"Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR.

Department of Statistics

Final Syllabus

B. Sc. II
Semester III and IV, CBCS

(Implemented from academic year 2019-20 onwards)

B. Sc. II
Semester III and IV, CBCS

Semester	Paper No.	Course Code	Course Title	No. of Credits
III	III	DSC - 1004 C	Probability Distributions I & Statistical Methods-I	04
IV	IV	DSC - 1004 D	Probability Distributions II & Statistical Methods-II	04
	Practical II	--	--	02
	Practical III	--	--	02

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B. Sc. Part – II CBCS Syllabus with effect from June, 2019

STATISTICS - DSC - 1004 C

Semester: III Statistics -Paper- III

(Probability Distributions & Statistical Methods-I)

Theory: 72 Hours (96 lectures of 48 minutes) - Credits -4 (Marks-100)

Section I: Probability Distributions-I

Course Outcome: At the end of this course students will be able to:
CO1: Compute descriptive statistics, moments, skewness, kurtosis, m.g.f. and c.g.f for continuous univariate distributions.
CO2: Compute various statistical measures for continuous bivariate distributions.
CO3: Understand transformation of continuous univariate and bivariate random variable.
CO4: Understand various continuous probability distributions and their applications in different fields.

Unit	Contents	Hours Allotted
1	**Continuous Univariate Distributions:** 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 (without proof). 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 MX (0) = 1, (ii) Effect of change of origin and scale, (iii) Uniqueness property of m.g.f., if exists, (statement only). Generation of raw and central moments. 1.4 Cumulant generating function (c.g.f.): definition, relations between cumulants and central moments (up to order four). 1.5 Transformation of univariate continuous r.v.: Distribution of Y=g(X), where g is monotonic or non-monotonic functions using, (i) Transformation method, (ii) Distribution function and (iii) m.g.f. methods. 1.6 Examples.	**10**
2	**Continuous Bivariate Distributions:** 2.1 Definition of bivariate continuous random variable (X, Y), Joint p.d.f., c.d.f with properties (without proof), marginal and conditional distribution, independence of random variables, evaluation of probabilities of various regions bounded by straight lines. 2.2 Expectation of function of r.v.s, means, variances, covariance, correlation coefficient, conditional expectation, regression as	**10**

	conditional expectation if it is linear function of other variable and conditional variance, proof of i) E (X± Y) = E(X) ± E(Y), ii) E [E(X/Y)] = E(X). 2.3 If X and Y are independent r.v.s. then proof of (i) E (XY) = E(X) E(Y), ii) Mx+y (t) = Mx (t) My (t). 2.4 Transformation of continuous bivariate random variables: Distribution of bivariate random variables using Jacobin of transformation. 2.5 Examples and problems.	
3	**Uniform and Exponential Distribution:** 3.1 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. Applications. 3.2 Exponential distribution: p.d.f with mean θ and mean (1/ θ), where θ is scale/rate 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/ θ) logX where X~U (0, 1). Applications.	**06**
4	**Normal Distribution:** Normal distribution with parameters μ and 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 and kurtosis, distribution of linear combination of variates. Distribution of X^2 and |X| if X~N (0, 1). Applications.	**10**

Section II: Statistical Methods-I

Course Outcome: At the end of this course students will be able to:

CO1: Compute simple, weighted Index numbers and cost of living Index number.
CO2: Understand vital statistics and computation of vital events.
CO3: Distinguish between process and product control, plotting control charts for variable and attributes**.**
CO4: learn applications of Chebychev's inequality in finding bounds for probabilities.

Unit	Contents	Hours Allotted
1	**Index Numbers:** 1.1 Meaning and utility of index numbers, problems in construction of index numbers. 1.2 Types of index numbers: price, quantity and value. 1.3 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) 1.4 Index numbers using; Laspeyre's, Paasche's and Fisher's formula. 1.5 Tests of index numbers: unit test, time reversal test, factor reversal tests. 1.6 Cost of living index number: definition, construction by using (i) Family Budget and (ii) Aggregate expenditure method.	**11**

	1.7 Shifting of base, splicing and purchasing power of money.	
2	**Demography:** 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).	**10**
3	**Statistical Quality Control:** 3.1 Meaning and purpose of S.Q.C., Process control, Product control, chance causes, assignable causes, Shewhart's control chart-construction and working, lack of control situation. 3.2 Control charts for variables - control chart for mean, control chart for range, construction and working of mean and 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	**10**
4	**Chebychev's Inequality:** Chebycheve's inequality for discrete and continuous distributions. 1.2: Examples	**05**

B. Sc. Part – II CBCS Syllabus with effect from June, 2019
STATISTICS - DSC - 1004 D
Semester: IV Statistics -Paper- IV
(Probability Distributions & Statistical Methods-II)
Theory: 72 Hours (96 lectures of 48 minutes) - Credits -4 (Marks-100)

Section I: Probability Distributions-II and Statistical Computing

Course Outcomes: At the end of this course students will be able to:
CO1: Understanding various continuous probability distributions and their applications in different fields.
CO2: Know the relation between various probability distributions.
CO3: Learn basics and data analysis using R- software.
CO4: Learn numerical methods.

Unit	Contents	Hours Allotted
1	**Gamma and Beta Distributions:** 1.1 Gamma distribution: Gamma distribution with scale parameter θ and shape parameter n, special case θ = 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. 1.2 Beta distribution of first kind: Beta distribution of first kind with parameters m and 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 and 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.	**12**
2	**Exact Sampling Distributions:** 2.1 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, nature of p.d.f. curve . c.g.f., mean, variance, moments, mode, skewness and kurtosis, additive property. 2.2 Student's t- distribution: Definition of student's t variate. Derivation of p.d.f., nature of p.d.f. curve, mean, mode, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients. 2.3 Snedecor's F distribution: Definition of F variate, derivation of p.d.f. ,nature of p.d.f. curve, mean, variance and mode. Distribution of 1/F. Inter relation between t, F and χ^2 (Without Proof).	**11**
3	**Introduction to R**: 3.1 Creating, listing and deleting the objects: combine, scan, matrix, data.frame, cbind, rbind, seq, rep, Converting objects. 3.2 Arithmetics and simple functions: sum, prod, sort, rank, Matrix computation: addition, multiplication, inverse. 3.3 Import and export data: read.table, read.csv, file.choose, write.table, write.csv. 3.4 For loop, while loop, if else statement, break statement. 3.5 R plot: plot, hist, boxplot. 3.6 Exploratory data analysis: mean, variance, quantiles, correlation, summary.	**08**

4	**Numerical Methods:** 4.1 Solutions to nonlinear equation: Explaination of Newton Raphson method and bisection method 4.2 Numerical integration: Quadrature Formula (Proof), trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rule for single integral (methodology without proof). 4.3 Bootstrap methods, estimation of bias and standard errors, estimation of sampling distribution. 4.4 Examples and problems.	**05**

Section II: Statistical Methods-II

Course Outcomes: At the end of this course students will be able to:
CO1: Understand the basic concepts of reliability and ageing properties.
CO2: Understand the basic concepts of testing of hypothesis.
CO3: Distinguish between large and small sample tests.
CO4: Apply small and large sample tests for real life examples.

Unit	Contents	Hours Allotted
1	**Reliability Theory I:** 1.1 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: Minimal cut, minimal path representation of system. 1.2 Reliability of binary System: reliability of above systems h(p), when components are independent and identically distributed with common probability p of operating.	**06**
2	**Reliability Theory II:** 2.1 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 of 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 independent IFR life times is IFR. 2.2 Examples on exponential distribution.	**08**
3	**Testing of Hypothesis - I:** 3.1 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. 3.2 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; $H_0: \mu_1 = \mu_2$.	**10**

	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)	
4	**Testingof Hypothesis - II:** 4.1 Definition of Fisher's t- variate t- test: a) test for means: i) H0: $\mu = \mu_0$, ii) H0: $\mu_1 = \mu_2$, ($\sigma_1 = \sigma_2$) iii) Paired t- test b) test for population correlation: H0: $\rho = 0$ 4.2 χ^2 – test: i) test for population variance H0: $\sigma^2 = \sigma_0^2$ 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. 4.3 F – test: test for equality of two population variances H0: $\sigma_1^2 = \sigma_2^2$.	**12**

Note:

i. Computer printout is to be attached to the journal.
ii. Observation table and/or calculations using statistical formulae should be done by MS-EXCEL and verify by using library functions.
iii. Student must complete the entire practical to the satisfaction of the teacher concerned.
iv. Student must produce the laboratory journal along with the completion certificate signed by Head of Department, at the time of practical examination.
v. There will be case study. A report on the same has to be submitted by every student along with the journal.

References

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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.
8. 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)
9. Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan Publishing Co. Inc, New York

10. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.
11. Gupta S.P: Statistical Methods, Sultan Chand and Sons, New Delhi.
12. Srivastav D.S: A Text book of Demography. Speigelman: Demography.
13. Snedecor G.W. and Cochoran W. G. Statistical Methods.Lowa State University Press.
14. Waikar and Lev: Elementary Statistical Methods.
15. Cotton, R. Learning R: A Step-by-Step Function Guide to Data Analysis. " O'Reilly Media, Inc.".
16. Atkinson K. E. An Introduction to Numerical Analysis. (Wiley)
17. William J., Kennedy, James E. Gentle. Statistical Computing. (Marcel Dekker)
18. Efron B. and Tibshirani. R. J. (1994): An Introduction to the Bootstrap. (Chapman and Hall)

Practical-II

1. Fitting of Discrete Uniform and Binomial distribution.
2. Fitting of Hypergeometric and Poisson distribution.
3. Fitting of Geometric and Negative Binomial distribution.
4. Model sampling from Discrete Uniform and Binomial distribution.
5. Model sampling from Hypergeometric and Poisson distribution.
6. Model sampling from Geometric and Negative Binomial distribution.
7. Fitting of Continuous Uniform distribution
8. Fitting of Exponential distribution
9. Fitting of Normal distribution.
10. Model sampling from Continuous Uniform and Exponential distribution
11. Model sampling from Normal distribution using: (i) Normal table and (ii) Box-Muller transformation.
12. Application of Exponential & Normal distribution.
13. Fitting of binomial, Poisson & Negative Binomial distribution using MS-EXCEL.
14. Fitting of Exponential & Normal distribution using MS-EXCEL.
15. Data input/output and data manipulation using R-Software.
16. Diagrammatic and graphical representation of data using R-Software.
17. Numerical method-I (Newton Raphson method and bisection method)
18. Numerical method-II (trapezoidal rule and Simpson's rule)

Practical –III

1. Fitting of straight lines, second degree curves.
2. Fitting of exponential and power curves of type $Y = a.b^X$, $Y = a.X^b$ and $Y = a.e^{bX}$
3. Construction of R and X charts.
4. Construction of P and C charts.
5. Index Numbers-I. (computations of index numbers)
6. Index Numbers-II (tests of adequacy, Shifting of base, cost of living index number.)
7. Demography I (Mortality rates).
8. Demography II (Fertility and Reproduction rates).
9. Large sample tests for means.
10. Large sample tests for proportions.
11. Tests for population correlation coefficients. (Using Fisher's Z transformation.)
12. Tests based on Chi square distribution.(Test for population variance, Test for goodness of fit.)
13. Tests for independence.

14. Tests based on t distribution ($\mu = \mu_0$, $\mu_1 = \mu_2$.; paired t test)
15. Tests based on F distribution. ($\sigma_1 = \sigma_2$)
16. Reliability (Examples on Ageing property)
17. Fitting of Straight line / Parabola / Exponential curves using MS-EXCEL.
18. Sketch of gamma and beta distributions for various parameters using MS-EXCEL

(Skill Enhancement Course)

Under Skill Enhancement Course practical's using spreadsheet and R- Software:

1. Practical paper II: Experiment nos. 13 to 18

2. Practical paper III: Experiments nos. 17 and 18.

Assessment Structure

Structure of Question Paper

Internal Evaluation

Semester	Evaluation	Marks
III	MCQ Test for each section	20
IV	1. MCQ Test/Unit Test	10
	2. Oral	10

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