Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(AUTONOMOUS)

Reaccredited by NAAC with 'A+' Grade

Proposed Syllabus For

Bachelor of Science

Part - II

STATISTICS

Syllabus to be implemented w .e. f. June, 2019

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE SATARA

(Autonomous)

Syllabus for Bachelor of Science (B.Sc.)–Part-II Statistics

1. **TITLE-** Statistics for B.Sc.II
2. **YEAR OF IMPLEMENTATION** – 2019-20
3. **LEARNING OBJECTIVES :**
   1. To provide the students a broad understanding of the subject with emphasis on theory based practical's
   2. The syllabus framing is done according to UGC norms
   3. To promote understanding of basic and advanced concepts in Statistics
   4. To develop curiosity, interest of the students to direct them to higher studies in the subject.
   5. To assess the students by continuous internal examinations and semester examinations so as to keep the students aware throughout the year.
   6. To encourage the students for study by conducting online tests, seminar, surprise test, mid term test , open book test.
   7. To monitor the quality of learning by evaluating day to day performance

DURATION- One year

PATTERN – Semester

MEDIUM OF INSTRUCTION - English

COURSE STRUCTURE

Semester	Paper No.	Title	Total number of lectures / practicals per week	Credits
		Theory		
Semester-III	BST-**301**	Continuous Probability Distributions-I	03	4
	BST-**302**	Statistical Methods-I	03	4
		Practical		
	BSP-**303**	practical III	8 No. of practical's= 20	4
Semester-IV		**Theory**		
	BST-**401**	Continuous Probability Distributions-II	03	4
	BST-**402**	Statistical Methods-II	03	4
		Practical		
	BSP-**403**	practical IV	8 No. of practical's= 20	4
			Total Credits	**24**

Evaluation Structure

Semester III

	ESE	Internal Exam		Practical			Submission		Total
		ISE-I	ISE-II		Exam	Journal	Seminar	Student Performance	
Paper V	30	5	5	Practical III(A)	25	5	5	5	150
Paper VI	30	5	5	Practical III(B)	25	5			

Semester IV

	ESE	Internal Exam		Practical-IV			Submission		Total
		ISE-I	ISE-II		Exam	Journal	Industrial visit/Educational Tour	Student Performance	
Paper VII	30	5	5	Practical IV(A)	25	5	5	5	150
Paper VIII	30	5	5	Practical IV(B)	25	5			

Structure and titles of the papers of B.Sc. II course

Semester III

Code	Name of Paper	Units
BST 301	**ContinuousProbability Distributions-I** **(CREDITS:02; TOTAL HOURS : 45)**	**Unit I: Continuous Univariate Distributions** **Unit II: Continuous Uniform and Exponential Distribution** **Unit III : Continuous Bivariate Distributions** **Unit IV : Transformations of continuous r.v**
BST 302	**Statistical Methods-I** **(CREDITS:02; TOTAL HOURS : 45)**	**Unit I: Time Series** **Unit II: Demography** **Unit III : Reliability Theory** **Unit IV : Order Statistics**

Semester IV

Code	Name of Paper	Units
BST 401	**Continuous Probability Distributions** **(CREDITS:02; TOTAL HOURS : 45)**	**Unit I: Gamma and Beta Distributions** **Unit II: Normal distribution** **Unit III : Exact Sampling Distributions** **Unit IV : Bivariate Normal Distribution**
BST 402	**Statistical Methods-II** **(CREDITS:02; TOTAL HOURS : 45)**	**Unit I: Testing of Hypothesis – I** **Unit II:Testing of Hypothesis -II** **Unit III : Statistical Quality control** **Unit IV :Chebycheve's Inequality**

B. Sc. Part II / Semester-III

Paper V : BST-301
Continuous Probability Distributions- I
(Credit – 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 Distributions: (15)

1.1: Definition of the continuous sample space with illustrations, 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, relations 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 Distributions: (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: Transformations 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: Transformation of continuous bivariate r.v.s : Distribution of bivariate r.v.s. using Jacobin 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 Bivariatedistributions
7. Define Transformation of univariate and Bivariate continuous r.v

Books Recommended:

1. ParimalMukhopadhyaya: 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 Publishing Co. Inc, New York
6. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.

Paper VI : BST-302
Statistical Methods- I
(Credit – 02)

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 vital statistics and concept of mortality and fertility
3. Understand concept of Binary Systems,Reliability of binary System,Ageing Properties.
4. Solve the examples on order statistics.

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

Unit-2: Demography (10)

2.1: Introduction and need of vital statistics

2.2: Mortality rates: Crude death rate (CDR), Specific Death Rate (SDR), Standardized Death Rate (STDR).

2.3: Fertility Rates: Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR), Total Fertility Rate (TFR).

2.4: Reproduction Rate: Gross Reproduction rate (GRR), Net Reproduction Rate (NRR).

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.

3.3: Ageing Properties: definitions: Hazard rate, hazard function, survival function, concept of distributions with increasing and decreasing failure rate (IFR, DFR). Relationship between survival function and hazard function, density function and hazard rate, derivations results (1) Hazard rate of a series system of components having independent life times is summation of component hazard rates.(2) Life time of series system of independent components with independentIFR life times is IFR.

Unit-4: Order Statistics (10)

4.1: Order statistics for a random sample of size n from a continuous distribution,definition, derivation of distribution function and density function of the i-thorder statistic , particular cases for i=1 and i=n.

4.2: Derivation of joint p. d. f. of i -th and j- th order statistics , statement ofdistribution of the sample range.

4.3: Distribution of the sample median when n is odd.

4.4: Examples.

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 need of vital statistics and concept of mortality and fertility
4. Solveexamples on Demography
5. Learn Binary Systems Reliability of binary System and Ageing Properties
6. Learn Order statistics for a random sample of size n from a continuous distribution
7. Solve the examples on order statistics

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.II : Semester III : Practical : : BSP-303

OBJECTIVES:

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

1. Understand the applications of Poisson, Geometric, Negative Binomial distribution, Hypergeometricdistributions.
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.

Practical – III(A)

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.

Practical – III(B)

1. Time Series.-I (Trend by Progressive averages, Moving average)
2.Time Series.-I(least square methods)
3. Demography I (Mortality rates).
4. Demography II (Fertility and Reproduction rates).
5.Reliability Theory-I
6.Reliability Theory-II
7.Applications of Order Statistics.
8.Fitting of Straight line / Parabola / Exponential curves.
9. Time Series (Trend by Progressive averages, Moving average,least square methods)using MS-EXCEL
10. Sketch of gamma and beta distributions for various parameters using MS-EXCEL.

Learning outcomes-

Students should be able to:

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

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.

B. Sc. Part II / Semester-IV
Paper VII : BST-401
Continuous Probability Distributions- II
(Credit – 02)

OBJECTIVES:

The main objective of this course is to acquaint students with the basic conceptsGamma 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 θ 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, 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 μ & σ^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 μ & σ^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
9. Learn bivariate Normal Distribution
10. SolveExamples on bivariate Normal Distribution

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 : BST-402
Statistical Methods- II
(Credit – 02)

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, χ^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) UseChebyshev'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: Testing of Hypothesis - I: **(12)**

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 2: Testing of Hypothesis - II: **(15)**

2.1: Definition of Fisher's t- variate

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

2.2: χ^2 – test: i) test for population variance H_0: $\sigma^2 = \sigma_0^2$,
ii) test for goodness of fit
iii) test for independence of attributes;
a) m x n contingency table

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

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

Unit 3: Statistical Quality Control: **(13)**

3.1: 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.

3.2: 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.

3.3: 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- 4: 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.)

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 : Practical – IV : BSP-403

OBJECTIVES:

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

1. Understand the applications of Continuous Uniformdistribution,Exponential distribution,Normal distribution,Bivariate Normal distribution.
2. Compute the expected frequencies and test the goodness of fit.
3. Apply Chebeshev's Inequality for various distributions
4. Construct various control charts
5. Apply large and small sample tests.

Practical – IV(A)

1. Fitting of Continuous Uniform distribution
2. Fitting of Exponential distribution
3. Fitting of Normal distribution.
4. Model sampling from Continuous Uniform and Exponential distribution
5. Model sampling from Normal distribution using: (i) Normal table and ii) Box-Muller transformation.
6. Application of Exponential distribution.
7. Application of Normal distribution.
8. Application of Bivariate Normal distribution.
9. Fitting of binomial, Poisson & Negative Binomial distribution using MS-EXCEL.
10. Fitting of Exponential & Normal distribution using MS-EXCEL.

Practical –VI(B)

1. Large sample tests for means.
2. Large sample tests for proportions.
3. Tests for population correlation coefficients. (Using Fisher's Z transformation.)
4. Tests based on Chi square distribution.(Test for population variance, Test for goodness of fit.)Tests for independence.
5. Tests based on t distribution ($\mu = \mu_0$, $\mu_1 = \mu_2$; paired t test)
6. Tests based on F distribution. ($\sigma_1^2 = \sigma_2^2$)
7. Applications of Chebeshev's Inequality
8. Construction of R and *X* charts.

9. Construction of P and C charts.
10. Single Sampling Plan
(OC, AOQ and ATI using Hypergeometric / Binomial / Poisson distribution)

Learning outcomes-

Students should be able to:

1. Learn the applications of Continuous Uniform distribution, Exponential distribution, Normal distribution, Bivariate Normal distribution.
2. Compute the expected frequencies and test the goodness of fit.
3. Apply Chebechev's Inequality for various distributions
4. Construct various control charts
5. Apply large and small sample tests.

Books Recommended:

1. ParimalMukhopadhyaya: 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. 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)

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