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Part III — STATISTICS

(English Version)

Time Allowed : 3 Hours]

[Maximum Marks : 150

PART - I*Note : Answer all the questions.*

Choose the correct answer :

50 × 1 = 50

1. Classical probability is also known as
 - a) Statistical probability
 - b) A priori probability
 - c) Empirical probability
 - d) none of these.

2. Probability can take values from
 - a) $-\infty$ to ∞
 - b) $-\infty$ to 1
 - c) 0 to 1
 - d) - 1 to 1.

3. When a coin and a die are thrown simultaneously, then the number of all possible events is
 - a) 0
 - b) 7
 - c) 8
 - d) 12.

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4. When a single die is thrown, the event of getting odd number or even number

is

- a) Mutually exclusive events b) Independent events
 c) Dependent events d) Non-mutually exclusive events.

5. In tossing 3 coins at a time, the probability of getting at least one head is

- a) $\frac{1}{8}$ b) $\frac{7}{8}$
 c) $\frac{3}{8}$ d) $\frac{1}{2}$.

6. If $P(A) = 0.4$, $P(B) = 0.5$ and $P(A \cap B) = 0.2$, then $P(B/A) =$

- a) $\frac{1}{2}$ b) $\frac{1}{3}$
 c) $\frac{4}{5}$ d) $\frac{2}{5}$.

7. A and B are independent events and $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{3}$, then the probability that one of them occurs is

- a) $\frac{1}{2}$ b) $\frac{1}{3}$
 c) $\frac{1}{4}$ d) $\frac{2}{3}$.

8. If $F(x)$ is the cumulative distribution function of a continuous random variable X with p.d.f. $f(x)$ then

- a) $F'(x) = f(x)$ b) $F(x) = f(x)$
 c) $F'(x) + f(x) = 0$ d) $F'(x) + f(x) = 1$.

9. The height of persons in a country is a random variable of the type

- a) continuous random variable
- b) discrete random variable
- c) continuous as well as discrete
- d) neither continuous nor discrete.

10. Variance of a constant c is

- a) c^2
- b) c
- c) \sqrt{c}
- d) 0.

11. $E(2X + 3)$ is

- a) $E(2X)$
- b) $2E(X) + 3$
- c) $4E(X)$
- d) $2X + 3$.

12. If $f(x)$ is the p.d.f. of a continuous random variable X , then $E(X^2)$ is

- a) $\int_{-\infty}^{\infty} f(x) dx$
- b) $\int_{-\infty}^{\infty} x f(x) dx$
- c) $\int_{-\infty}^{\infty} x^2 f(x) dx$
- d) $\int_{-\infty}^{\infty} f(x^2) dx$.

13. If X is a random variable with its mean \bar{X} , then $E(X - \bar{X})^2$ represents

- a) mean
- b) standard deviation
- c) variance
- d) second raw moment.

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14. The moment generating function for the discrete random variable is given by

a) $\sum_{r=0}^{\infty} \frac{t^r \mu_r}{r!}$

b) $\sum_{r=0}^{\infty} \frac{t^r \mu_r}{r}$

c) $\sum_{r=0}^{\infty} \frac{t^r \mu_r}{r!}$

d) $\sum_{r=0}^{\infty} \frac{t^r \mu_r}{r}$.

15. The standard deviation of a binomial distribution is

a) np

b) npq

c) 0

d) \sqrt{npq} .

16. If for a binomial distribution, $n = 4$ and also $P(X = 2) = 3P(X = 3)$ then the value of p is

a) $\frac{9}{11}$

b) 1

c) $\frac{1}{3}$

d) none of these.

17. If two independent variables X and Y follow binomial distribution with parameters (n_1, p) and (n_2, p) respectively then their sum $(X + Y)$

follows the binomial distribution with parameter,

a) $(n_1 + n_2, 2p)$

b) (n, p)

c) $(n_1 + n_2, p)$

d) $(n_1 + n_2, p + q)$.

18. Poisson distribution corresponds to

a) rare events

b) certain events

c) impossible events

d) almost sure events.

19. If a random variable X follows Poisson distribution such that

$P(X = 1) = P(X = 2)$, then the variance of the distribution is

a) 1

b) 2

c) 1.5

d) 3.

20. The normal distribution is a limiting form of Binomial distribution if

a) $n \rightarrow \infty, p \rightarrow 0$

b) $n \rightarrow 0, p \rightarrow q$

c) $n \rightarrow \infty, p \rightarrow n$

d) $n \rightarrow \infty$ and neither p nor q is small.

21. The standard normal distribution is represented by

a) $N(0, 0)$

b) $N(1, 1)$

c) $N(1, 0)$

d) $N(0, 1)$.

22. If the mean of a normal distribution is 60, then its mode is

a) 40

b) 50

c) 60

d) 150.

23. If X is $N(6, 1.2)$ and $P(0 \leq Z \leq 1) = 0.3413$, then $P(4.8 \leq X \leq 7.2)$ is

a) 0.3413

b) 0.6857

c) 0.6826

d) 0.3174.

24. The standard error of observed sample proportion P is

a) $\sqrt{\frac{P(1-Q)}{n}}$

b) $\sqrt{\frac{PQ}{n}}$

c) $\sqrt{\frac{(1-P)Q}{n}}$

d) $\frac{PQ}{n}$.

[Turn over

25. Critical region is
- a) Rejection Area b) Acceptance Area
- c) Probability d) Test Statistic Value.
26. The alternative hypothesis $H_1 : \mu \neq \mu_0$ ($\mu > \mu_0$ or $\mu < \mu_0$) takes the critical region as
- a) right tail only b) both right and left tails
- c) left tail only d) acceptance region.
27. A wrong decision about H_0 leads to
- a) Type I error b) Type II error
- c) Type III error d) Type IV error.
28. Standard error of number of success is given by
- a) npq b) \sqrt{npq}
- c) $\sqrt{\frac{pq}{n}}$ d) $\frac{pq}{n}$.
29. Test statistic for difference between two means is
- a) $\frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$ b) $\frac{p - P}{\sqrt{\frac{PQ}{n}}}$
- c) $\frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$ d) $\frac{p_1 - p_2}{\sqrt{PQ \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$

30. If $n_1 = 850$, $n_2 = 550$, $x_1 = 530$, $x_2 = 310$, then $\hat{Q} =$

a) $\frac{4}{10}$

b) $\frac{6}{10}$

c) $\frac{3}{10}$

d) $\frac{7}{10}$

31. Standard error of the difference of the proportions $(p_1 - p_2)$ in two classes under the hypothesis $H_0 : p_1 = p_2$ with usual notation is

a) $\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}$

b) $\sqrt{\hat{p} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$

c) $\sqrt{\hat{p} \hat{q} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$

d) $\hat{p} \hat{q} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$

32. Student's t -distribution was pioneered by

a) William S. Gosset

b) Laplace

c) R. A. Fisher

d) Karl Pearson.

33. The difference of two means in case of small sample is tested by the formula

a) $t = \frac{\bar{x}_1 - \bar{x}_2}{s}$

b) $t = \frac{\bar{x}_1 - \bar{x}_2}{s} \sqrt{\frac{n_1 + n_2}{n_1 n_2}}$

c) $t = \frac{\bar{x}_1 - \bar{x}_2}{s} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$

d) $t = \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$

34. Paired t -test is applicable when the observations in the two samples are

a) paired

b) correlated

c) equal in number

d) all of these.

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35. The calculated value of χ^2 is
- a) always positive
 - b) always negative
 - c) can be positive or negative
 - d) none of these.
36. The larger variance in the variance ratio for F -test is taken
- a) in the denominator
 - b) in the numerator
 - c) either way
 - d) none of these.
37. The test statistic $F = \frac{S_1^2}{S_2^2}$ is used for testing
- a) $H_0 : \mu_1 = \mu_2$
 - b) $H_0 : \sigma_1 = \sigma_2$
 - c) $H_0 : \sigma_1^2 = \sigma_2^2$
 - d) $H_0 : \sigma^2 = \sigma_0^2$.
38. The degrees of freedom for chi-square in case of contingency table of order $r \times c$ is
- a) $(r+1)(c-1)$
 - b) $(r-1)(c+1)$
 - c) $(r-1)(c-1)$
 - d) $(r+1)(c+1)$.
39. In the case of one-way classification, the total variation can be split into
- a) two components
 - b) three components
 - c) only one component
 - d) four components.

40. In the case of one-way classification with t treatments, the mean sum of squares for treatment is
- | | |
|------------------------|------------------------|
| a) $\frac{SST}{N - 1}$ | b) $\frac{SST}{t - 1}$ |
| c) $\frac{SST}{N - t}$ | d) $\frac{SST}{t}$ |
41. If $TSS = 90$, $SSR = 35$ and $SSC = 25$ then $SSE =$
- | | |
|-------|--------|
| a) 20 | b) 30 |
| c) 40 | d) 45. |
42. Salient features responsible for the seasonal variation are
- | | |
|--------------|-------------------|
| a) weather | b) social customs |
| c) festivals | d) all of these. |
43. If the slope of the trend line is positive, it shows,
- | | |
|-----------------|--------------------|
| a) Rising trend | b) Declining trend |
| c) Stagnation | d) none of these. |
44. The economic rhythm theory comes under the category of
- | | |
|-----------------------|----------------------|
| a) Analytical methods | b) Barometric method |
| c) Naive method | d) None of these. |
45. If A and B are independent, Yule's coefficient is equal to
- | | |
|--------|---------|
| a) 0 | b) 1 |
| c) - 1 | d) 0.5. |

46. If $N = 500$, $(A) = 300$, $(B) = 250$ and $(AB) = 40$, then the data are
- a) inconsistent
 - b) consistent
 - c) positively associated
 - d) negatively associated.
47. If for two attributes A and B , $(AB) = \frac{(A)(B)}{N}$ then the attributes are
- a) independent
 - b) positively associated
 - c) negatively associated
 - d) no conclusion.
48. Which of the following criteria does not apply to decision making under uncertainty ?
- a) Maximin return
 - b) Maximax return
 - c) Minimax return
 - d) Maximize expected return.
49. In decision under uncertainty, the Laplace criterion is the least conservative while the criterion is the most conservative.
- a) minimax
 - b) maximin
 - c) maximax
 - d) none of these.
50. Maximin return, maximax return and minimax regret are criteria that
- a) lead to the same optimal decision
 - b) cannot be used with probability
 - c) both (a) and (b)
 - d) none of these.

PART - II

Note : Answer any fifteen questions.

15 × 2 = 30

51. State the multiplication theorem on probability.
52. Two dice are thrown. What is the probability of getting the sum being 8 ?
53. A random variable X has $E(X) = \frac{1}{2}$ and $E(X^2) = \frac{1}{2}$. Find its standard deviation.
54. Verify that whether $f(x) = 5x^4$, $0 < x < 1$ is a probability density function.
55. A random variable X has the following probability distribution :

X	- 3	6	9
$P(X = x)$	$\frac{1}{6}$	$\frac{1}{2}$	$\frac{1}{3}$

Find the value of $E(X^2)$.

56. For the binomial distribution $(0.68 + 0.32)^{10}$, find the probability of 2 successes.
57. Give any two examples of Poisson Distribution.
58. Find the area under the normal curve between $z = 0$ and $z = 1.75$.
59. Define Null hypothesis and Alternative hypothesis.
60. Define standard error.
61. In a test, if $Z_e \leq Z_o$ what is your conclusion about the null hypothesis ?
62. What do you understand by paired t -test ?
63. Define χ^2 test for population variance.
64. What are the conditions necessary while applying χ^2 -test ?

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65. Name the different methods of measuring seasonal variation.
66. What is a time series ?
67. Write briefly about association of attributes.
68. For the attributes A and B , we have $(AB) = 35$, $(A) = 55$, $(\alpha\beta) = 20$, $N = 100$. Calculate the Yule's coefficient of association.
69. Explain the meaning of 'Statistical Decision theory'.
70. Write a note on 'Decision tree'.

PART - III

Note : Answer any six questions.

$6 \times 5 = 30$

71. If $P(A) = 0.3$, $P(B) = 0.2$ and $P(C) = 0.1$, and A, B, C are independent events, find the probability of occurrence of at least one of the three events A, B and C .
72. A random variable X has the density function $f(x) = Ax^2$, $0 < x < 1$, find the probability between 0.2 and 0.5 .
73. With the usual notation, find p for binomial random variable X , if $n = 6$ and $9 P(X = 4) = P(X = 2)$.
74. Given a normal distribution with $\mu = 50$ and $\sigma = 8$, find the probability that X assumes a value between 42 and 64 .
75. A sample of size 400 was drawn and the sample mean was found to be 99 . Test whether this sample could have come from a normal population with mean 100 and variance 64 at 5% level of significance.

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75. A sample of size 400 was drawn and the sample mean was found to be 99. Test whether this sample could have come from a normal population with mean 100 and variance 64 at 5% level of significance.

76. A sample of size 15 values shows the standard deviation to be 6.4. Does this agree with the hypothesis that the population S.D. is 5, the population being normal?

77. Calculate the trend value to the following data by the method of semi-averages :

Year	1995	1996	1997	1998	1999	2000	2001
Expenditure (Rs. in lakhs)	1.5	1.8	2.0	2.3	2.4	2.6	3.0

78. In a group of 400 students, the number of married is 160. Out of 120 students who failed 48 belonged to the married group. Find out whether the attributes of marriage and failure are independent.

79. The pay-off table for three courses of action (A) with three states of nature (E) (or events) with their respective probabilities (P) are given. Find the best course of action.

Events → Acts ↓	E_1	E_2	E_3
A_1	2.5	2.0	-1
A_2	4.0	2.6	0
A_3	3.0	1.8	1
Probability	0.2	0.6	0.2

PART - IV

Note : Answer any four questions.

$4 \times 10 = 40$

80. A bag contains 6 red and 8 black balls. Another bag contains 7 red and 10 black balls. A bag is selected and a ball is drawn. Find the probability that it is a red ball.

[Turn over

81. Ten coins are tossed simultaneously. Find the probability of getting (i) at least 7 heads, (ii) exactly 7 heads and (iii) at most 7 heads.
82. The mean life time of 100 fluorescent light bulbs produced by a company is computed to be 1570 hours with a standard deviation of 120 hours. If μ is the mean life time of all the bulbs produced by the company, test the hypothesis $\mu = 1600$ hours against the alternative hypothesis $\mu \neq 1600$ hours using a 5% level of significance.
83. The following table shows the distribution of goals in a football match.

No. of goals	0	1	2	3	4	5	6	7
No. of matches	95	158	108	63	40	9	5	2

Fit a Poisson distribution and test the goodness of fit.

84. The following are the defective pieces produced by four operators working in turn on four different machines.

Machine	Operator			
	I	II	III	IV
A	3	2	3	2
B	3	2	3	4
C	2	3	4	3
D	3	4	3	2

Perform analysis of variance at 5% level of significance to ascertain whether variability in production is due to variability in operator's performance or variability in machine's performance.

85. Fit a straight line trend by the method of least squares to the following data :

Year	1993	1994	1995	1996	1997	1998	1999	2000
Earnings	38	40	65	72	69	60	87	95

Estimate for the earnings for the year 2002.

86. A canteen prepares a food at a total average cost of Rs. 4 per plate and sell it at a price of Rs. 6. The food is prepared in the morning and is sold during the same day. Unsold food during the day is spoiled and is to be thrown away. According to the past sale, number of plates are not less than 50 or greater than 53. You are to formulate (i) action space, (ii) states of nature space, (iii) pay-off table and (iv) loss table.
