BIDHANNAGAR COLLEGE, GOVERNMENT OF WEST BENGAL, SALT LAKE, KOLKATA

Teaching Plan for Odd Semester, UG course

Department of Statistics

Session 2019-20

Class:B.A/ B.Sc
Semester 1,3 & Part-III(1+1+1) system UGcourse
Name of the Teacher: Mr. Arup Kumar Hait
Subject: Statistics
Paper : STSACOR01, Part-III, Paper-V & Part-III,Paper-VI (Theory and Practical)

S. No	Practical syllabus to be covered (Paper code to be mentioned)	Theory syllabus to be covered (Paper code to be mentioned)
Week 1 to week 4	**STSACOR01P** • Graphical representation of data. • Stem and Leaf Display • Problems based on measures of central tendency. **Part-III, Paper-V** • Simple linear regression. • Multiple regression. • Multiple Correlation • Partial Correlation	**STSACOR01T** Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement: nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives, column diagram and step diagrams. Stem and Leaf display. Measures of Central Tendency: mathematical and positional. **Part-III, Paper-V** Multivariate data – its graphical representation, multiple correlation and partial correlation and their properties, multiple regression and related results. , Partial Correlation. **Part-III,Paper-VI** Design of Experiments : Principles of Experimental Design :Randomization, Replication and Local Control, Uniformity trials, Shapes and Sizes of Plots and Blocks
Week 5 to week 8	**STSACOR01P** • Problems based on measures of dispersion. • Problems based on combined mean and variance and coefficient of variation. • Problems based on moments	**STSACOR01T** Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation. Moments, absolute moments, factorial moments, Sheppard's corrections (without proof). **Part-III, Paper-V** Regression with binary data: Logistic regression and fitting by least square method. **Part-III,Paper-VI** Standard Designs and their Analyses : Completely Randomised Design (CRD), Randomised Block Design (RBD), Latin Square Design (LSD),

Week 9 to Week 12	**STSACOR01P** • Problems based on moments, skewness and kurtosis. • Box Plot • Karl Pearson correlation coefficient. • Correlation coefficient for a bivariate frequency distribution. • Lines of regression, angle between lines and estimated values of variables. **Part-III,Paper-VI** • Analysis of CRD • Analysis of an RBD • Analysis of an LSD	**STSACOR01T** Measures of skewness and kurtosis. Box Plot. Definition, scatter diagram, simple correlation, linear regression and principle of least squares, **Part-III, Paper-V** Random Vector : Probability mass and density functions, Distribution Function, Mean Vector and Dispersion matrix, Marginal and Conditional Distributions, Multiple Regression, Multiple Correlation **Part-III,Paper-VI** Split Plot Design, comparison of efficiencies. Applications of the techniques of Analysis of variance to the analysis of the designs.
Week 13 to week 14		**Class Tests and Internal Exam**
Week 15 to 17	**STSACOR01P** • Fitting of polynomials, exponential curves. • Spearman rank correlation with and without ties. • Computation of correlation ratio. • Computation of intra class correlation coefficient. **Part-III,Paper-VI** • Analysis of 2^2 and 2^3 factorial in CRD and RBD • Analysis of 2^2 and 2^3 factorial in LSD	**STSACOR01T** Fitting of polynomials and exponential curves, Spearman rank correlation, correlation ratio, intra-class correlation. **Part-III,Paper-VI** Factorial Experiments : 2^n (2^3 and 2^2 only) experiments, Advantages,

Class: B.Sc. (Honours)
Semesters: 1, 3 (CBCS), Part III **(1+1+1 System)**
Name of the Teacher: Kiranmoy Chatterjee
Subject: Statistics
Paper : STSACOR01T, STSACOR02T, STSACOR05T (CBCS), Paper VI: ANOVA (1+1+1 System)

S. No	Practical syllabus to be covered (Paper code to be mentioned)	Theory syllabus to be covered (Paper code to be mentioned)
Week 1 to week 4	Paper STSSSEC01M(CBCS) : Statistical Data Analysis Using C-programming and Software Packages Minitab: Unit 1	Paper STSACOR02T(CBCS) : Vector spaces, subspaces, sum of subspaces, Span. Linear dependence and independence, basis and dimension, dimension theorem. Paper STSACOR05T(CBCS) : ***Unit 1: Two dimensional random variables: Discrete***
Week 5 to week 8	Practical exercises related to Paper VI: ANOVA (3rd Year, 1+1+1 System) Paper STSSSEC01M(CBCS) : Statistical Data Analysis Using C-programming and Software Packages Minitab: Unit 2	Paper STSACOR02T(CBCS) : Orthogonal vectors, Gram-Schmidt orthogonalization, ortho-complement space. Null space and nullity. A review, theorems related to triangular, symmetric and skew symmetric matrices, idempotent matrices, orthogonal matrices, singular and non-singular matrices and their properties. Trace of a matrix. Paper STSACOR05T(CBCS) : ***Unit 2: Two dimensional random variables: Continuous*** Paper VI: ANOVA (3rd Year, 1+1+1 System): Introduction: Heterogeneity and Analysis of Variance and Covariance, Linear Hypothesis, Orthogonal splitting of total variance, Selection of Valid Error.
Week 9 to Week 12	Paper STSACOR05P(CBCS) : 1. Problems based on the property of normal distribution. 2. To find the ordinate for a given area for normal distribution. 3. Application-based problems using normal distribution. 4. Fitting of normal distribution when parameters are given. 5. Fitting of normal distribution when parameters are not given. 6. Fitting of some other continuous distributions. Practical exercises related to Paper VI: ANOVA (3rd Year, 1+1+1 System)	Paper STSACOR02T (CBCS) : Row space and column space of a matrix. Definition, properties and applications of determinants for 3rd and higher orders, evaluation of determinants of order 3 and more using transformations. Symmetric and Skew symmetric determinants, Circulant determinants and Vandermonde determinants for nth order. Paper STSACOR05T(CBCS) : ***Unit 3: Generating Functions*** ***Unit 4: Standard continuous probability distributions:*** Uniform, normal, exponential, Cauchy, beta, gamma, lognormal distributions Paper VI: ANOVA (3rd Year, 1+1+1 System): One-way ANOVA Model, Applications of the ANOVA technique to one-way classified data.

	Paper STSSSEC01M(CBCS) : Statistical Data Analysis Using C-programming and Software Packages Minitab: Unit 3	
Week 13-14: Internal Exam (for CBCS) and Class Tests (for Part II & III in 1+1+1 system)		
Week 15 to 17	Paper STSSSEC01M(CBCS) : Statistical Data Analysis Using C-programming and Software Packages Minitab: Unit 4	Paper STSACOR02T : Jacobi's Theorem. Product of determinants. Adjoint and inverse of a matrix and related properties. Use of determinants in solution to the system of linear equations. Paper STSACOR05T(CBCS) : ***Unit 4: Standard continuous probability distributions:*** Logistic, double exponential and Pareto along with their properties and limiting/approximation cases. Bivariate Normal Distribution and its properties (Statement only).

Class:B.Sc
Semester 1, 3 and 5 **Name of the Teacher: Suryasish Chatterjee**
Subject: Statistics
Paper : STSACOR02T, STSACOR06T, STSACOR06P, STSADSE02T, STSADSE02P

S. No	Practical syllabus to be covered (Paper code to be mentioned)	Theory syllabus to be covered (Paper code to be mentioned)
Week 1 to week 4	**Paper STSACOR06P:** 1. Testing of significance for single proportion and difference of two proportions. 2. 2. Testing of significance for single Poisson mean and difference of means of two independent Poisson distributions. Practical exercises related to Paper V: Large Sample Theory (3rd Year, 1+1+1 System)	**Paper STSACOR02T**: Sequence of real numbers and their convergence, limits of sequences, Cauchy's general principle of convergence, Cauchy's first theorem on limits, monotonic sequences, limit superior and limit inferior of a bounded sequence **Paper STSACOR06T:** Definitions of random sample, parameter and statistic, sampling distribution of a statistic. Distributions of functions of random variables. Illustration through simple transformation and generating function technique. Paper V: Large Sample Theory (2nd Year, 1+1+1 System): Convergence in Distribution, Normal approximation to the Poisson distribution,Statement of Central limit Theorem (i.i.d. case) &its application, Relation among different modes of convergence-----slutsky's theorem

Week 5 to week 8	**Paper STSACOR06P:** 3. Testing of significance and confidence intervals for single mean and difference of two means and paired tests. 4. Testing if the population variance has a specific value and its confidence intervals Practical exercises related to Paper V: Large Sample Theory (3rd Year, 1+1+1 System)	**Paper STSACOR02T**: Infinite series, positive-termed series and their convergence. Comparison tests, D'Alembert's ratio test and Cauchy's n_{th} root test, (Statements and examples only). Absolute convergence of series, Leibnitz's test for the convergence of alternating series, Conditional convergence. **Paper STSACOR06T:** Definition and derivation of p.d.f. of $\chi 2$ with n degrees of freedom (d.f.) using m.g.f., nature of p.d.f. curve for different degrees of freedom, mean, variance, m.g.f., mode, additive property and limiting form of $\chi 2$ distribution. Student's and Fishers t-distribution, Derivation of its p.d.f., nature of probability curve with different degrees of freedom, mean, variance, moments and limiting form of t distribution <u>Paper V: Large Sample Theory (2nd Year, 1+1+1 System):</u> Derivation of large sample standard error of sample moments, standard deviation, coefficient of variation, b_1 and b_2 measures and correlation coefficient and their uses in large sample tests.
Week 9 to Week 12	**Paper STSACOR06P:** 5. Testing of significance and confidence intervals of correlation coefficient. 6. Testing of equality of population variances for two independent normal populations and related confidence intervals. table. Practical exercises related to Paper V: Large Sample Theory (3rd Year, 1+1+1 System)	**Paper STSACOR02T**: Statement of the fundamental theorem of algebra and its consequences. Relation between roots and coefficients of any polynomial equations. Solutions of cubic and biquadratic equations when some conditions on roots of equations are given **Paper STSACOR06T:** Snedecore's F-distribution, Derivation of p.d.f., nature of p.d.f. curve with different degrees of freedom, mean, variance and mode. Distribution of $1/F(n_1,n_2)$. Relationship between t, F and $\chi 2$ distributions. Sampling distributions of sample mean and sample variance when parent population is normal. Null distribution of sample correlation coefficient (statement only). Exact tests relating to Binomial proportion (s) and Poisson mean (s)

		Paper V: Large Sample Theory (2nd Year, 1+1+1 System): Transformations of Statistics to stabilize variance : derivation and use of $\sin^{-1}$,square root, logarithmic and z-transformations. Large sample tests for binomial proportions, Poisson means (single and two independent sample cases) and correlation coefficients.
Week13 to week 14		**Internal Exam**
Week 15 to 17	Practical exercises related to Paper V: Large Sample Theory (3rd Year, 1+1+1 System)	**Paper STSACOR06T:** Introduction, distribution of the rth order statistic, smallest and largest order statistics. Joint distribution of rth and sth order statistics, distribution of sample median and sample range Paper V: Large Sample Theory (2nd Year, 1+1+1 System): Large sample distribution of Pearsonian χ^2–statistic and its uses, Goodness of fit. Yate's correction in a 2x2 contingency table.

Class:B.Sc
Semester 3 and Part III **Name of the Teacher: Soumyadeep Das**
Subject: Statistics
Paper : STSACOR07T,STSACOR07P, STSHGECO3T, STSHGECO3P, Part III Paper V and VI (Theory and Practical)

S. No	Practical syllabus to be covered (Paper code to be mentioned)	Theory syllabus to be covered (Paper code to be mentioned)
Week 1 to week 4	**Paper V of Part III:** Practical problems on Maximum Likelihood estimation. **Paper STSACOR07P:** 1. To select a SRS with and without replacement. 2. 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. 3. For SRSWOR, estimate mean, standard error, the sample size **Paper STSHGEC03P:** 1. Estimators of population mean.	**Paper V of Part III:** Maximum Likelihood estimation. **Paper STSACOR07T**: 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. **Paper STSHGEC03T:** Estimation of population mean, confidence intervals for the parameters of a normal distribution (one sample and two sample problems).

	2. Confidence interval for the parameters of a normal distribution (one sample and two sample problems).	
Week 5 to week 8	**Paper V of Part III:** Practical problems on Minimum chi square estimators. **Paper STSACOR07P:** 4. Stratified Sampling: allocation of sample to strata by proportional and Neyman's methods. Compare the efficiencies of above two methods relative to SRS. 5. Estimation of gain in precision in stratified sampling.	**Paper V of Part III:** Minimum chi square estimators and their properties (excluding proofs of large sample properties). **Paper STSACOR07T:** 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. **Paper STSHGEC03T:** The basic idea of significance test. Null and alternative hypothesis. Type I & Type II errors.
Week 9 to Week 12	**Paper STSACOR07P:** 6. Comparison of systematic with stratified sampling and SRS in the presence of a linear trend.	**Paper VI of Part III:** Introduction : Concepts of a Finite population and a sample, Need for Sampling, Complete Enumeration and Sample Surveys. General Ideas : Planning and execution of sample surveys, analysis of data and reporting, Biases and Errors. Judgement and probability sampling.Tables of random numbers and their uses. **Paper STSACOR07T:** 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. **Paper STSHGEC03T:** level of significance, concept of p-value.
Week 13	**Paper VI of Part III:** Practical problems on Simple random sampling. **Paper STSACOR07P:** 7. 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. **Paper STSHGEC03P:** 3. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).	**Paper VI of Part III:** Basic sampling and Estimation Procedures : Simple random sampling with and without Replacement **Paper STSACOR07T:** Ratio and Regression methods of estimation in simple random sampling **Paper STSHGEC03T:** Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).
Week13 to week 14		**Internal Exam**

Week 15 to 17	**Paper VI of Part III:** Practical problems on Stratified random sampling, Linear and Circular Systematic Sampling, Cluster Sampling **Paper STSACOR07P:** 8. Cluster sampling: estimation of mean or total, variance of the estimate, estimate of intra-class correlation coefficient, efficiency as compared to SRS. 9. Two stage sampling. **Paper STSHGEC03P:** 4. Chi-square test of proportions. 5. Chi-square tests of association. 6. Chi-square test of goodness-of-fit.	**Paper VI of Part III:** Stratified random sampling, Linear and Circular Systematic Sampling, Cluster Sampling **Paper STSACOR07T:** Hartley-Ross estimator. 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. **Paper STSHGEC03T:** Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi square test, Yates' correction.

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Teaching Plan for Even Semester, UG course

Department of Statistics

Session 2019-20

Class:B.A/ B.Sc
Semester 2,4 & Part-III(1+1+1) system UGcourse
Name of the Teacher: Arup Kumar Hait
Subject: STATISTICS
Paper : STSACOR04,STSHGEC04, Part-III, Paper-V & Part-III, Paper-VI(Theory and Practical)

S. No	Practical works to be covered (Paper code to be mentioned)	Theory topics to be covered (Paper code to be mentioned)
Week 1 to week 4	**STSHGEC04** • Measurement of trend: Fitting of linear & quadratic trend and plotting of trend values and comparing with given data graphically. **Part-III, Paper-V** • Multinomial Distribution **Part-III, Paper-VI**	**STSACOR04T** Row reduction and echelon forms. Partitioning of matrices and simple properties. Rank of a matrix, row-rank, column-rank, standard theorems on ranks, rank of the sum and the product of two matrices. **STSHGEC04** Economic Time Series: Components of time series, Decomposition of time series- Additive and multiplicative model with their merits and demerits, Illustrations of time series.

	• Analysis of a completely confounded two level factorial design in 2 blocks • Analysis of a completely confounded two level factorial design in 4 blocks • Analysis of a partially confounded two level factorial design	Measurement of trend by method of free-hand curve, method of semi-averages. Method of least squares (linear & quadratic). **Part-III, Paper-V** Multivariate Distributions : Multinomial distributions and their properties. **Part-III, Paper-VI** Total and Partial Confounding, Analysis.
Week 5 to week 8	**STSHGEC04** • Measurement of trend: Fitting of exponential, modified exponential curve and plotting of trend values and comparing with given data graphically. • Measurement of seasonal indices by Ratio-to-trend method and plotting of trend values and comparing with given data graphically.	**STSACOR04T** Matrix equations Ax=b, solution sets of linear equations. Applications of linear equations, inverse of a matrix. **STSHGEC04** Measurement of exponential trend and modified exponential trend. Measurement of seasonal variations by method of ratio to trend.
Week 9 to Week 12	**STSHGEC04** • Construction of price and quantity index numbers by Laspeyre's formula, Paasche's formula, Marshall-Edgeworth's formula, Fisher's Formula. Comparison and interpretation. **Part-III, Paper-V** • Bivariate Normal Distribution, • Multivariate Normal Distribution **Part-III,Paper-VI** ANCOVA	**STSACOR04T** Characteristic roots and Characteristic vector, Properties of characteristic roots, Cayley Hamilton theorem, Quadratic forms: Classification and canonical reduction. Linear transformations. **STSHGEC04** Index numbers: Definition, Criteria for a good index number, different types of index numbers. **Part-III, Paper-V** Multivariate Distributions : Multivariate Normal distributions and their properties. **Part-III, Paper-VI** Analysis of Covariance (ANCOVA) : Application of the ANCOVA technique to oneway classified data to two- way classified data with number of observations per cell, use in control of error in CRD, RBD .
Week13 to week 14		**Tests and Internal Exam**

Week 15 to 17	**STSHGEC04** • Construction of wholesale price index number, fixed base index number and consumer price index number with interpretation **Part-III,Paper-VI** • Analysis of an RBD with one missing observation • Analysis of an LSD with one missing observation	**STSACOR04T** Applications of Linear Algebra in Statistics. **STSHGEC04** Construction of index numbers of prices and quantities, consumer price index number. Uses and limitations of index numbers. **Part-III,Paper-VI** Missing Plot Technique : Analysis with one missing plot in a RBD

Class: B.Sc. (Honours)
Semesters: 2, 4 (CBCS), Part III **(1+1+1 System)**
Name of the Teacher: Kiranmoy Chatterjee
Subject: Statistics
Paper : STSACOR03T, STSACOR04T, STSHGEC04T, STSHGEC04P (CBCS), and Paper VI (1+1+1 System)

S. No	**Practical works to be covered (Paper code to be mentioned)**	**Theory topics to be covered (Paper code to be mentioned)**
Week 1 to week 4	Paper STSACOR09P(CBCS): 1. Estimability in Gauss Markov Model. 2. Simple linear regression. 3. Multiple regression. Paper STSADSE04P(CBCS): 6. Computation of Mortality rate. 7. Preparation of Life Table.	Paper STSACOR03T(CBCS): Introduction, random experiments, sample space, events and algebra of events. Sigma algebra of events. Definitions of Probability – classical, statistical and axiomatic. Paper STSACOR04T(CBCS) : Row reduction and echelon forms. Partitioning of matrices and simple properties. Rank of a matrix, row-rank, column-rank, standard theorems on ranks, rank of the sum and the product of two matrices. Paper STSACOR09T(CBCS) : ***Unit 1: Multivariate Data*** ***Unit 2: Gauss-Markov set-up*** Theory of linear estimation, Estimability of linear parametric functions, Method of least squares, Gauss-Markov theorem, Estimation space and Error Space Paper STSHGEC04T(CBCS): ***Unit 4: Demography*** Demographic Methods: Introduction, measurement of population, rates and ratios of vital events Paper VI: ANOVA (3rd Year, 1+1+1 System):

		Two-way classified data with one and some equal no. of observations per cell separately. Applications of the ANOVA technique to two-way classified data.
Week 5 to week 8	Paper STSACOR03P(CBCS): 1. Numerical sums using classical definition of Probability. 2. Numerical sums on conditional probability. Paper STSACOR09P(CBCS): 4.Tests for linear hypothesis. 5. Analysis of variance of one way classified data. 6. Analysis of variance of a two way classified data with one observation per cell. Paper STSHGEC04P(CBCS): 7. Computation of measures of mortality 8. Completion of life table. 9. Computation of measures of fertility and population growth	Paper STSACOR03T(CBCS): Theorem of compound probability, theorem of total probability, Conditional probability and independence of event. Bayes theorem and its applications. Paper STSACOR04T(CBCS) : Matrix equations Ax=b, solution sets of linear equations. Applications of linear equations, inverse of a matrix. Characteristic roots and Characteristic vector. Paper STSACOR09T(CBCS) : ***Unit 2: Gauss-Markov set-up*** Estimation of error variance. Tests of General Linear Hypotheses (statements only). Classification of Linear Models. ***Unit 3: Regression analysis*** Hypothesis testing in case of simple and multiple regression models. Paper STSHGEC04T(CBCS): ***Unit 4: Demography*** Life (mortality) tables: definition of its main functions and uses. Measurement of fertility and reproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR. Paper VI: ANOVA (3rd Year, 1+1+1 System): Testing simple regression coefficients, and linearity of simple regression, correlation ratio.
Week 9 to Week 12	Paper STSACOR03P(CBCS): 3. Fitting of binomial distribution for given n and p. 4. Fitting of binomial distribution after computing mean and variance. 5. Fitting of Poisson distribution for given value of lambda. 6. Fitting of Poisson distribution after computing mean. 7. Fitting of negative binomial. 8. Fitting of suitable distribution. 9. Application problem based on binomial distribution 10. Application problem based on Poisson distribution. 11. Application problem based on negative binomial distribution.	Paper STSACOR03T(CBCS): Discrete random variables, p.m.f. and c.d.f., statement of properties of c.d.f: binomial, Poisson, geometric, negative binomial, hypergeometric, uniform. Paper STSACOR04T(CBCS) : Properties of characteristic roots, Cayley Hamilton theorem, Quadratic forms: Classification and canonical reduction. Paper STSACOR09T(CBCS): ***Unit 4: Analysis of variance and covariance*** Analysis of Variance in one-way and two-way classified data (with equal number of observations per cell) for fixed effect as well as random effect models.

	Paper STSACOR09P(CBCS): 7. Analysis of variance of two-way classified data with equal number of observations per cell. 8. Analysis of covariance of a one way classified data with one concomitant variable. Paper STSHGEC04P(CBCS): 5. Construction and interpretation of X bar & R-chart. 6. Construction and interpretation p-chart (fixed sample size) and c-chart	Paper STSHGEC04T(CBCS): ***Unit 3: Statistical Quality Control*** Statistical Quality Control: Importance of statistical methods in industrial research and practice. Determination of tolerance limits. Causes of variations in quality: chance and assignable. General theory of control charts, process & product control, Control charts for variables: X- bar and R-charts. Control charts for attributes: p and c-charts. Paper VI: ANOVA (3rd Year, 1+1+1 System): multiple correlation and partial correlation coefficients.
Week 13-14: Internal Exam (for CBCS) and Mid-Term Tests (for Part II & III in 1+1+1 system)		
Week 15 to 17	Paper STSACOR09P(CBCS): 9. Analysis of covariance of a two way classified data with one concomitant variable.	Paper STSACOR04T(CBCS) : Linear transformations. Applications of Linear Algebra in Statistics. Revision of all the topics. Paper STSACOR09T(CBCS) : ***Unit 4: Analysis of variance and covariance*** Analysis of covariance for one-way and two-way classified data with one concomitant variable

Class:B.Sc
Semester 2, 4 and 6 **Name of the Teacher: Suryasish Chatterjee**
Subject: Statistics
Paper : STSACOR04T, STSACOR08T,STSACOR08P, STSACOR14T, STSACOR14P, STSSSEC02M

S. No	Practical syllabus to be covered (Paper code to be mentioned)	Theory syllabus to be covered (Paper code to be mentioned)
Week 1 to week 4	**Paper STSACOR08P:** 1. Unbiased estimators (including unbiased but absurd estimators) 2. Cramer-Rao inequality and MVB estimators 3. Sufficient Estimators – Factorization Theorem, Rao-Blackwell theorem, Complete Sufficient estimators 4. Lehman-Scheffe theorem and UMVUE	**Paper STSACOR04T**: Sequence of real numbers and their convergence, limits of sequences, Cauchy's general principle of convergence, Cauchy's first theorem on limits, monotonic sequences, limit superior and limit inferior of a bounded sequence. Infinite series, positive-termed series and their convergence. Comparison tests, D'Alembert's ratio test and Cauchy's n_{th} root test, (Statements and examples only). Absolute convergence of series, Leibnitz's test for the convergence of alternating series, Conditional convergence.

	Paper STSSSECO2M: Learn how to 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.	**Paper STSACOR08T:** Concepts of estimation, unbiasedness, mean square error, sufficiency, completeness and exponential family of distributions. Factorization theorem. Minimum variance unbiased estimator (MVUE), Rao Blackwell and Lehmann-Scheffe theorems and their applications. Cramer-Rao inequality (statement and applications) and MVB estimators. Paper V: Statistical Inference II (3rd Year, 1+1+1 System): Point Estimation: Sufficiency, Completeness, Factorization Theorem, Exponential, Family of distributions, Properties of minimum variance unbiased estimators, consistent estimators and asymptotic efficiency, Cramer –Rao lower bound .Rao-Blackwell Theorem. Lehmann- Scheffe Theorem. Maximum Likelihood Minimum χ_2 estimators and their properties (excluding proofs of large sample properties).
Week 5 to week 8	**Paper STSACOR08P:** 5. Maximum Likelihood Estimation 6. Estimation by the method of moments, minimum Chi-square 7. Most powerful critical region (NP Lemma) 8. Uniformly most powerful critical region **Paper STSSSECO2M:** Generate automated reports giving detailed descriptive statistics, correlation and lines of regression. Practical exercises related to Paper V: Statistical Inference II (3rd Year, 1+1+1 System)	**Paper STSACOR04T**: Vector spaces, subspaces, sum of subspaces, Span. Linear dependence and independence, basis and dimension, dimension theorem. Orthogonal vectors, Gram-Schmidt orthogonalization, ortho complement space. Null space and nullity **Paper STSACOR08T:** Method of moments, method of maximum likelihood estimation, method of minimum Chi square, basic idea of Bayes estimators Paper V: Statistical Inference II (3rd Year, 1+1+1 System): Theory of Hypothesis Testing : Most Powerful(MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests, Randomized and nonrandomized Tests, Fundamental Neyman –Pearson Lemma (sufficiency part only), and its use in the construction of MP and UMP tests (single parameter with range independent of the parameter), Likelihood Ratio tests and its applications to tests for the equality of means and variances of several normal populations.
Week 9 to Week 12	**Paper STSACOR08P:** 9. Unbiased critical region. 10. Power curves. 11. Likelihood ratio tests for simple null hypothesis against simple	**Paper STSACOR04T**: A review, theorems related to triangular, symmetric and skew symmetric matrices, idempotent matrices, orthogonal matrices, singular and non-singular matrices and their properties. Trace of a

	alternative hypothesis. 12. Likelihood ratio tests for simple null hypothesis against composite alternative hypothesis **Paper STSSSECO2M:** Random number generation and sampling procedures. Fitting of polynomials and exponential curves. Application Problems based on fitting of suitable distribution, Normal probability plot. Practical exercises related to Paper V: Statistical Inference II (3rd Year, 1+1+1 System)	matrix. Row space and column space of a matrix. Definition, properties and applications of determinants for 3rd and higher orders, evaluation of determinants of order 3 and more using transformations. Symmetric and Skew symmetric determinants, Circulant determinants and Vandermonde determinants for nth order, Jacobi's Theorem. Product of determinants. Adjoint and inverse of a matrix and related properties. Use of determinants in solution to the system of linear equations **Paper STSACOR08T:** Most powerful test, uniformly most powerful test, Neyman Pearson Lemma (statement and applications to construct most powerful test). Likelihood ratio test, properties of likelihood ratio tests (without proof). <u>Paper V: Statistical Inference II (3rd Year, 1+1+1 System):</u> Interval Estimation :Confidence intervals Confidence sets, Concepts of Uniformly Most Accurate (UMA) and Uniformly Most Accurate Unbiased (UMAU) confidence sets, relationship with tests of hypotheses, confidence intervals with Shortest Expected Length
Week 13 to week 14		**Internal Exam & Class Tests**
Week 15 to 17	**Paper STSACOR08P:** 13. Asymptotic properties of LR tests 14. SPRT procedure 15. OC function and OC curve 16. ASN function and ASN curve **Paper STSSSECO2M:** Simple analysis and create and manage statistical analysis projects, import data, code editing. Basics of statistical inference in order to understand hypothesis testing and compute p-values and confidence intervals. Practical exercises related to Paper V: Statistical Inference II (3rd Year, 1+1+1 System)	**Paper STSACOR04T**: Statement of the fundamental theorem of algebra and its consequences. Relation between roots and coefficients of any polynomial equations. Solutions of cubic and biquadratic equations when some conditions on roots of equations are given. **Paper STSACOR08T:** Sequential probability ratio test (SPRT) for simple vs simple hypotheses. Fundamental relations among α, β, A and B, determination of A and B in practice. Wald's fundamental identity and the derivation of operating characteristics (OC) and average sample number (ASN) functions. Examples based on Normal, Poisson, Binomial and Exponential distributions <u>Paper V: Statistical Inference II (3rd Year, 1+1+1 System):</u> Nonparametric Methods : Sign test, Median test, Wilcoxon Signed-Rank test, Run test, Mann-Whitney U test.

Class:B.Sc
Semester 2, 4 and Part III **Name of the Teacher: Soumyadeep Das**
Subject: Statistics
Paper : STSACOR03T,STSACOR03P, STSACOR10T,STSACOR10P, STSSSEC02M, Part III Paper VI (Theory and Practical)

S. No	Practical syllabus to be covered (Paper code to be mentioned)	Theory syllabus to be covered (Paper code to be mentioned)
Week 1 to week 4	**Paper VI of Part III:** Practical problems on two-stage sampling. **Paper STSACOR03P**: 1. Numerical sums using classical definition of Probability. **Paper STSSSECO2M:** Learn how to 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.	**Paper VI of Part III:** two-stage (with equal-sized first stage units) sampling with selection probabilities at each stage. Associated unbiased estimators of population total, mean and proportion, their variances and unbiased variance estimators. Determination of sample size in simple random sampling. **Paper STSACOR03T**: Introduction, random experiments, sample space, events and algebra of events. Sigma algebra of events. Definitions of Probability – classical, statistical and axiomatic. **Paper STSACOR10T:** Definition, dimensions of quality, historical perspective of quality control and improvements starting from World War II, historical perspective of Quality Gurus and Quality Hall of Fame. Quality system and standards: Introduction to ISO quality standards, Quality registration. Statistical Process Control - Seven tools of SPC, chance and assignable Causes of quality variation. Statistical Control Charts- Construction and Statistical basis of 3-σ Control charts, Rational Sub-grouping.
Week 5 to week 8	**Paper V of Part III:** Practical problems on PPS sampling. **Paper STSACOR03P:** 2. Numerical sums on conditional probability. **Paper STSACOR10P:** 1. Construction and Interpretation of statistical control charts X-bar & R chart X-bar & s-chart np- chart p-chart c-chart u- chart **Paper STSSSECO2M:** Generate automated reports giving detailed descriptive statistics, correlation and lines of regression.	**Paper VI of Part III:** Probability Proportionate to Size Sampling with Replacement (PPSWR)—different methods of sample selection,Hansen Hurwitz Estimate of the Population total (without derivation), Allocation problem in stratified random sampling and optimum choice of sampling and sub-sampling fractions in two- stage sampling, Interpenetrating sub-sampling technique for unbiased variance estimation in systematic sampling. **Paper STSACOR03T**: Theorem of compound probability, theorem of total probability, Conditional probability and independence of event. Bayes theorem and its applications. **Paper STSACOR10T:**

		X-bar & R-chart, X-bar & s-chart. Control charts for attributes: np-chart, p-chart, c-chart and u-chart. Comparison between control charts for variables and control charts for attributes. Analysis of patterns on control chart. Estimation of process capability.
Week 9 to Week 12	**Paper VI of Part III:** Practical problems on Ratio and Regression methods of estimation. **Paper STSACOR03P:** 3. Fitting of binomial distribution for given n and p. 4. Fitting of binomial distribution after computing mean and variance. 5. Fitting of Poisson distribution for given value of lambda. 6. Fitting of Poisson distribution after computing mean. 7. Fitting of negative binomial. 8. Fitting of suitable distribution. 9. Application problem based on binomial distribution 10. Application problem based on Poisson distribution. 11. Application problem based on negative binomial distribution. **Paper STSACOR10P:** 2. Single sample inspection plan: Construction and interpretation of OC, AQL, LTPD, ASN, ATI, AOQ, AOQL curves. **Paper STSSSECO2M:** Random number generation and sampling procedures. Fitting of polynomials and exponential curves. Application Problems based on fitting of suitable distribution, Normal probability plot.	**Paper VI of Part III:** Ratio and Regression methods of estimation in simple random sampling. Double sampling for ratio and regression estimators. **Paper STSACOR03T**: Discrete random variables, p.m.f. and c.d.f., statement of properties of c.d.f, illustrations. Derivation of moments (discrete situation). Standard discrete probability distributions: binomial, Poisson, geometric, negative binomial, hypergeometric, uniform. p.d.f. and c.d.f., illustrations and properties, **Paper STSACOR10T:** Principle of acceptance sampling plans. Single and Double sampling plan their OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation, use and interpretation of Dodge and Romig's sampling inspection plan tables.
Week 13 to week 14		**Internal Exam**
Week 15 to 17	**Paper VI of Part III:** Practical problems on Warner's model, Practical problems on small area estimation. **Paper STSACOR10P:** **3.** Calculation of process capability and comparison of 3-sigma control limits with specification limits.	**Paper VI of Part III:** Randomised Response Techniques : Warner's Model. Small area estimation---concept of small areas, domains, direct and composite estimators. **Paper STSACOR03T**: univariate transformations with illustrations. Derivation of moments. Probability Inequalities: Markov and Chebyshev. **Paper STSACOR10T:** Overview of Six Sigma, Lean Manufacturing and Total Quality Management (TQM). Organizational Structure and Six Sigma training plans- Selection Criteria for Six-Sigma roles and training

	4. Use a case study to apply the concept of six sigma application in DMAIC: practical application. **Paper STSSSECO2M:** Simple analysis and create and manage statistical analysis projects import data, code editing. Basics of statistical inference in order to understand hypothesis testing and compute p-values and confidence intervals.	plans. Voice of customers (VOC): Importance and VOC data collection. Critical to Quality (CTQ). Introduction to DMAIC using one case study: Define Phase, Measure Phase, Analyse Phase, Improve Phase and Control Phase.