

उत्तर प्रदेश राजर्षि टण्डन मुक्त विश्वविद्यालय,इलाहाबाद

सांख्यिकी (स्नातक) कार्यक्रम अधिन्यास सत्र 2017-18

(July-2017 and January-2018)

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|------------------------|------------------------------------|--------------------|
| Course Code: UGSTAT-01 | Course Title : Statistical Methods | Maximum Marks : 30 |
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Section -A

Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. Define Harmonic Mean with its merits, demerits and uses.
2. Discuss about the Mean Deviation with its merits and demerits. Also show that Mean Deviation is minimum when it is measured about median of the frequency distribution.
3. Discuss about the Geometric Mean with its merits, demerits and Uses. Also define the additive property of Geometric Mean.
4. Define Standard Deviation. Also discuss the effect of Change of origin and scale on it.
5. Discuss about the different methods of diagrammatic representation of statistical data.
6. State and prove First Property of the mean. Also prove the additive property of the mean.
7. Discuss about the Arithmetic Mean with its application and merits and demerits. Also prove that the A.M. is not independent of change of origin and scale.
8. Define Variance. State and prove its additive property.
9. Discuss about the Dispersion. Also define its all measures of Dispersion in detail.
10. Prove that the sum of the squares of the deviations of a set of values is minimum when taken about mean.
11. Discuss about the co-efficient of variation. In the following data find which series has less C.V.

| | | | | |
|-----------------|---|----|----|----|
| Series A | 5 | 9 | 12 | 8 |
| Series B | 7 | 12 | 19 | 10 |

| | | | | |
|------------|-------|-------|-------|-------|
| C.I | 10-20 | 20-30 | 30-40 | 40-50 |
|------------|-------|-------|-------|-------|

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words.

1. Discuss about the Weighted Mean.
2. What is the difference between multiple bar diagram and divided bar diagram.
3. Define coefficient of variation. For what purpose is it used?
4. Discuss about Histogram.
5. Give short notes on Percentile and Decile.
6. Write a detailed note on the Ogives.
7. Discuss about the Pie Chart and Pictogram.
8. State and prove first property of the mean.
9. Distinguish between Frequency Curve and Frequency Polygon.
10. Write a note on the Mode with its merits, demerits and uses.
11. Show that the median of a variable is the intersection point of ogives.

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|----------------------------|--|--------------------|
| Course Code: UGSTAT- 02 | Course Title: Probability & Distribution | Maximum Marks : 30 |
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Section - A

Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. Define Binomial Distribution. Also calculate its moment generation function.
2. Define Normal Distribution. Also discuss about the area property and characteristic function of normal distribution.
3. What is random variable? Differentiate the probability mass function (p.m.f.) and probability density function (p.d.f.).
4. Each of n urns contains four white and six black balls, while another urn contains five white and five black balls. An urn is chosen at random from these intel urns and two balls are drawn from it both being black. The probability that five white and three black balls remain in the chosen urn is $1/7$. Find the value of n.
5. The probability mass functions of a random variable X is given by

$$b(x) = P(x = x) \begin{cases} \binom{x+4}{x} \left(\frac{1}{3}\right)^5 \left(\frac{2}{3}\right)^x & \text{if } x = 0, 1, 2, \dots \\ 0, & \text{otherwise} \end{cases}$$

Obtain (i) E (x) (ii) Moment generating function of X.

6. The probability density function of a random variable X I given by

$$f(x) = \frac{1}{4\sqrt{\pi}} e^{-\frac{(x-10)^2}{32}}, \quad -\infty < x < \infty$$

Obtain (i) $E(x)$ (ii) $E(x^2)$ and $E(x^4)$

7. For three mutually independent events A, B and C, verify if A^c , B^c , C^c are also mutually independent or not?
8. Let one out of 1000 person in a population suffers from a particular disease. Assume that a test wrongly detects the person suffering from disease is 5% and test correctly detects the person suffering from disease is 99%. What is the probability that a randomly selected person tested to have disease actually has the disease?
9. A fair dice is thrown two times. Let X is the number obtained in the first throw and Y is the minimum of two numbers obtained. Obtain joint pmf of (X, Y). Also obtain (i) conditional distribution of Y given $X = 4$, (ii) $E(XY)$
10. The pdf of a random variable is given by

$$f(x) = kx(1-x); 0 < x < 1$$

Find the value of constant k. Also obtain $E(X)$, $E(X^2)$, $V(X)$ and $P(X > 1/2 | X < 1/5)$.

11. Discuss in detail about Skewness and Kurtosis.

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words.

1. If $X \sim B(10, 1/4)$. Then calculate the mean and variance of the distribution.
2. If $X_1 \sim N(\mu, \sigma_1^2)$ and $X_2 \sim N(\mu_2, \sigma_2^2)$ then $X_1 + X_2$ follows which distribution.
3. What is mathematical expectation? Also calculate the values of $E(ax_1 + bx_2)$ and $V(ax_1 + bx_2)$ where X_1 and X_2 be the iid random variables.
4. State and Prove Baye's theorem.
5. For two events A and B, show that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
6. Define conditional probability and give an example.

7. The probability mass function of a random variable X is given by

$$b(x) = P(X=x) = \begin{cases} \frac{1}{5} \left(\frac{4}{5}\right)^x & \text{if } x=0,1,2,\dots \\ 0, & \text{otherwise} \end{cases}$$

Show that $P(X > 10 \mid X > 3) = P(X > 7)$

8. The p.d.f. of a random variable X is given by

$$\begin{cases} \frac{1}{\beta} e^{-x/\beta} & \text{if } x > 0, \beta > 0, \\ 0, & \text{otherwise} \end{cases}$$

Obtain the moment generating function of X.

9. If $A \cap B \cap C = \Phi$, $A \Rightarrow B$, then find $P(A \cap C)$.
10. The pmf of a random variable X is binomial with parameters (n, p). If $E(X)=10$, $E(X(X-1))=95$, then obtain n and p.
11. A fair dice is thrown unless one obtains either 1 or 6. Let X is the numbers of throws then obtain $E(X)$ and $V(X)$.

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|------------------------|--|--------------------|
| Course Code: UGSTAT-03 | Course Title : Correlation, Regression & Statistical Inference | Maximum Marks : 30 |
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Section - A

Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. Discuss about the Regression. Find out the angle between two regression lines.
2. Define the Spearman Correlation Coefficient also calculate from the following data.

| | | | | | | |
|---|----|----|----|----|----|----|
| X | 17 | 23 | 29 | 13 | 13 | 23 |
| Y | 14 | 22 | 22 | 19 | 14 | 08 |

3. State and Prove Rao Blackwell theorem.
4. Discuss about the effect of change of origin and scale on correlation coefficient.
5. Define non parametric tests. Also discuss about the Mann – Whitney U-test.
6. Discuss about the all properties of a good estimator.
7. Prove that: with n number of attributes defined over a group of individuals or units, there are 3^n total numbers of classes or class frequencies.
8. Prove that: If a sufficient estimator exists, then maximum likelihood estimator is a function of the sufficient estimator.
9. Discuss about the Mann-Whitney U-test.
10. Write in short about the wilcoxon signed Rank Test.
11. State and prove Cramer Rao inequality.

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words.

1. Write short notes on efficiency and sufficiency.
2. Discuss about Unbiasedness and Consistency
3. Discuss about the effect of change of origin and scale on correlation coefficient.
4. Write down the all properties of regression coefficient.
5. Discuss in detail about
 - a) Goodness of fit.
 - b) Sign test and Run test.
6. Discuss about
 - a) Contingency table
 - b) Yates correction.
7. Define
 - a) Critical region and Acceptance region.
 - b) MP & UMP test.
8. Write detail notes on
 - a. Significance test for "equality of means."
 - b. Types of error.
9. Discuss about the Effect of change of origin and scale on the correlation coefficient.
10. Write a note on the angle between two regression lines.
11. Distinguish between correlation coefficient and regression coefficient.

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| Course Code: UGSTAT-04 | Course Title : Sampling Theory & Design of Experiment | Maximum Marks : 30 |
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Section - A

Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. Calculate the mean and variance of SRSWOR.
2. Give the complete layout and statistical analysis of RBD. Also give its ANOVA table.
3. Discuss about the Latin square design (LSD) Give its different steps for its statistical analysis, also give its ANOVA table.
4. Discuss about the Non Sampling Errors.
5. Define linear models. Also give the complete lay out of one way classified data also give its ANOVA.
6. Discuss about the Systematic sampling also find its mean and variance.
7. Discuss how the efficiency of an experiment can be increased by increased replication and local control.
8. In SRSWOR, the sample mean square is an unbiased estimate of the population mean square

$$E(S^2) = S^2$$

9. For SRSWOR, Prove that, \bar{y} is an unbiased estimates of \bar{Y} and its variance is

$$V(\bar{y}) = \frac{N-n}{N} \frac{S^2}{n}$$

10. Prove that, the first approximation to the variance of the ratio estimator of the population total is given by

$$V_1\left(\hat{Y}_R\right) = \left(\frac{N-n}{Nn}\right)N^2\left(S_y^2 + R^2S_x^2 - 2rR S_yS_x\right)$$

11. If population consists of a linear trend, then prove that

$$V(\bar{Y}_{st}) \geq V(\bar{Y}_{sys}) \geq V(\bar{Y}_{srswor})$$

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words.

1. Discuss about the linear models and basic principle of Design of experiment.
2. Discuss about the different methods for collecting the sample under simple random sampling. (SRS)
3. Write short note on (a) Precision (b) Efficiency of Design
4. Compare and contrast the LSD with the RBD.
5. Distinguish the Difference Between multistage Sampling and two phase Sampling.
6. Discuss about the Measures of Sampling Errors.
7. Write a note on Precision and Efficiency of a design.
8. Write the basic assumptions of RBD. Also discuss its advantages and disadvantages.
9. Discuss about the sources of non response errors.
10. Discuss about the
 - (a) Efficiency of RBD
 - (b) Efficiency of LSD.
11. Discuss about the selection methods of Simple Random Sampling.

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| Course Code: UGSTAT-05 | Course Title: Numerical Methods & Basic Computers Knowledge | Maximum Marks : 30 |
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Section - A

Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. Discuss about the different generations of the computers.
2. Describe (a) Trapezoidal rule (b) Euler- Maculerain Formula
3. State and Prove Newton – Gregory Backward Interpolation formula
4. What do you mean by divided differences? State and prove their properties. Also derive their relationship with forward differences.
5. What is numerical differentiation? Derive the relationship between differential operator (D) and Shift operator (E).
6. Write a defiled Comparative note on various low-level and high-level programme languages.
7. Differentiate between E and Δ . Also show that
$$\left(\frac{\Delta^2}{E}\right)e^x \cdot \frac{Ee^x}{\Delta^2 e^x} = e^x$$
, the interval of differencing being h.
8. What do you understand by divided difference? Show that they are symmetrical in all the arguments.
9. Derive Bessel's formula in terms of central difference operator (δ) and mean value operator (μ).

10. Distinguish between Machine Language and Programming language. Describe high level language.
11. Write an algorithm and draw a flow chart to obtain factorial of a positive integer n.

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words.

1. Write short note as : (a) Simpson's one third rule and (b) Waddle's rule
2. Discuss about the Disk Management Commands.
3. Draw a flow chart to obtain factorial of positive integer n.
4. Discuss about the Stirling's formula and Bessel's formula.
5. Define inverse interpolation with an example.
6. Derive Simpson's One- third formula for numerical integration.
7. Differentiate between algorithms and flow-Chart Also, write algorithm and flow –Chart for finding median of green data.
8. Discuss any one method of estimating missing terms with example.
9. What do you mean by programming languages? Mention its uses.

10. Prove that
$$y_x = \sum_{i=1,2,3\dots} \frac{(-1)^{i+1}}{ih} (Y_{x+ih} - Y_{x-ih})$$

11. Using Simpson's one thied formula prove that

$$\int_a^b f(x)dx = \frac{b-a}{6n} [f(x_0) + 4f(x_1) + 2f(x_2) + \dots + f(x_{2n})]$$

where $x_0 = a$ & $x_{2n} = b$

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|------------------------|-----------------------------------|--------------------|
| Course Code: UGSTAT-06 | Course Title : Applied Statistics | Maximum Marks : 30 |
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Section - A
Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. Define index number. Also give an idea about the deal Index Number.
2. Discuss about the
 - (a) Factor Reversal Test
 - (b) Time Reversal Test.
3. Prove that Fisher's ideal index number lies between Laspeyres's and Paasche's index number.
4. Describe control charts. Also draw the steps control chart of \bar{x} & R.
5. Discuss about the methods of link relatives.
6. Discuss about the Double Sampling plan.
7. Discuss about the criteria of a Good Index Number.
8. Explain GRR and NRR. Show that $NRR \leq GRR$. Why? When GRR will be equal to NRR.
9. Discuss about the component of a time series.
10. Explain how the principle of least square used to estimate trend in a time series.
11. Describe any one method of fitting trend by
 - a. Modified exponential curve
 - b. Logistic curve
 - c. Gompertz curve

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words.

1. Write short notes on GRR and NRR.
2. Give the different steps for p-chart and d-chart.
3. Discuss about the time series. Also give its different trends.
4. Discuss about different steps for the method of least square.
5. Construct the Control Charts for number of defectives Charts.
6. Write a note on $3 - \sigma$ Central limits.
7. Construct the Control charts for number of defects.
8. Define Infant mortality rate and maternal mortality rate.
9. Discuss about the total fertility rate and standardized death rates.
10. Discuss about the Fisher's Index number.
11. Give an idea about Fitting of curve through Exponential Trend.

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| Course Code: UGSTAT-07 | Course Title - Operation Research | Maximum Marks : 30 |
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Section - A
Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. Discuss about the Linear Programming Also Define the different steps for Graphical solution to LPP.
2. Discuss about the principle of simplex method. Also define non basic variable and artificial variables.
3. Discuss about the different methods for the computation of an initial basic feasible solution.
4. Write a detailed note on classification of models used in operations research.
5. What is a game problem? How do we solve these problems using LPP technique? Give example.
6. What is a transportation problem? How could it be considered as LPP? Also, show that number of basic variables in a transportation problem of order $m \times n$, are at the most $m+n-1$
7. "Ram can buy young hens at Rs. 150 each and old hens at Rs. 120 each. The old hens lay 3 eggs per week and the young ones lay 5 eggs per week, each egg being worth Rs. 4. If any hen costs Rs. 10 per week to feed and Ram has only Rs. 3600 to spend for hens, how many of each kind should Ram buy to give a profit of more than Rs. 70 per week, assuming that Ram cannot house more than 25 hens." Formulate this problem and solve graphically.
8. Solve the following LPP :

$$\begin{aligned} \text{Max } Z &= 5x - 2y + 3z \\ \text{subject to } 2x + 2y - z &\geq 2 \\ 3x - 4z &\leq 3 \\ y + 3z &\leq 3 \\ \text{and } x, y, z &\geq 0 \end{aligned}$$

9. Find the dual of the following primal problem (mention all steps)

$$\begin{aligned} \text{Min } Z &= x + y + z \\ \text{subject to } x - 3y + 4z &= 5 \\ x - 2y &\leq 3 \\ 2y - z &\geq 4 \\ \text{and } x, y, z &\geq 0 \end{aligned}$$

10. Explain the following terms.

- (i) Feasible solution (FS)
- (ii) Basic solution (BS)
- (iii) Basic feasible solution (BFS).
- (iv) Optimum BFS.

11. What do you mean by LPP? Discuss geometric properties of LPP.

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words

1. Discuss in brief about the Hungarian method.
2. Discuss about the basic assumption of two person sum- zero game.

3. Write a note on pay off matrix.
4. Describe the graphical method for $2 \times n$ or $m \times 2$ games.
5. What is a dual problem? How do we get a dual of given primal?
6. State and prove reduction theorem for assignment problems.
7. Solve the following LPP graphically (give all steps).
Max . $Z = 3x + 2y$, subject to $x - y \leq 1$, $x + y \geq 3$ and $x, y \geq 0$.
8. Write a brief note on phases of OR problem.
9. Give the basic assumptions of Two-Person Sum-Zero Game.
10. Write a brief note a various types of variables used in LPP.
11. Differentiate clearly between primal and its dual problem (with example).

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| | | |
|------------------------|--|--------------------|
| Course Code: UGSTAT-08 | Course Title-Advance Statistical Inference | Maximum Marks : 30 |
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Section - A

Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. State and prove Crammer - Rao inequality.
2. State and prove Neyman - Fisher Factorization theorem.
3. State and prove Lehman- Scheffe theorem.
4. Distinguish parametric and non parametric test.
5. What do you mean by an unbiased estimator? If T is an unbiased estimator of Q , show that \sqrt{T} and T^2 are the biased estimators of \sqrt{Q} , and Q^2 , respectively.
6. What is sufficiency? Let X_1, X_2 be i.i.d. Poisson (Q) variates. Show that $(X_1 + 3X_2)$ is not sufficient for θ_1 but $(X_1 + X_2)$ is sufficient for θ .
7. Prove that the sampling from $N(\mu, \sigma^2)$ population, the sample mean is consistent estimator of μ .
8. Prove that, if T_1 and T_2 be two MVUE for a parameter θ , then $T_1 = T_2$.
9. Define MVU estimators. Also obtain the MVUE for μ in the normal population $N(\mu, \sigma^2)$, where σ^2 is known.
10. Let (x_1, x_2, \dots, x_n) be a random Sample of size n from the Poisson distribution with parameter θ . Obtain an unbiased estimator of $e^{-5\theta}$.

11. Let (x_1, x_2, \dots, x_n) be a random Sample of size n from the Distribution having p.d.f. given by

$$f(x, \theta) = \begin{cases} (1/\theta) * e^{-x/\theta} & \text{where } x > 0, \theta > 0, \text{ and} \\ 0 & \text{otherwise} \end{cases}$$

Obtain Uniformly Most Powerful test for testing $H_0: \theta = 1$ against $H_1: \theta > 1$. also obtain expression of power function.

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words

1. Write short notes on (a) Power of test (b) Level of Significance
2. Discuss about MP and UMP test.
3. State and prove Neyman- Pearson lemma.
4. Discuss about the confidence interval and confidence coefficient.
5. With the help of an example, show that the maximum likelihood estimator is not unique.
6. State and prove Cramer Rao Inequality.
7. Define Consistent estimator.
8. Write a brief note on sampling distribution.
9. Give an example of unbiased estimator which is not consistent and vice-versa.
10. Let X_1, X_2, \dots, X_n be a random sample of size n from uniform $(0, \theta)$. Then obtain sufficient estimator for θ .
11. Clearly differentiate between parameter and statistic.

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| Course Code: UGSTAT-12 | Course Title - Official Statistics | Maximum Marks : 30 |
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Section - A

Long Answer Questions

Note: Attempt any three questions. Each question should be answered in 800 to 1000 Words.

Maximum Marks: 18

1. Discuss about the use of statistics in different fields.
2. Define census and birth & death registration system.
3. Write short notes on stable population and stationary population.
4. Discuss about the various optical agencies responsible for data Collection.
5. Discuss about the methods of Collection of data.
6. Discuss about the use of Statistics in day to day life.
7. Write an essay on the cost of living index number in India.
8. What is meant family budget survey?
9. Write a detailed note on components of time series.
10. What do you meant by SQC. Discuss briefly its need and utility in industries.
11. How can we use the principles of design of experiments in the field of Agriculture? And also discuss its benefits.

Section - B

Short Answer Questions

Maximum Marks: 12

Note: Attempt any four questions. Answer should be given in 200 to 300 Words

1. Discuss about the GRR and NRR.
2. Discuss about the principle of local control and randomization.
3. Write short notes on (a) Critical Region (b) Types of error
4. Discuss about the Hypothesis. Also give its types.
5. Describe, How Statistics is useful in the field of Agriculture.
6. Write some limitations of the data Collection methods.
7. What is Census?
8. Define level of significance and power of test.
9. Distinguish between rates and ratio.
10. Define migration how can its effects the population of any area.
11. Discuss about the IMR and MMR.