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P.G. Entrance Examination, May - 2023 M.Sc. STATISTICS/APPLIED STATISTICS & INFORMATICS Sub. Code : 58715

Day and Date : Tuesday, 09 - 05 - 2023 Time : 03.30 p.m. to 05.00 p.m. Total Marks : 100

- Instructions : 1) All questions are compulsory.
 - 2) Each question carries 1 mark.
 - 3) Answers should be marked in the given OMR answer sheet by darkening the appropriate option.
 - 4) Follow the instructions given on OMR sheet.
 - 5) Rough work shall be done on the sheet provided at the end of question paper.

Questions : Choose most correct alternatives.

- 1) For any two positive observations, which of the following is true?
 - A) $A.M. \ge G.M. \ge H.M.$ B) $A.M. \le G.M. \le H.M.$
 - C) A.M. > H.M. > G.M. D) A.M. < H.M. < G.M.
- 2) Mean square deviation is minimum when calculated from _____
 - A) Mode B) Median
 - C) Mean D) GM
- 3) For negatively skewed distribution, the correct relation between mean, median and mode is
 - A) Mode < Median < Mean B) Mean < Median < Mode
 - C) Median < Mean < Mode D) Median > Mean > mode

- 4) In a random experiment _____
 - A) All possible outcomes are known in advance
 - B) All possible outcomes are not known in advance
 - C) Some possible outcomes can be known in advance
 - D) Outcome of a particular trial is known in advance
- 5) The probability that a leap year will have 53 Sunday is _____
 - A) 1/7 B) 2/7
 - C) 2/53 D) 1/53
- 6) If $r_{xy} = 0.9$ and if u = 2x + 1, v = 3 y, then $r_{uv} =$ _____. A) 0.9 B) -0.9 C) 0.18 D) -0.18

7) If X + 3Y = 0 holds for all values of random variables X and Y, then the coefficient of correlation (*r*) between X and Y is _____

A) -0.8B) 0.64C) -1D) 0.8

8) In Paasche's quantity index number _____ are used as weights.

- A) current year quantities B) base year quantities
 - C) base year prices D) current year prices
- 9) The distribution function of a discrete random variable is _____.
 - A) logarithmic function B) step function
 - C) exponential function D) constant function

10) The conditional mean E(Y | X=x) is a function of _____.

- A) x B) y
- C) x and y D) None of these

11) If X is a Poisson variate with P[X = 1] = P[X=2] then mean of X is _____.

- A) 1
 B) 4

 C) 3
 D) 2
- **12)** The cumulant generating function (c.g.f,) of a continuous r. v. X is $-\log(1-2t)$ then E(X) is _____

| A) | 2 | B) | 5 |
|----|---|----|-----|
| C) | 3 | D) | 0.5 |

 13) If E[E(X / Y)] = 5 then _____

 A) E(X) = 5 B) E(Y) = 5

 C) V(Y) = 5 D) V(X) = 5

14) If $R_{1.23} = 0$ then all total and partial correlation coefficients involving X_1 are

- A) 1 B) 0
- C) -1 D) 0.5

15) If NRR > 1 then the total population

- A) decreases B) increases
- C) double D) remain as it is

- 16) Which of the following distribution does not have equal mean and variance?
 - A) U(0,6) B) Exp(1)
 - C) N(1,1) D) $\beta_1(1,2)$
- 17) The maximum height of the density curve of normal distribution with mean 2 and variance 4 is _____

A)
$$\frac{1}{\sqrt{2\pi}}$$

B) $\frac{1}{\sqrt{8\pi}}$
C) $\frac{1}{\sqrt{4\pi}}$

D) None of these

18) Control chart in statistical quality control is not meant for checking the

- A) pattern of variation
- B) variability in the product is within the tolerance limit or not
- C) variability in the product is due to assignable causes or not
- D) linear trend
- **19**) Which of the following is true?
 - A) F-test is used for testing goodness of fit.
 - B) F-test is used for testing independence of two attributes.
 - C) F-test is used for testing significance of single population variance.
 - D) F-test is used for testing equality of two population variances.

20) The relation between t and f distribution is _____.

A) $t_n^2 = F(1,1)$ B) $t_n^2 = F(1,n)$

C)
$$t_n^2 = F(n,1)$$
 D) None of these

21) If X follows Laplace distribution with parameter (μ, λ) then its interquartile range is _____.

| A) $(2/\lambda)\log 2$ | B) | $2/\lambda^2$ |
|------------------------|----|---------------|
|------------------------|----|---------------|

C) $(2/\mu)\log 2$ D) $2/\mu^2$

| 22) | If X | $\sim LN(25,5)$, then $Var(loq X) = $ | | _ |
|-----|------|--|----|-------------------|
| | A) | 5 | B) | e ^{52.5} |
| | C) | e ³⁰ | D) | 25 |

23) If X ~ C(μ , λ) then fourth order central moment is _____.

A) exist and equal to μ
B) exist and equal to 2μ
C) 0
D) do not exists

24) If X follows Weibull distribution with shape parameter 1 then the distribution of X is _____.

- A) Exponential B) Double Exponential
- C) Normal D) Cauchy

25) If X follows logistic distribution with parameter (μ, σ) then the mode of X is
A) σ
B) μ

C) $\mu + \sigma$ D) none of these

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| | A) | $\frac{\alpha\beta^2}{(\alpha-1)(\alpha-2)^2}$ | | | |
|-----|-----|--|------|---------|---------------|
| | B) | $\frac{\alpha\beta^2}{(\alpha-2)(\alpha-1)^2}$ | | | |
| | C) | $\frac{\alpha\beta}{\left(\beta-1\right)^2}$ | | | |
| | D) | none of these | | | |
| | | | | | |
| 27) | Mul | tinomial distribution is generalizati | on o | f | distribution. |
| | A) | Binomial | B) | Poisson | |
| | C) | Geometric | D) | Normal | |

26) If X has Pareto distribution with parameters α and β then variance of X is

28) If X is truncated normal variate, truncated left at X=a and truncated to the right at X=b then _____.

- A) P(X < a) = 0 B) $P(X \le b) = 0$
- C) P(X > a) = 0.5 D) P(X > a, X > b) = 1

29) If X is truncated Exponential variate with mean $\frac{1}{\theta}$ truncated to the left at 3 then E(X) is _____.

- A) $\frac{1}{\theta} + 3$ B) $\frac{1}{\theta}$
- C) $\frac{1}{\theta^2}$ D) 3

30) If $(X, Y) \sim BN(0, 0, 1, 1, 0)$ then distribution of $\frac{X}{Y}$ is _____.

- A) NormalB) Bivariate Normal
- C) Cauchy D) Uniform

31) If 4, 1, 3, 2, 5 are observations on X where X has a geometric distribution with parameter θ then the moment estimator of θ is

- A) 1/3 B) 2/3
- C) 1/2 D) 1/4

32) If X_1, X_2, \dots, X_n is random sample from B(1, *p*) then the statistic $T(x) = \sum_i X_i$ is

| A) unbiased | B) | sufficient |
|-------------|----|------------|
|-------------|----|------------|

- C) consistent D) none of these
- **33**) If X_1, X_2, \dots, X_n s a random sample from U($\theta, \theta + 2$) then the unbiased estimator of θ is
 - A) $(\overline{X}-1)/2$ B) $\overline{X}/2$
 - C) $(\overline{X}+1)/2$ D) \overline{X}
- **34**) T_n is a consistent estimator of $\psi(\theta)$ if
 - A) T_n converges to θ with probability one
 - B) $\lim_{n\to\infty} P(|T_n \psi(\theta)| < \epsilon) \to 0$
 - C) $\lim_{n\to\infty} P(|T_n \psi(\theta)| \ge \epsilon) \to 1$
 - D) None of the above

- **35**) If s^2 is sample variance then an unbiased estimator of population variance σ^2 is
 - A) $(n-1)s^2/n$
 - B) ns^2/n
 - C) $ns^{2}/(n-1)$
 - D) None of the above

36) Cramer-Rao inequality with regard to the variance of an estimator provides

- A) Upper bound of the variance
- B) Lower bound of the variance
- C) Asymptotic variance of an estimator
- D) None of these.
- **37**) If a statistic T is unbiased estimator of parameter θ then unbiased estimator of 4θ -7 is
 - A) 4T B) 4T+7
 - C) 4T-7 D) T+7

38) If T_n is a sufficient statistic of θ then $\frac{d \log L}{d\theta}$ is function of only

- A) T_n B) T_n and θ
- C) θ D) Neither $T_n \operatorname{nor} \theta$

39) A one-dimensional statistic that best estimates the parameter is known as

- A) Point EstimatorB) Interval Estimator
- C) Interval Estimate D) Point Estimate

40) Estimator T_1 is said to be more efficient than estimator T_2 if

- A) $V(T_1) > V(T_2)$
- B) Bias of $T_1 > Bias of T_2$
- C) Bias of $T_1 < Bias of T_2$
- D) $V(T_1) < V(T_2)$

41) A completely randomized design is also known as _____.

- A) systematic design B) restrictional design
- C) single block design D) None of the above

42) In one-way ANOVA with total number of observations 15 and 5 treatments, the error degrees of freedom is _____.

- A) 56 B) 4
- C) 10 D) 14
- **43**) A randomized block design has _____.
 - A) one way classification B) two way classification
 - C) three way classification D) no classification

44) While analyzing the data of a $k \times k$ latin-square design, the error d.f. in analysis of variance is equal to _____.

- A) (k-1)(k-2) B) k(k-1)(k-2)
- C) k^2-2 D) k^2-k-2

45) In 2³ factorial experiment the arrangement of replicate with two blocks each of four plots is shown below. Which interaction effect is confounded in given replicate?

| Block | (1) | c | ab | abc |
|-------|-----|----|----|-----|
| 1 | | | | |
| Block | ac | bc | b | a |
| 2 | | | | |

A) AB is confounded

C) AC is confounded

- B) BC is confounded
- D) ABC is confounded

- **46)** Local control helps to
 - A) reduce the number of treatments
 - C) reduce the error variance
- B) increase the number of plots
- D) increase the error d.f.

47) If different effects are confounded in different blocks, it is said to be

- A) complete confounding
- B) partial confounding
- C) balanced confounding D) none of the above
- **48**) In one-way ANOVA, if,
 - SS due to Treatment = 2400,
 - SS due to error = 1600,

Number of treatments = 4,

Total number of observations = 20

then the value of F is _____.

- A) 7 B) 8
- C) 9 D) 19

- **49)** Two linear combinations $\sum c_{i}t_{i}$ and $\sum d_{i}t_{i}$ of treatment means are called as orthogonal contrasts if ______.
 - A) $\Sigma c_i = 0$ and $\Sigma d_i = 0$
 - B) $\Sigma c_i = 1$ and $\Sigma d_i = 1$
 - C) $\Sigma c_i = \Sigma d_i$
 - D) $\Sigma c_i = 0, \Sigma d_i = 0$ and $\Sigma c_i d_i = 0$

50) In which of the following situation(s), CRD is most suitable?

- i) all experimental units are homogeneous
- ii) the units are likely to be destroyed during experimentation
- iii) some units are likely to fail to response
- A) Only i) B) Only i) and ii)
- C) Only ii) D) All i), ii) and iii)

51) ______ visualizes the most significant problem to be worked out first.

- A) histogram B) control chart
- C) pareto chart D) flow chart
- **52**) Generally, in process control cost of production is _____ as compared to that in product control.
 - A) high B) low
 - C) almost the same D) exactly the same
- **53**) The probability of false alarm for \overline{X} chart with 3/2 limits and with usual assumptions is _____.
 - A) 0.027 B) 0.27
 - C) 0.0027 D) 0.0027%

| 54) | | invented the PDCA cycle. | | |
|-----|-----|--------------------------------------|--------|--------------------------|
| | A) | Shewhart | B) | Deming |
| | C) | Montgomery | D) | Fisher |
| | | | | |
| 55) | Acc | eptance sampling is used for all but | whic | ch one of these? |
| | A) | Incoming raw material | B) | Work-in-progress |
| | C) | Final goods | D) | Incoming purchased parts |
| | | | | |
| 56) | The | output of the following statements | in R i | s |
| | | x=rep(seq(1,3), c(rep(1,2),3)) | | |
| | | mean(x[c(4,3)]) | | |
| | A) | 2 | B) | 2.5 |
| | C) | 3 | D) | 3.5 |
| | | | | |
| 57) | The | output of the following statements | in R i | S |

x=100 y=(x <= 200*20) y A) TRUE B) FALSE C) 4000 D) 100

58) pchisq(2,3) command in R returns _____.

- A) $P(X \le 2)$ where $X \sim \chi_3^2$ B) $P(X \ge 2)$ where $X \sim \chi_3^2$
- C) $P(X \le 3)$ where $X \sim \chi_2^2$ D) $P(X \ge 3)$ where $X \sim \chi_2^2$

59) The output of the following R program is

t=1 x={} for(i in c(10,15,20)){ if(i%%2==0) x[t]=i } x[2] A) 10 B) 15 C) 20 D) NA

60) The output of the following R statements is _____.

s1=10
s2=-5
x=seq(10,40,10)
for(i in 1:2){

$$s1=s2+x[i]$$

 $s2=s1-x[i]$
}
 $s1+s2$
A) 10
B) -5
C) 30
D) None of the above

61) Let $X_1, X_2, ..., X_n$ be i.i.d. random variables with pdf f(x) and distribution function F(x) then distribution function of $X_{(1)}$ is _____.

- A) $1-[1-F(x)]^n$ B) $[F(x)]^n$
- C) $[1-F(x)]^n$ D) $[1-F(x)]^{n-1}$

62) Let $X_{(1)}, X_{(2)}, ..., X_{(n)}$ be order statistics of size n from U (0,1) distribution, then the distribution of range is _____.

- A) $\beta_1(n-2,2)$ B) $\beta_1(n,2)$
- C) $\beta_1(n-1,2)$ D) $\beta_1(2,n-1)$
- **63**) Let $X_1, X_2, ..., X_n$ be a random sample of size n from U (0,1) distribution, then expected value of nth order statistic is _____.
 - A) $\frac{n-1}{n+1}$ B) $\frac{1}{n+1}$ C) $\frac{n}{n+1}$ D) $\frac{n-1}{n+1}$
- 64) If X_1 and X_2 are independent exponential variates with mean 1 and 2 respectively, then P [min $\{X_1, X_2\} > 1$] is _____.
 - A) e^{-2} B) e^{-3}
 - C) e^{-1} D) $e^{-1.5}$

65) If $X_n \xrightarrow{p} a$ as $n \to \infty$ then which of the following is/are always true?

i) $X_n^2 \xrightarrow{p} a^2$ ii) $\frac{1}{X_n} \xrightarrow{p} \frac{1}{a}$ iii) $(X_n - a) \xrightarrow{p} 0$ A) Only i) B) Only i) and iii) C) Only ii) D) All i), ii) and iii)

- **66)** A sequence of random variables $\{X_n, n \ge 1\}$ with CDF $F_n(x)$, is said to converges in distribution to random variable X with CDF F(x) if,
 - A) $\lim_{n \to \infty} F_n(x) = 1$ B) $\lim_{n \to \infty} F(x) = 0$
 - C) $\lim_{n \to \infty} F_n(x) = 0$ D) None of the above

67) Let X follows exponential distribution with mean 4 then upper bound of $P[|X - \mu| \ge 8]$ given by Chebyshev's inequality is _____.

- A) 0.5 B) 0.25
- C) 0.75 D) 1

68) Structure function for series system of 2 independent components is _____

A) X_1X_2 B) $1 - (1-X_1X_2)$ C) $1 - (1-X_1)(1-X_2)$ D) $X_1 + X_2$

69) A binary system of n components is said to be coherent system if

- i) Structure function is non decreasing function of vector X
- ii) All the components in system are relevant components
- iii) All the components in the system are working
- A) Only i) is true B) Only ii) is true
- C) Only i) and ii) are true D) All i), ii) and iii) are true
- **70**) For a series system of two components having 0.6 reliability each, the reliability of a system is _____
 - A) 1 B) 0.84
 - C) 0.36 D) 0.12

- 71) The most preferred confidence interval for a parameter should be _____.
 - A) with shortest width and largest confidence coefficient
 - B) with largest width and smallest confidence coefficient
 - C) based on sufficient statistics
 - D) none of these
- 72) If $X_1, X_2, ..., X_n$ is a random sample from exponential distribution with parameter θ then interval estimate of θ can be obtained by use of _____.
 - A) Normal distribution B) t distribution
 - C) F distribution D) Chi-square distribution
- **73**) A sample of size 144 from N (μ , σ^2) gives the sample mean \overline{X} =10 and sample variance s²=36 then 95% confidence interval for μ is _____.
 - A) (9.02, 10.98)B) (9.02, 9.98)C) (10.02, 10.98)D) (9.20, 10.98)
- 74) If random variable X has N (μ , σ^2)-distribution then which of the following is simple null hypothesis?
 - A) $|\mu|=0$ B) $\mu=10$ C) $\sigma^2=16$ D) None of the Above

75) The critical region of a likelihood Ratio test criterion is always

- A) Left tailed
- B) Right tailed
- C) Two tailed
- D) Depends on null hypothesis

76) In SPRT of strength (0.02, 0.03) the stopping bounds (A, B) are given by

A)
$$\left(\frac{97}{3}, \frac{2}{98}\right)$$
 B) $\left(\frac{97}{2}, \frac{3}{98}\right)$

C)
$$\left(\frac{98}{3}, \frac{2}{98}\right)$$
 D) $\left(\frac{98}{2}, \frac{3}{97}\right)$

77) The likelihood ratio test statistic for testing H₀:σ² = σ₀² against H₁:σ² ≠ σ₀² based on a sample of size n from normal population N (2, σ²) leads to
A) χ_n² distribution B) χ_{n-1}² distribution
C) t_{n-1} distribution D) t_{2n-1} distribution

78) For small sample Sign Test, Test statistics will follow ______.

- A) Normal Distribution B) t-Distribution
 - C) Binomial Distribution D) Chi-Square Distribution

79) Wilcoxon's Signed Rank Test is used to test _____?

- A) Mean B) Median
- C) Mode D) None of the above

80) Which of the following Non-parametric test utilizes the empirical distribution function?

- A) Median test B) Wilcoxon's signed rank test
- C) Wald-Wolfowitz run test D) Kolmogorov -Smirnov test

81) Consider the statements :

Statement I : In SRSWOR, sample mean is unbiased estimator of population mean.

Statement II : In SRSWOR, S. E.
$$(\hat{Y}) = \sqrt{\frac{N-n}{Nn}} S$$

Which of the following is true?

- A) Only Statement I
- B) Only Statement II
- C) Both Statement I and II are true
- D) Neither statement I nor statement II
- 82) In SRSWR, which of the following is not true?
 - A) Total number of possible samples is N^n
 - B) Units in the sample are independent
 - C) Any unit in the population has the same chance of being selected at any draw
 - D) Sample mean square is unbiased estimator for population mean square
- **83**) In SRSWOR (N=5, n=2), which of the following is not true?
 - A) Probability that unit 1 selected at 2^{nd} draw is 1/5.
 - B) Probability that unit 1 selected at 2^{nd} draw is 1/4.
 - C) Probability that unit 1 selected at 2nd draw given that unit 2 selected at first draw is 1/4.
 - D) Probability that sample $\{1,2\}$ selected is 1/10.

84) Consider the following statements

Statement I: In SRSWOR, sampling error is directly proportional to sample size.

Statement II: In SRSWOR(N, n), confidence interval for sample mean is

$$(\overline{y} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{(1-f)}{Nn}} S^2$$

Then which of the following is true?

- A) Both Statement I and II are true
- B) Neither statement I nor statement II
- C) Only Statement II
- D) Only Statement I
- **85**) Let {25, 15, 23, 34, 12, 20, 37, 48, 36, 42, 18, 60} be the population. Which of the following is not a systematic sample of size 4?
 - A) 25,34,37,42 B) 15,12,48,18
 - C) 23,20,36,60 D) 42,25,12,37

86 Which of the following is true?

- A) In stratified random sampling $V(\hat{Y}) = \sum_{i=1}^{k} \left(\frac{N_i n_i}{N_i n_i}\right) N_i^2 S_i^2$
- B) In Stratified sampling with proportional allocation $n_i \propto 1/N_i$
- C) In stratified random sampling with equal allocation $n_i \propto N_i$
- D) In stratified random sampling with Neyman allocation $n_i \propto \frac{1}{N_i S_i}$

- **87**) What is true about two stage sampling method?
 - A) In state I sample is drawn from auxiliary variable and in stage II true sample about study variable is drawn.
 - B) In state I population is divided into clusters and some clusters are drawn randomly, and in stage II from each of the selected cluster, a sample of the specified number of elements is selected.
 - C) In cluster sampling population is divided into N clusters with equal cluster size and n clusters are selected randomly.
 - D) Cluster sampling is always superior to stratified sampling.
- **88**) Ratio method of estimation is useful _____.
 - A) When there exists auxiliary information on sampling units and relation between the study variable and auxiliary variable is linear.
 - B) When there exists auxiliary information on sampling units and relation between the study variable and auxiliary variable is quadratic.
 - C) In all situations
 - D) When there exists auxiliary information on sampling units and relation between the study variable and auxiliary variable is exponential.
- **89**) Which of the following is true?
 - A) As sample size increases, sampling error increases
 - B) As sample size increases non sampling errors decrease
 - C) Sample size does not affect sampling as well as non sampling errors.
 - D) As sample size increases, sampling error decreases.
- **90**) Which of the following is not random sampling?
 - A) Quota sampling B) Two phase sampling
 - C) Stratified sampling D) Cluster sampling

- **91**) Which of the following is used to convert "≥" to constraint into equation so as to solve the given LPP by simplex method?
 - A) Slack Variable B) Surplus Variable
 - C) Surplus and artificial Variable D) Artificial variable
- 92) A solution which optimizes the objective function of given LPP is called as
 - A) Solution B) Basic Solution
 - C) Feasible solution D) Optimal solution
- **93)** If, when we are using a Simplex table to solve a maximization problem, we find that the ratios for determining the pivot row are all negative, then we know that the solution is

| A) | unbounded | B) | infeasible |
|----|------------|----|------------|
| C) | degenerate | D) | optimal |

- 94) Suppose that a MAX (Maximization type) problem contained the following constraint: $5x + 8y \le 40$. Then which of the following statements is true
 - A) For the point (8, 5), the slack for this constraint would have a value of 40.
 - B) For the point (4, 2.5), the slack for this constraint would be a positive value
 - C) For the point (1,4), the slack for this constraint would have a value of 3.
 - D) For the point (4, 2), the slack for this constraint would be zero.
- **95**) For which of the following method is used to obtain initial solution to Transportation Problem.
 - A) Hungarian Method B) North-West Corner Method
 - C) Simplex Method D) MODI Method

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96) Given a system of m simultaneous liner equations in n unknown. (m<n), the number of basic variables will be

- A) m B) n
- C) n-m D) m+n

97) If two constraints do not intersect in the first quadrant of the graph, then

- A) One of the constraint is redundant
- B) The solution is infeasible
- C) The solution is unbounded
- D) The solution is optimum
- **98**) A sequencing problem involving five jobs and three machines required evaluation of
 - A) (5+5+5) sequences B) (5!+5!+5!) sequences
 - C) $(5!)^3$ sequences D) $(5 \times 5 \times 5)$ sequences

99) When there are more than one servers, customer behavior in which he moves from one queue to another is known as

A) alternatingB) jockeyingC) renegingD) balking

100) As simulation is not an analytical model, therefor, results of the simulation must be viewed as

- A) Exact B) Unrealistic
- C) Approximation D) Simplified

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Rough Work

Rough Work