Rayat Shikshan Sanstha's

SADGURU GADAGE MAHARAJ COLLEGE, KARAD

(An Autonomous College)

Revised Syllabus

Bachelor of Science

Part II

STATISTICS (Major)

Choice Based Credit System (CBCS) as per NEP - 2020

Syllabus Implemented w. e. f. June, 2024

Paper V : MJ-BST23-301

Continuous Probability Distributions-I

Credits:02

Course Outcomes: The students will acquire knowledge of

i) Bivariate discrete distributions with real life situations.
ii) Continuous random variable and find the various measures, probabilities using its probability distribution.
iii) Transformation of univariate continuous random variable.
iv) Some standard continuous probability distributions with real life situations.
v) The relations among the different distributions.

Unit 1 : Credit:01

1.1: Continuous Univariate Distribution:

Definition of the continuous sample space with illustration, Definition of continuous random variable (r.v.), probability density function (p.d.f.), cumulative distribution function (c.d.f.) and its properties.

Expectation of r.v. expectation of function of r.v., mean, median, mode, quartiles, variance, harmonic mean, raw and central moments, skewness and kurtosis, examples

Moments generating function (m.g.f.): definition and properties (i) Standardization property $M_x(0) = 1$, (ii) Effect of change of origin and scale , (iii) Uniqueness property of m.g.f., (statement only). Generation of raw and central moments.

Cumulative generating function (c.g.f.): definition, relation between cumulants and central moments (up to order four), Examples.

1.2: **Transformation of continuous r.v. :**

Transformation of univariate continuous r.v. : Distribution of $Y = g(X)$, where g is monotonic or non-monotonic functions using (i) Jacobian of transformation , (ii) Distribution function and (iii) m.g.f. methods.

Unit-2 : Credit:01

2.1: Continuous Bivariate Distribution :

Definition of bivariate continuous random variable (X,Y), joint p.d.f., c.d.f. with properties , marginal and conditional distribution , independence of random variables , evaluation of probabilities of various regions bounded by straight lines.

Expectation of function of r.v.s means, variances, covariance, correlation coefficient , conditional expectation , regression as conditional expectation if it is linear function of other variable and conditional variance , proof of i) $E(X \pm Y) = E(X) \pm E(Y)$, ii) $E[E(X/Y) = E(X)$.

If X and Y are independent r.v.s. then (i) $E(XY) = E(X)\,E(Y)$, (II) $M_{x+y}(t) = M_x(t)\,M_y(t)$. Examples.

2.2: Transformations of continuous bivariate r.v. s : Distribution of bivariate r.v.s. using Jacobian of transformation. Examples

2.3: Continuous Uniform and Exponential Distribution :
Uniform distribution : Definition of Uniform distribution over (a,b), c.d.f., m.g.f., mean, variance, moments. Distribution of (i) (X- a) / (b-a) , (ii) (b-X) / (b-a), (iii) Y= F(x) where F(x) is c.d.f. of any continuous r.v.
Exponential distribution : p.d.f. (one parameter), c.d.f., m.g.f., c.g.f., mean , variance , c.v., moments, Cumulants, Median, Quartiles, lack of memory property , distribution of $-(1/\theta)\log X$ where $X \sim U(0,1)$.Examples

Books Recommended:

1. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.
2. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
3. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
4. Gupta S. C. & Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.
5. Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan
6. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.

Paper VI: MJ-BST23-302

Statistical Methods –I

Credits:02

Course Outcomes: The students will acquire knowledge of

i) Obtaining multiple linear regression equations and their applications.

ii) The concept of multiple correlations, partial correlation and their computations.

iii) Need, Construction and utility of various index numbers.

iv) The concepts related to national income and different methods of estimation of national income.

Unit-1: Credit:01

1.1 : Multiple Linear Regression (for trivariate data only)

Concept of multiple linear regression , Plane of regression , Yule's notation , correlation matrix. Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation.

Residual : Definition , order, properties, derivation of mean and variance , Covariance between residuals.

1.2 : Multiple and Partial Correlation (for trivariate data only) :

Concept of multiple correlation: Definition of multiple correlation coefficient.

Properties of multiple correlation coefficients :

i) $0 \leq R_{i.jk} \leq 1$, (ii) $R_{i.jk} > |r_{ij}|$, iii) $R_{i.jk} > |r_{ik}|$ $I = j = k = 1,2,3.$ $i \neq j$, $i \neq k$.

Interpretation of $R_{i.jk} = 1$, $R_{i.jk} = 0$, coefficient of multiple determination $R^2_{1.23}$

Concept of partial correlation. Definition of partial correlation coefficient $r_{ij.k}$, derivation of formula for $r_{ij.k}$.

Properties of partial correlation coefficient (i) $1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij}.b_{ji.}k = r^2_{ij.k}$

Examples and problems.

Unit-2: Credit: 01

2.1 : Index Numbers :

Meaning and utility of index numbers , problems in construction of index numbers. Types of index numbers: price, quantity and value. Unweighted and Weighted index numbers using (i) aggregate method , (ii) average of price or quantity relative method (A.M. or G.M. is to be used as an average).Index numbers using : Laspeyre's , Paasche's and Fisher's formula. Tests of index numbers : unit test, time reversal test ad factor reversal tests. Cost of living index number : definition , problems in construction, construction by using (i) Family Budget and (ii) Aggregate expenditure method.

2.2 : National Income :

Definitions of national income by (i) Marshall,(ii) Pigou and (iii) Fisher.

Different concept of national income (i) Gross national product (GNP),(ii) Net national product (NNP).

Personal income, disposable income, per capita income, gross domestic product(GDP), national income at market price, national income at factor cost, national income at current prices, national income at constant prices.
Methods of estimation of national income and the difficulties in methods (i) output method, (ii) income method, (iii) expenditure method.
Importance of national income.

Books Recommended:

1. Cochran, W.G: Sampling Techniques, Wiley Eastern Ltd., New Delhi.
2. Des Raj: Sampling Theory.
3. Gupta S. C. & Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.
4. Dr. Kore B.G. and Dr. Dixit P.G.:"Statistical Methods-I",Nirali Prakashan, Pune.
5. Barlow R. E. and Proschan Frank: Statistical Theory of Reliability and Life Testing. Holt Rinebart and Winston Inc., New Yark.
6. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.
7. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.

MJ-BSP23-303: Practical

Credits:04

Pre requisites : Knowledge of the topics in the theory papers and MS-Excel.

Course Outcomes : Students will able to;

i) Fit plane of multiple regression, compute multiple and partial correlation coefficients.
ii) Know applications of some standard bivariate discrete probability distribution.
iii) Understand how to obtain random sample from various probability distributions
iv) Sketch of the p.m.f./ p.d.f. for given parameters.
v) Fit and test the goodness of fit of specified distribution for given data.

Practical – III (A)

1. Fitting of Discrete Uniform Distribution & Fitting of Binomial Distribution.
2. Fitting of Hypergeometric Distribution.
3. Fitting of Poisson Distribution.
4. Fitting of Geometric Distribution & Negative Binomial distribution.
5. Model sampling from Discrete Uniform distribution and Binomial distribution.
6. Model sampling from Hypergeometric distribution.
7. Model sampling from Poisson distribution.
8. Model sampling from Geometric and Negative Binomial distribution

Practical –III (B)

1. Sketching of Discrete Probability Distributions.
2. Sketching of Continuous Probability Distributions.
3. Multiple Regression.
4. Multiple Correlation.
5. Partial Correlation.
6. Index Numbers-I
7. Index Numbers-II
8. National Income.

Note:

a) Students must complete all practicals by using MS-EXCEL.
b) MS-EXCEL should be used at a time of practical examination for computation purpose.
c) For fitting of all distributions, test of goodness of fit is necessary.
d) For model sampling from all distributions, inverse c.d.f. transformation Method has to be used in Practical – II.
e) For practicals on fitting of discrete distributions, probabilities are to be calculates by recurrence relation only.
f) Student must complete the entire practical to the satisfaction of the teacher concerned.

Student must produce the laboratory journal along with the completion certificate signed by Head of Department, at the time of College practical Examination

Nature of Practical Examination:

a) Student will be asked to solve/attempt any Two problems out of FOUR for every Practical paper (Practical Paper III(A) and Paper III(B) .
b) Practical Paper III(A) carries 45 Marks with distribute 5 marks will be reserved for Practical Journal completion and 4 marks for oral on entire practical work.
c) Practical Paper III(B) carries 45 Marks with distribute 5 marks will be reserved for Practical Journal completion and 4 marks for oral on entire practical work.
d) 10 marks will be reserved for Project Work and oral on it.

e) MS-EXCEL should be used for computation purpose. Students evaluation during practical examination will be online and students should demonstrate / explain his computations to the examiner.

f) Practical examination of each Paper will be of 4 hours duration which includes oral as well as online demonstration.

g) There should be two subject experts at the time of Practical examination.

Nature of Question Paper for Theory Examination (40+10 Pattern) as per NEP-2020:

Maximum Marks : 40

Duration : 2 Hrs

Que. 1 Select the most correct alternatives from the following [8 Marks]

Que. 2 Attempt any TWO of the following [16 Marks]

Que. 3 Attempt any FOUR of the following [16 Marks]

B. Sc. Part II (Semester-IV)

Paper VII : MJ-BST23-401

Continuous Probability Distributions-II

Credits:02

Course Outcomes: The students will acquire knowledge of

i) Some standard continuous probability distributions with real life situations.

ii) Finding the various of continuous random variable and probabilities by using it's probability distributions.

iii) The relationships among different distributions.

iv) Continuous bivariate r.v. and probability distributions of their transformations.

v) Concept of sampling distributions of a statistic : Normal, Chi-square , t and F distributions with their applications and interpretations.

Unit-1: Credit:01

1.1: Gamma and Beta Distributions:

1.1.1: Gamma distribution: Gamma distribution with scale parameter θ and shape parameter n, special case $\theta = 1$, $n = 1$, m.g.f., c.g.f., mean, mode, variance, moments, cumulants, β_1, β_2, γ_1 and γ_2 coefficients, additive property: distribution of sum of i.i.d. exponential variates.

1.1.2: Beta distribution of first kind: Beta distribution of first kind with parameters m & n. mean, mode, variance, symmetric when m = n, Uniform distribution as a particular case when m = n = 1, distribution of (1-X).

1.1.3: Beta distribution of second kind: Beta distribution of second kind with parameters m & n. Mean, mode, variance, relation between beta distribution of first kind and second kind, distribution of X/Y and X/(X+Y) where X and Y are independent gamma variate.

1.2: Normal distribution:

Normal distribution with parameters μ & σ^2, Definition of standard normal distribution,properties of normal curve, m.g.f., c.g.f., mean, variance, median, mode, mean deviation, moments, cumulants, measures of skewness & kurtosis, distribution of linear combination of variates.

Distribution of X^2 if $X \sim N(0, 1)$.

Unit -2: Credit:01

2.1 : Exact Sampling Distributions:

Chi-Square distribution: Definition of chi square, derivation of p.d.f. of chi square distribution with n degrees of freedom using m.g.f.. c.g.f., mean, variance, moments, cumulants, mode, skewness and kurtosis, additive property.

Student's t- distribution: Definition of student's t variate. Derivation of p.d.f., mean, mode, variance, moments, β_1,β_2, γ_1 and γ_2 coefficients.

Snedecor's F distribution: Definition of F variate, derivation of p.d.f., mean, variance and mode. Distribution of 1/F. Inter relation between t, F and χ^2 (Without Proof).

2.2: Laplace (Double Exponential) Distribution:

Laplace distribution with parameters μ and θ (- $\infty < \mu < \infty$ *and* $\theta > 0$) :

$$f(x;\theta,\mu) = \begin{cases} \frac{\theta}{2} e^{-\theta|x-\mu|} & if -\infty < x < \infty \\ 0 & if\ otherwise \end{cases}$$

Nature of the probability curve, Distribution function, quartiles, moment generating function, mean, variance, moments,β_1, β_2, γ_1, γ_2 coefficients.

Laplace distribution as a distribution of the difference of two i.i.d. exponential variates with parameter θ. Examples and problems.

Books Recommended:

1. Barlow R. E. and Proschan Frank: Statistical Theory of Reliability and Life Testing. Holt Rinebart and Winston Inc., New Yark.
2. Sinha S. K.: Reliability and Life Testing, Second Edition, Wiley Eastern Publishers, New Delhi.
3. Trivedi R. S.: Probability and Statistics with Reliability and Computer Science Application, Prentice – Hall of India Pvt. Ltd., New Delhi.
4. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.
5. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
6. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
7. Gupta S. C. & Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi

Paper VIII : MJ-BST23-401

Statistical Methods-II

Credits:02

Course Outcomes: The Students will acquire knowledge of

i) The Concept and use of time series analysis.

ii) The meaning, purpose and use of Statistical Quality, Construction and working of control charts for variables and attributes.

iii) Applying the appropriate small sample tests and large sample tests in various situations.

Unit 1: Credit:01

1.1 : Time Series:

Meaning and need of time series analysis, components of times (i) Secular trend (ii) Seasonal Variation (iii) Cyclical Variation (iv) Irregular Variation , Additive and Multiplicative model, Utility of time series.

Measurements of trends : (i) Moving averages method (ii) Progressive averages method (iii) Least square method (iv) Measurement of seasonal indices by simple average method.

1.2: Statistical Quality Control:

Meaning and purpose of S.Q.C., Process control, Product control, chance causes, assignable causes, Shewhart's control chart- construction & working, lack of control situation.

Control charts for variables - control chart for mean, control chart for range, construction and working of mean & range charts for unknown standards, revised control limits.

Control charts for Attributes – Defects, defectives, fraction defective, control chart for fraction defective (p-chart) for fixed sample size and unknown standards, construction and working of chart. Control charts for number of defects (C-chart), for unknown standards, construction and working of C-chart.

Unit 2: Credit:01

2.1: Testing of Hypothesis - I:

Notion of Population, Sample, Parameter, Statistic, Sampling distribution of Statistics $\bar{X}$ and S^2 when sample is drawn from normal distribution (statement only). Hypothesis, Simple and composite hypothesis, Null and alternative hypothesis, type I and type II errors, Critical region, level of significance, p-value. One and two tailed test, power of test.

2.2: **Testing of Hypothesis - II:** General procedure of testing of hypothesis.

Small Sample Tests:

t- test : Test for means: i) H_0: $\mu = \mu_0$,ii) H_0: $\mu_1 = \mu_2$, (where $\sigma_1^2 = \sigma_2^2$), iii) Paired t-test

χ^2 _ test : Test for population variance H_0: $\sigma^2 = \sigma_0^2$ (Mean Known and unknown)

F – test : Test for equality of two population variances H_0: $\sigma_1^2 = \sigma_2^2$

Large Sample Tests:

A) Tests for means: i) Testing of population mean; H_0: $\mu = \mu_0$

ii) Testing equality of population means; H_0: $\mu_1 = \mu_2$

B) Tests for Proportion: i) Testing of population Proportion; H_0: $P = P_0$

ii) Testing equality of population Proportion; H_0:$P_1 = P_2$

C) Test for population correlation by using Fisher's Z- transformation:

i)Testing of population correlation; H_0: $\rho = \rho_0$

ii) Testing equality of population correlations;H_0: $\rho_1 = \rho_2$

D) χ^2 – tests for : i)Goodness of fit of given probability distribution and

ii)Test for independence of attributes when data is in the form of:

a) m x n contingency table

b) 2 x 2 contingency table, Yate's correction for continuity.

Books Recommended:

1. Chatfield C. : "The Analysis of Time Series –An Introduction",Chapman & Hall.
2. Gupta S. C. & Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.
3. Kendall M.G. : "Time Series", Charles Griffin.
4. Dr. Kore B.G. and Dr. Dixit P.G.: "Statistical Methods-II", Nirali Prakashan, Pune.
5. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.

MJ-BSP23-403: Practical

Credits:04

Pre requisites : Knowledge of the topics in the theory papers and MS-Excel.

Course Outcomes : Students will able to;

i) Fit and test the goodness of fit of specified distribution for given data.
ii) Know applications of some standard continuous probability distributions.
iii) Understand how to obtain random sample from various probability distributions
iv) Test various hypothesis about parameters of specified distribution for given data.
v) Construct various control chart.
vi) Apply appropriate statistical method while doing project on real life problems.

Practical – IV (A)

1.Fitting of Continuous Uniform distribution

2.Fitting of Exponential distribution

3.Fitting of Normal distribution.

4. Fitting of Laplace (Double Exponential) Distribution

5.Model sampling from Continuous Uniform and Exponential distribution

6.Model sampling from Normal distribution using: (i) Normal table and ii) Box-Muller transformation

7. Model Sampling from Laplace (Double Exponential) Distribution.

8.Application of Exponential distribution.

9. Application of Normal distribution.

Practical – IV (B)

1. Large sample tests for means.

2. Large sample tests for proportions.

3. Tests based on Chi square distribution.(Test for population variance, Test for goodness of fit.)Tests for independence.

4. Tests based on t distribution ($\mu = \mu_0$, $\mu_1 = \mu_2$; paired t test)

5. Tests based on F distribution. ($\sigma_1^2 = \sigma_2^2$)

6.Time Series.-I (Trend by Progressive averages, Moving average)

7.Time Series.-II (least square methods)

8. Construction of R and *X* charts.

9. Construction of P and C charts.

Note:

- **a)** Students must complete all practical's by using MS-EXCEL.
- **b)** MS-EXCEL should be used at a time of practical examination for computation purpose.
- **c)** For fitting of all distributions, test of goodness of fit is necessary.
- **d)** For model sampling from all distributions, inverse c.d.f. transformation Method has to be used in Practical – II.
- **e)** For practical's on fitting of discrete distributions, probabilities are to be calculates by recurrence relation only.
- **f)** Student must complete the entire practical to the satisfaction of the teacher concerned.
- **g) Project Work : Students** should do project, especially on real life problems. Primary data will be preferable. Students will be asked to use statistical techniques/tools which they have learnt during their B.Sc. I and B.Sc. II program. Students may do project work in groups and number of students in a group should not exceed FOUR.

Student must produce the laboratory journal along with the completion certificate signed by Head of Department, at the time of College practical Examination

Nature of Practical Examination:

a) Student will be asked to solve/attempt any Two problems out of FOUR for every Practical paper (Practical Paper IV(A) and Paper IV(B) .
b) Practical Paper IV(A) carries 45 Marks with distribute 5 marks will be reserved for Practical Journal completion and 4 marks for oral on entire practical work.
c) Practical Paper IV(B) carries 45 Marks with distribute 5 marks will be reserved for Practical Journal completion and 4 marks for oral on entire practical work.
d) 10 marks will be reserved for Project Work and oral on it.
e) MS-EXCEL should be used for computation purpose. Students evaluation during practical examination will be online and students should demonstrate / explain his computations to the examiner.
f) Practical examination of each Paper will be of 4 hours duration which includes oral as well as online demonstration.
g) There should be two subject experts at the time of Practical examination.

Nature of Question Paper for Theory Examination (40+10 Pattern) as per NEP-2020:

Maximum Marks : 40

Duration : 2 Hrs

Que. 1 Select the most correct alternatives from the following [8 Marks]

Que. 2 Attempt any TWO of the following [16 Marks]

Que. 3 Attempt any FOUR of the following [16 Marks]