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

Course Structure for F. Y. B. Sc. STATISTICS (2022 Pattern)

Name of the Programme: B.Sc. Statistics

Program Code: USST

Class: F.Y.B.Sc.

Paper Code	Title of Paper	No. of Credits
USST111	Descriptive Statistics – I	2
USST112	Discrete Probability and Probability Distributions – I	2
USST113	Practical – I	2
USST121	Descriptive Statistics – II	2
USST122	Discrete Probability and Probability Distributions – II	2
USST123	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.

SYLLABUS (CBCS) FOR F. Y. B. Sc. STATISTICS
(w. e. from June, 2022)
(2022 Pattern)

Name of the Programme : B.Sc. Statistics
Program Code : USST
Class : F.Y.B.Sc.
Semester : II
Course Name :Descriptive Statistics- II
Course Code : USST121
No. of lectures : 36
Credit : 2 credits

Course Outcomes:

The students will acquire knowledge about the;

CO1. the correlation coefficient for bivariate data and interpret it

CO2. Fit linear, quadratic and exponential curves to the bivariate data to investigate relation between two variables

CO3. Applications of demography in the field of insurance, government etc.

CO4. understand the various components of life tables, construct life tables from given data, interpret life table data.

CO5. Analyze data pertaining to attributes and to interpret the results

CO6. fit quadratic and exponential curves to the bivariate data to investigate relation between two variables.

CO7. compute the coefficient of association and interpret it.

TOPICS/CONTENTS:

Unit 1: Correlation (7 L)

1.1 Bivariate data, bivariate frequency distribution

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

1.3 Scatter diagram, interpretation of the type of correlation from scatter diagram.

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

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

1.6 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.)

Unit 2: Regression (7 L)

2.1 Fitting of curves to the bivariate data

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

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

2.4 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.

2.5 Linear Regression Model

2.6 Meaning of regression, the difference between correlation and regression,

2.7 Concept of error in regression, error modeled as a continuous random variable. Simple linear regression model: $Y= a + b X + \varepsilon$, 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. The formula of the estimator of σ^2. Concept of the residual, plot of residual against X, the concept of explained and unexplained variation, the concept of coefficient of determination

Unit 3: Theory of Attributes (6 L)

3.1 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, the relationship among different class frequencies (up to three attributes) and dot operator to find the relation between frequencies, fundamental set of class frequencies.

3.2 Consistency of data up to 2 attributes. Concepts of independence and association of two attributes.

3.3 Yule's coefficient of association (Q), $-1 \square Q \square 1$, interpretation (with proof).Definition of odds ratio and its interpretation.

Unit 4: Demography (10 L)

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

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

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

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

4.5 Interpretations of different rates, uses, and applications.

4.6 Trends in vital rates due to the latest census.

Unit 5: Life Table (6 L)

5.1 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, WorldPress, 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.
8. Moore D. S., Norz W. I, Flinger M. A., (2013), The Basic Practice of Statistics, Sith Edition, Freeman and Company New York
9. Brase C.H. and Brase C. P, (2018), Understandable Statistics, Twelfth Edition, Cengage Learning
10. Biston Feedman D., Pisani R., Purves R. (2007), Statistics, Fourth Edition, W. W. Nortan and Company, New York

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	3								
CO5		3							
CO6		3							
CO7				3					

PO-1: Disciplinary Knowledge

CO1: Calculate the correlation coefficient for bivariate data and interpret it

Weightage: 3 (Strongly Related)

Justification: Understanding and interpreting correlation coefficients is fundamental to disciplinary knowledge in statistical analysis.

CO2: 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, contributing significantly to disciplinary knowledge.

CO4: Understand the various components of life tables, construct life tables from given data, and interpret life table data

Weightage: 3 (Strongly Related)

Justification: Life tables are an integral part of demographic analysis, enhancing disciplinary knowledge in demography.

PO-2: Critical Thinking and Problem Solving

CO3: Applications of demography in the field of insurance, government, etc.

Weightage: 3 (Strongly Related)

Justification: Applying demographic knowledge to various fields requires critical thinking and problem-solving skills.

CO5: Analyze data pertaining to attributes and interpret the results

Weightage: 3 (Strongly Related)

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

CO6: Fit quadratic and exponential curves to bivariate data to investigate the relation between two variables

Weightage: 3 (Strongly Related)

Justification: Investigating relationships through different curve fits requires critical thinking and problem-solving skills.

PO-4: Research-related Skills and Scientific Temper

CO7: Compute the coefficient of association and interpret it

Weightage: 3 (Strongly Related)

Justification: Computing the coefficient of association and interpreting results contribute to research-related skills and scientific temper.

SYLLABUS (CBCS) FOR F. Y. B. Sc. STATISTICS

(w. e. from June, 2022)

(2022 Pattern)

Name of the Programme : B.Sc. Statistics
Program Code : USST
Class : F.Y.B.Sc.
Semester : II
Course Name : Discrete Probability and Probability Distributions - II
Course Code : USST122
No. of lectures : 36
Credit : 2 credits

Course Outcomes:

The students should be able to,

CO1. 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.

CO2. To apply standard discrete probability distribution in different situations

CO3. To study the properties of the distributions.

CO4. To study the interrelation between the distributions.

CO5. Use R built-in functions to solve numerical problems.

CO6. To apply discrete bivariate probability distributions studied in this course in different situations.

CO7. Distinguish between standard discrete probability distribution in case of finite and countably infinite sample space.

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 the 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 Probability Distribution: [12L]

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

2.2 Computation of probabilities of events in the bivariate probability distribution, the

concept of a marginal and conditional probability distribution, independence of two discrete r.v.s. Examples.

2.3 Mathematical Expectation: Definition of expectation of a 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 a linear combination of two

discrete r.v.s., the definition of conditional mean, conditional variance, covariance and correlation coefficient, $Cov(aX+bY, cX+dY)$, the distinction between uncorrelated and independent variables, joint m.g.f, proof of the m.g.f. of the 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) [10L]

3.1 Review of a random variable based on finite 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 the 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. The conditional distribution of X given (X+Y) for Binomial distributions.
3.6 Hypergeometric 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 Distributions for Countable infinite sample space: [10L]

4.1 Review of a random variable based on countably infinite sample space.
4.2 Poisson distribution: 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, and Real life situations.
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 Geometric Distribution: Definition of Geometric with parameter p in both cases with support {0,1,2,….} and with support{1,2, …..}. Mean, Variance, distribution function, Lack of memory property, examples.

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, the second edition.Narosa Publishing House, New Delhi.
10. M. B. Kulkarni and S. B. Ghatpande : Discrete Probability and Probability Distributions, SIPF Academy, Nashik.

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	2								
CO4									
CO5				3					2
CO6		3		2					
CO7									

PO1: Disciplinary Knowledge

CO1: 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: Understanding and applying properties of bivariate random variables aligns directly with the comprehensive knowledge of the discipline.

CO2: To apply standard discrete probability distribution in different situations

Weightage: 3 (Strongly Related)

Justification: Applying standard discrete probability distributions demonstrates a strong theoretical and practical understanding of probability in various situations.

CO3: To study the properties of the distributions.

Weightage: 2 (Moderately Related)

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

PO2: Critical Thinking and Problem Solving

CO2: To apply standard discrete probability distribution in different situations

Weightage: 3 (Strongly Related)

Justification: Application of standard discrete probability distributions requires critical thinking and problem-solving skills.

CO6: To apply discrete bivariate probability distributions studied in this course in different situations.

Weightage: 3 (Strongly Related)

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

PO4: Research-related Skills and Scientific Temper

CO5: Use R built-in functions to solve numerical problems.

Weightage: 3 (Strongly Related)

Justification: Using R functions for numerical problem-solving contributes to research-related skills and scientific temper.

CO6: To apply discrete bivariate probability distributions studied in this course in different situations.

Weightage: 2 (Moderately Related)

Justification: While applying distributions is more practical, it still contributes to research-related skills, though to a lesser extent.

PO9: Self-directed and Life-long Learning

CO5: Use R built-in functions to solve numerical problems.

Weightage: 2 (Moderately Related)

Justification: Using R functions for problem-solving encourages self-directed learning and adaptability to new tools.

SYLLABUS (CBCS) FOR F. Y. B. Sc. STATISTICS
(w.e. from June, 2022)
(2022 Pattern)

Name of the Programme : B.Sc. Statistics
Program Code : USST
Class : F.Y.B.Sc.
Semester : II
Course Name : Practical - II
Course Code : USST123
No. of lectures : 36
Credit : 2 credits

Prerequisites: Knowledge of the topics in the theory papers.

Course Outcomes:

The students should be able to,

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

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

Sr. No.	Title of Experiments
1	Life Tables
2	Demography
3	Bivariate Discrete Probability distribution (Computations of probabilities, Expectations and Variances)
4	Applications of Binomial and Hyper-geometric Distribution
5	Applications of Poisson and Geometric Distribution.
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.
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								
CO2	3								
CO3		3							
CO4				3					
CO5				3					
CO6		3							
CO7				2		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 directly contributes to disciplinary knowledge in statistics.

CO2: Know applications of some standard discrete probability distributions.

Weightage: 3 (Strongly Related)

Justification: Understanding and applying standard discrete probability distributions enhances disciplinary knowledge.

PO-2: Critical Thinking and Problem Solving

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

Weightage: 3 (Strongly Related)

Justification: Computing and interpreting correlation and regression coefficients requires critical thinking and problem-solving skills.

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

Weightage: 3 (Strongly Related)

Justification: Fitting regression models involves critical thinking in selecting appropriate models and interpreting the results.

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 demonstrates research-related skills and contributes to scientific temper.

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

Weightage: 3 (Strongly Related)

Justification: Computing demographic indicators involves research-related skills and contributes to scientific temper.

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

Weightage: 2 (Moderately Related)

Justification: Analyzing attribute data contributes to research-related skills, though to a slightly lesser extent.

PO-6: Personal and Professional Competence

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

Weightage: 3 (Strongly Related)

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