## (Bachelor of Science in Statistics) (Bachelor of Science)
## (B. Sc.) (Statistics) Semester (V)

| Course Code | US05CSTA51 | Title of the Course | MATHEMATICAL STATISTICS |
|---|---|---|---|
| Total Credits of the Course | 04 | Hours per Week | 04 |

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| Course Objectives: | 1. To understand the key concepts in probability and distribution theory<br>2. To understand the concepts of various inequalities, law of large numbers<br>3. To learn various discrete probability distributions as a particular case of power series distribution<br>4. Large sample results such as the central limit theorem will be used to approximate a sampling distribution<br>5. To learn various continuous probability distributions<br>6. Emphasis is placed on theoretical understanding combined with problem solving. |

| Course Content | | |
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| Unit | Description | Weightage* (%) |
| 1. | Probability:<br>Probability of union of $n$ events, Boole's inequality, Bonferroni's inequality, convergence in probability and in distribution, Chebychev's inequality, Weak law of large numbers, Characteristic function and its properties (without proof) | 25 |
| 2. | General statement of Central Limit Theorem (CLT), Lindberg Levy form, Statement of Liapunov form (without proof). Applications of Central Limit Theorem (CLT). | 25 |
| 3. | Power Series Distributions:<br>Definition, p.g.f and m.g.f. of PSD, the recurrence relations between raw moments and central moments of PSD. The results of known discrete distributions as particular cases. Truncated Binomial and Truncated Poisson distributions (truncated at $X = 0$) | 25 |
| 4. | Continuous Probability Distributions:<br>Lognormal, Cauchy, Laplace and Weibull distributions. Moments and their relations. Incomplete Gamma and incomplete Beta distributions | 25 |

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| | as tail probabilities of Poisson and Binomial distributions. Truncated Normal distribution (Truncated at left) | |

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| Teaching-Learning Methodology | |

| Evaluation Pattern | | |
|---|---|---|
| Sr. No. | Details of the Evaluation | Weightage |
| 1. | Internal Written / Practical Examination (As per CBCS R.6.8.3) | 15% |
| 2. | Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3) | 15% |
| 3. | University Examination | 70% |

| Course Outcomes: Having completed this course, the learner will be able to | |
|---|---|
| 1. | learn key concepts of probability and probability distributions |
| 2. | learn central limit theorem and its applications in understanding the concepts of statistical inference. |

| Suggested References: | |
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| Sr. No. | References |
| 1. | Dudewic and Misra: Modern Mathematical Statistics, John Wiley & Sons. |
| 2. | Mukhopadhyay, P.(2006): Mathematical Statistics, 3ed., Books abd Allied(P) Ltd. |
| 3 | Rohatgi, V.K. & A.K. Md.E. Saleh (2001): An Introduction to Probability and Statistics, John Wiley (2nd Edition) |
| 4 | Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan |

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| | Chand and Sons |
| 5 | Hogg, Mckean and Craig : Introduction to Mathematical Statistics, 8th edition |

| On-line resources to be used if available as reference material |
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| On-line Resources |
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## (Bachelor of Science in Statistics) (Bachelor of Science)
## (B. Sc.) (Statistics) Semester (V)

| Course Code | US05CSTA52 | Title of the Course | THEORY OF ESTIMATION |
|---|---|---|---|
| Total Credits of the Course | 04 | Hours per Week | 04 |

| Course Objectives: | 1. To learn the concepts of point estimation , methods including method of moments and maximum likelihood, bias and variance, mean squared error, sufficiency, completeness, the Cramer – Rao inequality, uniformly minimum variance unbiased estimators.<br>2. Confidence intervals construction methods, including likelihood based intervals, inversion methods, intervals based on pivots. |
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| Course Content | | |
|---|---|---|
| Unit | Description | Weightage* (%) |
| 1. | Point Estimation – I<br>Estimation: Concepts of estimation, unbiasedness, consistency and efficiency. Rao – Cramer inequality, Fisher's information, Minimum Variance Bound Unbiased Estimators (MVBUE). | 25 |
| 2. | Sufficiency: Fisher Neyman factorization criterion (theorem) (for one parameter discrete distributions with proof and for continuous distributions without proof). | 25 |
| 3. | Point Estimation – II<br>Methods of Estimation:<br>Methods of moments, method of maximum likelihood. Properties of maximum likelihood estimation (Without proof). Method of iteration for maximum likelihood estimators (Method of scoring) | 25 |
| 4. | Interval estimation:<br>Random interval, definition of confidence interval, confidence intervals for the parameters of a normal distribution, for difference of two normal means, for ratio of two normal variances, for binomial | 25 |

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| | proportion and for difference of two binomial proportions. | |

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| Teaching-Learning Methodology | |

| Evaluation Pattern | | |
|---|---|---|
| Sr. No. | Details of the Evaluation | Weightage |
| 1. | Internal Written / Practical Examination (As per CBCS R.6.8.3) | 15% |
| 2. | Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3) | 15% |
| 3. | University Examination | 70% |

| Course Outcomes: Having completed this course, the learner will be able to | |
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| 1. | explain in detail the notion of a parametric model and point estimation of the parameters of those models. |
| 2. | explain in detail and demonstrate approaches to include a measure of accuracy for estimation procedures and our confidence in them by examining the area of interval estimation. |

| Suggested References: | |
|---|---|
| Sr. No. | References |
| 1. | Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh edition, Pearson Education, New Delhi |

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|---|---|
| 2. | Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with applications, (7th Edition), Pearson Education, Asia |
| 3 | Dudewic and Misra: Modern Mathematical Statistics, John Wiley & Sons. |
| 4 | Hogg, R.V. and Craig, A.T. (1972): Introduction to Mathematical Statistics, Amerind Publishing Co. |
| 5 | Lehmann, E.L. (1983): Theory of Point Estimation, Wiley Eastern |
| 6 | Robert V. Hogg and Elliot Tanis : Probability and Statistical Inference, 8th edition |


| On-line resources to be used if available as reference material |
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| On-line Resources |
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## (Bachelor of Science in Statistics) (Bachelor of Science)
## (B. Sc.) (Statistics) Semester (V)

| Course Code | US05CSTA53 | Title of the Course | SURVEY SAMPLING |
|---|---|---|---|
| Total Credits of the Course | 04 | Hours per Week | 04 |

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| Course Objectives: | 1. To introduce the basic concepts of survey sampling theory including brief introduction to questionnaire design, methods of sample selection, estimation, sampling variance, standard error of estimation in finite population<br>2. Development of sampling theory for use in sample survey problems and sources of errors in surveys.<br>3. Practical examples will be used to illustrate the principles and methods. |

| Course Content | | |
|---|---|---|
| Unit | Description | Weightage* (%) |
| 1. | Basics of Survey sampling and Equal Probability Sampling Scheme:<br>Concept of population and sample, Complete enumeration V/S sampling. Basic principles of sample survey.<br>Simple Random Sampling (SRS) with and without replacement, definition and procedure of selecting a random sample, estimates of population mean, total and proportion, variances of these estimates, estimates of their variances. | 25 |
| 2. | Stratified Random Sampling: Technique, estimates of population mean and total, variances of these estimates, proportional and optimum allocations and their comparison with SRS. Practical difficulties in allocation. | 25 |
| 3. | Systematic sampling: Technique, estimates of population mean and total, variances of these estimates ($N = nk$). Comparison of systematic sampling with SRS and stratified random sampling. | 25 |

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| 4. | Determination of sample size: Determination of sample size for proportion and continuous data in case of SRS. Cluster sampling (Equal clusters only) (Introduction only)<br>Sampling and non – sampling errors. | 25 |

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| Teaching-Learning Methodology | |

| Evaluation Pattern | | |
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| Sr. No. | Details of the Evaluation | Weightage |
| 1. | Internal Written / Practical Examination (As per CBCS R.6.8.3) | 15% |
| 2. | Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3) | 15% |
| 3. | University Examination | 70% |

| Course Outcomes: Having completed this course, the learner will be able to | |
|---|---|
| 1. | understand and interpret real life survey reports |
| 2. | understand concepts and techniques in sampling methods |
| 3. | understand solution methodology to estimate population parameters |

| Suggested References: | |
|---|---|
| Sr. No. | References |
| 1 | Cochran W.G. (1984): sampling Techniques (3rd Edition), Wiley Eastern |

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| 2. | Sukhatme, P.V., Sukhatme, B.V.: Sampling Theories of Survey With Application, IOWA State University Press and Indian Society of Agricultural Statistics |
| 3 | Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta. |
| 4 | Gupta, S.C. And Kapoor, V.K. (2005): Fundamentals of Applied Statistics, Sultan Chand & Sons |

| On-line resources to be used if available as reference material |
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| On-line Resources |
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## (Bachelor of Science in Statistics) (Bachelor of Science)
## (B. Sc.) (Statistics) Semester (V)

| Course Code | US05CSTA54 | Title of the Course | STATISTICAL QUALITY CONTROL |
|---|---|---|---|
| Total Credits of the Course | 04 | Hours per Week | 04 |

| Course Objectives: | 1. To understand the concepts underlying statistical quality control<br>2. To develop ability to apply those concepts to the design and management of quality control processes in industries<br>3. To apply statistical tools to analyze, design and use of various charts for quality control |
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| Course Content | | |
|---|---|---|
| Unit | Description | Weightage* (%) |
| 1. | Quality:<br>Definition, dimensions of quality, Quality system and standards. Introduction to ISO quality standards, Quality registration.<br>Statistical Process Control (SPC), chance and assignable causes of quality variation. | 25 |
| 2. | Statistical quality control charts:<br>Construction and statistical basis of $3\sigma$ control charts.<br>Control charts for variable: X – bar & R chart, X – bar and S chart.<br>Control charts for attribute: $p$ – chart, $np$ chart, $C$ chart and $u$ chart. Comparison between control charts for variables and attributes. | 25 |
| 3. | Acceptance sampling plan:<br>Principles of acceptance sampling plans. Single sampling plan their OC, AQL, LTPD, AOQ, AOQL, ASN and ATI functions with graphical interpretations. | 25 |
| 4. | Double sampling plans their OC, AQL, LTPD, AOQ, AOQL, ASN and ATI functions. | 25 |

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| Teaching-Learning Methodology | |

| Evaluation Pattern | | |
|---|---|---|
| Sr. No. | Details of the Evaluation | Weightage |
| 1. | Internal Written / Practical Examination (As per CBCS R.6.8.3) | 15% |
| 2. | Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3) | 15% |
| 3. | University Examination | 70% |

| Course Outcomes: Having completed this course, the learner will be able to | |
|---|---|
| 1. | understand the basic concepts of quality, quality control and tools to improve quality |
| 2. | demonstrate the ability to use and interpret control charts for variables and attributes understand the concepts of various acceptance sampling plans |
| 3. | understand the concepts of various acceptance sampling plans |

| Suggested References: | |
|---|---|
| Sr. No. | References |
| 1. | Montogomery, D.C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd. |
| 2. | Mukhopadhyay, P (2011): Applied Statistics, 2nd Edition revised reprint, Books and Allied (P) Ltd. |

| | |
|---|---|
| 3 | Gupta, S.C. And Kapoor V.K.(2005): Fundamentals of Applied Statistics, Sultan Chand & Sons |
| 4 | Chapman and Hall, - Brownlee, K.A.(1960): Statistical Theory and Methodology in Science and Engineering, john Wiley & Sons. |

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| On-line Resources |
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## (Bachelor of Science in Statistics) (Bachelor of Science)
## (B. Sc.) (Statistics) Semester (V)

| Course Code | US05CSTA55 | Title of the Course | PRACTICAL: STATISTICAL DATA ANALYSIS MANUALLY and USING SOFTWARE PACKAGES |
|---|---|---|---|
| Total Credits of the Course | 08 | Hours per Week | 16 |

| Course Objectives: | 1. To practice data entry, loading data, plotting graph, generating different descriptive statistical measures, correlation and regression analysis using statistical software<br>2. To generate random numbers and understand the concepts of fitting of polynomials and exponential curves and normal probability plot using statistical software<br>3. To learn to do univariate and bivariate data analysis and create output, interpret applying statistical methods including hypotheses testing. |
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| Course Content | | |
|---|---|---|
| Unit | Description | Weightage* (%) |
| 1. | Learn how to enter data, load data, plot a graph viz. histograms (equal class intervals and unequal class intervals), Box – plot, Stem – leaf, frequency polygon, pie chart, ogives with graphical summaries of data. | 25 |
| 2. | Generate automated reports giving detailed descriptive statistics, correlation and regression. | 25 |
| 3. | Random number generation and sampling procedures. Fitting of polynomials and exponential curves. Application problems based on fitting of suitable distribution. Normal probability plot. | 25 |
| 4. | Simple analysis and create and manage statistical analysis projects, import data, code editing, Basics of statistical inference in order to understand hypotheses testing and compute p – values and confidence intervals. | 25 |

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| Teaching-Learning Methodology | |

| Evaluation Pattern | | |
|---|---|---|
| Sr. No. | Details of the Evaluation | Weightage |
| 1. | Internal Written / Practical Examination (As per CBCS R.6.8.3) | 15% |
| 2. | Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3) | 15% |
| 3. | University Examination | 70% |

| Course Outcomes: Having completed this course, the learner will be able to | |
|---|---|
| 1. | do graphical presentation, fitting of various curves and hypotheses testing based on given data and is able to do statistical analysis of the data. |

| Suggested References: | |
|---|---|
| Sr. No. | References |
| 1. | Moore, D.S. and McCabe, G.P. and Craig, B.A. (2014): Introduction to Practice of Statistics, W.H.Freeman. |
| 2. | Cunningham, B.J. (2012): Using SPSS: An Interactive Hands on approach. |

| On-line resources to be used if available as reference material |
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| On-line Resources |
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