) $-\frac{\partial u}{\partial y}dx+\frac{\partial u}{\partial x}dy$

(3) $\frac{\partial u}{\partial x}dx-\frac{\partial u}{\partial y}dy$

(4) $\frac{\partial u}{\partial y}dx+\frac{\partial u}{\partial x}dy$

41. Consider the LPP

$$\text{Maximize } Z = x_1+x_2 \text{ subject to}$$
$$x_1-2x_2\le 10$$
$$x_2-2x_1\le 10$$
$$x_1, x_2\ge 0$$

then,

(1) the LPP admits an optimal solution

(2) the LPP is unbounded

(3) the LPP admits no feasible solution

(4) the LPP admits a unique feasible solution

42. An assignment problem is a special form of transportation problem where all supply and demand values equal :

(1) 0 (2) 1 (3) 2 (4) 3

43. What happens when maxmin and minimax values of the game are same :

(1) no solution exists

(2) solution is mixed

(3) saddle point-exists

(4) none of these

44. The solution to a transportation problem with m-rows (supplies) and n-columns (destination) is feasible if number of positive allocations are :

(1) m + n (2) m × n (3) m + n − 1 (4) m + n + 1

45. A department of a company has three employees with five jobs to be performed. The time that each man takes to perform each is given in the effective matrix :

$$\begin{array}{cc|ccc|} & & \multicolumn{3}{c}{\textbf{Employees}} \\ & & A & B & C \\ \cline{3-5} & 1 & 12 & 10 & 8 \\ \textbf{Jobs} & 2 & 8 & 9 & 11 \\ & 3 & 11 & 14 & 12 \\ \cline{3-5} \end{array}$$

How should the jobs be allocated one per employee, so as to minimize the total man hours :

(1) 1 → C
2 → B
3 → A

(2) 1 → B
2 → C
3 → A

(3) 1 → C
2 → A
3 → B

(4) 1 → A
2 → B
3 → C

46. If the unit cost rises, then optimal order quantity :

(1) increases

(2) decreases

(3) either increase or decrease

(4) none of the above

47. A newspaper –boy buys papers for Rs. 2.60 each and sells them for Rs. 3.60 each. He cannot return unsold newspapers. Daily demand has the following distribution :

No. of outcomes	:	23	24	25	26	27
Probability	:	.01	.03	.06	.10	.20
No. of outcomes	:	28	29	30	31	32
Probability	:	.25	.15	.1	.05	.05

If each day's demand is independent of the previous day's, how many papers should be ordered each day ?

(1) 24 (2) 30 (3) 25 (4) 27

48. A baking company sells cake by one Kg weight. It makes a profit of Rs. 5.00 a Kg on each Kg sold on the day it is baked. If disposes of all cakes not sold on the date it is baked at a loss of Rs. 1.20 a Kg. If demand is known to be rectangular between 2000 to 3000 Kg, then what is the optimal daily amount baked ?

(1) 2807 Kg (2) 2702 Kg

(3) 2608 Kg (4) 2859 Kg

49. Let $[X_n, n \geq 0]$ be a Markov chain with three states 0, 1, 2 and with transition matrix

$$\begin{array}{c} \\ 0 \\ 1 \\ 2 \end{array}\begin{array}{c} \begin{array}{ccc} 0 & 1 & 2 \end{array} \\ \begin{bmatrix} 3/4 & 1/4 & 0 \\ 1/4 & 1/2 & 1/4 \\ 0 & 3/4 & 1/4 \end{bmatrix} \end{array}$$

and the initial distribution $\Pr[X_0 = i] = 1/3$ for $i = 0, 1, 2$, then $\Pr[X_2 / X_1 = 1]$ is :

(1) 3/4 (2) 1/4 (3) 1/2 (4) =0

50. Suppose that the prob. of a dry day (state 0) following a rainy day (state 1) is 1/3 and the prob. of rainy day following a dry day is 1/2. Then the prob. that May 3 is a dry day given that May 1 is a dry day is :

(1) 5/12 (2) 7/12 (3) 2/3 (4) 7/18

51. For estimating the population proportion P in a class of a population having N units, the variance of the estimator p of P based on sample for size n is :

(1) $\frac{N}{N-1} \cdot \frac{PQ}{n}$ (2) $\frac{N}{N-1} \cdot \frac{PQ}{N}$

(3) $\frac{N-n}{N-1} \cdot \frac{PQ}{n}$ (4) $\frac{N-1}{N-n} \cdot \frac{PQ}{n}$

52. Two stage sampling design is more efficient than single stage sampling if the correlation between units in the first stage is :

(1) negative (2) positive (3) zero (4) none of the above

53. The consumer price index in 1990 increases by 80 percent as compared to the base year 1980. A person in 1980 getting Rs. 60,000 per annum should now get :

(1) Rs. 1,08,000 per annum (2) Rs. 72,000 per annum

(3) Rs. 54,000 per annum (4) Rs. 96,000 per annum

54. The condition for the time reversal test to hold good with usual notations are :

(1) $P_{01} \times P_{10} = 1$
(2) $P_{10} \times P_{01} = 0$
(3) $P_{01} / P_{10} = 1$
(4) $P_{01} + P_{10} = 1$

55. If Laspeyre's price index is 324 and Paasche's price index is 144, then Fisher's ideal index is :

(1) 234
(2) 180
(3) 216
(4) 196

56. For the given five values 17, 26, 20, 35, 44 the three years moving averages are :

(1) 21, 27, 33
(2) 21, 24, 33,
(3) 21, 25, 33
(4) 21, 27, 31

57. A linear trend shows the business movement to a time series towards :

(1) growth
(2) decline
(3) stagnation
(4) all of the above

58. Given the annual trend with 1981 as origin and X unit = 1 year and Y = annual demand as Y = 148.8 + 7.2X, the monthly trend equation is :

(1) Y = 12.4 + 7.2 X
(2) Y = 12.4 + 0.05 X
(3) Y = 12.4 + 0.6 X
(4) Y = 148.8 + 0.6 X

59. The central mortality rate m_x in terms of q_x is given by the formula :

(1) $2q_x/(2 + q_x)$
(2) $2q_x/(2 - q_x)$
(3) $q_x/(2 + q_x)$
(4) $q_x/(2 - q_x)$

60. The relation between NRR and GRR is :

(1) NRR and GRR are usually equal
(2) NRR can never exceed GRR
(3) NRR is generally greater than GRR
(4) None of the above

61. Which one of the following is incorrect ?

(1) If K is a transient state and j is an arbitrary state then $\overset{(n)}{\Sigma} p_{jk}$ converges and $\lim_{n\to\infty} p_{jk}^{(n)} \to 0$

(2) State j is persistent iff $\sum_{n=0}^{\infty} p_{jj}^{(n)} \neq \infty$

(3) Infinite irreducible Markov chain all states are non-null persistent

(4) If state K is persistent null, then for every j $\lim_{n\to\infty} p_{jk}^{(n)} \to 0$

62. Suppose the customers arrive at a service counter in accordance with a Poisson process with mean rate of 2 per minute. Then the probability that the interval between two successive arrivals is more than 1 minute is :

(1) e^{-2} (2) $e^{-1/2}$ (3) e^{-1} (4) none of these

63. If $N(t)$ is a Poisson process then the autocorrelation (correlation) l co-efficient between $N(t)$ and $N(t+s)$ is :

(1) $t/(t+s)^{½}$ (2) $t^{½}/(t+s)$

(3) $t/(t+s)$ (4) $[t/(t+s)]^{½}$

64. If the intervals between successive occurrences of an event E are independently distributed with a common exponential distribution with mean $1/\lambda$, then the events E form a Poisson process with mean :

(1) λ/t (2) λ (3) λt (4) $1/\lambda$

65. Which one of the following is incorrect statement ?

(1) The sum of two Poisson process is a Poisson process

(2) Time dependent Poisson process is also called Non-homogeneous Poisson process

(3) The difference of two Poisson process is a Poisson process

(4) The mean number of occurrences in an interval of length t in case of Poisson Process is λt

66. The order of convergence in Newton Raphson method is :

(1) 2 (2) 3

(3) 0 (4) None of these

67. The second order Runge-Kutta method is applied to the initial value problem $y' = -y, y(0) = y_0$, with step size h, then, $y(h)$ is :

(1) $y_0(h-1)^2$ (2) $\frac{1}{2}y_0(h^2-2h+2)$

(3) $\frac{y_0}{6}(h^2-2h+2)$ (4) $y_0\left(1-h+\frac{h}{2}+\frac{h^3}{6}\right)$

68. The Newton divided difference polynomial which interpolate $f(0) = 1, f(1) = 3, f(3) = 55$ is :

(1) $8x^2+6x+1$ (2) $8x^2-6x+1$

(3) $8x^2-6x-1$ (4) $8x^2+6x-1$

69. In Simpson's one-third rule the curve $y = f(x)$ is assumed to be a :

(1) circle (2) parabola

(3) hyperbola (4) straight line

70. Consider the series $x_{n+1} = \frac{x_n}{2} + \frac{9}{8}x_n, x_0 = 0.5$ obtained from the Newton-Raphson method. The series converges to :

(1) 1.5 (2) $\sqrt{2}$ (3) 1.6 (4) 1.4

71. If Δ and ∇ are the forward and the backward difference operators respectively, then $\Delta - \nabla$ is equal to :

(1) $-\Delta\nabla$ (2) $\Delta\nabla$ (3) $\Delta + \nabla$ (4) $\frac{\Delta}{\nabla}$

72. By Euler's method to initial value problem $\frac{dy}{dx} = x + y, y_0 = y(0) = 0$, the value of y_2 by taking h = 0.2 is :

(1) $y_2 = 0.04$ (2) $y_2 = 0.08$

(3) $y_3 = 0.01$ (4) $y_2 = 0.06$

73. The residue of $f(z) = \frac{z^3}{(z-1)^4(z-2)(z-3)}$ at z = 3 is :

(1) 0 (2) 8 (3) –8 (4) 27/16

74. For the function $f(z) = \frac{z - \sin z}{z^3}, z = 0$ is :

(1) essential singularity (2) pole

(3) removal singularity (4) none of these

75. If $f(z) = u + iv$ is a analytic function in a finite region and $u = x^3 - 3xy^2$, the v is equal to :

(1) $3x^2y - y^3 + c$ (2) $3x^2y^2 - y^3$

(3) $3x^2y - y^2 + c$ (4) $3x^2y^2 - y^3$

76. The value of $\int_L Z^n dZ, n \neq 1,$ where $L : |Z| = r$ is :

(1) $2\pi i$ (2) 2π (3) i (4) 0

77. Which of the following function $f(z)$ satisfies Cauch-Riemann equations ?

(1) $f(z) = \bar{z} = x - iy$ at $z = 1 + i$

(2) $f(z) = |z|^2$ at z $(z \neq 0)$

(3) $f(z) = \sqrt{|xy|}$ at $z = 0$

(4) $f(z) = \frac{x^3(1+i) - y^3(1-i)}{x^2 + y^2}, z \neq 0, f(0) = 0$

78. Which of the following is not analytic ?

(1) $\sin z$ (2) $\cos z$

(3) $az^2 + bz + c$ (4) $1/(z - 1)$

79. If V and W are subspace of R^n, then :

(1) $V \cup W$ is necessarily a subspace of R^n

(2) $V \cup W$ is never a subspace of R^n

(3) $V \cup W$ is a subspace of R^n if and only if one of V, W is contained in the other

(4) $V \cup W$ is a subspace of R^n if and only if one of V, W is $\{0\}$

80. All the eigen value of the matrix $\begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ lie in the disc :

(1) $|\lambda + 1| \leq 1$ (2) $|\lambda - 1| \leq 1$

(3) $|\lambda + 1| \leq 0$ (4) $|\lambda - 1| \leq 2$

81. The relation between the mean and variance of χ^2 with nd.f is :

(1) mean = 2 variance (2) 2 mean = variance

(3) mean = variance (4) none of these

82. If X ~ B(n, p), Y ~P(λ) and E(X) = E(Y) :

(1) Var(X) < VarY (2) Var(X) > Var(Y)

(3) Var(X) = Var Y (4) Var(X) can't estimate

83. If the sum of squares of the difference between ten ranks of two series is 33, then the rank correlation co-efficient is :

(1) 0.967 (2) 0.80 (3) 0.725 (4) =0.67

84. The Binomial distribution have number of parameters :

(1) one (2) two (3) three (4) four

85. Given the two lines of regression as $3X - 4Y + 8 = 0$ and $4X - 3Y = 1$, the mean of X and Y are :

(1) $\overline{X} = 4, \overline{Y} = 5$ (2) $\overline{X} = 3, \overline{Y} = 4$

(3) $\overline{X} = 4/3, \overline{Y} = 5/4$ (4) None of these

86. The area under the standard normal curve beyond the lines Z = ±1.96 is :

(1) 95 percent (2) 90 percent (3) 5 percent (4) 10 percent

87. If $X \sim N(0, 1)$ and $Y \sim \chi^2/n$, the distribution of the variate $X/\sqrt{Y}$ follows :

(1) Cauchy's distribution (2) Fisher's t-distribution

(3) Student's t-distribution (4) none of the above

88. Mean of the F-distribution with d.f. u_1 and u_2 for $u_2 \geq 3$ is :

(1) $\frac{u_2}{u_1 - 2}$ (2) $\frac{u_1}{u_2 - 2}$

(3) $\frac{u_1}{u_1 - 2}$ (4) $\frac{u_2}{u_2 - 2}$

89. If an estimator T_n of population parameter θ converges in probability to θ as n tends to infinity is said to be :

(1) Sufficient (2) Efficient

(3) Consistent (4) Unbiased

90. For a random sample from a Poisson population P(λ), the maximum likelihood estimate of λ is :

(1) median (2) mode (3) mean (4) geometric mean

91. In M | M | 1 queueing system, the expected number of customers in the system are :

(1) $L_s = \frac{\lambda}{\mu - \lambda}$
(2) $L_s = \frac{\lambda - \mu}{\lambda}$
(3) $L_s = \frac{\mu}{\mu - \lambda}$
(4) $L_s = \frac{\mu - \lambda}{\mu}$

92. Let N = 10, arrival rate $\lambda = 2$ then for M | M | 1 | N system the expected waiting time in the system for P = 1 is :

(1) $W_s = 10/3$
(2) $W_s = 5/2$
(3) $W_s = 3$
(4) $W_s = 5$

93. A TV repairman finds that the time spent on his job has an exponential distribution with mean 30 min. He repairs sets in the order in which they came in and the arrival of sets is approximately Poisson with an average rate of 10 per 8 hours a day. What is repairman's expected idle time each day ?

(1) 2 hours
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94. In M | M | C queueing model the expected number of customers in the system are :

(1) $L_q + \frac{\rho}{C}$
(2) $L_q + \frac{\lambda}{C}$
(3) $L_q + \frac{C}{\rho}$
(4) $L_q + \frac{\mu}{C}$

95. Little formula states the relationship :

(1) W_s, W_q and λ
(2) L_s, L_q and λ
(3) W_s, L_s and λ
(4) None of these

96. Let W_s and W_q be the expected and waiting time in system and queue and L_s and L_q be the expected no. of customers in the system and queue, then :

(1) $\frac{L_s}{W_s} < \frac{L_q}{W_q}$
(2) $\frac{L_s}{W_s} > \frac{L_q}{W_q}$
(3) $\frac{L_s}{W_s} = \frac{L_q}{W_q}$
(4) none of these

97. In linear programming problem :

(1) Objective function, constraints and variables are all linear

(2) Only objective function is linear

(3) Only constraints are to be linear

(4) Variables and constraints are to be linear

98. The maximum value of $Z = 4x + 2y$ subject to $2x + 3y \leq 18$, $x + y \geq 10$, $x, y \geq 0$ is :

(1) 36 (2) 40

(3) 20 (4) None of these

99. If in LPP the number of variable in primal are n and number of constraints in its dual are m, then :

(1) $m \geq n$ (2) $m \leq n$

(3) $m = n$ (4) none of these

100. If the primal has no feasible solution, then its dual has :

(1) unbounded solution

(2) either unbounded or no feasible solution

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1. The relation between the mean and variance of χ^2 with nd.f is :

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9. If an estimator T_n of population parameter θ converges in probability to θ as n tends to infinity is said to be :

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10. For a random sample from a Poisson population P(λ), the maximum likelihood estimate of λ is :

(1) median (2) mode

(3) mean (4) geometric mean

11. A linear transformation $T: R^2 \to R^2$ such that $T(3, 1) = (2, -4)$ and $T(1, 1) = (0, 2)$. Then $T(7, 8)$ is :

(1) (–1, 3) (2) (–1, 19)

(3) (2, –3) (4) (–3, 2)

12. If $A\begin{bmatrix} 2 & 1 \\ 3 & -1 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ which of the following is zero matrix :

(1) $A^2 - A - 5I$ (2) $A^2 + A - 5I$

(3) $A^2 + A - I$ (4) $A^2 - 3A + 5I$

13. Which one of the following quadratic forms is positive definite :

(1) $-x_1{}^2 - x_2{}^2 - x_3{}^2$

(2) $x_1{}^2 - x_2{}^2 + x_3{}^2$

(3) $x_1{}^2 + x_2{}^2 + 2x_3{}^2 - x_1x_3 - 2x_2x_3$

(4) $6x_1{}^2 + 3x_2{}^2 + 3x_3{}^2 - 4x_1x_2 - 2x_2x_3 + 4x_2x_3$

14. The non-zero vector which is orthogonal to $u_1 = (1,2,1)$ and $u_2 = (2,5,4)$ in R^3 is :

(1) (1, 3, 2) (2) (3, –2, 1)

(3) (3, 2, –1) (4) None of these

15. Ever open set of real numbers is the union of :

(1) Countable collection of disjoint open intervals.

(2) Uncountable collection of disjoint open intervals.

(3) Countable collection of disjoint closed intervals.

(4) Uncountable collection of disjoint closed intervals.

16. The series $1 + \frac{3}{\lfloor 1} + \frac{5}{\lfloor 3} + \frac{7}{\lfloor 5} + ...$ is :

(1) Convergent (2) Divergent

(3) Oscillatory (4) None of these

17. The sequence $\{x_n\}$, where $x_n = \left[1+\frac{1}{n+1}\right]^n$ converges to :

(1) e (2) 0 (3) 1 (4) None of these

18. Which one of the following statement is ***true*** ?

(1) A constant function is not Riemann integrable

(2) A constant function is Riemann integrable

(3) A constant function may or may not be Riemann integrable

(4) None of these

19. Which of the following real valued function on (0, 1) is uniformly continuous :

(1) $f(x)=1/x$ (2) $f(x)=\frac{\sin x}{x}$

(3) $f(x)=\sin\frac{1}{x}$ (4) $f(x)=\frac{\cos x}{x}$

20. If $u + iv$ is analytic, the dv is equal to :

(1) $\frac{\partial v}{\partial x}dx-\frac{\partial v}{\partial y}dy$ (2) $-\frac{\partial u}{\partial y}dx+\frac{\partial u}{\partial x}dy$

(3) $\frac{\partial u}{\partial x}dx-\frac{\partial u}{\partial y}dy$ (4) $\frac{\partial u}{\partial y}dx+\frac{\partial u}{\partial x}dy$

21. Which one of the following is incorrect ?

(1) If K is a transient state and j is an arbitrary state then $\overset{(n)}{\sum p_{jk}}$ converges and $\lim_{n\to\infty} p_{jk}^{(n)} \to 0$

(2) State j is persistent iff $\sum_{n=0}^{\infty} p_{jj}^{(n)} \neq \infty$

(3) Infinite irreducible Markov chain all states are non-null persistent

(4) If state K is persistent null, then for every j $\lim_{n\to\infty} p_{jk}^{(n)} \to 0$

22. Suppose the customers arrive at a service counter in accordance with a Poisson process with mean rate of 2 per minute. Then the probability that the interval between two successive arrivals is more than 1 minute is :

(1) e^{-2} (2) $e^{-1/2}$ (3) e^{-1} (4) none of these

23. If $N(t)$ is a Poisson process then the autocorrelation (correlation) l co-efficient between $N(t)$ and $N(t+s)$ is :

(1) $t/(t+s)^{1/2}$ (2) $t^{1/2}/(t+s)$

(3) $t/(t+s)$ (4) $[t/(t+s)]^{1/2}$

24. If the intervals between successive occurrences of an event E are independently distributed with a common exponential distribution with mean $1/\lambda$, then the events E form a Poisson process with mean :

(1) λ/t (2) λ (3) λt (4) $1/\lambda$

25. Which one of the following is incorrect statement ?

(1) The sum of two Poisson process is a Poisson process

(2) Time dependent Poisson process is also called Non-homogeneous Poisson process

(3) The difference of two Poisson process is a Poisson process

(4) The mean number of occurrences in an interval of length t in case of Poisson Process is λt

26. The order of convergence in Newton Raphson method is :

(1) 2 (2) 3

(3) 0 (4) None of these

27. The second order Runge-Kutta method is applied to the initial value problem $y' = -y, y(0) = y_0$, with step size h, then, $y(h)$ is :

(1) $y_0(h-1)^2$ (2) $\frac{1}{2}y_0(h^2-2h+2)$

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(2) $L_s = \frac{\lambda - \mu}{\lambda}$

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(2) $\frac{L_s}{W_s} > \frac{L_q}{W_q}$

(3) $\frac{L_s}{W_s} = \frac{L_q}{W_q}$

(4) none of these

37. In linear programming problem :

(1) Objective function, constraints and variables are all linear

(2) Only objective function is linear

(3) Only constraints are to be linear

(4) Variables and constraints are to be linear

38. The maximum value of $Z = 4x + 2y$ subject to $2x + 3y \leq 18$, $x + y \geq 10$, $x, y \geq 0$ is :

(1) 36 (2) 40

(3) 20 (4) None of these

39. If in LPP the number of variable in primal are n and number of constraints in its dual are m, then :

(1) $m \geq n$ (2) $m \leq n$

(3) $m = n$ (4) none of these

40. If the primal has no feasible solution, then its dual has :

(1) unbounded solution

(2) either unbounded or no feasible solution

(3) no feasible solution

(4) feasible solution but not optimal

41. For estimating the population proportion P in a class of a population having N units, the variance of the estimator p of P based on sample for size n is :

(1) $\frac{N}{N-1} \cdot \frac{PQ}{n}$ (2) $\frac{N}{N-1} \cdot \frac{PQ}{N}$

(3) $\frac{N-n}{N-1} \cdot \frac{PQ}{n}$ (4) $\frac{N-1}{N-n} \cdot \frac{PQ}{n}$

42. Two stage sampling design is more efficient than single stage sampling if the correlation between units in the first stage is :

(1) negative (2) positive

(3) zero (4) none of the above

43. The consumer price index in 1990 increases by 80 percent as compared to the base year 1980. A person in 1980 getting Rs. 60,000 per annum should now get :

(1) Rs. 1,08,000 per annum
(2) Rs. 72,000 per annum
(3) Rs. 54,000 per annum
(4) Rs. 96,000 per annum

44. The condition for the time reversal test to hold good with usual notations are :

(1) $P_{01} \times P_{10} = 1$
(2) $P_{10} \times P_{01} = 0$
(3) $P_{01} / P_{10} = 1$
(4) $P_{01} + P_{10} = 1$

45. If Laspeyre's price index is 324 and Paasche's price index is 144, then Fisher's ideal index is :

(1) 234
(2) 180
(3) 216
(4) 196

46. For the given five values 17, 26, 20, 35, 44 the three years moving averages are :

(1) 21, 27, 33
(2) 21, 24, 33,
(3) 21, 25, 33
(4) 21, 27, 31

47. A linear trend shows the business movement to a time series towards :

(1) growth
(2) decline
(3) stagnation
(4) all of the above

48. Given the annual trend with 1981 as origin and X unit = 1 year and Y = annual demand as $Y = 148.8 + 7.2X$, the monthly trend equation is :

(1) $Y = 12.4 + 7.2\ X$
(2) $Y = 12.4 + 0.05\ X$
(3) $Y = 12.4 + 0.6\ X$
(4) $Y = 148.8 + 0.6\ X$

49. The central mortality rate m_x in terms of q_x is given by the formula :

(1) $2q_x/(2 + q_x)$
(2) $2q_x/(2 - q_x)$
(3) $q_x/(2 + q_x)$
(4) $q_x/(2 - q_x)$

50. The relation between NRR and GRR is :

(1) NRR and GRR are usually equal
(2) NRR can never exceed GRR
(3) NRR is generally greater than GRR
(4) None of the above

51. The diameter of cylindrical rods is assumed to be normally distributed with a variance of 0.04 cm. A sample of 25 rods has a mean diameter of 4.5 cm. 95% confidence limits for population mean are :

(1) 4.5 ∓ 0.004 (2) 4.5 ∓ 0.0016

(3) 4.5 ∓ 0.078 (4) 4.5 ∓ 0.2

52. Let $x_1, x_2, ... x_n$ be a random sample from a Bernoulli population $p^x(1-p)^{n-x}$. A sufficient statistics for p is :

(1) $\sum x_i$ (2) πx_i

(3) $\text{Max}(x_1, x_2, ... x_n)$ (4) $\text{Min}(x_1, x_2, ..., x_n)$

53. Size of the critical region is known as :

(1) Power of the test

(2) Size of type II error

(3) Critical value of the test statistics

(4) Size of the test

54. If $x \geq 1$ is the critical region for testing $H_0 : \theta = 2$ against the alternative $\theta = 1$ on the basis of the single observation from the population :

$f(x, \theta) = \theta \exp(-\theta x), 0 \leq x < \infty$, then size of type II error is :

(1) $1/e$ (2) $1-(1/e)$ (3) e (4) $1-e$

55. Let $X_1, X_2, ... X_n$ be a random sample from a population with *pdf*

$f(x, \theta) = \theta x^{\theta-1}, 0 < x < 1, \theta > 0$, then $t = \overset{n}{\underset{i=1}{\pi}} X_i$ is :

(1) sufficient estimate of θ

(2) not sufficient estimate for θ

(3) sufficient estimate for nθ

(4) not sufficient estimate for nθ

56. How many types of optimum allocation are in common use ?

(1) one (2) two (3) three (4) four

57. Each contrast among K treatments has :

(1) (K – 1) d.f (2) one d.f

(3) K d.f (4) none of these

58. Variance of $\overline{x}_{st}$ under random sampling, proportional allocation and optimum allocation hold the correct inequality as :

(1) $V_{ran}(\overline{x}_{st}) \leq V_{prop}(\overline{x}_{st}) \leq V_{opt}(\overline{x}_{st})$

(2) $V_{ran}(\overline{x}_{st}) \geq V_{opt}(\overline{x}_{st}) \geq V_{prop}(\overline{x}_{st})$

(3) $V_{ran}(\overline{x}_{st}) \geq V_{prop}(\overline{x}_{st}) \geq V_{opt}(\overline{x}_{st})$

(4) all of the above

59. If the sample values are 1, 3, 5, 7, 9 the standard error of sample mean is :

(1) S. E. $= \sqrt{2}$ (2) S. E. $= 1/\sqrt{2}$

(3) S. E. $= 2.0$ (4) S. E. $= 1/2$

60. Under proportional allocation, the size of sample from each stratum depends on :

(1) total sample size (2) size of stratum

(3) population size (4) all of the above

61. The ratio of birth to the total deaths in a year is called :

(1) survival rate (2) total fertility rate

(3) vital index (4) population death rate

62. The following layout stands for :

A	B	C	D
A	C	B	D
B	A	C	C
A	A	B	C

meets the requirement of a :

(1) Completely randomized design

(2) Randomized block design

(3) Latin square design

(4) None of these

63. In the analysis of data of a randomized block design with b blocks and x treatments, the error degrees of freedom are :

(1) $b(x-1)$ (2) $x(b-1)$

(3) $(b-1)(x-1)$ (4) none of these

64. The ratio of the number of replications required in CRD and RBD for the same amount of information is :

(1) 6 : 4 (2) 10 : 6 (3) 10 : 8 (4) 6 : 10

65. If K effects are confounded in a 2^n factorial to have 2^k blocks of size 2^{n-k} units, the number of automatically confounded effect is :

(1) $2^k - k$ (2) $k^2 - k - 1$

(3) $2^k - k - 1$ (4) $2^k - k + 1$

66. The contrast representing the quadratic effect among four treatments is :

(1) $-3T_1 - T_2 + T_3 + 3T_4$ (2) $-T_1 + 3T_2 - 3T_3 + T_4$

(3) $-T_1 - T_2 - T_3 + T_4$ (4) None of these

67. If X is K variate normal with mean μ and covariance matrix $\Sigma = [\sigma_{ij}]$ which is non-singular, then X has a pdf given by :

(1) $f_x(X) = \dfrac{1}{(2\pi)^K |\Sigma|^{1/2}} e^{-\frac{1}{2}(x-\mu)\Sigma(x-\mu)}$

(2) $f_x(X) = \dfrac{1}{(\sqrt{2\pi})^K |\Sigma|^{1-2}} e^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

(3) $f_x(X) = \dfrac{1}{(2\pi)^{K/2} |\Sigma|} e^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

(4) $f_x(X) = \dfrac{1}{(2\pi)^{K/2} |\Sigma|^{K/2}} \exp^{-\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$

68. If the joint density of X_1, X_2 and X_3 is given by :

$$f(x_1, x_2, x_3) = \begin{cases} (x_1 + x_2)e^{-x_3} & \text{for } 0 < x_1 < 1; 0 < x_2 < 1; \; x_3 > 0 \\ 0 & , \quad \text{elsewhere} \end{cases}$$

then the regression equation of X_2 on X_1 and X_3 is :

(1) $\left(x_1 + \frac{2}{3}\right) \Big/ (2x_1 + 1)$ (2) $x_1 / (x_1 + 1)$

(3) $(x_1 + x_2)$ (4) $(x_1 + x_2) / x_3$

69. If A be the Wishart matrix following Wishart (Σ, N − 1), which of the following statement is incorrect ?

(1) $\phi_A(\theta) = |I - 2i\Sigma\theta|^{-n/2}; n = N - 1$

(2) If $A = \begin{array}{cc} \left[\begin{array}{cc} A_{11} & A_{12} \\ A_{21} & A_{22} \end{array}\right]^{q}_{q-p} \\ \begin{array}{cc} q & p-q \end{array} \end{array}$ and $\Sigma = \begin{array}{c} \left[\begin{array}{cc} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{array}\right]^{q}_{p-q} \\ \begin{array}{cc} q & p-q \end{array} \end{array}$

(3) $E(|A|) = (N - 1)|\Sigma|$

(4) $\phi_A(\theta) = |I + 2i\Sigma\theta|^{-n/2}; n = N - 1$

70. If σ_1^2 is the error variance of design - 1 and σ_2^2 of design 2 utilizing the same experiment materials the efficiency of design 1 over 2 is :

(1) $\frac{1}{\sigma_1^2} \Big/ \frac{1}{\sigma_2^2}$

(2) $\frac{1}{\sigma_2^2} \Big/ \frac{1}{\sigma_1^2}$

(3) $\frac{\sigma_1^2 + \sigma_2^2}{\sigma_2^2}$

(4) none of the above

71. Consider the LPP

Maximize Z = $x_1 + x_2$ subject to

$$x_1 - 2x_2 \le 10$$
$$x_2 - 2x_1 \le 10$$
$$x_1, x_2 \ge 0$$

then,

(1) the LPP admits an optimal solution

(2) the LPP is unbounded

(3) the LPP admits no feasible solution

(4) the LPP admits a unique feasible solution

72. An assignment problem is a special form of transportation problem where all supply and demand values equal :

(1) 0 (2) 1 (3) 2 (4) 3

73. What happens when maxmin and minimax values of the game are same :

(1) no solution exists (2) solution is mixed

(3) saddle point-exists (4) none of these

74. The solution to a transportation problem with m-rows (supplies) and n-columns (destination) is feasible if number of positive allocations are :

(1) $m + n$ (2) $m \times n$

(3) $m + n - 1$ (4) $m + n + 1$

75. A department of a company has three employees with five jobs to be performed. The time that each man takes to perform each is given in the effective matrix :

		Employees		
		A	B	C
Jobs	1	12	10	8
	2	8	9	11
	3	11	14	12

How should the jobs be allocated one per employee, so as to minimize the total man hours :

(1) 1 → C, 2 → B, 3 → A

(2) 1 → B, 2 → C, 3 → A

(3) 1 → C, 2 → A, 3 → B

(4) 1 → A, 2 → B, 3 → C

76. If the unit cost rises, then optimal order quantity :

(1) increases

(2) decreases

(3) either increase or decrease

(4) none of the above

77. A newspaper –boy buys papers for Rs. 2.60 each and sells them for Rs. 3.60 each. He cannot return unsold newspapers. Daily demand has the following distribution :

No. of outcomes	:	23	24	25	26	27
Probability	:	.01	.03	.06	.10	.20
No. of outcomes	:	28	29	30	31	32
Probability	:	.25	.15	.1	.05	.05

If each day's demand is independent of the previous day's, how many papers should be ordered each day ?

(1) 24 (2) 30 (3) 25 (4) 27

78. A baking company sells cake by one Kg weight. It makes a profit of Rs. 5.00 a Kg on each Kg sold on the day it is baked. If disposes of all cakes not sold on the date it is baked at a loss of Rs. 1.20 a Kg. If demand is known to be rectangular between 2000 to 3000 Kg, then what is the optimal daily amount baked ?

(1) 2807 Kg (2) 2702 Kg

(3) 2608 Kg (4) 2859 Kg

79. Let $[X_n, n \geq 0]$ be a Markov chain with three states 0, 1, 2 and with transition matrix

$$\begin{array}{c|ccc} & 0 & 1 & 2 \\ \hline 0 & 3/4 & 1/4 & 0 \\ 1 & 1/4 & 1/2 & 1/4 \\ 2 & 0 & 3/4 & 1/4 \end{array}$$

and the initial distribution $\Pr[X_0 = i] = 1/3$ for $i = 0, 1, 2$, then $\Pr[X_2 / X_1 = 1]$ is :

(1) 3/4 (2) 1/4 (3) 1/2 (4) =0

80. Suppose that the prob. of a dry day (state 0) following a rainy day (state 1) is 1/3 and the prob. of rainy day following a dry day is 1/2. Then the prob. that May 3 is a dry day given that May 1 is a dry day is :

(1) 5/12 (2) 7/12 (3) 2/3 (4) 7/18

81. What is the probability of getting a sum of 9 from two throws of a dice ?

(1) 1/6 (2) 1/8 (3) 1/9 (4) 1/2

82. If P(A) = 0.8, P(B) = 0.3 and P(A/B) = 0.6. What is P(A and B) ?

(1) 0.18 (2) 0.24 (3) 0.03 (4) 0.30

83. If P(A/B) = 1/4, P(B/A) = 1/3, then P(A)/P(B) is equal to :

(1) 3/4 (2) 7/12 (3) 4/3 (4) 1/12

84. What should be the value of K for $f(x)=\begin{cases} kx, & 0\le x\le 1 \\ k, & 1\le x\le 2 \\ -kx+3a, 2\le x\le 3 \\ 0 & \text{elsewhere} \end{cases}$

(1) 1/4 (2) 1/2 (3) 1/8 (4) 2

85. The expected value of the random variable X whose probability density is given by

$$f(x)=\begin{cases} \dfrac{x+1}{8}, & 2<x<4 \\ 0, & \text{otherwise} \end{cases}$$

(1) 37/6 (2) 37/12

(3) 37/18 (4) 37/24

86. The relationship between mean μ, variance σ^2 and second moment about the origin μ_2^1 is :

(1) $\sigma^2 = \mu_2^1 - \mu^2$ (2) $\sigma^2 = \mu - \mu_2^1$

(3) $\sigma^2 = \mu_2^1 + \mu$ (4) None of these

87. The joint probability density function of a two dimensional random variable (*X*, *Y*) is given by $f(x, y) = 2, 0 < x < 1, 0\ 2y < x = 0$ elsewhere then :

(1) WLLN holds (2) WLLN does not hold

(3) SLLN holds (4) SLLN does not hold

88. Let $X_1, X_2, ...X_n$ be n independent and identically distributed random variable each with mean μ and variance σ^2, and let $\overline{X}_n$ be the sample mean, i.e., $\overline{X}_n = (X_1 + X_2 + ... + X_n)/n$ then for any $\alpha > 0$, as $n \to \infty$ $P(\mu - \alpha \le \overline{X}_n \le \mu + \alpha)$ tends to :

(1) 0 (2) 1 (3) μ (4) σ

89. A random variable X has Poisson distribution. If 2P(X = 2) = P(X = 1) + 2P(X = 0), then variance of X is :

(1) 3/2 (2) 2 (3) 1 (4) 1/2

90. For a positive skewed distribution which of the following inequality does not hold :

(1) Median > Mode (2) Mode > Mean

(3) Mean > Median (4) Mean > Mode

91. If Δ and ∇ are the forward and the backward difference operators respectively, then $\Delta - \nabla$ is equal to :

(1) $-\Delta\nabla$ (2) $\Delta\nabla$

(3) $\Delta + \nabla$ (4) $\frac{\Delta}{\nabla}$

92. By Euler's method to initial value problem $\frac{dy}{dx} = x + y,\ y_0 = y(0) = 0$, the value of y_2 by taking h = 0.2 is :

(1) $y_2 = 0.04$ (2) $y_2 = 0.08$

(3) $y_3 = 0.01$ (4) $y_2 = 0.06$

93. The residue of $f(z) = \frac{z^3}{(z-1)^4(z-2)(z-3)}$ at z = 3 is :

(1) 0 (2) 8 (3) –8 (4) 27/16

94. For the function $f(z) = \frac{z - \sin z}{z^3}, z = 0$ is :

(1) essential singularity (2) pole

(3) removal singularity (4) none of these

95. If $f(z) = u + iv$ is a analytic function in a finite region and $u = x^3 - 3xy^2$, the v is equal to :

(1) $3x^2y - y^3 + c$ (2) $3x^2y^2 - y^3$

(3) $3x^2y - y^2 + c$ (4) $3x^2y^2 - y^3$

96. The value of $\int_L Z^n dZ, n \neq 1$, where $L : |Z| = r$ is :

(1) $2\pi i$ (2) 2π (3) i (4) 0

97. Which of the following function $f(z)$ satisfies Cauch-Riemann equations ?

(1) $f(z) = \overline{z} = x - iy$ at $z = 1 + i$

(2) $f(z) = |z|^2$ at z $(z \neq 0)$

(3) $f(z) = \sqrt{|xy|}$ at $z = 0$

(4) $f(z) = \dfrac{x^3(1+i) - y^3(1-i)}{x^2 + y^2}, z \neq 0, f(0) = 0$

98. Which of the following is not analytic ?

(1) $\sin z$ (2) $\cos z$

(3) $az^2 + bz + c$ (4) $1/(z-1)$

99. If V and W are subspace of R^n, then :

(1) $V \cup W$ is necessarily a subspace of R^n

(2) $V \cup W$ is never a subspace of R^n

(3) $V \cup W$ is a subspace of R^n if and only if one of V, W is contained in the other

(4) $V \cup W$ is a subspace of R^n if and only if one of V, W is $\{0\}$

100. All the eigen value of the matrix $\begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ lie in the disc :

(1) $|\lambda + 1| \leq 1$ (2) $|\lambda - 1| \leq 1$

(3) $|\lambda + 1| \leq 0$ (4) $|\lambda - 1| \leq 2$

Statistics Key.
MPhil /Ph.D./URS-2018

S.No	A	B	C	D
1	3 ✓	2	3	2 ✓
2	1 ✓	1	1	1 ✓
3	1 ✓	4	3	2 ✓
4	2 ✓	3	2	2 ✓
5	2 ✓	3	3	1 ✓
6	1 ✓	1	3	3 ✓
7	1 ✓	2	2	2 ✓
8	2 ✓	2	1	4 ✓
9	3 ✓	2	4	3 ✓
10	2 ✓	1	1	3 ✓
11	2 ✓	1	3	2 ✓
12	1 ✓	2	1	1 ✓
13	2 ✓	2	4	4 ✓
14	2 ✓	1	2	2 ✓
15	1 ✓	3	1	1 ✓
16	3 ✓	4	3	1 ✓
17	2 ✓	1	2	1 ✓
18	4 ✓	4	3	2 ✓
19	3 ✓	3	1	2 ✓
20	3 ✓	2	4	2 ✓
21	3 ✓	3	3	2 ✓
22	1 ✓	2	1	1 ✓
23	4 ✓	1	1	4 ✓
24	2 ✓	1	2	3 ✓
25	1 ✓	3	2	3 ✓
26	3 ✓	1	1	1 ✓
27	2 ✓	4	1	2 ✓
28	3 ✓	2	2	2 ✓
29	1 ✓	2	3	2 ✓
30	4 ✓	2	2	1 ✓
31	3 ✓	2	2	1 ✓
32	2 ✓	1	1	2 ✓
33	1 ✓	2	4	2 ✓
34	1 ✓	2	2	1 ✓
35	3 ✓	1	1	3 ✓
36	1 ✓	3	1	4 ✓
37	4 ✓	2	1	1 ✓
38	2 ✓	4	2	4 ✓
39	2 ✓	3	2	3 ✓
40	2 ✓	3	2	2 ✓
41	3 ✓	2	2	3 ✓
42	1 ✓	1	2	2 ✓
43	3 ✓	4	3	1 ✓
44	2 ✓	2	3	1 ✓
45	3 ✓	1	1	3 ✓
46	3 ✓	1	2	1 ✓

16/11/18

S.Kumar
16/11/18

47	2 ✓	1	4	4 ✓
48	1 ✓	2	1	2 ✓
49	4 ✓	2	1	2 ✓
50	1 ✓	2	1	2 ✓
51	1 ✓	2	3	3 ✓
52	2 ✓	2	2	1 ✓
53	2 ✓	3	1	4 ✓
54	1 ✓	3	1	2 ✓
55	3 ✓	1	3	1 ✓
56	4 ✓	2	1	3 ✓
57	1 ✓	4	4	2 ✓
58	4 ✓	1	2	3 ✓
59	3 ✓	1	2	1 ✓
60	2 ✓	1	2	4 ✓
61	2 ✓	2	2	3 ✓
62	2 ✓	1	1	1 ✓
63	3 ✓	4	4	3 ✓
64	3 ✓	3	3	2 ✓
65	1 ✓	1	3	3 ✓
66	2 ✓	4	1	3 ✓
67	4 ✓	3	2	2 ✓
68	1 ✓	4	2	1 ✓
69	1 ✓	3	2	4 ✓
70	1 ✓	4	1	1 ✓
71	2 ✓	3	2	2 ✓
72	1 ✓	1	1	2 ✓
73	4 ✓	3	4	3 ✓
74	3 ✓	2	3	3 ✓
75	3 ✓	3	1	1 ✓
76	1 ✓	3	4	2 ✓
77	2 ✓	2	3	4 ✓
78	2 ✓	1	4	1 ✓
79	2 ✓	4	3	1 ✓
80	1 ✓	1	4	1 ✓
81	2 ✓	3	2	3 ✓
82	1 ✓	1	1	1 ✓
83	4 ✓	4	2	1 ✓
84	3 ✓	2	2	2 ✓
85	1 ✓	1	1	2 ✓
86	4 ✓	3	3	1 ✓
87	3 ✓	2	2	1 ✓
88	4 ✓	3	4	2 ✓
89	3 ✓	1	3	3 ✓
90	4 ✓	4	3	2 ✓
91	2 ✓	3	1	2 ✓
92	1 ✓	1	2	1 ✓
93	4 ✓	1	2	4 ✓

94	2 ✓	2	1	3 ✓
95	1 ✓	2	3	1 ✓
96	1 ✓	1	4	4 ✓
97	1 ✓	1	1	3 ✓
98	2 ✓	2	4	4 ✓
99	2 ✓	3	3	3 ✓
100	2 ✓	2	2	4 ✓