Minor Courses in Statistics
for 4-years Honours Students of Other Subjects

STSMIN101T/STSCOR101T–Descriptive Statistics-I and Probability-I

[Credit3] **[45 LectureHours]**

Unit1: Statistical Data **[12LectureHours]**

Statistics: Definition and scope. Concepts of statistical population and sample. Data: quantitative and qualitative, cross-sectional and time-series, discrete and continuous. Scales of measurement: nominal, ordinal, interval and ratio. Collection of data, concept of questionnaire. Presentation of data: tabular and graphical. Frequency distributions, cumulative frequency distributions and their graphical representations. Stem and leaf displays.

Unit2: Univariate Data Analysis **[15LectureHours]**

Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: Range, Mean deviation, Standard deviation, Coefficient of variation, Gini's Coefficient, Lorenz Curve. Moments, skewness and kurtosis. Quantiles and measures based on them. Box Plot. Outliers and its detection using quantiles. Trimmed mean.

Unit3: Introduction to Probability **[18 Lecture Hours]**

Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability: classical, statistical and axiomatic. Probability space and different properties of probability function. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

STSMIN101P/STSCOR101P: List of Practicals
[Credit2] **[60 Lecture Hours]**

- Graphical representation of data.
- Problems based on construction of frequency distributions, cumulative frequency distributions and their graphical representations.
- Problems based on measures of central tendency.
- Problems based on measures of dispersion.
- Problems based on combined mean and variance and coefficient of variation.
- Problems based on moments, skewness and kurtosis.
- Problems related to quantiles and measures based on them.
- Problem of detection of outliers using quantiles, construction of boxplot.
- Numerical sums using classical definition of Probability.
- Numerical sums on conditional probability.

Reference Books

- Goon, A.M., Gupta, M.K. and Dasgupta, B.(2002):Fundamentals of Statistics, Vol. I & II, 8thEdition, World Press, Kolkata.
- Miller, Irwin and Miller, Marylees John E. Freunds(2006): MathematicalStatisticswithApplications,7thEdition, Pearson Education, Asia.
- Mood, A.M., Graybill, F.A. and Boes, D. C.(2007): Introduction to the Theory of Statistics,3rdEdition, Tata McGraw-Hill Pub. Co. Ltd.
- Tukey, J. W. (1977): Exploratory Data Analysis, Addison-Wesley Publishing Co.
- Freedman, D., Pisani, R. and Purves, R. (2014): Statistics,4thEdition, W.W. Norton & Company.
- Chung, K. L. (1983): Elementary Probability Theory with Stochastic Process, Springer/ Narosa.
- Feller, W. (1968): An Introduction to Probability Theory & its Applications, John Wiley.
- Goon, A.M., Gupta, M.K. & Dasgupta, B. (2003): An Outline of Statistical Theory Vol- I, World Press.
- Parzen, E. (1972): Modern Probability Theory and its Applications, John Wiley.
- Uspensky, J.V.(1937): Introduction to Mathematical Probability, McGraw Hill.
- Cacoullos, T.(1973): Exercises in Probability, Narosa.
- Ross, S. (2002): A First Course in Probability, Prentice Hall.
- Stirzaker, D. (2003): Elementary Probability, 2ndEdition, Cambridge University Press
- Rahman, N.A.(1983): Practical Exercises in Probability and Statistics, Griffin.
- Rohatgi, V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2nd Edition, John Wiley and Sons.

STSMIN202T/STSCOR202T –Descriptive Statistics- II & Probability-II

[Credit3] **[45LectureHours]**

Unit1: Bivariate Data Analysis **[12 Lecture Hours]**

Bivariate data: Definition, scatterdiagram, simple correlation, linear regression, principle of least squares, fitting of polynomial and exponential curves, correlation ratio, correlation index, intra-class correlation. Rank correlation: Spearman's and Kendall's measures.

Unit2: Categorical Data Analysis **[12 Lecture Hours]**

Analysis of Categorical Data: Contingency table, independence & association of attributes. Ideas of complete and absolute association. Yule's measures of association and colligation, Cramer's measure of association, odds-ratio.

Unit3: Random Variables & Standard Discrete and Continuous Probability Distributions-I **[21 Lecture Hours]**

Random Variables: Definition of discrete and continuous random variables, cumulative distribution function (c.d.f.) and its properties (without proof), probability mass function (p.m.f.), and probability density function (p.d.f.). Expectation and Variance. Standard discrete probability distributions I: Discrete Uniform, Binomial, Poisson; Standard continuous probability distributions I: Rectangular, Exponential, Normal.

STSMIN202P/STSCOR202P:List of Practicals
[Credit2] **[60 Lecture Hours]**

- Correlation coefficient for a bivariate frequency distribution.
- Lines of regression, angle between lines and estimated values of variables.
- Fitting of polynomials, exponential curves.
- Spearman rank correlation with and with outlies.
- Computation of correlation ratio.
- Computation of intra class correlation coefficient.
- Fitting of binomial distribution for given n and p.
- Fitting of binomial distribution after computing mean and variance.
- Fitting of Poisson distribution for given value of lambda.
- Fitting of Poisson distribution after computing mean.
- Fitting of exponential distribution.
- Fitting of normal distribution.
- Application problem based on binomial distribution.
- Application problem based on Poisson distribution.
- Application problem based on negative binomial distribution.

Reference Books

- Goon, A.M., Gupta, M.K. and Dasgupta,B. (2002): Fundamentals of Statistics, Vol.I & II,8th Edition, World Press, Kolkata.
- Miller, Irwin and Miller, Marylees(2006):John E.Freunds Mathematical Statistics with Applications,7th Edition, Pearson Education, Asia.
- Mood, A.M., Graybill, F.A. and Boes,D.C.(2007): Introduction to the Theory of Statistics, 3rd Edition,Tata McGraw-Hill Pub. Co. Ltd.
- Tukey, J.W.(1977): Exploratory Data Analysis, Addison-Wesley Publishing Co.
- Freedman, D., Pisani, R. and Purves, R.(2014): Statistics, 4th Edition, W. W. Norton & Company.
- Agresti, A. (2010): Analysis of Ordinal Categorical Data,2nd Edition, Wiley.
- Chung, K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer/ Narosa.
- Feller, W.(1968): An Introduction to Probability Theory & its Applications, John Wiley.
- Goon, A.M., Gupta, M.K. & Dasgupta, B. (2003): An Outline of Statistical Theory Vol- I, World Press.
- Parzen, E.(1972):Modern Probability Theory and its Applications, John Wiley.
- Uspensky, J.V. (1937): Introduction to Mathematical Probability, McGraw Hill.
- Cacoullos, T.(1973):Exercises in Probability, Narosa.
- Ross, S. (2002): A First Course in Probability, Prentice Hall.
- Stirzaker, D.(2003): Elementary Probability, 2nd Edition, Cambridge University Press
- Rahman, N.A.(1983):Practical Exercises in Probability and Statistics, Griffin.
- Rohatgi, V.K. and Saleh, A.K.Md.E.(2009): An Introduction to Probability and Statistics. 2nd Edition, John Wiley and Sons.

STSMIN303T/STSCOR303T –Survey Sampling

[Credit3] **[45 Lecture Hours]**

Unit1: Simple Random Sample **[15 Lecture Hours]**

Concept of population and sample, complete enumeration versus sampling, sampling and non- sampling errors. Types of sampling: non-probability and probability sampling, basic principles of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of population mean, total and proportion, variances of these estimates, estimates of their variances and sample size determination.

Simple Random sampling using auxiliary information: Ratio and Regression methods of estimation.

Unit2: Stratified and Systematic Sampling **[18 Lecture Hours]**

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, estimation of gain in precision.

Systematic Sampling, Technique, estimates of population mean and total, variances of these estimates (N=n x k case). Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections.

Unit3: Other Sampling Methods **[12 Lecture Hours]**

Cluster sampling (equal-size clusters only) estimation of population mean and its variance, Concept of sub-sampling. Two-stage sampling, Estimation of Population mean and variance of the estimate, comparison between two-stage, cluster and uni-stage sampling. Randomized response technique: Warner's method.

STSMIN303P/STSCOR303P: List of Practicals

[Credit2] **[60 Lecture Hours]**

- Select an SRS with and without replacement.
- For a population of size 5, estimate population mean, population mean square and population variance. Enumerate all possible samples of size 2 by WR and WOR and establish all properties relative to SRS.
- For SRSWOR, estimate mean, standard error, the sample size
- Ratio and Regression estimation: Calculate the population mean or total of the population. Calculate mean squares. Compare the efficiencies of ratio and regression estimators relative to SRS.
- Stratified Sampling: allocation of sample to strata by proportional and Neyman's methods. Compare the efficiencies of above two methods relative to SRS.
- Estimation of gain in precision in stratified sampling.
- Comparison of systematic with stratified sampling and SRS in the presence of a linear trend.
- Cluster sampling: estimation of mean or total, variance of the estimate, estimate of intra-class correlation coefficient, efficiency as compared to SRS.
- Two stage sampling.

Reference Books

- Cochran, W.G. (1984): Sampling Techniques (3rd Ed.), Wiley Eastern
- Sukhatme, P.V., Sukhatme, B.V. Sukhatme, S. (1984). Sampling Theories of Survey with Application, IOWA State University Press and Indian Society of Agricultural Statistics
- Murthy, M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta
- Des Raj and Chandhok P. (1998): Sample Survey Theory, Narosa PublishingHouse
- Goon A.M., Gupta M.K. and Dasgupta B. (2008): Fundamentals of Statistics, Vol-2, World Press

STSSMC701T –Research Methodology in Statistics

[Credit 3] **[45 Lecture Hours]**

Unit 1: Foundations of Research [15 Lecture Hours]

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method –Understanding the language of research – Concept, Construct, Definition, Variable. Research Process. Problem Identification & Formulation – Research Question – Investigation Question –Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis &Alternative Hypothesis. Hypothesis Testing– Logic & Importance.

Unit2: Research Design [15 Lecture Hours]

Research Design: Concept and Importance in Research–Features of a good research design–Exploratory Research Design–concept, types and uses, Descriptive Research Designs– concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

Unit3: Preparing report [15 Lecture Hours]

Preparing the text: Title, list of authors, abstract, introduction, materials and methodologies, results, acknowledgments, bibliography, cross-citation, cross-reference. Design effective tables, graphs. Submitting the manuscript: Rights and Permissions, Cover letter, Review process, publishing process. Writing review paper, book chapter, preparing a poster, conference report, preparing thesis, grant proposals and progress report.

STSSMC701P: List of Practical

[Credit 2] **[60 Lecture Hours]**

- Review and summarize some published statistical works in journals.
- The students may work in groupsandthelistofpublicationsmayincludesomepopular,foundational and classical works on the discipline.
- Each group need to prepare a report based in own language on the journalpaper assigned to them bytheinstructor.

Reference Books

- Robert A. Day and Barbara Gastel, How toWriteand Publish a Scientific Paper
- M. Alley, The Craft of Scientific Writing Research Methodology–C.R.Kothari
- Wayne C. Booth, Gregoy G. Colomb and Joseph M.Williams, The Craft of

Research (3rd edition, Chicago: University of Chicago Press, 2008.
- G. D. Gopen and J. A. Swan, "The Science of Scientific Writing", American Scientist **78** (1990):550--558

STSSMC702T –Advanced Statistical Inference

[Credit 3] **[45 Lecture Hours]**

Unit1: Introduction to Statistical Inference **[15 Lecture Hours]**

Estimation of population mean, confidence intervals for the parameters of a normal distribution (one sample and two sample problems). Minimum variance unbiased estimator.
The basic idea of significance test. Null and alternative hypothesis. Type I& Type II errors, level of significance, concept of p-value. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).

Unit2: Some Statistical test **[15 Lecture Hours]**

Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi-square test, Yates' correction. Fisher's exact test.
Tests for the significance of correlation coefficient. Sign test for median, Sign test for symmetry, Wilcoxon two-sample test. Run Test for randomness.

Unit3: Analysis of Variance and Design of Experiment **[15 Lecture Hours]**

Analysis of variance, one-way and two-way classification. Brief exposure of three basic principles of design of experiments, treatment, plot and block. Analysis of completely randomized design, randomized complete block design.

STSSMC702P: List of Practical
[Credit 2] **[60 Lecture Hours]**

- Estimators of population mean.
- Confidence interval for the parameters of a normal distribution (one sample and twosample problems).
- Tests of hypotheses for the parameters of a normal distribution (one sample and twosample problems).
- Chi-square test of proportions.
- Chi-square tests of association.
- Chi-square test of goodness-of-fit.
- Test for correlation coefficient.
- Sign test for median.
- Sign test for symmetry.
- Wilcoxon two-sample test.
- Run test for randomness.
- Analysis of Variance of a one way classified data
- Analysis of Variance of a two way classified data.

Reference Books

- Daniel, Wayne W., Bio-statistics: A Foundation for Analysis in the Health Sciences.John Wiley (2005).
- Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).
- Das, M. N. &Giri, N. C.: Design and analysis of experiments. John Wiley.
- Dunn, O.J Basic Statistics: A primer for the Biomedical Sciences .(1964, 1977) byJohn Wiley.
- Bancroft, Holdon Introduction to Bio-Statistics (1962) P.B. Hoebar New York.
- Goldstein, A Biostatistics-An introductory text (1971). The Macmillion New York.