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.

Semester: I

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

Name of the Programme: B.Sc. Statistics

Program Code: USST

Class: F.Y.B.Sc.

Semester: II

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

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

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;

1. the correlation coefficient for bivariate data and interpret it
2. Fit linear, quadratic and exponential curves to the bivariate data to investigate relationbetween two variables
3. Applications of demography in the field of insurance, government etc.
4. Analyze data pertaining to attributes and to interpret the results

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), $-1 \leq Q \leq 1$, 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.

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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.
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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

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

(w. e. from June, 2022)

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,

1. 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.
2. To apply standard discrete probability distribution in different situations
3. To study the properties of the distributions.
4. To study the interrelation between the distributions.
5. Use R built-in functions to solve numerical problems.

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.
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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.

(w.e. from June, 2019)

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,

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

2. Know applications of some standard discrete probability distributions.

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 using **R**-Software.
10	Computations of probabilities of Binomial and Hyper-geometric Distribution and Poisson Distributions using **R**-Software.
11	Project (2)