



St. Xavier's College – Autonomous Mumbai

T.Y.B.Sc

Syllabus For 5th Semester Courses in STATISTICS (June 2019 onwards)

Contents:

Theory Syllabus for Courses:

SSTA0501 – Probability Theory

SSTA0502– Statistical Estimation

SSTA0503– Applied Statistics (IA)

SSTA0504- Applied Statistics (IIA)

Practical Course Syllabus for: SSTA05PR

Academic/field/industrial visits and seminars may be organized by the Department, at other venues, as part of the curriculum.

Title: Probability Theory

Learning Objectives:

- 1) **To strengthen their concepts in mathematical statistics.**
- 2) **To prepare students to develop their own models.**

Number of lectures: 60

Unit 1 (15L)

Probability

Theorems on Probability of realization of (i) at least one. (ii) exactly m
(iii) at least m events out of N events $A_1, A_2, A_3, \dots, A_N$.

Maxwell Boltzmann, Bose Einstein and Fermi Dirac statistics

Ordered samples and runs.

Occupancy problems, Matching and guessing problems.

Conditional probability and application of Bayes' theorem

Urn Model probability

Unit 2 (15L)

Inequalities and Law of Large Numbers

- (i) Markov Inequality
- (ii) Chebychev's inequality.
- (iii) Boole's Inequality
- (iv) Cauchy Schwartz's Inequality
- (v) Weak Law of Large Numbers

Unit 3 (15L)

Generating Functions

Definitions of generating function and probability generating function. Expression for mean and variance in terms of generating functions. Definition of a convolution of two or more sequences. Generating function of a convolution. Generating functions of the standard discrete distributions. Relation between.

- i) Bernoulli and Binomial distributions.
 - ii) Geometric and Negative Binomial distributions in terms of convolutions.
- Generating function of compound distribution

Unit 4 (15L)

Order Statistics

Definition of the order statistics for a random sample of size n from a continuous distribution. Derivation of the distribution function and hence the probability density function of the n^{th} order statistic.

Joint p.d.f. of the i^{th} and j^{th} order statistics. Joint p.d.f. of all n order statistics.

Correlations coefficient between the i^{th} and j^{th} order statistics of the uniform distribution.

Distribution of range and median (n odd) for the Uniform and Exponential distribution.

Topics For Practicals

1. Probability.
2. Generating Function.
3. Order statistics

List Of Recommended Reference Books

1. Feller W. An Introduction to Probability Theory and its Applications. Vol I. Third edition.
2. Alexander M Mood, Franklin A Graybill, Duane C. Boes : Introduction to theory of statistics, Third edition , Mcgraw-Hill Series
3. Hogg R.V. and Craig A.T.: Introduction to Mathematical Statistics.
4. Hogg R.V. and Tanis E.A: Probability and Statistical Inference.
5. S. C Gupta & V K Kapoor: Fundamentals of mathematical statistics, Eleventh edition, Sultan Chand & Sons

Title: Statistical Estimation

Learning Objective:

To empower students with methods of estimation and inference in order to predict future trends on the basis of current data, with enhanced precision.

Number of lectures: 60

Unit 1. (15L)

Point Estimation

General problem of estimation. Definition of a statistic, estimator & estimate. Properties of a good estimator. Unbiasedness, Consistency, Efficient estimator. Minimum variance unbiased Estimator (MVUE). Relative efficiency, Uniqueness of MVUE if it exists. Cramer-Rao inequality. Definition of an efficient estimator using CRL. Definition of a sufficient statistic, Statement of Neyman's factorization theorem.

Unit 2. (15L)

Methods Of Estimation

Method of maximum likelihood estimation Properties of maximum likelihoods estimators
Method of moments.
Method of minimum chi-square. Method of modified minimum chi-square.

Unit 3 (15L)

Bayesian Estimation

Prior distribution. Posterior distribution. Loss function Risk function. Bayes' solution under squared error and Absolute error loss function.

Unit 4. (15L)

Interval Estimation

Concept of confidence interval and confidence limits. Definition of pivotal quantity and its uses in obtaining confidence intervals

Derivation of $100(1-\alpha)\%$ equal tailed confidence intervals for

- (i) single population mean & proportion

- (ii) difference of two population means and proportions
- (iii) population variance
- (iv) ratio of population variances of normal distribution
(Based on large and small samples)
- (v) population median (Concept of Bootstrapping)

Confidence intervals based on asymptotic properties of maximum likelihood estimators for Poisson and Exponential distribution

Topics for Practicals

1. Method of maximum likelihood estimation.
2. Method of Moments.
3. Method of modified minimum Chi-square.
4. Bayesian estimation.
5. Interval estimation.

List Of Recommended Reference Books

1. Hogg R.V. and Craig A.T.: Introduction to Mathematical Statistics. (Macmillan Publishing Co.)
2. Hogg R.V. and Tanis E.A: Probability and Statistical Inference. (Macmillan Publishing Co)
3. Rohatgi V.K.: Statistical Inference. John Wiley
4. Rohatgi V.K & Ehsanes Saleh A.K. Md. (2008): An Introduction to Probability Theory and Mathematical Statistics, Second Edition: Wiley series in Probability and Statistics.
6. S C Gupta & V K Kapoor: Fundamentals of mathematical statistics, Eleventh edition, Sultan Chand & Sons
7. Alexander M Mood, Franklin A Graybill, Duane C. Boes : Introduction to theory of statistics , Third edition, Mcgraw-Hill Series
8. Parimal Mukhopadhyay: Mathematical Statistics, Second edition, Books and Allied (P) Ltd.

T.Y. B.Sc. Statistics

Course: SSTA0503

Title: Applied Statistics (I A)

Learning Objective:

To apply Statistics to the Biological Sciences.

Number of lectures: 60

Unit 1. (15L)

Epidemic Methods

The features of an epidemic.

Definitions of various terms.

Definition of deterministic and stochastic models.

Deterministic models without removals (for 'a' introductions).

Carrier model. Chain binomial models. Reed-Frost and Greenwood models.

Distribution of individual chains and total number of cases. Maximum likelihood estimator of p and its asymptotic variance for the households of size upto 4.

Unit 2. (15L)

Bioassays

Meaning and scope of bioassays. Basic terms. Direct assays. Fieller's theorem. Indirect assays. Conditions of similarity monotony and linearity. Linearizing transformation for Parallel line and slope ratio assays.

Definitions – Symmetric and unsymmetric parallel line assays.

Symmetrical 2K-point parallel line assays ($k=2,3$), using orthogonal contrasts.

Quantal assays, ED50 and LD 50. Probit analysis.

Unit 3. (15L)

Clinical Trials – I

Introduction to clinical trials: The need and ethics of clinical trials.

Overview of phases (I – IV).

Introduction to ICH E9 guidelines,
Common terminology used in clinical trials.
Study protocol, case record/report form/blinding (single/double).
Randomized control (placebo/active control).
Study designs (parallel, cross over).
Type of trials : inferiority, superiority and equivalence. Multi centric trial.
Inclusion/exclusion criteria.
Estimation of sample size (for specified power) for the following cases
i) Single population means
ii) Single population proportion
iii) Difference of two population means
iv) Difference of two population proportions

Unit 4.

(15L)

Clinical Trials - II and Bioequivalence

Statistical tools : Analysis of parallel design using Analysis of Variance.
Concept of Odd's Ratio, Concept of Repeated Measures ANOVA, Survival analysis for estimating Median survival time, Kaplan- Miere approach for survival analysis.
Statistics in Bioequivalence Studies: Introduction to Bioequivalence studies
Commonly used designs in BE studies.
Estimation of Pharmacokinetic Parameters:
Cmax, Tmax and Area Under Curve (AUC)
Analysis of Variance for parallel design and concept of Cross over design. Ratio Analysis
90% Confidence Interval and Bioequivalence Criteria.

TOPICS FOR PRACTICALS

1. Epidemics
2. Bio Assays.
3. Clinical Trials

List Of Recommended Reference Books

1. Bailey N.T.J.: The mathematical theory of Infectious Diseases, Second edition, Charles Griffin and Co. Ltd. London.
2. Das M.N. and Giri N.C: Design and Analysis of Experiments. Second edition, Wiley Eastern.
3. Finney D.J.: Statistical methods in Biological Assays. First edition, Charles Griffin and Co. Ltd. London.
4. Stanford Boltan and Charles Bon: Pharmaceutical statistics, Fourth edition, Marcel Dekker Inc.
5. Zar Jerrold H: Biostatistical Analysis, Fourth edition, Pearson's education.
6. Friedman L. M., Furburg. C., Demets D. L: Fundamentals of clinical trials, First edition (1998) . Springer Verlag.
7. Fleiss J.L: Design and Analysis of Clinical experiments, Second edition (1989), Wiley and Sons.
8. Glenwalke : Common Statistical Methods.

9. Shein-Chung-Chow: Design and analysis of Bioavailability and Bioequivalence studies, 3rd edition, Chapman & Hall / CRC BioStatistics series.
10. Daniel Wayne W: Biostatistics- A foundation for analysis in the health sciences 7th edition, Wiley Series in Probability and Statistics.
11. Charles. S.Davis: Statistical Methods for the analysis of repeated measurements, Springer Publications.

T.Y. B.Sc. Statistics

Course: SSTA0504

Title: Applied Statistics (IIA)

Learning Objective:

To apply Statistics to the Insurance industry.

Number of lectures: 60

Unit 1

(15L)

Concepts of Vital Statistics & Mortality Tables:

Vital Statistics:

Crude death rate, Age specific death rate & Standardized death rate.

Crude birth rate, General fertility rate, Age specific fertility rate & Total fertility rate. Gross & Net Reproduction rates.

Mortality Tables:

Various mortality functions. Probabilities of living and dying. The force of mortality.

Estimation of μ_x from the mortality table. Select and ultimate mortality table. Mortality table as a population model. Stationary population. Stable population

Expectation of life and Average life at death. Central death rate.

Unit 2.

(15L)

Compound Interest and Annuities Certain:

Accumulated value and present value, nominal and effective rates of interest. Discount and discounted value, Varying rates of interest. Equation of value. Equated time of payment.

Present and accumulated values of annuity certain, perpetuity (immediate and due) with and without deferment period.

Present and accumulated values of

i) increasing annuity

ii) increasing annuity when successive installments form

a) arithmetic progression

b) geometric progression. (iii) annuity with frequency different from that with which interest is convertible.

Redemption of Loan.

Unit 3

(15L)

Life Annuities:

Present value in terms of commutation functions of Life annuities and Temporary life annuities (immediate and due) with and without deferment period. Present values of variable and increasing life annuities (immediate and due).

(15L)

Unit 4

Assurance Benefits:

Present value of assurance benefits in terms of commutation functions of i) pure endowment assurance ii) temporary assurance iii) endowment assurance iv) whole life assurance v) double endowment assurance vi) increasing temporary assurance vii) increasing whole life assurance viii) special endowment assurance ix) deferred temporary assurance x) deferred whole life assurance.

Net premiums and Level annual premiums for the various assurance plans.

Natural and Office premiums.

TOPICS FOR PRACTICALS

1. Mortality tables & Vital Statistics
2. Annuities
3. Life annuities
4. Assurance benefits

List Of Recommended Reference Books

1. Neill A.: Life Contingencies, First edition, Heineman educational books London
2. Dixit S.P., Modi C.S., Joshi R.V.: Mathematical Basis of Life Assurance, First edition Insurance Institute of India
3. Gupta S. C. & Kapoor V. K.: Fundamentals of Applied Statistics, Fourth edition, Sultan Chand & Sons.
4. Ajay Kumar Srivastava & Gorakhnath Agarwal: Mathematical Basis of Life Assurance, First edition Insurance Institute of India



St. Xavier's College – Autonomous Mumbai

T.Y.B.Sc

Syllabus For 6th Semester Courses in STATISTICS (June 2019 onwards)

Contents:

Theory Syllabus for Courses:

SSTA0601– Probability Distributions and Stochastic Processes.

SSTA0602– Statistical Inference.

SSTA0603– Applied Statistics (I B)

SSTA0604- Applied Statistics (II B)

Practical Course Syllabus for: SSTA06PR

Academic/field/industrial visits and seminars may be organized by the Department, at other venues, as part of the curriculum.

T.Y.B.Sc
(STATISTICS)

SEMESTER 6

COURSE: SSTA0601

PROBABILITY DISTRIBUTIONS AND STOCHASTIC PROCESSES

[60 LECTURES]

LEARNING OBJECTIVES:

- 1) To strengthen their concepts in mathematical statistics.
- 2) To prepare students to develop stochastic and queueing models.

- UNIT 1 **BIVARIATE DISTRIBUTIONS:** (15 L)
- i) Definition and properties of Moment Generating Function of two random variables of continuous and discrete type. Necessary and sufficient condition for independence of two random variables.
- ii) **Trinomial distribution:**
Definition of joint probability distribution (X,Y). Joint moment generating function, moments μ_{rs} where $r = 0,1,2$ and $s = 0,1,2$
Marginal & conditional distributions. Their Means & Variances.
Correlation coefficient between the random variables.
Distribution of the Sum X+Y.
- iii) **Multinomial distribution:**
Definition of joint probability distribution with parameters $(n, p_1, p_2, \dots, p_{k-1})$ where $p_1 + p_2 + \dots + p_{k-1} + p_k = 1$.
Other properties (Concept only)
- UNIT 2 **BIVARIATE NORMAL DISTRIBUTIONS:** (15 L)
- Definition of joint probability distribution (X, Y). Joint moment generating function, moments μ_{rs} where $r = 0,1,2$ and $s = 0,1,2$
Marginal & conditional distributions. Their Means & Variances.
Correlation coefficient between the random variables. Condition for the independence of X and Y. Distribution of $aX+bY$, where a and b are constants.
- SIGNIFICANCE OF CORRELATION COEFFICIENT:**
Distribution of sample correlation coefficient when $\rho = 0$. Testing the significance of a correlation coefficient.
Fisher's z – transformation. tests for
i) $H_0 : \rho = \rho_0$ and ii) $H_0 : \rho_1 = \rho_2$. Confidence interval for ρ .
- UNIT 3 **STOCHASTIC PROCESSES:** (15L)
- Definition of stochastic process. Postulates and difference differential equations for the i) Poisson process ii) Pure birth process iii) Yule's process iv) Pure death process v) Poisson type of death process vi) Yule's type / Linear Markovian death process vii) Birth and death process viii) Linear growth model.
Derivation of $P_n(t)$, mean and variance wherever applicable.

UNIT 4 QUEUEING THEORY

(15L)

Basic elements of the Queueing model. Roles of the Poisson and Exponential distributions. Derivation of Steady state probabilities for the birth and death process.

Steady state probabilities and the various average characteristics for the following models

- i) (M/M/1): (GD/ ∞ / ∞) ii) (M/M/1) : (GD/ N / ∞)
iii) (M/M/c): (GD/ ∞ / ∞) iv) (M/M/c) : (GD/ N / ∞)
v) (M/M/c): (GD/ N / N) c<N vi) (M/M/ ∞) : (GD/ ∞ / ∞)

Derivation of the waiting time distribution for the(M/M/1):(FCFS/ ∞ / ∞) model

Topics For Practicals;

1. Trinomial & Multinomial distributions.
2. Bivariate Normal distribution.
3. Significance of correlation coefficient.
4. Stochastic processes.
5. Queueing theory

REFERENCES:

1. Feller W: An introduction to probability theory and it's applications, Volume:1, Third edition, Wiley Eastern Limited.
2. Robert V. Hogg & Allen T. Craig: Introduction to Mathematical Statistics, Fifth edition, Pearson Education Pvt Ltd.
3. Alexander M Mood, Franklin A Graybill, Duane C. Boes: Introduction to the theory of statistics, Third edition, Mcgraw- Hill Series.
4. Hogg R. V. and Tanis E.A. Probability and Statistical Inference Fourth edition McMillan Publishing Company
5. S C Gupta & V K Kapoor: Fundamentals of Mathematical statistics, eleventh edition, Sultan Chand & Sons.
6. Taha H.A. Operations Research Mcmillan Publishing Co.
7. Kantiswaroop, P.K Gupta and Manmohan, Fourth edition, Sultan Chand & Sons.
8. Vohra N.D. Quantitative Techniques in Management Third edition McGraw Hill Companies
9. J Medhi: Stochastic Processes, Second edition, Wiley Eastern Ltd.
10. Biswas S. Topics in Statistical Methodology Wiley Eastern Ltd.
11. J. N. Kapur, H. C. Saxena Mathematical Statistics Fifteenth edition S. Chand and Company

(STATISTICS)

SEMESTER 6

COURSE: SSTA0602

STATISTICAL INFERENCE

[60 LECTURES]

LEARNING OBJECTIVE: To empower students to validate assumptions made on population parameters.

- Unit 1 TESTING OF HYPOTHESIS:
Statistical hypothesis. Problem of testing of hypothesis. Definitions and illustrations of i) Simple hypothesis ii) Composite hypothesis iii) Null Hypothesis iv) Alternative Hypothesis v) Test of hypothesis vi) Critical region vii) Type I and Type II errors viii) Level of significance ix) p-value. x) size of the test xi) Power of the test xii) Power function of a test. xiii) Power curve.
Definition of most powerful test of size α for a simple hypothesis against a simple alternative hypothesis. Neyman –Pearson fundamental lemma. Definition of uniformly most powerful (UMP) test. Construction of UMP test for one tailed alternative hypothesis. Randomized test. (15L)
- Unit 2 LIKELIHOOD RATIO TEST:
Likelihood ratio principle. Definition of the test statistic and its asymptotic distribution (statement only) Derivation of the test procedure for testing a composite hypothesis against a composite alternative hypothesis for the parameters of Binomial, Poisson, Discrete & Continuous Uniform and Normal distribution. (15L)
- Unit 3 NON-PARAMETRIC TESTS:
Need for non-parametric tests. Distinction between a parametric and a non parametric test. Concept of a distribution free statistic.
Confidence interval for a quantile.
One sample and Two sample non parametric test: (i) Sign test (ii) Wilcoxon Signed Rank test. (iii) Run test (iv) Kolmogrov Smirnov test.
(v) Median test (vi) Mann-Whitney-Wilcoxon test. (vii) Kruskal-Wallis test (viii) Friedman test (ix) Fisher’s Exact test
Assumptions, justification of the test procedure, critical regions for one tailed and two tailed test procedures. Problems with no ties. (15L)
- Unit4 SEQUENTIAL PROBABILITY RATIO TEST:
Sequential probability ratio test procedures for testing a simple null hypothesis against a simple alternative hypothesis. Its comparison with fixed sample size. Most powerful test procedure. Definition of Wald’s SPRT of strength (α, β) . Problems based on standard distributions such as Bernoulli, Poisson, Normal, Exponential. Graphical and tabular procedures for carrying out the tests. O.C function and A.S.N function and their respective curves. (15L)

TOPICS FOR PRACTICALS:

1. Testing of Hypotheses.

2. Likelihood Ratio Tests.
3. Non-Parametric Tests.
4. Sequential Probability Ratio Test.

REFERENCES:

1. Hogg R.V. and Craig A.T: Introduction to Mathematical Statistics Fourth edition London Macmillan Co. Ltd.
2. Hogg R.V. and Tanis E.A.: Probability and Statistical Inference. Third edition Delhi Pearson Education.
3. Daniel W.W.: Applied Non-Parametric Statistics First edition Boston-Houghton Mifflin Company
4. Sidney Siegal, N. John Castelian Jr. Nonparametric Statistics For Behavioral Sciences , Second edition McGraw Hill International editions
5. Wald A.: Sequential Analysis First edition New York John Wiley & Sons
6. Biswas S.: Topics in Statistical Methodology. First edition New Delhi Wiley eastern Ltd.
7. Gupta S.C. and Kapoor V.K.: Fundamentals of Mathematical Statistics Tenth edition New Delhi S. Chand & Company Ltd.
8. F.D. Gibbons: Non-Parametric Statistical Inference.

T.Y.B.Sc
(STATISTICS)

SEMESTER 6

COURSE: SSTA0603

APPLIED STATISTICS (I B)

[60 LECTURES]

LEARNING OBJECTIVE: To orient students on various applications of Statistics in industry.

Unit 1	<p><u>INVENTORY CONTROL:</u> <u>Deterministic Models:</u> Single item static EOQ models for i) Constant rate of demand with instantaneous replenishment, with and without shortages. ii) Constant rate of demand with uniform rate of replenishment, with and without shortages. iii) Constant rate of demand with instantaneous replenishment without shortages, with at most two price breaks. <u>Probabilistic models. :</u> Single period with i) Instantaneous demand (discrete and continuous) without setup cost. ii) Uniform demand (discrete and continuous) without set up cost.</p>	15L
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Unit 2	<u>REPLACEMENT THEORY:</u> Replacement of items that deteriorate with time and the value of money: i) remains constant ii) changes with time (weighted average of costs method). Replacement of items that fail completely. Individual replacement and Group replacement policies.	15L
Unit 3	<u>GAME THEORY:</u> Definitions of Two-person Zero Sum Game, Saddle Point, Value of the Game, Pure and Mixed strategy. Optimal solution of two-person zero sum games: Dominance property, Derivation of formulae for (2 x 2) game. Graphical solution of (2 x n) and (m x 2) games. Reduction of Game Theory to LPP.	15L
Unit 4	<u>SIMULATION:</u> Scope of simulation applications. Types of simulation. Monte Carlo Technique of Simulation. Elements of discrete event simulation. Generation of random numbers. Sampling from probability distribution. Inverse method. Generation of random observations from i) Uniform distribution ii) Exponential distribution iii) Gamma distribution. iv) Normal distribution. Simulation techniques applied to inventory and Queueing models.	15L

TOPICS FOR PRACTICALS:

1. Deterministic inventory models
2. Probabilistic inventory models.
3. Replacement Theory.
4. Game Theory.
5. Simulation.

REFERENCES:

1. Sharma J. K.: Operations Research Theory and Application, Third edition, Macmillan India Ltd.
2. Sharma S.D.: Operations Research. Eleventh edition, Kedarnath, Ramnath & Co.
3. Kantiswaroop , P.K Gupta and Manmohan, Fourth edition, Sultan Chand & Sons.
4. V.K. Kapoor. Operations Research. -Techniques for Management. Seventh edition, Sultan Chand & Sons Educational Publishers New Delhi.
5. Taha H.A. Operations Research, Sixth edition, Prentice Hall of India Pvt Ltd.
6. Vohra N.D. Quantitative Techniques in Management Third edition McGraw Hill Companies
7. Bannerjee B. Operation Research Techniques, Second edition, Mumbai Business Books.
8. Bronson R. Operations Research, Shaum's Outline series
9. Smith P.J. Analysis of Failure and Survival Data.

T.Y.B.Sc
(STATISTICS)

SEMESTER 6

COURSE: SSTA0604

APPLIED STATISTICS (II B)

[60 LECTURES]

LEARNING OBJECTIVE : To enable students to develop the technique of model building

Unit 1	<u>MULTIPLE LINEAR REGRESSION – I :</u> Concept of General Linear Model. Introduction to Binary Logistic Regression. Multiple linear regression model with two independent variables: Assumptions of the model, Derivation of ordinary least square (OLS) estimators of regression coefficients. Properties of least square estimators (without proof) Concept of multiple correlation, partial correlation, R^2 and adjusted R^2 . Properties of multiple and partial correlation coefficients. Testing the significance of multiple and partial correlation coefficients. Procedure of testing i) overall significance of the model ii) significance of individual coefficients iii) significance of contribution of additional independent variable to a model. Confidence intervals for the regression coefficients Residual analysis using graphs.	15L
Unit 2	<u>MULTIPLE LINEAR REGRESSION – II :</u> <u>Autocorrelation:</u> Concept, Detection using i) Run Test ii) Durbin Watson Test, Consequences of using OLS estimators in presence of autocorrelation, Generalized least square (GLS) method. <u>Heteroscedasticity:</u> Concept, Detection using i) Spearman's rank correlation test ii) Breusch – Pagan – Godfrey Test. Consequences of using OLS estimators in presence of heteroscedasticity Weighted least square (WLS) estimators <u>Multicollinearity:</u> Concept, Detection using R square & t ratios, simple correlation coefficients, Tolerance-Variance Inflation Factor (VIF) Consequences of using OLS estimators in presence of multi collinearity.	15L
Unit 3	<u>TIME SERIES:</u> Definition of Time series. Its components. Models of Time Series. Estimation of trend by i) Freehand curve method ii) Method of semi averages iii) Method of moving averages iv) Method of least squares.	15L

- v) Exponential smoothing method
- Estimation of seasonal component by i) Method of simple averages
- ii) Ratio to moving average method iii) Ratio to trend method

Unit 4	<p><u>RELIABILITY:</u> Concept of reliability or survival function, Hazard function, Cumulative hazard function Life time distributions: i) Exponential ii) Gamma iii) Weibull iv) Gumbel. Definitions of increasing (decreasing) failure rate. Observation schemes and censoring: left and right censoring, interval censoring, Type I, Type II, random right censoring. Kaplan-Meier estimator of survival function and median survival time. Reliability: Structure function, coherent system, standard systems: series, parallel, k-out-of-n system of independent components having exponential life distributions. Mean Time to Failure of a system (MTTF).</p>	15L
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TOPICS FOR PRACTICALS:

1. Multiple regression model.
2. Autocorrelation, Heteroscedasticity, Multicollinearity.
3. Time series.
4. Reliability.

REFERENCES:

1. S.C.Gupta , V.K.Kapoor: Fundamentals of Applied Statistics, Third edition, Sultan Chand & Sons.
2. Barlow R.E. and Prochan Frank: Statistical Theory of Reliability and Life Testing, First edition, John Wiley & Sons.
3. Mann N.R., Schafer R.E., Singapurwalla N.D.: Methods for Statistical Analysis of Reliability and Life Data., First edition, Wiley International
4. Damodar Gujrathi: Basic Econometrics, Second edition McGraw-Hill Companies.
5. S.M.Ross: Probability Models & Applications.
6. A.M.Goon, M.K.Gupta, B.Dasgupta: Fundamentals of Statistics, Vol Two, Fifth Revised edition, The World Press Pvt Ltd.
7. Smith P.J: Analysis of Failure and Survival Data
8. Daniel W.W: Applied Non-Parametric Statistics First edition Boston-Houghton Mifflin Company