B.Sc.II (Semester-III)

# Paper V : BST22-301

# Continuous Probability Distributions-I

## (Credit : 02)

Theory- 30 Hours Credits:02

**LEARNING OBJECTIVES:**

1. Understand concept of continuous distributions with real life situations.
2. Distinguish between discrete and continuous distributions.
3. Find various measures of r.v. and probabilities using its probability distributions.
4. Know the relations among the different distributions.
5. Understand the concept of transformation of univariate and bivariate continuous random variables.

**Unit 1 : Continuous Univariate Distribution : (15)**

**1.1:** 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.

**1.2:** 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.

**1.3 :** 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.

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

Examples.

**Unit-2 : Continuous Uniform and Exponential Distribution : (10)**

**2.1:** 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.

**2.2 :** 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 $X \sim U(0,1)$.

**Unit-3 : Continuous Bivariate Distribution : (10)**

**3.1 :** 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.

**3.2:** 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) $E[E(X/Y) = E(X)$.

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

**3.4:** Examples.

**Unit-4: Transformation of continuous r.v. : (10)**

**4.1 :** 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.

**4.2:** Transformations of continuous bivariate r.v.s : Distribution of bivariate r.v.s. using Jacobian of transformation.

**4.3 :** Examples **Learning outcomes-**

Students should be able to:

1. Learn the basic concepts of Statistics.
2. Understand concept of continuous distributions with real life situations
3. Learn uniform and exponential distributions
4. Solve examples on Continuous distributions
5. Learn Bivariate distributions
6. Solve examples on Bivariate distributions
7. Define Transformation of univariate and Bivariate continuous r.v

**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.

B.Sc.II (Semester-III)

# Paper VI : BST22-302

# Statistical Methods -I

# (Credit : 02)

## LEARNING OBJECTIVES:

The main objective of this course is to acquaint students with the basic concepts of Time Series, Demography, Reliability Theory and Order Statistics. By the end of course students are expected to be able to :

1. Know the concept and use of time series
2. Understand the need of Multiple and Partial Correlation and Regression.
3. Understand concept of Binary Systems, Reliability of binary System, Ageing Properties.
4. Solve the examples on Index Numbers.

**Unit 1: Time Series:**
**(10)**

**1.1:** 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.

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

**Unit-2: Multiple Linear Regression (for trivariate data only) and Multiple and Partial Correlation (for trivariate data only) :**
**(15)**

**2.1 :** Concept of multiple linear regression , Plane of regression , Yule's notation , correlation matrix.

**2.2 :** Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation.

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

**2.4 :** Concept of multiple correlation: Definition of multiple correlation coefficient.

**2.5:** 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. $i \neq j$ , $i \neq k$.

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

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

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

**2.9 :** Examples and problems.

**Unit-3: Reliability Theory**
**(15)**

**3.1:** Binary Systems : Block diagrams , definition of binary coherent structure and illustrations. Coherent system of component at most three (a) Series , (b) Parallel , (c) 2 out of 3: G Minimal cut, minimal path representation of system.

**3.2:** Reliability of binary system: Reliability of above systems h(p), when components are independent and identically distributed with common probability p of operating.

**Unit-4: Index Numbers:**
**(10)**

**4.1 :** Meaning and utility of index numbers , problems in construction of index numbers.

**4.2 :** Types of index numbers: price, quantity and value.

**4.3:** 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)

**4.4 :** Index numbers using : Laspeyre's , Paasche's and Fisher's formula.

**4.5 :** Tests of index numbers : unit test, time reversal test ad factor reversal tests.

**4.6 :** Cost of living index number : definition , problems in construction, construction by using (i) Family Budget and (ii) Aggregate expenditure method.

**Learning outcomes-**

Students should be able to:

1. learn the Meaning and need of time series analysis.
2. Do Measurement of trend
3. Understand the concept of Multiple and Partial Correlation and regression.
4. Solve examples on Reliability Theory.
5. Learn Binary Systems Reliability of binary System and Ageing Properties
6. Solve the examples on Index Numbers.

**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. ParimalMukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.

4. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.

5. Gupta S. C. &Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.

**B. Sc. Part II (Semester-IV)**

# Paper VII : BST22-401

# Continuous Probability Distributions-II

# (Credit : 04)

**LEARNING OBJECTIVES:**

The main objective of this course is to acquaint students with the basic concepts Gamma and Beta Distributions ,Normal distribution, Exact Sampling Distributions, Bivariate Normal Distribution By the end of course students are expected to be able to

1. Find various measures of r.v. and probabilities using its probability distributions
2. Know the relations among the different distributions
3. Understand the concept of Normal distribution, Chi-Square distribution , Student's t-distribution, Snedecor's F distribution, Bivariate Normal Distribution.

**Unit -1: Gamma and Beta Distributions: (15)**

**1.1:** Gamma distribution: Gamma distribution with scale parameter $\theta$ and shape parameter n, special case $\theta = 1$, n =1, m.g.f., c.g.f., mean, mode, variance, moments, cumulants, $\beta 1, \beta 2$, $\gamma 1$ and $\gamma 2$ coefficients, additive property: distribution of sum of i.i.d. exponential variates.

**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).

**1.3**: 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.

**Unit -2: Normal distribution: (10)**

**2.1**: Normal distribution with parameters $\mu$ & $\sigma^2$, Definition of standard normal distribution,

**2.2**: 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.

**2.3**: Distribution of $X^2$ if X~N (0, 1).

**Unit -3: Exact Sampling Distributions: (10)**

**3.1**: 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.

**3.2**: Student's t- distribution: Definition of student's t variate. Derivation of p.d.f., mean, mode, variance, moments, $\beta 1$, $\beta 2$, $\gamma 1$ and $\gamma 2$ coefficients.

**3.3**: 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 $\chi 2$ (Without Proof).

**Unit-4 Bivariate Normal Distribution (10)**

**4.1 :** p.d.f. of bivariate Normal Distribution, $BN(\mu_1,\mu_2,\sigma_1^2,\sigma_2^2,\rho)$, marginal and conditional distributions, identifications of parameters, conditional expectation and conditional variance, regression of Y on X and of X on Independence and uncorrelated –ness imply each other, m.g.f. and moments. Distribution of aX+bY+c, where a, b, and c are real numbers.

**4.2** : Examples

**Learning outcomes-**

Students should be able to:

1. Learn Gamma and Beta Distributions
2. Compute mean, mode, variance, moments, cumulants for Gamma and Beta Distributions
3. Learn Normal distribution with parameters $\mu$ & $\sigma^2$
4. Learn properties of normal curve
5. Compute Distribution of $X^2$
6. Learn Exact Sampling Distributions

7. Understand Chi-Square distribution, Student's t- distribution, Snedecor's F distribution

8. Know the relations among the different distributions

**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. ParimalMukhopadhyaya: 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.

**B. Sc. Part II (Semester-IV)**

# Paper VIII : BST22-402

# Statistical Methods-II

# (Credit : 04)

**LEARNING OBJECTIVES:**

The main objective of this course is to acquaint students with the basic concepts of Testing of Hypothesis, Large Sample Tests, small sample tests, t-test, $\chi^2$ – test, F – test, Statistical Quality Control, Chebychev's Inequality.

By the end of course students are expected to be able to

a) Understand the small sample tests and large sample tests in various situations

b) Use Chebyshev's inequality for various distributions to find probabilities.

c) Understand the meaning, purpose and use of SQC , construction and working of control charts for variables and attributes.

**Unit -1: Chebychev's Inequality:** **(05)**

4.1 Chebychev's inequality for discrete and continuous distributions.

4.2 Examples and problems on standard distributions( Binomial, Normal, Exponential etc.)

**Unit -2: Statistical Quality Control:** **(05)**

**2.1**: 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.

**2.2**: 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.

**2.3**: 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 3: Testing of Hypothesis - I:**

**1.1**: Notion of Population, Sample, Parameter, Statistic, Sampling distribution of Statistic, 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.

**1.2**. Large Sample Tests:

General procedure of testing of hypothesis.

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: i) $H_0$: $\rho = \rho_0$ ii) $H_0$: $\rho_1 = \rho_2$ (by Z-transformation)

**Unit 4: Testing of Hypothesis - II:**

**4.1:** Definition of Fisher's t- variate

a) 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

**4.2**: i) Test for population variance $H_0$: $\sigma^2 = \sigma_0^2$ ( Mean Known and unknown)

iv) test for goodness of fit

v) test for independence of attributes;

a) m x n contingency table

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

**4.3**:Test for equality of two population variances $H_0$: $\sigma_1^2 = \sigma_2^2$

**Learning outcomes-**

Students should be able to:

1. Learn Testing of Hypothesis
2. Understand Large Sample Tests
3. Learn Testing of Hypothesis
4. Understand Small Sample Tests
5. Learn Meaning and purpose of S.Q.C
6. Draw Control charts for Attributes
7. Draw Control charts for variables
8. Learn Chebychev's inequality for discrete and continuous distributions
9. Solve examples on Chebychev's inequality

**Books Recommended:**


1. Sinha S. K.: Reliability and Life Testing, Second Edition, Wiley Eastern Publishers, New Delhi.

2. Gupta S. C. &Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.

3. Gupta S. C. &Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.

## B.Sc.II : Semester IV :

### BSP22-403: Practical

**OBJECTIVES:**

By the end of course students are expected to be able to:

1. Understand the applications of Poisson, Geometric, Negative Binomial distribution, Hypergeometric distributions.
2. Compute the expected frequencies and test the goodness of fit.
3. Understand how to obtain random sample from standard probability distribution.
4. Apply time series, reliability, order statistics in real life situations.
5. Sketch time series plots using MS-EXCEL.
6. Understand the applications of Continuous Uniform distribution,Exponential distribution,Normal distribution,Bivariate Normal distribution.
7. Compute the expected frequencies and test the goodness of fit.
8. .Apply Chebeshev's Inequality for various distributions
9. Construct various control charts
10. Apply large and small sample tests

### Practical – II

1. Fitting of Discrete Uniform Distribution
2. Fitting of Binomial Distribution.

3. Fitting of Hypergeometric distribution.
4. Fitting of Poisson and Geometric distribution.
5. Fitting of Negative Binomial distribution.
6. Model sampling from Discrete Uniform distribution.
7. Model sampling from Binomial distribution.
8. Model sampling from Hypergeometric distribution.
9. Model sampling from Poisson and Geometric distribution.
10. Model sampling from Negative Binomial distribution
11. Fitting of Continuous Uniform distribution
12. Fitting of Exponential distribution
13. Fitting of Normal distribution.
14. Model sampling from Continuous Uniform and Exponential distribution
15. .Model sampling from Normal distribution using: (i) Normal table and ii) Box-Muller transformation.
16. Application of Exponential distribution.
17. Application of Normal distribution.

## Practical –III

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

2.Time Series.-I(least square methods)

3. Multiple Regression.

4. Multiple and Partial Correlation.

5.Reliability Theory-I

6.Reliability Theory-II

7. Index Numbers-I ( Computations of index numbers and tests of adequacy)

8. Index Numbers-II ( Shifting of base , splicing, deflating, purchasing power of money)

9.Fitting of Straight line / Parabola / Exponential curves.

10.Time Series (Trend by Progressive averages, Moving average,least square methods)using MS-

EXCEL

11. Large sample tests for means.

12. Large sample tests for proportions.

13. Tests for population correlation coefficients. (Using Fisher's Z transformation.)

14. Tests based on Chi square distribution.(Test for population variance, Test for goodness of

fit.)Tests for independence.

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

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

17. Applications of Chebeshev's Inequality

18. Construction of R and *X* charts.

19. Construction of P and C charts.

- **Project (20 marks)**

**Learning outcomes-**

Students should be able to:

i) Solve the applications of Poisson,Geometric, Negative Binomial distribution, Hypergeometric distributions.

ii) Sketch time series plots using MS-EXCEL.

iii) Compute the expected frequencies and test the goodness of fit

iv) Compute the expected frequencies and test the goodness of fit.

v) Learn the applications of Continuous Uniform distribution, Exponential distribution Normal distribution

vi) Compute the expected frequencies and test the goodness of fit.

vii) Apply Chebechev's Inequality for various distributions

viii) Construct various control charts

ix) Apply large and small sample tests.

**Notes:**

i) Students must complete all the practical's to the satisfaction of the concerned teacher.

ii) Students must produce laboratory journal along with completion certificate signed by Head of the Department at the time of practical examination.

Laboratory Requirement:

Laboratory should be well equipped with sufficient number of scientific calculators and computers along with necessary software's, UPS, and printers.

**Books Recommended:**


1. Barlow R. E. and Proschan Frank: Statistical Theory of Reliability and Life Testing. Holt Rinebart and Winston Inc., New Yark.

2. ParimalMukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.

3. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.

4. Gupta S. C. &Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.

5. Gupta S. C. &Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.

6. Gupta S.P: Statistical Methods, Sultan Chand and Sons, New Delhi.

7. Waikar and Lev: Elementary Statistical Methods.

8. ParimalMukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.

9. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.

10. Gupta S. C. &Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.

11. Gupta S. C. &Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.

12. Mood A.M., Graybill F.A.: Introduction to theory of Statistics. (Chapter II, IV, V,VII) and

Boes D.C. Tata,McGraw Hill, New Delhi. (Third Edition)

13. Gupta S.P: Statistical Methods, Sultan Chand and Sons, New Delhi.

## EQUIVALENCE FOR THEORY PAPERS

| **Old Syllabus** | | **Revised Syllabus** | |
|---|---|---|---|
| **Paper No.** | **Title of the Paper** | **Paper No.** | **Title of the Paper** |
| Sem.III /P.V | Continuous Probability Distributions -I | Sem.III /P.V | Continuous Probability Distributions -I |
| Sem. III/ P.VI | Statistical Methods-I | Sem. III/ P.VI | Statistical Methods-I |
| Sem. IV / P VII | Continuous Probability Distributions -II | Sem. IV / P VII | Continuous Probability Distributions -II |
| Sem. IV / P VIII | Statistical Methods-II | Sem. IV / P VIII | Statistical Methods-II |
| Practical | | | |