

Progressive Education Society's
Modern College of Arts, Science and Commerce,
Shivajinagar, Pune – 5
Second Year of B.Sc. NEP 2024
(Course under NEP 2020)

Course Code: 24ScStaU3101

Course Name: Discrete Probability Distributions and Time series analysis.

Teaching Scheme: 4 Hours / Week

Credit: 4

Examination Scheme: CIA: 40 Marks

End-Sem: 60 Marks

Course Objectives: Introduce students to:

- basic concepts of bivariate probability distribution.
- concept of time series.
- concept of truncated distribution.

Course Outcomes: On completion of the course, student will be able to:

1. distinguish between standard probability distribution and truncated distribution.
2. identify real life situations where multinomial distributions can be applied.
3. fit Time series models
4. forecast time series values using various methods of time series.
5. differentiate between methods of estimating trend.
6. differentiate between methods of estimating seasonal variation.

Course Contents:

Unit 1	Bivariate discrete probability distribution	14 Lectures
	1.1 Definition of two-dimensional discrete random variable, its joint p.m.f. and its distribution function and their properties, concept of identically distributed random variables. 1.2 Computation of probabilities of events in bivariate probability distribution. 1.3 Concepts of marginal and conditional probability distributions. 1.4 Independence of two discrete random variables based on joint and marginal p.m.f. 1.5 Definition of raw and central moments. 1.6 Theorems on expectations of sum and product of two jointly distributed random variables. 1.7 Conditional expectation. 1.8 Definitions of conditional mean and conditional variance. 1.9 Definition of covariance, coefficient of correlation, 1.10 Variance of linear combination of variables 1.11 Illustrations of some standard bivariate probability distributions 1.12 Conditional distribution of X given (X+Y) for binomial distribution. 1.13 Examples and problem	

Unit 2	Multinomial Distribution 2.1 Probability mass function (p.m.f.) $P(X_1 = x_1, X_2 = x_2, \dots, X_k = x_k) = \frac{n! p_1^{x_1} p_2^{x_2} \dots p_k^{x_k}}{x_1! x_2! \dots x_k!}$ $x_i = 0, 1, 2, \dots, n - \sum_{r=1}^{i-1} x_r,$ $i = 1, 2, \dots, k$ $0 < p_i < 1; i = 1, 2, \dots, k;$ $p_1 + p_2 + \dots + p_k = 1;$ <i>Notation:</i> $(X_1, X_2, \dots, X_k) \sim MD(n, p_1, p_2, \dots, p_k),$ $\underline{X} \sim MD(n, \underline{p}),$ <i>where</i> $\underline{X} = (X_1, X_2, \dots, X_k), \underline{p} = (p_1, p_2, \dots, p_k).$ 2.2 Joint MGF of $(X_1, X_2, \dots, X_k)$, use of MGF to obtain means, variances, covariances, total correlation coefficients, multiple and partial correlation coefficients for $k=3$. 2.3 univariate marginal distribution, distribution of $X_i + X_j$, 2.4 conditional distribution of X_i given $X_i + X_j = r$, 2.5 variance- covariance matrix and its interpretation and real life situations and applications.	14 Lectures
Unit 3	Truncated Distributions: 3.1 Concept of truncated distribution, truncation to the right, left and on both sides. 3.2 Binomial distribution left truncated at $X = 0$ (value zero is discarded), its p.m.f., mean and variance. 3.3 Poisson distribution left truncated at $X = 0$ (value zero is discarded), its p.m.f., mean and variance. 3.4 Real life situations and applications.	6 Lectures
Unit 4	Time Series 4.1 Meaning and utility of time series, components of time series: trend, seasonal variations, cyclical variations, irregular (error) fluctuations, Auto covariance function (ACVF) and Auto correlation function (ACF), PACF, Introduction of stationarity and non-stationarity, white-noise. 4.2 Exploratory data analysis: Time series plot to (i) check any trend & seasonality in the time series (ii) capture trend. 4.3 Methods of trend estimation and smoothing: (i) moving average, (ii) curve fitting by least square principle, (iii) exponential smoothing. 4.4 Choosing parameters for smoothing and forecasting. 4.5 Forecasting based on exponential smoothing.	16 lectures

	4.6 Measurement of seasonal variations: i) simple average method, ii) ratio to moving average method, iii) ratio to trend where linear trend is calculated by method of least squares.(To be taken in practical) 4.7 Fitting of autoregressive model AR (p), $p=1,2$, Plotting of residuals.	
Unit 5	Demography	10 lectures
	5.1 Vital events, vital statistics, methods of obtaining vital statistics, rates of vital events, sex ratios, dependency ratio. 5.2 Death/Mortality rates: Crude death rate, specific (age, sex etc.) death rate, standardized death rate (direct and indirect), infant mortality rate. 5.3 Fertility/Birth rate: Crude birth rate, general fertility rate, specific (age, sex etc.) fertility rates, total fertility rate. 5.4 Growth/Reproduction rates Gross reproduction rate, net reproduction rate. 5.5 Interpretations of different rates, uses and applications.	

References :	
1	Brockwell P.J. and Davis R.A. (2003), Introduction to Time Series and Forecasting (Second Edition), Springer Texts in Statistics.
2	Chatfield C. (2001), The Analysis of Time Series An Introduction, Chapman and Hall / CRC, Texts in Statistical Science.
3	Goon A. M., Gupta, M. K. and Dasgupta, B. (1986), Fundamentals of Statistics, Vol. 2, World Press, Kolkata.
4	Gupta, S. C. and Kapoor, V. K. (2002), Fundamentals of Mathematical Statistics, Eleventh Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi, 110002 .
5	Gupta, S. C. and Kapoor V. K. (2007), Fundamentals of Applied Statistics (Fourth Edition), Sultan Chand and Sons, New Delhi.

Progressive Education Society's
Modern College of Arts, Science and Commerce,
Shivajinagar, Pune – 5
Second Year of B.Sc. NEP 2024
(Course under NEP 2020)

Course Code: 24ScStaU3102

Course Name: Lab course on 24ScStaU3101

Teaching Scheme: 4 Hours/Week

Examination Scheme: CIA: 20 Marks

Credit: 2

End-Sem: 30 Marks

Course Objective:

To develop analytical and problem solving skills enabling them to apply statistical methods to real world.

Course Outcomes:

On completion of the course, student will be able to:

1. Distinguish between standard probability distribution and truncated distribution.
2. Identify real life situations where multinomial distributions can be applied.
3. Fit Time series models
4. Forecast time series values using various methods of time series.
5. Differentiate between methods of estimating trend.
6. Differentiate between methods of estimating seasonal variation.

Coursre Contents:

Sr. No.	Title of the practical	No. of practical
1	Estimation and elimination of trend component using least square method, Moving average method, exponential smoothing method.	1
2	Estimation and elimination of seasonal component using simple average method and ratio to moving average method.	1
3	Estimation and elimination of seasonal component using ratio to trend method.	1
4	Fitting of AR(1) model.	1
5	Bivariate Probability distributions.	1
6	Applications of Multinomial probability distribution.	1
7	Applications of Truncated probability distribution.	1
8	Queuing models I	1
9	Queuing models II	1
10	Queuing models III	1
11	Computation of birth rates or fertility rates	1
12	Computation of death rates or mortality rates	1
13	Computation of population growth rates	1
14-15	Experiential Learning	2

Progressive Education Society's
Modern College of Arts, Science and Commerce,
Shivajinagar, Pune - 5
Second Year of B.Sc. NEP 2024
(Course under NEP 2020)

Course Code: 24ScStaU3501

Course Name: Statistics using R software I

Teaching Scheme: 4 Hours/Week

Credit: 2

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisite Courses:

- Basic Statistics

Course Objectives:

1. To learn graphical representation of data in R.
2. To compute the appropriate measures of central tendency and dispersion applicable to the dataset using R.
3. To learn graphical representation of time series data using R.
4. To estimate and eliminate the components of time series in R.
5. To compute probabilities for discrete probability distributions in R.

Course Outcomes:

On completion of the course, student will be able to–

1. Represent the data graphically in R.
2. Compute the probability for discrete distributions in R
3. Compute measures of central tendency and dispersion for the dataset using R.
4. Plot, identify and remove the components of the time series data in R.

Course Contents

Sr No	Title of the experiment	No of practicals
1	Use of basic R software commands (c, scan, rep, seq, min, max, sort) and extraction of data	1
2	To create data frame, matrix and accessing inbuilt datasets in R	1
3	To save R file and import Excel file in R	1
4	Exploratory data analysis (Bar diagram, subdivided bar diagram, multiple bar diagram)	1
5	Exploratory data analysis (Scatter diagram, Histogram, Pie Chart)	1
6	Measures of central tendency for ungrouped data	1
7	Measures of dispersion for ungrouped data	1
8	Measures of skewness and kurtosis for ungrouped data	1
9	Computation of correlation coefficient and Spearman's Rank correlation coefficient	1

10	Computation of probabilities for Binomial and Poisson distribution	1
11	Computation of probabilities for Geometric and Negative Binomial distribution.	1
12	Plotting time series data and its components	1
13	Estimation and elimination of trend from time series data	1
14	Estimation and elimination of seasonality from time series data	1
15	Experiential Learning	1

Progressive Education Society's
Modern College of Arts, Science and Commerce, Shivajinagar, Pune - 5
Second Year of B.Sc. NEP 2024
(Course under NEP 2020)

Course Code: 24ScStaU3901

Course Name: Indian Official statistics

Teaching Scheme: 2 Hours/ Week

Examination Scheme: CIA: 20 Marks

Credit:2

End-Sem:30 Marks

Prerequisite Courses:

- Basic concepts of Arithmetic.

Course Objectives:

- To learn statistical system in India.

Course Outcomes:

On completion of the course, student will be able to

1. Understand the statistical systems in India.
2. Understand the contribution of Indian statisticians.
3. Understand role and functions of statistical systems in India.
4. Understand the different methods of data collection.
5. Understand applications of official statistics.
6. Understand the state statistical systems in India.

Course Contents

Unit 1	Introduction	5 Lectures
	Contribution of Indian Statisticians. Prof. P.C. Mahalonobis, Prof. C.R.Rao, Prof. P.V. Sukhatme, Prof. Huzurbazar Prof. B.K.Kale	
Unit 2	The Statistical system in India	9 Lectures
	2.1 The Central and State Government organizations. 2.2 National statistical commission. 2.3 Functions of the important statistical agencies in India CSO, National Sample Survey Organization (NSSO), MOSPI, NSSTA, NSO.	
Unit 3	Methods of Collection of Official Statistics	7 Lectures
	3.1 Introduction to Nation wise Censuses- population, economic, agriculture. 3.2 Introduction to Nation wise Sample Surveys 3.3 State Statistical Systems.	
Unit 4	Applications of Official Statistics	9 Lectures
	4.1 Overview of agricultural statistics. 4.2 Overview of social statistics 4.3 Overview of economic statistics. 4.4 Overview of labor and employment statistics. 4.5 National income	

Reference:

1	Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
2	www.mospi.gov.in .
3	Reports of Censuses, NSSO

Progressive Education Society's
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Second Year of B.Sc. NEP 2024 (Minor)
(Course under NEP 2020)

Course Code: 24ScStaU3301

Course Name: Standard Continuous Probability Distributions

Teaching Scheme: 2 Hours/Week

Credit: 2

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisite Courses:

- Basic concept of probability and probability distribution

Course Objectives:

6. To study different types of the continuous distribution.
7. To learn different type of sampling distribution.

Course Outcomes:

On completion of the course, student will be able to–

1. To learn application of uniform distribution in real life situation
2. To learn application of exponential distribution in real life situation
3. To learn application of normal distribution in real life situation.
4. To study chi square distribution and nature of chi square distribution curve.
5. To study t distribution and nature of t distribution curve.
6. To study F distribution and nature of F distribution curve.

Course Contents

Unit 1	Uniform distribution	5 Lectures
	Uniform Distribution: Statement of p. d. f., mean, variance, nature of probability curve.	
Unit 2	Exponential distribution	5 Lectures
	Exponential distribution: Statement of p. d. f., mean, variance, nature of probability curve, lack of memory property.	
Unit 3	Normal Distribution	10 Lectures
	Normal Distribution :Definition, p.d.f. curve, properties of normal distribution, state mean and variance, standard normal variate, problems to evaluate probabilities(using statistical table and excel), additive property for two variables (statement only). Fitting of normal distribution. Examples and problems.	
Unit 4	Sampling Distributions	10 Lectures
	4.1 Chi-square Distribution: Definition, p.d.f. curve, properties of chi-square distribution, state mean and variance, real life	

	examples and problems. 4.2 t-distribution: Definition, p.d.f. curve, properties of chi-square distribution, state mean and variance, real life examples and problems. 4.3 F-Distribution: Definition, p.d.f. curve, properties of chi-square distribution, state mean and variance, real life examples and problems.	
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References:
1. Gupta, S. C. and Kapoor, V. K. (2002), Fundamentals of Mathematical Statistics, Eleventh Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi , 110002.
2. Hogg, R. V. and Craig, A. T. , McKean J. W. (2012), Introduction to Mathematical Statistics (Tenth Impression), Pearson Prentice Hall.
3. Meyer, P. L., Introductory Probability and Statistical Applications, Oxford and IBH Publishing Co. New Delhi.
4. Mood, A. M., Graybill F. A. and Bose, F. A. (1974), Introduction to Theory of Statistics McGraw - Hill Series G A 276
5. Mukhopadhyaya Parimal (1999), Applied Statistics, New Central Book Agency, Pvt. Ltd. Kolkata .
6. Purohit S. G., Gore S. D. and Deshmukh S. R. (2008), Statistics using R, Narosa Publishing House, New Delhi.
7. Ross, S. (2003), A first course in probability (Sixth Edition), Pearson Education publishers, Delhi, India
8. Walpole R. E., Myers R. H. and Myers S. L. (1985), Probability and Statistics for Engineers and Scientists, Macmillan Publishing Co. Inc. 866, Third Avenue, New York 10022

Progressive Education Society's
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Second Year of B.Sc. NEP 2024 (Minor)
Course under NEP 2020

Course Code: 24ScStaU3302

Course Name: Lab Course on 24ScStaU3301

Teaching Scheme: 4 Hours/Week

Examination Scheme: CIA: 20 Marks

Credit: 2

End-Sem: 30 Marks

Prerequisite Courses:

- Basic probability and probability distribution.

Course Objectives:

1. To study application of uniform, exponential and normal distribution in real life situation
2. To learn different type of sampling distribution for real life situation.

Course Contents

Sr. No.	Title of Experiment/ Practical
1	Sketching p.d.f., c.d.f. of a continuous random variables
2	Application of uniform distribution.
3	Application of exponential distribution.
4	Application of normal distribution-I
5	Application of normal distribution-II
6	Application of chi-square , t and f distribution
7	Fitting of exponential distribution
8	Fitting of normal distribution-I
9	Fitting of normal distribution-II
10	Simulation from exponential distribution.
11	Simulation from normal distribution.
12-15	Experiential learning

**Progressive Education Society's
Modern College of Arts, Science and Commerce,
Shivajinagar, Pune – 05
Second Year B.Com./B.A NEP 2024
(Course under NEP 2020) (OE)**

Course Code: 24ScStaU3401

Course Name: Applied Statistics – I

Teaching Scheme: 2 hours/week

Examination Scheme: CIA: 20 Marks

Credits: 2

End Sem: 30 Marks

Prerequisite Courses:

- Basic knowledge of algebra.
- Basic knowledge of fundamental concepts of set theory and Venn diagrams.

Course Objectives:

- To introduce the fundamental concepts of probability.
- To develop skills in calculating and interpreting simple, conditional, and independent probabilities.
- To introduce the concept of index numbers and their role in measuring economic, social, and business changes over time.
- To understand various methods of operational research to obtain optimum solutions and apply it to real life data

Course Outcomes:

On completion of the course, student will be able to:

1. Understand and apply the classical and axiomatic definitions of probability.
2. Calculate simple and conditional probabilities.
3. Interpret and apply probability distributions to real-life situations.
4. Apply various method of linear programming model and obtain optimum solution.
5. Apply various method of Transportation and Assignment Problems:
6. Uses and Applications of Index Numbers. Practical Problem-solving with Index Numbers:

Course Contents:

Unit 1	Probability and Applications of Probability	12 Lectures
	1.1 Introduction of Probability : Classical definition of probability and its limitations. 1.2 probability of an event, equiprobable and non-equiprobable sample space 1.3 Axiomatic definition of probability, 1.4 computation of simple probabilities, conditional Probabilities, probabilities based on independence events.	
Unit 2	Applications of probability distributions	12 Lectures
	Introduction to Bernoulli, Binomial and Poisson distribution and its applications.	

Unit 3	Index Numbers	6 Lectures
	4.1 Introduction: Meaning and definition, Problems or Consideration in the construction of Index numbers. 4.2 Types and Construction of Index Numbers: Simple and weighted. 4.3 Some specific Index Numbers (Laspeyre's, Paasche's, Fisher's Index Numbers) 4.4 Uses of Index Numbers	

References:	
1	Fundamentals of Mathematical Statistics, by Gupta and Kapoor, Sultan Chand and Sons, New Delhi.
2	Fundamentals of Applied Statistics, by Gupta and Kapoor, Sultan Chand and Sons, New Delhi.

Progressive Education Society's
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Second Year of B.Sc. NEP 2024
(Course under NEP 2020)

Course Code: 24ScStaU4101

Course Name: Continuous Probability Distributions

Teaching Scheme: 4 Hours/Week

Credit: 4

Examination Scheme: CIA: 40 Marks

End-Sem: 60 Marks

Course Objectives:

Students are enabled to learn different continuous probability models and there applications

Course Outcomes:

On completion of the course, student will be able to:

1. Compute the probability of various continuous probability distributions.
2. Study the probability distributions by studying the nature of probability curves.
3. Identify appropriate continuous probability distribution to real life situations.
4. Fit appropriate continuous probability distribution to real life situations.
5. Model sample from various continuous probability distributions.
6. Interrelate relation among the distributions.

Course Contents:

Unit 1	Continuous Univariate Distributions:	10 Lectures
	1.1 Continuous sample space: Definition, illustrations. Continuous random variable: Definition, probability density function (p.d.f.), cumulative distribution function (c.d.f.), properties of c.d.f.(without proof), probabilities of events related to random variable. 1.2 Expectation of continuous r.v., expectation of function of r.v. $E[g(X)]$, mean, variance, geometric mean, harmonic mean, raw and central moments, skewness, kurtosis, mean deviation about mean. 1.3 Moment generating function (MGF): Definition, properties. Cumulant generating function (CGF): Definition. 1.4 Mode, partition values: quartiles(Q_1, Q_2, Q_3), deciles, percentiles. 1.5 Probability distribution of function of r. v. : $Y = g(X)$ using i) Jacobian of transformation for $g(.)$ monotonic function and one-to-one, on to functions, ii) Distribution functions for $Y = X^2, Y = X$ etc. iii) M.G.F. of $g(X)$.	
Unit 2	Uniform or Rectangular Distribution:	3 Lectures
	Probability density function (p.d.f.) $f(x) = \begin{cases} \frac{1}{b-a}, & a \leq x \leq b \\ 0, & \text{otherwise} \end{cases}$ Notation : $X \sim U[a, b]$. p. d. f., sketch of p. d. f., c. d. f., mean, variance, symmetry, MGF. Distribution of i) $\frac{x-a}{b-a}$,ii) $\frac{b-x}{b-a}$,iii) $Y = F(X)$, where $F(X)$ is the c. d. f. of continuous r.v. X. Application of the result to model sampling.	

	(Distributions of $X + Y, X - Y, XY$ and X/Y are not expected.)	
Unit 3	Normal Distribution:	12 Lectures
	Probability density function (p. d. f.) $f(x) = \begin{cases} \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} & ; -\infty < X < \infty, -\infty < \mu < \infty, \sigma > 0 \\ 0 & ; \text{otherwise} \end{cases}$ Notation: $X \sim N(\mu, \sigma^2)$. p. d. f. curve, identification of scale and location parameters, nature of probability curve, mean, variance, (MGF, CGF, central moments, cumulants, skewness, kurtosis, mode, quartiles(Q_1, Q_2, Q_3) (statement only)), points of inflexion of probability curve, mean deviation, additive property, probability distribution of : i) $\frac{X-\mu}{\sigma}$, standard normal variable (S.N.V.), ii) $aX + b$, iii) $aX + bY + c$, where X and Y are independent normal variates. Probability distribution of $\bar{X}$, the mean of n i.i.d. $N(\mu, \sigma^2)$ r.v.s., computations of normal probabilities using normal probability integral tables. Central limit theorem (CLT) for i.i.d. r.v.s. with finite variance (statement only), its illustration for Poisson and Binomial distributions.	
Unit 4	Exponential Distribution:	5 Lectures
	Probability density function (p. d. f.) $f(x) = \begin{cases} \alpha e^{-\alpha x} & ; x \geq 0, \alpha > 0 \\ 0 & ; \text{otherwise} \end{cases}$ Notation : $X \sim \text{Exp}(\alpha)$. Nature of density curve, interpretation of α as a scale and $\frac{1}{\alpha}$ as mean, mean, variance, MGF, CGF, skewness, kurtosis, c.d.f., graph of c.d.f., lack of memory property, quartiles(Q_1, Q_2, Q_3), mean deviation about mean, distribution of sum of k i.i.d exponential random variables.	
Unit 5	Gamma Distribution:	6 Lectures
	Probability density function (p. d. f.) $f(x) = \begin{cases} \frac{\alpha^\lambda}{\Gamma(\lambda)} x^{\lambda-1} e^{-\alpha x} & ; x > 0, \alpha, \lambda > 0 \\ 0 & ; \text{otherwise} \end{cases}$ Notation: $X \sim G(\alpha, \lambda)$, Nature of probability curve, special cases: i) $\alpha = 1$, ii) $\lambda = 1$, MGF, CGF, moments, cumulants, skewness, kurtosis, mode, additive property. Distribution of sum of n i.i.d. exponential variables. Relation between distribution function of Poisson and Gamma variates (Statement only).	
Unit 6	Chi-square Distribution:	8 Lectures
	Definition as a sum of squares of i.i.d. standard normal variables. Derivation of the p.d.f. of Chi-square variable with n degrees of freedom (d.f.) using MGF. Notation: $X \sim \chi_n^2$ Mean, variance, MGF, CGF, central moments, skewness, kurtosis, mode, additive property. Use of chi-square tables for calculations of probabilities.	

	Normal approximation: $\frac{\chi_n^2 - n}{\sqrt{2n}}$ (statement only)	
Unit 7	S Student's t –distribution:	8 Lectures
	Definition of t r.v. with n d.f. in the form of $= \frac{U}{\sqrt{\frac{V}{n}}}$, where $U \sim N(0, 1)$ and V is chi-square with n d.f., where U & V are independent random variables. Notation: $t \sim t_n$ Derivation of the p.d.f of t distribution, nature of probability curve, mean, variance, (moments (derivations are not expected)), mode. Use of t-tables for calculations of probabilities, statement of normal approximation.	
Unit 8	Snedecore's F –distribution:	8 Lectures
	Definition of F r.v. with n_1 and n_2 d.f. as $F_{n_1, n_2} = \frac{X_1/n_1}{X_2/n_2}$ where X_1 & X_2 are independent chi-square variables with n_1 and n_2 d.f. Notation: $F \sim F_{n_1, n_2}$ Derivation of the p.d.f, nature of probability curve, mean, variance, (moments (derivations are not expected)), mode. Distribution of $\frac{1}{F_{n_1, n_2}}$—use of F –tables for calculation of probabilities. Interrelationship between Chi-square, t and F distributions.	

References :	
1	Gupta, S. C. and Kapoor, V. K. (2002), Fundamentals of Mathematical Statistics, Eleventh Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi , 110002.
2	Hogg, R. V. and Craig, A. T. ,McKean J. W. (2012), Introduction to Mathematical Statistics (Tenth Impression), Pearson Prentice Hall.
3	Mood, A. M., Graybill F. A. and Bose, F. A. (1974), Introduction to Theory of Statistics McGraw - Hill Series G A 276
4	Mukhopadhyaya Parimal (1999), Applied Statistics, New Central Book Agency, Pvt. Ltd. Kolkata .
5	Purohit S. G., Gore S. D. and Deshmukh S. R. (2008), Statistics using R, Narosa Publishing House, New Delhi.
6	Ross, S. (2003), A first course in probability (Sixth Edition), Pearson Education publishers, Delhi, India.

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Shivajinagar, Pune - 5
Second Year of B.Sc. NEP 2024
(Course under NEP 2020)**

Course Code: 24ScStaU4102

Course Name: Lab course on 24ScStaU4101

Teaching Scheme: 4 Hours/Week

Examination Scheme: CIA: 20 Marks

Credit: 2

End-Sem:30 Marks

Course Objective:

To develop analytical and problem solving skills enabling them to apply statistical methods to real world.

Course Outcomes:

On completion of the course, student will be able to:

1. Formulate the real life problem in linear programming problem.
2. Find optimal solution to linear programming problem.
3. Compute the probability of continuous probability distributions.
4. Identify appropriate continuous probability distribution to real life situations.
5. Fit appropriate continuous probability distribution to real life situations.
6. Model sample various continuous probability distribution.
7. Apply appropriate parametric test to a real life data sets.

Course Contents:

	Title of Experiment/ Practical
1	Formulation and Solving LPP using graphical method (Cases: feasible solution, infeasible solution, no solution, unbounded solution, alternate solution)
2	Solving LPP using simplex method (Cases: feasible solution, infeasible solution, unbounded solution, alternate solution)
3	Solving LPP using Big-M method.
4	Introduction to Transportation problem (TP) and finding initial basic feasible solution using least cost method, Vogel's approximation method.
5	Finding Optimal solution of TP using modified distribution method.
6	Solving an Assignment problem using Hungarian method.
7	Applications of exponential distribution, Model sampling from exponential distribution.
8	Model sampling from normal distribution using : (i) distribution function (ii) Box-Muller transformation.
9	Applications of normal distribution.
10	Fitting of exponential distribution and computation of expected frequencies.
11	Fitting of normal distribution and computation of expected frequencies.
12	Tests based on normal distribution.
13	Tests based on chi-square distribution.
14	Tests based on t distribution.
15	Tests based on F distribution.

Progressive Education Society's

**Modern College of Arts, Science and Commerce,
Shivajinagar, Pune - 5
Second Year of B.Sc. NEP 2024
Course under NEP 2020**

Course Code: 24ScStaU4501

Course Name: Statistics using R software II

Teaching Scheme: 4 Hours/Week

Credit: 2

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisite Courses:

- Basics of R software

Course Objectives:

1. To learn graphical representation of continuous distributions in R.
2. To study fitting and model sampling for some continuous distributions in R.
3. To learn computation of probabilities for continuous distributions in R.
4. To apply tests based on normal, t, f and chi-square distribution in real life situations in various fields in R.
5. To compute different rates in demography in R.
6. To compute various index numbers in R.

Course Outcomes:

On completion of the course, student will be able to:

1. Draw the curve of a continuous distribution in R and interpret it.
2. Compute the probability for continuous distributions in R
3. Simulate the data from distribution in R.
4. Identify and apply tests based on normal, t, f and chi-square distribution in real life situations in various fields in R.
5. Compute different rates in demography in R

Course Contents:

Sr No	Title of the experiment	No of practicals
1	Sketching pdf, cdf of continuous random variables and computation of quartiles, deciles and percentiles	1
2	Application of exponential and normal distribution	1
3	Model sampling and fitting of exponential distribution	1
4	Model sampling and fitting of normal distribution	1
5	Application of central limit theorem	1
6	Computation of probability from continuous uniform, exponential, normal, gamma, chi square, T and F distribution	1
7	Tests based on normal distribution	1
8	Tests based on t distribution	1
9	Tests based on f and chi square distribution	1
10	Computation of birth rates or fertility rates	1
11	Computation of death rates or mortality rates	1

12	Computation of population growth rates	1
13	Unweighted and weighted index numbers (Laspeyre's, Paasche's and Fisher's index number) (Price, Quantity and Value index number)	1
14	Cost of living index number, base shifting, splicing and deflating	1
15	Test of consistency and commonly used index numbers (Time reversal test, Factor reversal test and circular test)	1

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Second Year of B.Sc. (Minor)
Course under NEP 2020**

Course Code: 24ScStaU4301

Course Name: Testing of hypothesis

Teaching Scheme: 2 Hours/Week

Examination Scheme: CIA: 20 Marks

Credit: 2

End-Sem: 30 Marks

Prerequisite Courses:

- Basic Mathematics.

Course Objectives:

1. To study different types of exact sample test.
2. To learn approximate sample test data.
3. To Study ANOVA technique.
4. To learn attributes and its measure of association.

Course Outcomes:

On completion of the course, student will be able to:

1. To study different types of approximate sample test.
2. To apply different type of approximate test for real life situation.
3. To study different types of exact sample test.
4. To apply different type of exact sample test for real life situation.
5. To study application of chi-square test.
6. To study application of test based on F distribution.

Course Contents

Unit 1	Tests of hypothesis-I	15 lectures
	2.1 Definitions of : Hypothesis, Null hypothesis, Alternating hypothesis, Critical region, Types of errors, Level of significance, P-value. 2.2 Test for Population Mean(Approximate and Exact tests): Describe test procedure for testing i. $H_0: \mu = \mu_0$ against $H_1: \mu \neq \mu_0$ and ii. $H_0: \mu_1 = \mu_2$ against $H_1: \mu_1 \neq \mu_2$. If population variance is known. Construction of confidence interval for population mean and difference of population means 2.3 Test for Population Mean: Describe test procedure for testing Approximate and Exact tests) i. $H_0: \mu = \mu_0$ against $H_1: \mu \neq \mu_0$ and ii. $H_0: \mu_1 = \mu_2$ against $H_1: \mu_1 \neq \mu_2$. If population variance is unknown 2.4 Describe the test procedure for paired t-test. 2.5 Test for population proportion : Describe test procedures for testing i. $H_0: P = P_0$ against $H_1: P \neq P_0$ and ii. $H_0: P_1 = P_2$ against $H_1: P_1 \neq P_2$. Construction of confidence interval on above test.	
Unit 2	Tests of hypothesis-II	15

		lectures
	3.1 Describe Chi-square test for testing i. Goodness of fit. ii. Independence of attributes. 3.2 Describe test procedure for testing $H_0: \sigma_1^2 = \sigma_2^2$ against $H_1: \sigma_1^2 \neq \sigma_2^2$ (test based on F-distribution) 3.3 Construction of confidence interval for population variance.	

References:
1. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. 1, 6 th Revised Edition, The World Press Pvt. Ltd., Calcutta.
2. Goon A. M., Gupta, M. K. and Dasgupta, B. (1986), Fundamentals of Statistics, Vol. 2, a. World Press, Kolkata.
3. Gupta S.C., Kapoor V.K.(2014). Fundamentals of Mathematical Statistics, Sultan Chand & Sons publication, Delhi
4. Gupta S.C. (2018). Fundamentals of Statistics: Himalaya Publishing House
5. Gupta, S. C. and Kapoor, V. K. (2000). Fundamentals of Mathematical Statistics, 10 th Edition, Sultan Chand and Sons Publishers, New Delhi.
6. Hogg, R. V. and Craig, A. T. , McKean J. W. (2012), Introduction to Mathematical a. Statistics (Tenth Impression), Pearson Prentice Hall.
7. Mohanty (2016). Basic Statistics, Scientific Publisher
8. Mukhopadhyay P. (2015). Applied Statistics , <i>Publisher</i> : Books & Allied (P) Ltd.

**Modern College of Arts, Science and Commerce,
Shivajinagar, Pune - 5
Second Year of B.Sc. (Minor)
Course under NEP 2020**

Course Code: 24ScStaU4302

Course Name: Lab Course on 24ScStaU4301

Teaching Scheme: 4 Hours/Week

Credit: 2

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisite Courses:

- Basic probability and standard continuous probability distributions.

Course Objectives:

1. To study different types of approximate sample test.
2. To study different types of exact sample test.
3. To learn analysis of variance technique.

Course Contents

Sr. No.	Title of Experiment/ Practical
1	Construction and identification of hypothesis.
2	Approximate tests-I
3	Approximate tests-II
4	Problems using t test-I
5	Problems using t test-II
6	Problems using paired t test.
7	Chi-square test for independence of attributes
8	Chi-square test for goodness of fit.
9	Tests for comparison of variance.
10	Construction and decision making using confidence interval for approximate test.
11	Construction and decision making using confidence interval for exact tests I
12	Construction and decision making using confidence interval for exact tests II
13-15	Experiential learning

Shivajinagar, Pune - 5
Second Year of B.Sc. NEP 2024
Course under NEP 2020

Course Code: 24ScStaU4601

Course Name: Lab Course on C Programming

Teaching Scheme: 4 Hours/Week

Examination Scheme: CIA: 20 Marks

Credit: 2

End-Sem: 30 Marks

Prerequisite Courses:

- Basic Mathematics and Statistics.

Course Outcomes: At the end of this course students should be able to:

1. Read and print the different types of data and use of in built functions
Carry out simple arithmetic calculations and find the value of functions of a variable.
2. Apply different control structures of C.
3. To find roots of a quadratic equation and to solve given system of linear equations.
4. Apply Arrays in C.
5. Compute different measures of central tendencies and dispersions for raw data for frequency distributions.
6. To fit a regression line for given data.
7. Apply different string operations.

Course Contents:

Sr. No.	Title of Experiment/ Practical
1	i) Enter and print the different data types. ii) To carry out arithmetic calculations. iii) To convert degree Celsius temperature to Fahrenheit.
2	i) To find area of triangle using Herons Formula and area for a right angled triangle ii) To find area of circle and area of a semi-circle. To print Fibonacci series.
3	i) To check given number is odd or even. ii) To check given number is prime or not. iii) To check whether given number is positive, negative or zero.
4	i) To find maximum/minimum number among two numbers and three numbers ii) To check whether a given number 'm' is divisible by 'n' or not.
5	i) To find sum of digits of a number. ii) To find factorial of a given integer number.
6	i) To find roots of a quadratic equation. ii) Newton-Raphson method to solve transcendental equation
7	To solve given system of linear equations. (two equations in two variables).
8	i) To find arithmetic mean, geometric mean, harmonic mean and mode of n observations. ii) To arrange the data in increasing/decreasing order of magnitude and calculate median.
9	To find variance, coefficient of variation, mean deviation from different measure of central tendency for given 'n' observations.

10	i) To prepare frequency distribution table from the following data sets. ii) To find mean, quartiles, variance, coefficient of variation for frequency distribution.
11	i) To find Correlation coefficient for a given bivariate data. ii) To Fit regression line for a given bivariate data.
12	(i) To find value of X^n where 'n' is integer.(Using in built function) (ii) To find GCD of two integer numbers.
13	(i) To test Palindrome string using string function (ii) To sort a string using string function. (iii)To search string using string function. (iv)To combine two strings using string function
14-15	Experiential learning

References:	
1.	Kanitkar Y (2008): Let us C, BFB publishers, New Delhi.
2.	Peter van der Linden (1994): Expert C Programming: Deep C Secrets.
3.	Rajaraman V. (2007): Computer Programming in C, Prentice Hall of India