Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure for F. Y. B. Sc. STATISTICS

Semester	Paper Code	Title of Paper	No. of Credits
I	STAT1101	Descriptive Statistics- I	2
	STAT1102	Discrete Probability and Probability Distributions - I	2
	STAT1103	Practical-I	2
II	STAT1201	Descriptive Statistics-II	2
	STAT1202	Discrete Probability and Probability Distributions – II	2
	STAT1203	Practical-II	2

Programme Outcomes :

PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioural skills needed for successful social adaptation , work in groups, exhibit thoughts and ideas effectively in writing and orally
PO4	**Research-related skills and Scientific temper :** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem

PO6	**Personal and professional competence:** Performing dependently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Class   : **F.Y. B. Sc. (Semester- II)**

Paper Code: **STAT-1201**

Paper	: **I**	Title of Paper: Descriptive Statistics- II
Credit	: 2 credits	No. of lectures: 36

B) Course Objectives:
1. The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some elementary statistical methods of analysis of data and basic concept of life table and demography.
2. Analyze data pertaining to attributes and to interpret the results.

C) Course Outcome:
Students are expected to be able,

CO1. Compute the correlation coefficient for bivariate data and interpret it.

CO2. Understand the basic concept of linear regression and fit linear regression model to the bivariate data, interpretation of coefficients, and prediction of outcomes.

CO3. Fit linear, quadratic and exponential curves to the bivariate data to investigate relation between two variables.

CO4. Applications of demography in the field of insurance, government etc.

CO5. Understand the various components of life tables, construct life tables from given data, interpret life table data.

CO6. Analyze data pertaining to attributes and to interpret the results.

CO7. Understand the concepts of population growth, birth rate, death rate, and fertility rates, etc.

TOPICS/CONTENTS:

Unit I: Bivariate Data Analysis   (14 L)

1.1 Correlation

1.1.1 Bivariate data, Scatter diagram.

1.1.2 Concept of correlation between two variables, positive correlation, negative correlation, no correlation. Interpretation of correlation using scatter diagram.

1.1.3 Covariance between two variables: Definition, computation, effect of change of origin and scale.

1.1.4 Karl Pearson's coefficient of correlation (r): Definition, computation for ungrouped data and interpretation. Properties: (i) $-1 \le r \le 1$ (with proof) (ii) Effect of change of origin and scale (with proof).

1.1.5 Spearman's rank correlation coefficient: Definition, derivation of formula, computation and interpretation (without ties). In case of ties, compute Karl Pearson's correlation coefficient between ranks. (Spearman's rank correlation coefficient formula with correction for ties not expected.)

1.2 Fitting of curves to the bivariate data

1.2.1 Fitting of line (Y = a + b X),

1.2.2 Fitting of second degree curve ($Y = a + bX + cX^2$),

1.2.3 Fitting of exponential curves of the type $Y = ab^X$ and $Y = aX^b$. In all these curves parameters are estimated by the method of least squares.

1.3 Linear Regression Model

1.3.1 Meaning of regression, difference between correlation and regression,

1.3.2 Concept of error in regression, error modeled as a continuous random variable. Simple linear regression model: $Y = a + bX + \varepsilon$, where ε is a continuous random variable with $E(\varepsilon) = 0$, $Var(\varepsilon) = \sigma^2$. Estimation of a, b by the method of least squares. Interpretation of parameters. Formula of the estimator of σ^2.

1.3.3 Concept of residual, plot of residual against X, concept of explained and unexplained variation, concept of coefficient of determination

Unit 2: Theory of Attributes (6 L)

Attributes: Concept of a Likert scale, classification, notion of manifold classification, dichotomy, class-frequency, order of a class, positive class-frequency, negative class frequency, ultimate class frequency, relationship among different class frequencies (up to three attributes) and dot operator to find the relation between frequencies, fundamental set of class frequencies. Consistency of data upto 2 attributes.

Concepts of independences and association of two attributes.

Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, interpretation (with proof).

Definition of odds ratio and its interpretation.

Unit 3: Demography (10 L)

3.1 Vital events, vital statistics, methods of obtaining vital statistics, rates of vital events, sex ratios, dependency ratio.

3.2 Death/Mortality rates: Crude death rates, specific (age, sex etc.) death rate, standardized death rate (direct and indirect), infant mortality rate.

3.3 Fertility/Birth rate: Crude birth rates, general fertility rate, specific (age, sex etc.) fertility rates, total fertility rates.

3.4 Growth/Reproduction rates: Gross reproduction rate, net reproduction rate.

3.5 Interpretations of different rates, uses and applications.

3.6 Trends in vital rates due to the latest census.

Unit 4: Life Table (6 L)

4.1 Introduction, Construction of life table, functions (l_x, d_x, p_x, q_x, L_x, T_x, e_x) and their interpretation, expectation of life, example and problems.

References:

1. Gupta S. C. and Kapoor V. K.: Fundamentals of Mathematical Statistic, Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.
2. Gupta S. P.: Statistical Methods, Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.
3. Mukhopadhyay Parimal (1999): Applied Statistics, New Central Book Agency, Pvt. Ltd. Calcutta. 11.

4. Goon A. M., Gupta, M. K. and Dasgupta, B. (1986): Fundamentals of Statistics, Vol. 2, World Press, Calcutta.
5. Gupta S. C. and Kapoor V. K. (1987): Fundamentals of Applied Statistics, S. Chand and Sons, New Delhi.
6. Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East.
7. Shailaja R. Deshmukh (2009): Actuarial Statistics An Introduction Using R, University Press (India) Private Limited.

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3								
CO2	3	3							
CO3	3								
CO4				3			2		
CO5				3					
CO6		3				3			
CO7									

PO-1: Disciplinary Knowledge

CO1: Compute the correlation coefficient for bivariate data and interpret it.

Weightage: 3 (Strongly Related)

Justification: Computing and interpreting the correlation coefficient is a fundamental aspect of disciplinary knowledge in statistics.

CO2: Understand the basic concept of linear regression and fit a linear regression model to bivariate data, interpretation of coefficients, and prediction of outcomes.

Weightage: 3 (Strongly Related)

Justification: Understanding and applying linear regression is a core concept in statistics and contributes significantly to disciplinary knowledge.

CO3: Fit linear, quadratic and exponential curves to bivariate data to investigate the relation between two variables.

Weightage: 3 (Strongly Related)

Justification: Investigating relationships through curve fitting involves advanced statistical concepts, enhancing disciplinary knowledge.

PO-2: Critical Thinking and Problem Solving

CO2: Understand the basic concept of linear regression and fit a linear regression model to bivariate data, interpretation of coefficients, and prediction of outcomes.

Weightage: 3 (Strongly Related)

Justification: Applying linear regression involves critical thinking and problem-solving in understanding relationships and making predictions.

CO6: Analyze data pertaining to attributes and interpret the results.

Weightage: 3 (Strongly Related)

Justification: Analyzing attribute data requires critical thinking and problem-solving skills in statistical interpretation.

PO-4: Research-related Skills and Scientific Temper

CO4: Applications of demography in the field of insurance, government etc.

Weightage: 3 (Strongly Related)

Justification: Applying demography in different fields contributes to research-related skills and scientific temper.

CO5: Understand the various components of life tables, construct life tables from given data, interpret life table data.

Weightage: 3 (Strongly Related)

Justification: Understanding and applying life table concepts contribute to research-related skills and scientific temper.

PO-6: Personal and Professional Competence

CO6: Analyze data pertaining to attributes and interpret the results.

Weightage: 3 (Strongly Related)

Justification: Analyzing and interpreting attribute data contributes to personal and professional competence.

PO-7: Effective Citizenship and Ethics

CO4: Applications of demography in the field of insurance, government etc.

Weightage: 2 (Moderately Related)

Justification: Applying demography in various fields is moderately related to effective citizenship and ethics.

SYLLABUS (CBCS) FOR F. Y. B. Sc. STATISTICS (w.e. from June, 2019)

Academic Year 2019-2020

Class   : **F.Y. B. Sc. (Semester-II)**
Paper Code: **STAT-1202**
Paper   : **II**   Title of Paper : Discrete Probability and
                                                       Probability Distributions - II

Credit   : 2 credits   No. of lectures: 36

A) Course Objectives:
       The main objective of this course is to acquaint students with concept of developing computing abilities and discrete bivariate random variable and its probability distribution.

B)Course Outcome:

By the end of the course, students will be able to:

   CO1. To apply discrete bivariate probability distributions studied in this course in different situations.

   CO2. Distinguish between discrete variables and study of their distributions.

   CO3. Know some standard discrete probability distributions with real life situations.

   CO4. Understand concept of bivariate distributions and computation of related probabilities.

   CO5. describe bivariate random variable, joint distribution function, joint probability mass function, marginal and conditional distributions, mathematical expectation, and independence of random variables, and apply their properties in problem-solving.

   CO6. Study the properties of the distributions.

   CO7. Study the interrelation between the standard probability distributions learnt above.

TOPICS/CONTENTS:

Unit-1. Introduction to R-Software.   [4L]

1.1 Introduction to R, features of R, getting help in R.
1.2 Vectors and vector arithmetic:
       (a) Creating of vector using functions c, seq, rep.
       (b) Arithmetic operations on vectors using operations +, -, *, /, ^.
       (c) Numerical functions: log, sort, max, min, unique, range, length, var, prod, sum, summary, fivenum, etc.
       (d) Accessing vectors.
1.3 Data frames: Creation using data. Frame, subset and transform commands.
1.4 p, q, d, r functions.

Unit-2. Bivariate Discrete Distribution: [14L]

2.1: Definition of bivariate discrete random variable (X,Y) on finite sample space, Joint p.m.f., and c.d.f., Properties of c.d.f. (without proof).

2.2: Computation of probabilities of events in bivariate probability distribution, concept of marginal and conditional probability distribution, independence of two discrete r.v.s. Examples.

2.3: Mathematical Expectation: Definition of expectation of function of r.v. in bivariate distribution, Theorems on expectations: (i) $E(X+Y) = E(X) + E(Y)$ (ii) $E(XY) = E(X) \cdot E(Y)$ when X and Y are independent, expectation and variance of linear combination of two discrete r.v.s., definition of conditional mean, conditional variance, covariance and correlation coefficient, $Cov(aX+bY, cX+dY)$, distinction between uncorrelated and independent variables, joint m.g.f, proof of the m.g.f. of sum of two independent r.v.as the product of their m.g.f. examples.

Unit-3. Some Standard Discrete Probability Distributions: (Finite sample space) [12L]

3.1: Review of random variable based on infinite sample space.
3.2: Degenerate Distribution:
3.3: Discrete Uniform Distribution: p.m.f., mean and variance.
3.4: Bernoulli Distribution: p.m.f., mean, variance, distribution of sum of independent and identically distributed Bernoulli variables.
3.5:Binomial Distribution: Binomial random variable, p.m.f. with parameters(n, p), Recurrence relation for successive probabilities, Computation of probabilities of different events, mean and variance, mode, skewness, m..g.f., deduction of moments from m.g.f. Additive property of binomial variables. Examples. Conditional distribution of X given (X+Y) for Binomial distributions.
3.6: Hyper geometric Distribution: p.m.f. with parameters (N, M, n), Computation of probability of different events, Recurrence relation for successive, probabilities, mean and variance of distribution assuming $n \leq N - M \leq M$, approximation of Hypergeometric to Binomial.
3.7: Real life situations.

Unit-4: Standard Discrete Probability Distribution for Countably infinite sample space: Poisson Distribution: [6L]

4.1: Review of random variable based on countably infinite sample space.
4.2: Definition of Poisson with parameter λ. Mean, variance, mode, m.g.f., c.g.f. skewness, kurtosis, Recurrence relation for successive Probabilities, Additive property of Poisson distribution.
4.3: Poisson distribution as a limiting case of Binomial distribution, examples.
4.4: Conditional distribution of X given (X+Y) for Poisson distributions.
4.5 Real life situations.

References:
1. Bhat B. R., Srivenkatramana T and Madhava Rao K. S. (1997): Statistics: a Beginner's Text, Vol. II, New Age International (P) Ltd.

2 Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.

3. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.

4. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.

5. Meyer P. L. (1970): Introductory Probability and Statistical Applications, Edition Wesley.

6. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)

7. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

8. B. L. Agarwal : Programmed Statistics, New Age International Publishers,New Delhi.

9. Purohit, S.G.; Gore, S.D. and Deshmukh, S.R. (2015). Statistics using R, second edition. Narosa Publishing House, New Delhi.

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		3							
CO2	3								
CO3	3								
CO4									
CO5	3	3		2					
CO6	2								
CO7		3							

PO-1: Disciplinary Knowledge

CO2: Distinguish between discrete variables and study their distributions.

Weightage: 3 (Strongly Related)

Justification: Distinguishing between discrete variables and studying their distributions is foundational to disciplinary knowledge in probability and statistics.

CO3: Know some standard discrete probability distributions with real-life situations.

Weightage: 3 (Strongly Related)

Justification: Knowing standard discrete probability distributions aligns directly with disciplinary knowledge in probability.

CO5: Describe bivariate random variable, joint distribution function, joint probability mass function, marginal and conditional distributions, mathematical expectation, and independence of random variables, and apply their properties in problem-solving.

Weightage: 3 (Strongly Related)

Justification: Describing and applying properties of bivariate random variables contributes significantly to disciplinary knowledge.

CO6: Study the properties of the distributions.

Weightage: 2 (Moderately Related)

Justification: Studying the properties of distributions contributes to theoretical knowledge, though to a slightly lesser extent.

PO-2: Critical Thinking and Problem Solving

CO1: To apply discrete bivariate probability distributions studied in this course in different situations.

Weightage: 3 (Strongly Related)

Justification: Applying discrete bivariate probability distributions involves critical thinking and problem-solving.

CO5: Describe bivariate random variable, joint distribution function, joint probability mass function, marginal and conditional distributions, mathematical expectation, and independence of random variables, and apply their properties in problem-solving.

Weightage: 3 (Strongly Related)

Justification: Describing and applying properties of bivariate random variables requires critical thinking and problem-solving skills.

CO7: Study the interrelation between the standard probability distributions learnt above.

Weightage: 3 (Strongly Related)

Justification: Studying the interrelation between standard probability distributions involves critical thinking in understanding relationships and patterns.

PO-4: Research-related Skills and Scientific Temper

CO5: Describe bivariate random variable, joint distribution function, joint probability mass function, marginal and conditional distributions, mathematical expectation, and independence of random variables, and apply their properties in problem-solving.

Weightage: 2 (Moderately Related)

Justification: Describing and applying properties of bivariate random variables contribute to research-related skills, though to a lesser extent.

SYLLABUS (CBCS) FOR F. Y. B. Sc. STATISTICS (w.e. from June, 2019)

Academic Year 2019-2020

Class : **F.Y. B. Sc. (Sem-II)**
Paper Code: **STAT-1203**
Paper : **III**   Title of Paper: Practical-II

Credit : 2 credits   No. of lectures: 40

Pre requisites: Knowledge of the topics in the theory papers.

A) Course Objectives:

The main objective of this course is to acquaint students with concept of developing computing abilities.

B) Course Outcome:

By the end of the course, students should be able to:

CO1. Analyze the data with respect to Bivariate discrete distributions and.

CO2. Know applications of some standard discrete probability distributions.

CO3. Compute correlation coefficient, regression coefficients and to interpret the results.

CO4. Construct life tables from given data, interpret life table data.

CO5. Compute population growth, birth rate, death rate, and fertility rates, etc.

CO6. Fit the linear and non-linear regression models.

CO7. Analyse data pertaining to attributes and to interpret the results.

INDEX

Sr.No.	Title of Experiments
1	Life Tables
2	Demography
3	Bivariate Discrete distribution (Computations of probabilities, Expectations and Variances)
4	Applications of Binomial and Hyper-geometric Distribution and Poisson Distribution.
5	Computations of probabilities of Binomial and Hyper-geometric Distribution and Poisson Distributions using **R**-Software.
6	Fitting of binomial distribution
7	Fitting of Poisson distribution

8	Model sampling from binomial and Poisson distribution
9	Fitting of regression line and regression curves using **R**-Software.
10	Computations of probabilities of Binomial and Hyper-geometric Distribution and Poisson Distributions using **R**-Software.
11	Project (2)

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3							
CO2	3								
CO3	3	3							
CO4	3			3					
CO5	3								
CO6	2								
CO7	3	3				3			

PO-1: Disciplinary Knowledge

CO1: Analyze the data with respect to Bivariate discrete distributions.

Weightage: 3 (Strongly Related)

Justification: Analyzing data using bivariate discrete distributions is fundamental to disciplinary knowledge in statistics.

CO2: Know applications of some standard discrete probability distributions.

Weightage: 3 (Strongly Related)

Justification: Knowing and applying standard discrete probability distributions contributes significantly to disciplinary knowledge.

CO3: Compute correlation coefficient, regression coefficients and interpret the results.

Weightage: 3 (Strongly Related)

Justification: Computing and interpreting correlation and regression coefficients is a core aspect of disciplinary knowledge.

CO4: Construct life tables from given data, interpret life table data.

Weightage: 3 (Strongly Related)

Justification: Constructing and interpreting life tables is a part of disciplinary knowledge in demography.

CO5: Compute population growth, birth rate, death rate, and fertility rates, etc.

Weightage: 3 (Strongly Related)

Justification: Computing demographic indicators aligns directly with disciplinary knowledge in demography.

CO6: Fit the linear and non-linear regression models.

Weightage: 2 (Moderately Related)

Justification: Fitting regression models involves theoretical and practical knowledge, though to a slightly lesser extent.

CO7: Analyze data pertaining to attributes and interpret the results.

Weightage: 3 (Strongly Related)

Justification: Analyzing and interpreting attribute data contributes to disciplinary knowledge in statistics.

PO-2: Critical Thinking and Problem Solving

CO1: Analyze the data with respect to Bivariate discrete distributions.

Weightage: 3 (Strongly Related)

Justification: Analyzing data involves critical thinking and problem-solving in statistical analysis.

CO3: Compute correlation coefficient, regression coefficients and interpret the results.

Weightage: 3 (Strongly Related)

Justification: Computing and interpreting correlation and regression coefficients requires critical thinking.

CO7: Analyze data pertaining to attributes and interpret the results.

Weightage: 3 (Strongly Related)

Justification: Analyzing and interpreting attribute data involves critical thinking and problem-solving.

PO-4: Research-related Skills and Scientific Temper

CO4: Construct life tables from given data, interpret life table data.

Weightage: 3 (Strongly Related)

Justification: Constructing and interpreting life tables contributes to research-related skills and scientific temper.

PO-6: Personal and Professional Competence

CO7: Analyze data pertaining to attributes and interpret the results.

Weightage: 3 (Strongly Related)

Justification: Analyzing and interpreting attribute data contributes to personal and professional competence.