UNIVERSITY OF CALICUT

Abstract

General and Academic - Faculty of Science - Scheme and Syllabus of BSc Statistics Programme under CBCSS UG Regulations 2019 with effect from 2019 Admission onwards - Implemented- Orders Issued

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G & A - IV - J

U.O.No. 8618/2019/Admn	Dated, Calicut University.P.O, 02.07.2019

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*Read:-*1. U.O.No. 4368/2019/Admn dated 23.03.2019
2. Item No. 1 of the minutes of the meeting of the Board of Studies in Statistics UG held on 15.05.2019
3. Item No.I.24 of the minutes of the meeting of Faculty of Science held on 27.06.2019

ORDER

The Regulations for Choice Based Credit and Semester System for Under Graduate (UG) Curriculum-2019 (CBCSS UG Regulations 2019) for all UG Programmes under CBCSS-Regular and SDE/Private Registration w.e.f. 2019 admission has been implemented vide paper read first above .

The meeting of Board of Studies in Statistics UG held on 15/05/2019 has approved the Syllabus of B Sc Statistics Programme in tune with the new CBCSS UG Regulation with effect from 2019 Admission onwards, vide paper read second above.

The Faculty of Science at its meeting held on 27/06/2019 has approved the minutes of the meeting of the Board of Studies in Statistics UG held on 15/05/2019, vide paper read third above.

Under these circumstances , considering the urgency, the Vice Chancellor has accorded sanction to implement the Scheme and Syllabus of B Sc Statistics Programme in accordance with new CBCSS UG Regulations 2019, in the University with effect from 2019 Admission onwards, subject to ratification by the Academic Council.

Sanction is therefore accorded for implementing the Scheme and Syllabus of B Sc Statistics Programme in accordance with CBCSS UG Regulations 2019, in the University with effect from 2019 Admission onwards.

Orders are issued accordingly. (Syllabus appended)

Biju George K

Assistant Registrar

To
  1.The Principals of all Affiliated Colleges 2. Director, SDE
  Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE IV/JCE VIII/EX IV and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT
SYLLABUS OF B. Sc STATISTICS
CBCSSUG 2019 (2019 admission onwards)

Seme ster	Paper Code	Paper title	Instructional Hours per Week	Credit	Duration of Exam
I	STA1B01	OFFICIAL STATISTICS AND PROBABILITY	4	4	2.5
II	STA2B02	BIVARIATE RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS	4	4	2.5
III	STA3B03	STATISTICAL ESTIMATION	5	4	2.5
IV	STA4B04	TESTING OF HYPOTHESIS	5	4	2.5
V	STA5B05	MATHEMATICAL METHODS IN STATISTICS	5	4	2.5
	STA5B06	SAMPLE SURVEYS	5	5	2.5
	STA5B07	LINEAR REGRESSION ANALYSIS	5	4	2.5
	STA5B08	STATISTICAL COMPUTING	5	5	2.5
	STA5D 01 STA5D 02 STA5D 03	ECONOMIC STATISTICS QUALITY CONTROL BASIC STATISTICS	3	3	2
		PROJECT WORK	2	--	--
VI	STA6B09	TIME SERIES AND INDEX NUMBERS	5	4	2.5
	STA6B10	DESIGN OF EXPERIMENTS	5	5	2.5
	STA6B11	POPULATION STUDIES, ACTUARIAL SCIENCE AND VITAL STATISTICS	5	4	2.5
	STA6B12	OPERATIONS RESEARCH AND STATISTICAL QUALITY CONTROL	5	4	2.5
	STA6B13	PROJECT WORK	2	2	--

	STA6B14(E)	PROBABILITY MODELS AND RISK THEORY			
	STA6B15(E)	STOCHASTIC PROCESSES	3	2	2
	STA6B16(E)	RELIABILITY THEORY			

Pattern of Question Papers

Question paper type 1 (for 80 marks)

Scheme of Examinations:
The external QP with 80 marks and Internal examination is of 20 marks. Duration of each external examination is 2.5 Hrs. The pattern of External Examination is as given below. The students can answer all the questions in Sections A & B. But there shall be Ceiling in each section.
Section A
Short answer type carries 2 marks each - 15 questions   Ceiling - 25
Section B
Paragraph/ Problem type carries 5 marks each - 8 questions   Ceiling - 35
Section C
Essay type carries 10 marks (2 out of 4)   2×10=20

Question paper type 1 (for 60 marks)

Scheme of Examinations:
The external QP with 80 marks and internal examination is of 15 marks. Duration of each external examination is 2 Hrs. The pattern of External Examination is as given below. The students can answer all the questions in Sections A & B. But there shall be Ceiling in each section.
Section A
Short answer type carries 2 marks each - 12 questions   Ceiling - 20
Section B
Paragraph/ Problem type carries 5 marks each - 7 questions   Ceiling - 30
Section C
Essay type carries 10 marks (1 out of 2)   1×10 =10

Questions in each part should be equally distributed among the various modules of the syllabus

STA1B01: OFFICIAL STATISTICS AND PROBABILITY

Objective:

1. To summarize the data in a diagrammatic and graphical way, obtain descriptive statistics and make possible & appropriate interpretations
2. To understand various approaches to probability & compute probabilities.

Module 1: Statistical organizations in India-MOSPI; CSO, NSSO, DES; Roles functions and activities of CSO, NSSO and DES; Measures of central tendency – Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode, Percentiles, Quartiles; Measures of dispersion- Variance, Standard deviation, Mean deviation, Quartile deviation, Coefficient of variation; moments, skewness, Kurtosis. 20 hours

Module 2: Fitting of straight line, parabola, exponential, polynomial, (least square method), correlation-Karl Pearson's Correlation coefficient, Rank Correlation-Spearman's rank correlation co-efficient, Partial Correlation, Multiple Correlation, Scatter diagram, regression, two regression lines, regression coefficients. 17 hours.

Module 3: Experiment, Non- random and Random experiments, Sample space, event, classical definition of probability, statistical regularity, field, sigma field, axiomatic definition of probability and simple properties, addition theorem (two and three events), conditional probability of two events, multiplication theorem, independence of events-pair wise and mutual, Bayes theorem. 25 hours

Module 4: Random variable-discrete and continuous, probability mass function (pmf) and probability density function (pdf)-properties and examples, Cumulative Distribution function and its properties, change of variable (univariate case). 10 hours

References
1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi
5. Statistical system in India (CSO), 1995.

STA2B02: BIVARIATE RANDOM VARIABLE AND PROBABILITY DISTRIBUTIONS

Objective:
1. To derive various descriptive statistics; verify the existence of reproductive property of distributions using generating functions-their limitations and advantages.
2. To understand the applications of theoretical discrete distributions

Module 1: Mathematical expectations-definition, raw and central moments (definition and relationships), moment generating function and properties, characteristic function (definition and basic properties). 20 hours

Module 2: Bivariate random variable, joint pmf and joint pdf, marginal and conditional probability, independence of random variables, 15 hours

Module 3: Skewness and kurtosis using moments, bivariate case-conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation. 12 hours

Module 4: Degenerate distribution, Standard discrete distributions-Bernoulli, Binomial, Poisson, Geometric, negative binomial, Hyper geometric (definition, properties and applications), Uniform. Limit Theorems: Chebyshev's inequality, Convergence in probability, Convergence in distribution (definition and example only), weak law of large numbers (iid case), Bernoulli's law of large numbers.   25 hours

References
1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. kapoor Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

STA3B03: STATISTICAL ESTIMATION

Objectives:
1. To understand the applications of theoretical discrete distributions
2. To equip the students with the theory essential for estimation of unknown parameters.
3. Understand various sampling distributions and the related concepts, criteria of good estimators and interval estimation

Module 1: Continuous type-Uniform, exponential, gamma, Beta, Normal (definition, properties and applications), Lognormal, Pareto and Cauchy (Definition only). Central limit theorem (Llindberg- Levy-iid case). 20 hours

Module 2: Sampling distributions: Parameter, Statistic, standard error, Sampling from normal distribution: distribution of sample mean, sample variance, chi-square, students t distribution, and F distribution (definition, derivation, property and relationships). 15 hours

Module 3: Estimation of Parameter: Point Estimation. Desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher - Neyman factorization theorem (Statement and application only), efficiency, Cramer - Rao inequality; Methods of Estimation - method of maximum likelihood, method of moments, Bayesian estimation method. 40 hours.

Module 4; Interval Estimation: Large sample confidence interval for mean, equality of means, equality of proportions. Derivation of exact confidence intervals for means , variance and ratio of variances based on Normal, t, chi square distribution and F distribution; 15 hours

References
1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor. Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

STA4B04: TESTING OF HYPOTHESIS

Objectives:
1. To introduce the concepts of hypothesis testing
2. Identify a suitable test of significance to test a given hypothesis -large sample test/small sample test for testing different parameters

Module 1: Testing of Hypotheses; concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses, type I and type II errors, critical region, level of significance, power of test. Most powerful tests Uniformly most powerful test, Neyman Pearson Lemma (statement only). Sequential sampling and SPRT (Basic concepts only). 20 hours

Module 2: Large sample tests concerning mean, equality of means, proportions, equality of proportions. Small sample tests based on t distribution for mean, equality of means and paired t test, one-way ANOVA. (Include real life applications and practical problems): 30 hours

Module 3: Tests based on F distribution. Tests based on chi square distribution – Test for the significance of population variance, goodness of fit and for independence of attributes. Test for correlation coefficients. (Include real life applications and practical problems). 20 hours.

Module 4: Non parametric tests - advantages, disadvantages; Kolmogorov - Smirnov test; one sample and two sample sign tests; Wilcoxon signed rank test; Median test; Mann Whitney test; Kruskal Wallis test and test for randomness (run test). (Include real life applications and practical problems). 20 hours

References
1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

STA5B05: MATHEMATICAL METHODS IN STATISTICS

Objectives:

1. To get a good exposure to the basic concepts of Mathematics.
2. To introduce the mathematical concepts required to learn theoretical statistics.

Module 1: Real Number system: Mathematical induction, order properties of real number, Bernoulli, Cauchy, triangle inequality, absolute value, Completeness property-suprema & infima, Archimedean property, Density theorem, nested interval property. 20 hours

Module 2: Sequences: Limit, limit theorems, Squeeze theorem, convergence of sequence, root test and ratio test, monotone convergence theorem, subsequence and Bolzano-Weierstrass theorem, Cauchy criterion, limits of functions, limit theorems of functions. Infinite series and its convergence, Ratio test and Root test. 25 hours

Module 3: Continuous functions: Definition, Boundedness theorem, Maximum minimum theorem, Location of roots theorem, Intermediate value theorem, uniform continuity, Differentiation, Interior extremum theorem, Rolle's theorem, Mean value theorem, Taylor's theorem. 25 hours

Module 4: Riemann Integration: Definition, Integrability criteria, integrability of continuous and monotone functions, properties of integrals, first and second fundamental theorems on integral calculus. 20 hours

References
1. Malik S.C. and Savitha Arora, Real Analysis, New Age International
2. Robert G Bartle, Real Analysis, Wiley
3. Shanti Narayanan, Elements of Real Analysis

STA5B06: SAMPLE SURVEYS

Objectives:
1. To equip students with Sampling Techniques used in conducting sample surveys.
2. To compare the efficiency of various estimation strategies resulting from different sampling techniques.

Module 1: Census and Sampling, principal steps in sample survey-probability sampling, judgment sampling, organization and execution of large sample surveys, sampling and non-sampling errors, preparation of questionnaire
20 hours

Module 2: Simple random sampling with and without replacement- methods of collecting simple random samples, unbiased estimate of the population mean and population total-their variances and estimate of these variances-simple random sampling for proportions :20 hours

Module 3: Stratified random sampling: estimation of population mean and total, proportional and Neymann allocation of sample sizes-cost function-optimum allocation considering cost-comparison with simple random sampling. Systematic Sampling: Linear and circular systematic sampling, comparison with simple random sampling. 30 hours

Module 4: Cluster sampling: Clusters with equal sizes-estimation of the population mean and total, comparison with simple random sampling, two stage cluster sampling-estimate of variance of population mean. 20 hours

References
1. Murthy M N, Sampling theory and methods, Statistical Publishing society, Calcutta
2. Daroja Singh and F S Chaudhary, Theory and Analysis of Sample Survey Designs, Wiely Estrn Limitted
3. Cochran W.G, Sampling Techniques, Wiely Estern

STA5B07: LINEAR REGRESSION ANALYSIS

Objectives:
1. To identify an appropriate relationship between two variables using scatter plot and fitting the same by the method of least squares- straight line, second degree polynomial, power & exponential curves

2. Describe the concepts of correlation & regression and perform regression analysis for the given data

Module 1: Regression and Model building: Scatter diagram, regressor, response, error, uses of regression. Simple linear regression: Simple liner regression model, assumptions, Least square estimation of parameters, Properties of the Least-square estimators and the fitted Regression Model. Estimation of σ^2, Hypothesis testing of slope and intercept. Interval estimation of regression parameters (Slope, intercept and σ^2). Coefficient of determination. Estimation of regression parameters by the method of Maximum likelihood. 25

Module 2: Multiple Linear Regression: Multiple linear regression model, assumptions, least square estimation of parameters, Properties of the Least-square estimators Hypothesis testing in Multiple linear regression (ANOVA), Test on individual regression coefficients, Interval estimation of coefficients, slope and intercept, co-efficient of determination. 20 hours

Module 3: Model adequacy checking: Residual analysis, Methods of scaling residuals – standardized residuals, studentized residuals, PRESS residuals, R- Student. Residual plots – Normal probability plots, plot of residuals against fitted values, plot of residuals against the regressor, plot of residuals in time sequence. PRESS Statistic, R^2 for prediction based on PRESS.   25 hours

Module 4: Polynomial and logistic regression: Polynomial models in one variable and two variables, Piece wise polynomial fitting (Basic concept only). Logistic regression- model with binary response variable, Estimation and Interpretation of the Parameters in logistic regression model. 20hours

Book for Study
1. D C. Montegomerry, E A Peak and G G Vining, Introduction to Linear regression analysis, Wiley 2003.

References
1. Seber, Linear Regression Analysis, Wiley 1977.
2. D. D Joshi, Linear Estimation and Design of Experiments, Wiley 1987.
3. D N Gujarathi, D C Porter and G Sangeetha, Basic Econometrics, Mc Graw Hill, 2003

STA5B08: STATISTICAL COMPUTING

Objectives: Statistical computing is a practical course. Its objectives are to develop scientific and experimental skills of the students and to correlate the theoretical principles with application based studies.

An introductory section is included in the course to familiarise the students with the basics of R package.
Introduction to R: R as a calculator, statistical software and a programming language, R preliminaries, getting help, data inputting methods(direct and importing from other spread sheet applications like Excel), data accessing, and indexing, Graphics in R, built in functions, saving, storing and retrieving work. Looping and Decision making – *for* loop, *while* loop, *if* command, *if else* command.
The practical is based on the following modules:

  Module 1.   Diagrammatic representation of univariate and bivariate data - box plots, stem and leaf diagrams, bar plots, pie diagram, scatter plots.
  Module 2.   Descriptive statistics - measures of central tendency (mean, median and mode), partition values, measures of dispersion (range, standard deviation, mean deviation and inter quartile range), summaries of a numerical data, skewness and kurtosis, random sampling with and without replacement.
  Module 3.   Probability Distributions: Random number generation.
  Module 4.   Statistical Inference: One- and two-sample tests, z test, t-test, F-test, chi-square test of independence and goodness of fit, interval estimation for mean, difference of mean and variance, tests for normality (Shapiro-Wilks test, Wilcoxon's test and q-q plot), ANOVA (one- way)
  Module 5.   Correlation and regression analysis (bivariate and multivariate data), polynomial regression, logistic regression.

Practical is to be done using R package. At least five statistical data oriented/supported problems should be done from each course. Practical record shall be maintained by each student and the same shall be submitted for verification at the time of external examination.

The Board of examiners (BoE) shall decide the pattern of question paper and the duration of the external examination. The external examination at each centre shall be conducted and evaluated on the same day jointly by two examiners – one external and one internal, appointed at the centre of the examination by the college on the recommendation of the Chairman, BoE. The question paper for the external examination at the centre will be set by the external examiner in consultation with the Chairman, BoE and HoD of the centre. The questions are to be evenly distributed over the entire syllabus. Evaluation shall be done by assessing each candidate on the scientific and experimental skills, the efficiency of the algorithm/program implemented, the presentation and interpretation of the results.

References:
1. Michale J. Crawley, THE R BOOK, John Wiley & Sons, England (2009)
2. Sudha G. Purohit et.al., Statistics Using R, Narosa Publishing House, , India(2008)
3. John Verzani, simple R-Using R for Introductory Statistics, (http:// www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple.)
4. W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R , Notes on R: A Programming Environment for Data Analysis and Graphics, Version 2.15.2 (2012-10-26) (http://www.r-project.org)

STA6B09: TIME SERIES AND INDEX NUMBERS

Objectives:
1. To expose statistics students to the areas of time series and index numbers.
2. To bring out its significant role in various areas of study

Module 1: Time series analysis: Economic time series, different components, illustrations, additive and multiplicative models, determination of trends, growth curves, analysis of seasonal fluctuations, construction of seasonal indices. 25 hours

Module 2: Analysis of Income and allied distributions-Pareto distribution, graphical test, fitting of Pareto's law, illustrations, lognormal distribution and properties, Lorenz curve, Gini's coefficient . 20 hours

Module 3: Index numbers: Meaning and definition-uses and types-problems in the construction of index numbers-simple aggregate and weighted aggregate index numbers. Test for consistency of index numbers-factor reversal, time reversal and unit test, Chain base index numbers-Base shifting-splicing and deflating of index numbers. Consumer price index numbers-family budget enquiry-limitations of index numbers. 30 hours

Module 4: Attitude Measurements and Scales: issues in attitude measurements scaling of attitude-Guttman scale, Semantic differential scale, Likert scale; selection of appropriate scale-limitations of scales 15 hours

Books for references
1. SC Gupta and V K Kapoor, Fundamentals of applied statistics, Sulthan chand and sons
2. Goon A M, Gupta M K and Das Gupta, Fundamentals of Statistics Vol II, The World press, Calcutta
3. Box G E P and Jenkins G M, Time series analysis, Holden Day
4. Meister David, Behavioral Analysis and Measurement methods, John Wiley New York
5. Luck et al. Marketing Research, Prentice Hall of India, New Delhi

STA6B10. DESIGN OF EXPERIMENTS

Objectives:
1. To provide basic principles of experimentation
2. To discuss the analysis of data relating to agriculture, biological sciences and industry.

Module 1: Linear estimation, estimability of parametric functions and BLUE Gauss- Markov theorem-Linear Hypothesis 15 hours

Module 2: Analysis of variance, one way and two way classification (with single observation per cell), Post Hoc Tests - Least Significant Difference (LSD) test, Duncan's multiple range test. Analysis of covariance with a single observation per cell (Concept and model only). 15 hours

Module 3: Principles of design-randomization-replication-local control, completely randomized design; Randomized block design; Latin square design. Missing plot technique; comparison of efficiency; Greco-Latin square design (Concept only). 35 hours

Module 4: Basic concepts of factorial experiments, 2^2 and 2^3 factorial experiments, Basic concepts of Incomplete block design, Balanced incomplete block design and Partially Balanced incomplete block design. 25 hours

Books for references
1. S.C. Gupta and V K Kapoor, Fundamentals of applied Statistics, Sulthan Chand and Sons
2. M N Das and N Giri, Design of Experiments, New Age international,
4. D.D Joshy, linear Estimation and Design of Experiments, Wiley Eastern
5. Montgomery, D C, Design and Analysis of Experiments, John Wiley

STA6B11: POPULATION STUDIES, ACTUARIAL SCIENCE AND VITAL STATISTICS

Objectives:
1. To impart basic concepts in population studies, actuarial science and vital statistics
2. To prepare students to take up a career in Actuarial Practice

Module 1: Sources of vital statistics in India-functions of vital statistics, Rates and ratios-mortality rates-crude, age specific and standard death rates-fertility and reproduction rates-crude birth rates-general and specific fertility rates-gross and net reproduction rates. 30 hours

Module 2: Life Tables-complete life tables and its characteristics-Abridged life tables and its characteristics, principle methods of construction of abridged life tables-Reed Merrel's method 30 hours

Module 3: Fundamentals of insurance: Insurance defined meaning of loss, peril, hazard and proximate cause in insurance, Costs and benefits of insurance to society-branches of insurance. Insurable loss exposures-feature of loss that is deal of insurance, Construction of Mortality table-computation of premium of life insurance for fixed duration and for the whole life. 30 hours

Books for reference
1. S.C. Gupta and V K Kapoor, Fundamentals of applied Statistics, Sulthan Chand and Sons
2. Benjamin B, Health and Vital Statistics, Allen and Unwin
3. Mark S Dorfman, Introduction to Risk Management and Insurance, Prentice Hall
4. C.D.Daykin, T. Pentikainen et al, Practical Risk Theory of Acturies, Chapman and Hill

STA6B12: OPERATIONS RESEARCH AND STATISTICAL QUALITY CONTROL

Objectives:

1. To impart an insight of the applications of Operations Research in Management
2. To provide an insight into quality assessment techniques.

Module 1: Linear programming: Mathematical formulation of LPP, Graphical and Simplex methods of solving LPP-duality in linear programming 20 hours

Module 2: Transportation and assignment problems, North-west corner rules, row column and least cost method-Vogel's approximation method, Assignment problem, Hungarian algorithm of solution 20 hours

Module 3: General theory of control charts, causes of variations in quality, control limits, sub-grouping, summary of out-of-control criteria, charts of attributes, np chart, p chart, c chart, Charts of variables: X bar chart, R Chart and sigma chart, Revised control charts, applications and advantages 25 hours

Module 4: Principles of acceptance sampling-problems and lot acceptance, stipulation of good and bad lots-producer' and consumer' risk, simple and double sampling plans, their OC functions, concepts of AQL, LTPD,AOQL, Average amount of inspection and ASN function. 25 hours

References
1. Gupta and Manmohan, Linear programming, Sulthan Chand and sons
2. Hardley G, Linear programming, Addison-Wesley
3. Taha, Operations Research, Macmillan,
4. V.K.Kapoor, Operations Research, Sultan Chand and Sons
5. S.C.Gupta and V.K.Kapoor Fundamentals of Applied Statistics, Sultan Chand and Sons

STA6B13: PROJECT WORK

Objectives:
1. The project work will helps the students to enhance their Research attitude.

2. It also helps in applying the theory of research in real life situations. Students get an exposure to study the working atmosphere of an enterprise or they can undertake research on any socially relevant area based on their various courses.

The following guidelines may be followed for project work.
1. The project is offered in the fifth and sixth semester of the degree course and the duration of the project may spread over the complete year.
2. A project may be undertaken by a group of students, the maximum number in a group shall not exceed 5. However the project report shall be submitted by each student.
3. There shall be a teacher from the department to supervise the project and the synopsis of the project should be approved by that teacher. The head of the department shall arrange teachers for supervision of the project work.
4. As far as possible, topics for the project may be selected from the applied branches of statistics, so that there is enough scope for applying and demonstrating statistical skills learnt in the degree course.
5. Field/Industrial/Organization visit is mandatory for the data collection.

ELECTIVE COURSES

1. STA6B14 (E): PROBABILITY MODELS AND RISK THEORY

Module 1: Individual risk model for a short time: Model for individual claim random variables-sums of independent random variables-Approximation for the distribution of sum-Application to insurance 10 hours
Module 2: Collective risk models for a single period: The distribution of aggregate claims-selection of basic distributions-properties of compound Poisson distribution-approximation to the distributions of aggregate claims
15 hours
Module 3: Collective risk models over an extended period: Claims process-The adjustment coefficients-Discrete time model-the first surplus below the initial level-The maximal aggregate loss 15 hours
Module 4: Application of risk theory: Claim amount distributions approximating the individual model-stop-loss re-insurance-the effect of reinsurance on the probability of ruin 14 hours

Books for reference
1. Institute of Actuaries, Act Ed. Study Materials
2. McCutcheon, JJ, Scott William (1986): An introduction to Mathematics of Finance
3. Butcher M V, Nesbit, Cecil (1971) Mathematics of Compound Interest, Ulrich's book
4. Neil, Alistair, Heinemann (1977) Life contingencies
5. Bowers, Newton Let et al (1997) Actuarial mathematics, society of Actuaries, 2nd

2. STA6B15 (E): STOCHASTIC PROCESSES

Module 1: Conditional Probability, compound probability, Baye's theorem. Probability generating functions. 6 hours

Module 2: Definition of stochastic process, Four classifications of Stochastic Processes, Markov Property, Markov process, Markov Chain, Graphical representations. Initial distributions (problems), Transition probabilities, Chapmann and Kolmogrov equations, Transition probability matrices (examples and computation). Higher order transition probabilities (P^n) 30 hours

Module 3: Accessibility and communication of states. First passage probabilities, classification of states (recurrent, transient), mean recurrence. Periodicity, Ergodic theorem (Statement only), irreducible, class property. Stationary distribution. Limiting distribution (Definition and problems only). 18 hours

Books for reference

1. Medhi, J(1996). Stochastic Processes, Wiley Eastern Limited.
2. Karlin, S and Taylor, H.M.(1978). An Introduction to Stochastic Modeling (3rd edition), Academic Press
3. Karlin, S and Taylor, H.M.(1978). A first course in Stochastic Processes. Academic Press, New York.
4. Ross, S.M.(1983). Stochastic Processes, John Wiley and Sons.

3. STA6B16(E): RELIABILITY THEORY

Module 1: Structural properties of coherent Systems: System of components series and parallel structure with example-dual structure function-coherent structure-preservation of coherent system in terms of paths and cuts representation of bridge structure-times to failure-relative importance of components-modules of coherent systems. 20 hours

Module 2: Reliability of Coherent systems: Reliability of a system of independent components-some basic properties of system reliability-computing exact system reliability-inclusion exclusion method-reliability importance of components 20 hours

Module 3: Parametric distributions in reliability: A notion of ageing (IFR and DFR only) with examples-exponential distribution-Poisson distribution.
14 hours

Books for references
1. R E Barlow and F Proschan (1975) Statistical Theory of Reliability and life testing, Holt Rinhert, Winston
2. N Ravi Chandran, Reliability Theory, Wiley Eastern

OPEN COURSES

1. STA5D 01: ECONOMIC STATISTICS

Module 1: Time series analysis: Economic time series, different components, illustrations, additive and multiplicative models, determination of trends, growth curves, analysis of seasonal fluctuations, construction of seasonal indices 24 hours

Module 2: Index numbers: Meaning and definition-uses and types-problems in the construction of index numbers-simple aggregate and weighted aggregate index numbers. Test for consistency of index numbers-factor reversal , time reversal and unit test, Chain base index numbers-Base shifting-splicing and deflating of index numbers. Consumer price index numbers-family budget enquiry-limitations of index numbers. 30 hours

Books for references
1. S C Gupta and V K Kapoor, Fundamentals of Applied Statistics, Sulthan Chands and sons
2. Goon A M, Gupta M K and Das Gupta, Fundamentals of Statistics Vol II, The World Press, Calcutta

2. STA5D 02: QUALITY CONTROL

Module 1: General theory of control charts, causes of variations in quality, control limits, sub-grouping, summary of out-of-control criteria, charts of ttributes, np chart, p chart, c chart, Charts of variables: X bar chart, R Chart and sigma chart, Revised control charts, applications and advantages 30 hours

Module 2: Principles of acceptance sampling-problems of lot acceptance, stipulation of good and bad lots-producer' and consumer' risk, simple and double sampling plans, their OC functions, concepts of AQL, LTPD,AOQL, Average amount of inspection and ASN function 24 hours

References
1. Grant E L, Statistical quality control, McGraw Hill
2. Duncan A J, Quality Control and Industrial Statistics, Taraporewala and sons
3. Montegomery D C, Introduction to Statistical Quality Control, John Wiley and son

3. STA5D 03: BASIC STATISTICS

Module 1: Elements of Sample Survey: Census and Sampling, advantages, principal step in sample survey-sampling and non-sampling errors. Probability sampling, judgment sampling and simple random sampling. 10 hours

Module 2: Measures of Central tendency: Mean, median and mode and their empirical relationships ; Measures of Dispersion: absolute and relative measures, standard deviation and coefficient of variation. 12 hours

Module 3: Fundamental characteristics of bivariate data: univariate and bivariate data, scatter diagram, Pearson's correlation coefficient, limit of correlation coefficient. Curve fitting, principle of least squares, fitting of straight line. 15 hours

Module 4: Basic probability: Random experiment, sample space, event, algebra of events, Statistical regularity, frequency definition, classical definition and axiomatic definition of probability-addition theorem, conditional probability, multiplication theorem and independence of events (limited to three events). 17 hours

References
1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
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MODEL QUESTION PAPERS

STA1B01: OFFICIAL STATISTICS AND PROBABILITY

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. List out the important activities of Central Statistics Organization.
2. What are the main roles of state level statistical organizations?
3. The mean salary of 80 male employees in a firm is Rs. 5200 and that of 20 females in the same firm is Rs. 4200. What is the mean salary of all the employees in that firm?
4. Obtain the median for the following frequency distribution

X	1	2	3	4	5	6
Frequency	8	10	11	16	20	25

5. Compare range and quartile deviation.
6. The mean, median and standard deviation of a moderately asymmetrical distribution are 25, 23 and 4.5 respectively. Calculate Pearson's coefficient of skewness.
7. Write down the normal equation for fitting an exponential curve $y = ab^x$
8. Describe negative and positive correlation. Give example.
9. Define random experiment. Write an example.
10. State addition theorem of probability for three events.
11. Define independence of events.
12. Write the axiomatic definition of probability.
13. Distinguish between discrete and continuous random variables.
14. Define distribution function. Write any two properties of distribution function.
15. Let f(x) = 2x+3, 0 < x < 1; 0 otherwise. Verify whether f(x) is a probability density function or not.

Maximum Mark = 25

PART B
Each question carries 5 marks

16. For a group of 150 candidates, the mean and standard deviation of scores were found to be 38 and 16 respectively. Latter on it was found that the scores 45 ad 53 were misread as 54 and 35 respectively. Find the standard deviation of corrected figures.
17. Explain skewness and kurtosis.
18. Explain the least square method of fitting a parabola.
19. Consider the following set of rankings for a sample of 10 elements. Compute Spearman's rank correlation coefficient for the data.

Element	1	2	3	4	5	6	7	8	9	10
x	10	6	7	3	4	2	8	5	1	9
y	8	4	10	2	5	7	6	3	1	9

20. State and prove Baye's theorem.

21. A problem in Statistics is given to 3 students A,B and C whose chances of solving it are ½, ¾ and ¼ respectively. What is the probability that the problem will be solved?

22. Let f(x) = 1, 0<x<1; 0 otherwise. Find the distribution of Y= -2log X

23. For a discrete r.v. X with probability distribution

x	-2	-1	0	1	2
P(X=x)	0.1	0.2	0.3	k	0.2

find the value of (i) k   (ii) p(-1 $\leq X \leq 1$ ¿

Maximum Mark = 35

PART C

Each question carries 10 marks (Answer any **TWO** Questions)

24. Police records show the following numbers of daily crime reports for a sample of days during the winter months and a sample of days during the summer months. Compare the variability of the two periods.

Winter	18	20	15	16	21	20	12	16	19	20
Summer	28	18	24	32	18	29	23	38	28	18

25. A box contains 3 blue and 2 red balls while another box contains 2 blue and 5 red balls. A ball drawn at random from one of the boxes turns out to be blue. What is the probability that it came from the first box

26. A committee of 4 people is appointed from 3 officers of the production department, 4 officers   of the purchase department, 2 officers of the sales department and 1 charted accountant. Find the probability of forming the committee in the following manner.

 (1) There must be one from each category

 (2) It should have at least one from the purchase department

 (3) The charted accountant must be in the committee.

27. For n events $A_1, A_2, \ldots, A_n$ show that

(1)
$$P(\dot{c}n\,A_i) \geq \sum_{i=1}^{n} P(A_i) - (n-1)$$
$$\dot{c}\,i=1$$

(2)
$$\dot{c}\,i=1$$
$$\dot{c}$$
$$A_i$$
$$n\dot{c}$$
$$P\dot{c}$$

2 × 10 = 20

STA2B02: BIVARIATE RANDOM VARIABLE AND PROBABILITY DISTRIBUTIONS

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks

1. Define expectation of a random variable. Write any two properties of expectation.
2. Show that $V(aX + b) = a^2V(X)$.
3. Let X_1 and X_2 be two independent random variables. Prove that $M_{X_1+X_2}(t) = M_{X_1}(t) M_{X_2}(t)$.
4. Define characteristic function and write any two properties.
5. Define distribution function of a bivariate random variable and write any two properties.
6. When do you say that two random variables are independent?
7. State and prove the multiplication theorem of expectation
8. Define conditional expectation and conditional variance of a bivariate random variable.
9. For a discrete bivariate random variable (X, Y), prove that $E\{E(X|Y)\} = E(X)$
10. If X and Y are two independent random variables then show that $Cov(X, Y) = 0$.
11. Write the moment coefficients of skewness and kurtosis.
12. Describe degenerate probability distribution.
13. Define Binomial random variable.
14. Derive the mean of a Poisson random variable.
15. Define convergence in probability.

Maximum Mark = 25

PART B
Each question carries 5 marks

16. Let X be a random variable with the following probability distribution

x	-3	6	9
P(X = x)	1/6	1/2	1/3

Compute (i) $V(X)$ and (ii) $E(2X+1)^2$

17. A random variable X has the density function $f(x) = 1/2\sqrt{x}$; $0 < x < 1$ Obtain the m.g.f. of X and hence fid its mean and variance.
18. The joint pdf of a bivariate random variable ifs $f(x\,y) = 2$; $0 < x < 1$; $0 < y < x$. Check for independence f X ad Y
19. If X and Y have joint pdf $f(x, y) = x + y, 0 < x, y < 1$. Find P $\left(0 < X < \frac{1}{2}, \frac{1}{2} < Y < 1\right)$
20. Sow that $V(X) = E[V(X|Y)] + V[E(X|Y)]$
21. Let X and Y are two independent and identically distributed geometric random variables. Then show that the conditional distribution of $X|X+Y = n$ is uniform
22. Establish the memory less property of geometric distribution.
23. State and prove Chebychev's inequality for continuous random variables.

Maximum Mark = 35

PART C

Each question carries 10 marks (Answer any **TWO** Questions)

24. (i) State and prove the addition theorem of expectation (ii) Derive the relationship between raw moments and central moments

25. If (X, Y) is a bivariate discrete random variable with joint probability mass function

X Y	1	2	3
1	$\dfrac{2}{21}$	$\dfrac{3}{21}$	$\dfrac{4}{21}$
2	$\dfrac{3}{21}$	$\dfrac{4}{21}$	$\dfrac{5}{21}$

(i) Find the marginal distributions of X and Y (ii) Compute P(X|Y=1) and (ii) Compute P(Y|X=2)

26. If X and Y are two r.v.s having the joint pdf $f(x\ y) = 2 - x - y$; $0 < x, y < 1$. Find ρ_{xy}.

27. Show that Poisson distribution is a limiting case of Binomial distribution under certain conditions.

$$2 \times 10 = 20$$

STA3B03: STATISTICAL ESTIMATION

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. If X is a random variable with a continuous distribution function F. Then show that F ~ Uniform[0, 1]

2. Write the relationship between normal and log normal distributions.

3. Define Pareto distribution.

4. Derive the moment generating function of Gamma distribution.

5. State Lindberg-Levy central limit theorem.

6. Distinguish between parameter and statistic.

7. State the additive property of Chi square distribution.

8. Establish the relationship between t and F distributions.

9. Define Cramer-Rao inequality

10. State Neyman –Pearson Factorisation theorem

11. Define unbiasedness and efficiency of an estimator.

12. What is the significance of Bayesian estimation method?

13. Describe interval estimation.

14. Define confidence interval and confidence coefficient.

15. Write the confidence for the mean of normal distribution when population standard deviation is unknown.

Maximum Mark = 25

PART B
Each question carries 5 marks

16. State and prove memory less property of exponential distribution.

17. If X follows Beta distribution of second kind then $(1 + X)^{-1}$ follows Beta distribution of first kind with same parameter.

18. If two independent random samples of sizes 15 and 20 are taken from $N(\mu, \sigma)$. What is the probability of $(S_1^2 / S_2^2) < 2$.

19. Derive the moment generating function of X^2 distribution

20. Prove that in a Normal distribution sample mean is a consistent estimator of population mean.

21. Find the maximum likelihood estimator of λ for the Poisson distribution.

22. Establish confidence interval for the difference of proportions of two binomial populations

23. Derive exact confidence interval for the difference of population means based on t distribution.

Maximum Mark = 35

PART C

Each question carries 10 marks (Answer any **TWO** Questions)

24. X is a normal variate with mean 42 and standard deviation 4. Find the probability that a value taken by X is (i) less than 50, (ii) greater than 50, (iii) greater than 40, (iv) in between 40 and 50 and (v) equal to 45.

25. Derive Student's t distribution and state some of its applications.

26. (i) If T is a consistent estimator of θ, then prove that T^2 is a consistent estimator of θ^2. (ii) For a rectangular distribution over (a, b), a<b , find the Maximum likelihood estimates of a and b.

27. Derive the confidence interval for the mean of a Normal population $N(\mu, \sigma^2)$, when (a) σ is known (b) σ is unknown and the sample size is small

$2 \times 10 = 20$

STA4B04- TESTING OF HYPOTHESIS

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. Define simple and composite hypotheses.
2. Distinguish between Type I error and Type II error.
3. Discuss sequential sampling.
4. What is the significance of SPRT?
5. Distinguish between small sample tests and large sample tests.
6. Write the critical regions of large sample test.
7. Compare parametric and non-parametric tests
8. Write a suitable situation where ANOVA test is applicable.
9. List the assumptions of one sample t test.
10. When do you use Yate's correction?
11. Identify a suitable test and its test statistic for testing the significance of a correlation coefficient.
12. What is meant by goodness of fit?
13. Write short note on Median Test
14. Write the test statistic of Wilcoxon-signed rank and identify its asymptotic distribution.
15. Briefly discuss run test.

Maximum Mark = 25

PART B
Each question carries 5 marks

16. The continuous random variable X has the frequency function

$$f(x,\theta)=\frac{1}{\theta},0\le x\le\theta,0 \, otherwise$$

It is desired to test the hypothesis $H_0:\theta=1 \, against \, H_1:\theta=2$ using a single observation X. $X \ge 0.95$ is used as the critical region. Evaluate Type I error and Type II error.

17. Explain pared t test. Give a practical situation where this test is suitable.

18. A sample of 25 boys who passed SSLC examination are found to have mean marks 50 with standard deviation 5 for English. The mean marks of 18 girls are found to be 48 with standard deviation 4 for the same subject. Does this indicate any significance difference between the marks of boys and girls assuming the population standard deviation are equal?

19. In a sample of 600 men from a certain city 400 are fund to be smokers In 900 from another city 450 are smokers Do the data indicate that the cities are significantly different as far as smoking habits of people are concerned.

20. Tests were carried out to assess the strength of single fibre yarn spun on two different machines A and B and the results are given below:

Machine A	4	4.4	3.9	3	4.2	4.4	5
Machine B	5.3	4.3	4.1	4.4	5.3	4.2	3.8

Assuming the samples have been taken from normal population, test the hypothesis that variability is same for both the machines.

21. Explain Chi square test for independence of attributes.
22. A sample of 10 men   was used in a study to test the effects of a relaxant on the time required to fall asleep for male adults. Data for 10 subjects showing the number of minutes required to fall asleep with and without the relaxant follow. Use a 0.05 level of significance to determine whether the relaxant reduces the time required to fall asleep. Perform sign test and draw your conclusion.

Subject	1	2	3	4	5	6	7	8	9	10
Without Relaxant	15	12	22	8	10	7	8	10	14	9
With Relaxant	10	10	12	10	8	5	9	7	11	6

23. Explain Kolmogorov-Smirnov test. Suggest a situation where this test is useful.

Maximum Mark = 35

PART C
Each question carries 10 marks (Answer any **TWO** Questions)

24. State Neyman Pearson Lemma. Use the lemma to obtain the best critical region for testing $H_0: \mu = \mu_0$ against $H_1: \mu = \mu_1$, in the case of a normal population with   mean μ and variance σ^2. Find the power of the test.

25. List basic assumptions of ANOVA and explain the procedure or performing an ANOVA test.
26. Fit a Poisson distribution for the following data and test the goodness of fit.

X	0	1	2	3	4	5	6
frequency	275	72	30	7	5	2	1

27. Explain (i) Wilcoxon signed rank test and (ii) Mann Whitney test

$2 \times 10 = 20$

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. Write any two properties of real numbers?
2. Show that every convergent sequence is bounded
3. Find the region of x in $¿x+1 \vee ¿1$
4. State Taylor's theorem.
5. What is nested intervals?
6. Compute $\lim_{n \to \infty} (n!)^{1/n}$.
7. Why the set of rational numbers is not order-complete?
8. Write triangle inequality for two variables.
9. Identify the sixth term in the sequence {7, 26, 63, 124, 215, ….}.
10. Find $\frac{d}{dx}\left(e^{e^x}\right)$.
11. Discuss the relationship between continuability and differentiability of a function.
12. State a sufficient condition for uniform continuity.
13. Define Riemann integral.
14. Write the necessary and sufficient condition for a bounded function f is integrable.
15. Prove or disprove $\int_a^b f(x)\,dx = -\int_b^a f(x)\,dx$

Maximum Mark = 25

PART B
Each question carries 5 marks

16. If $\{x_n\}$ and $\{y_n\}$ are two sequences of real numbers converging to real numbers x and y respectively. Show that $\{x_n y_n\}$ converges to xy.
17. State and Prove Archmedian Property of Real numbers
18. Show every bounded sequence of real numbers has a convergent subsequence.
19. Show that every monotone sequence of bounded real numbers is convergent
20. State and prove mean value theorem
21. Establish Rolle's Theorem.
22. Prove that a bounded and continuous function f(.) over a closed interval (finite) is a sufficient condition for integrability.
23. If Q is a refinement of P, show that $L(P,f) \leq U(Q,f)$

Maximum Mark = 35

PART C
Each question carries 10 marks (Answer any TWO Questions)

24. /State and prove Cauchy convergence criteria
25. State and prove principle of Mathematical induction
26. State and prove intermediate value theorem.

27. If f and g are integrable then check whether the following are integrable or not: a) $|f|$
b) f^2 c) $f.g$

$2 \times 10 = 20$

STA5B06: SAMPLE SURVEYS

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. Distinguish between census and sampling.
2. What is meant by judgement sampling?
3. Define secondary data. State its major sources.
4. Compare sampling and non-sampling errors.
5. Write any four properties of a good questionnaire.
6. Discuss simple random sampling.
7. Compute the total number of samples of size n = 2 from a population of N = 6.
8. Write the unbiased estimate of population total and its variance.
9. Write Bowley's formula for proportional allocation.
10. In a systematic sampling N =40 and n = 4, find the value of k.
11. If ρ is the intraclass correlation coefficient between the units of the same systematic sample, then when do you say that systematic sampling would be more efficient as compared with srswor?
12. Briefly explain cluster sampling.
13. Write a situation where two stage sampling is applicable.
14. Distinguish between a stratum and a cluster.
15. Discuss Neyman allocation of sample sizes.

Maximum Mark = 25

PART B
Each question carries 5 marks

16. What are the advantages of sampling over census?
17. Explain the probability sampling and non-probability sampling with the help of examples.
18. Explain the concept of stratified sampling.
19. Obtain an unbiased estimate of population mean in simple random sampling with replacement. Find the variance of the estimate.
20. Show that sample proportion, p is an unbiased estimate of population proportion, P. Also obtain the confidence interval for the population proportion
21. Show that sample mean is an unbiased estimate of population mean in stratified random sampling. Also find its variance.
22. What you mean by precision of an estimate? Show that mean of a systematic sample is more precise than mean of simple random sample.
23. Obtain an unbiased estimator of population mean in cluster sampling. Also find its variance.

Maximum Mark = 35

PART C
Each question carries 10 marks (Answer any TWO Questions)

24. Explain in detail the principal steps in a sample survey.

25. Show that Var ($\bar{y}'_{sys}$) = $\dfrac{N-1}{Nn}$ (1+ (n-1)ρ) S^2 , where ρ is the interclass correlation between the units of the same systematic sample.

26. If the population consists of a linear trend, then prove that

$$\text{Var } (\bar{y}'_{st}) \leq \text{Var } (\bar{y}'_{sys}) \leq \text{Var } (\bar{y}'_{ran}).$$

27. Compare the efficiencies of the Neyman and proportional allocations with that of an unstratified random sample of the same size.

$$2 \times 10 = 20$$

STA5B07- LINEAR REGRESSION ANALYSIS

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. Describe scatter diagram.
2. Write the confidence interval for the slope and intercept in simple linear regression model.
3. List some of the uses of regression.
4. Show that the least square estimate of multiple linear regression coefficient is unbiased.
5. Write the hypotheses and test statistic for testing the significance of slope coefficient in simple linear regression model.
6. Show that the residual mean square is an unbiased estimate of population variance of random error component in linear regression model.
7. Write the properties of least square estimates of simple linear regression coefficients.
8. What is the importance of ANOVA in multiple linear regression?
9. Define hat matrix.
10. Distinguish between R^2 and adjusted R^2.
11. What is the significance of coefficient of determination?
12. Write a situation where logistic regression is applicable.
13. List the assumptions of logistic regression.
14. Define Splines.
15. Define logit function.

Maximum Mark = 25

PART B
Each question carries 5 marks

16. Derive the variance of regression coefficients in simple linear regression
17. Estimate the variance of the response variable.
18. From a study conducted by the Department of transportation on driving speed and mileage for midsize automobiles, following results are obtained:

Driving speed (x)	30	50	40	55	30	25	60	25
Mileage (y)	28	25	25	23	30	32	21	35

Fit a linear regression model for the mileage and interpret the result.

19. Consider the simple linear regression model $y = \beta_0 + \beta_1 x + \varepsilon$ with $E(\varepsilon) = 0, Var(\varepsilon) = \sigma^2 \wedge \varepsilon$ uncorrelated

   a) Show that Cov($\hat{\beta}_0, \hat{\beta}_1$)$= -\acute{x}\sigma^2/S_{xx}$

   b) Show that Cov($\acute{y}, \hat{\beta}_1$)=0.

20. Describe multiple linear regression model.
21. Discuss the properties of least square estimators in multiple linear regression.
22. Explain polynomial regression models and list some of its applied areas.
23. Explain the logistic regression model with a Binary response variable.

PART C

Each question carries 10 marks (Answer any **TWO** Questions)

24. Derive the least square estimates of simple linear regression coefficients and show that they are unbiased.

25. Explain the role of residual in model adequacy checking.

26. Explain test for significance of regression coefficients in multiple linear regression

27. Describe the estimation of regression coefficients in logistic regression model.

$2 \times 10 = 20$

STA6B09: TIME SERIES AND INDEX NUMBERS

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. Give example for seasonal and cyclic variations in time series.
2. Define Time series
3. What is meant by de-seasonalisation of data?
4. Write the steps for calculating the seasonal index using the method of simple averages.
5. Define moving averages.
6. What is family budget method?
7. Write the importance of lognormal distribution in income analysis.
8. Briefly describe the fitting of Pareto's law.
9. Describe additive models in time series.
10. What is Gini's coefficient?
11. Define index numbers.
12. Mention any three uses of index numbers.
13. Write Marshal-Edgeworth index number and Dorbish and Bowley's index number.
14. What are the scales of measurements?
15. Define Guttman scale.

Maximum Mark = 25

PART B
Each question carries 5 marks

16. How trend is measured using Moving Averages.
17. Explain periodic variations in Time series with suitable examples
18. Describe the Link Relative Method of measuring seasonal variation.
19. Explain Lorentz curve
20. Explain classification of index numbers
21. Give major limitations of index numbers
22. Explain the method of leastsquares.
23. How is a Likert scale measured? Is a Likert scale quantitative or qualitative?

Maximum Mark = 35

PART C
Each question carries 10 marks (Answer any TWO Questions)

24. What are the components of time series explain with example
25. Explain the use of Pareto distribution and its applications.
26. Briefly explain Link relative methods also explain its merits and demerits
27. What is attitude scale? Explain the advantages and limitations of scales in attitude measurements?

$2 \times 10 = 20$

STA6B10: DESIGN OF EXPERIMENTS

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. Explain Gauss Markov set up of linear model.
2. Define estimable parametric function.
3. What is meant by best linear unbiased estimator?
4. Discuss the concept of ANCOVA.
5. In a LSD with 4 treatments and error sum of squares is 16, find the Mean error sum of squares.
6. Write any situation where Graeco-Latin square design is suitable.
7. Distinguish between CRD and RBD.
8. Define treatment.
9. How to compare various designs of experiments?
10. In a 2^2 factorial design two factors A and B are given each at two levels, Write down the main effects and interaction effects of A and B
11. Distinguish between 2^2 and 2^3 factorial designs.
12. Define incidence matrix
13. Discuss orthogonal design.
14. Describe BIBD.
15. What is the significance of PBIBD?

Maximum Mark = 25

PART B
Each question carries 5 marks

16. Consider three independent random variables y_1 , y_2 and y_3 having common variance σ^2 and $E(Y_1)=\theta_1-\theta_2, E(Y_2)=\theta_1+\theta_2$, $E(Y_3)=2\theta_1-\theta_2$. Show that 3 $\theta_1-2\theta_2$ is an estimable parametric function
17. Find the least square estimate of the parameter vector θ in Gauss - Markov model and also find an unbiased estimator of $\sigma 2$.
18. What is meant by analysis of variance of experimental data? What are the assumptions used in it?
19. Give the analysis for completely randomized design
20. Derive the expression for estimating one missing observation in RBD
21. Explain the efficiency of LSD compared to RBD
22. How can estimate the effects and calculate the sum of squares in factorial experiment?
23. Explain Duncan's multiple range test

Maximum Mark = 35

PART C
Each question carries 10 marks (Answer any TWO Questions)

24. State and prove Gauss-Markov theorem.

25. What is meant by missing plot technique and what are procedures used to obtain the missing observation. Write the expression for estimating two missing values in LSD and explain the ANOVA table in this case.

26. Explain the principles of design of experiments.

27. Define the main effects and interaction effects in a 2^3 factorial experiment. Also give its ANOVA table.

$$2 \times 10 = 20$$

STA6B11: POPULATION STUDIES, ACTUARIAL SCIENCE AND VITAL STATISTICS

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. Define vital statistics. Give examples.
2. What is Crude birth rate?
3. Write the relation between N. R. R. And G. R. R.
4. Define mortality rate.
5. Write merits and demerits of general fertility rate.
6. Write any two characteristics of complete life tables.
7. What do you understand by an abridged life table?
8. What are the various uses of vital statistics?
9. What is expectation of life? Distinguish between 'curate expectation' and 'complete expectation' of life.
10. Discuss the costs and benefits of insurance to society.
11. Explain different kinds of policies.
12. Explain life insurance and fire insurance.
13. Define peril and hazard.
14. What is proximate cause in insurance?
15. List different branches of insurance.

Maximum Mark = 25

PART B
Each question carries 5 marks

16. Explain different methods of obtaining vital statistics.
17. Explain direct method of standardisation.
18. What are the assumptions in a life table?
19. State the merits and demerits of Crude Birth Rate.
20. Differentiate between Life insurance and General insurance.
21. Describe reinsurance and double insurance. Also explain the difference between them.
22. Explain the principles of insurance.
23. Discuss the costs and benefits of insurance to society.

Maximum Mark = 35

PART C
Each question carries 10 marks (Answer any TWO Questions)

24. Determine the standardised death rates for region A and B from the following.

Age Group	0-10	10-25	25-40	40-60	Above 60
Death per 1000, A (m_x^A)	2	8	15	32	41
Death per 1000, B(m_x^B))	4	10	18	28	38
Standard Population (in thousands)	3	12	12	30	50

25. Give brief account on sample registration system.

26. Explain the chief characteristics of an ideally insurable loss exposure.
27. Explain the method of calculating the premium of life insurance.

$2 \times 10 = 20$

STA6B12: OPERATIONS RESEARCH AND STATISTICAL QUALITY CONTROL

Time: 2 ½ Hours   Max.: 80 Marks

PART A
Each question carries 2 marks.

1. Define slack and surplus variables.
2. Distinguish between feasible solution and optimal feasible solution
3. Define artificial variable? When do we use it?
4. Define degeneracy in transportation problem

5. What is meant by North West corner rule in lpp?
6. What are the disadvantages of BIG-M method over two phase method?
7. What are the causes of variation in quality control?
8. Explain the need for quality control techniques in production.
9. Describe C chart.
10. How to read a control chart?
11. What are the difference between defects & defectives?
12. What is the significance of OC curve?
13. Distinguish between consumer's risk and producer's risk.
14. Define LTPD.
15. What are ASN and ATI for the single sampling plan?

Maximum Mark = 25

PART B
Each question carries 5 marks

16. Describe linear programming problem. Write some of its applications.
17. Explain the graphical method for solving linear programming problem.
18. Find a geometrical interpretation and solution as well for the following linear programming problem.

$$\text{Maximize} \quad Z = 3x_1 + 5x_2$$

Subject to

$$x_1 + 2x_2 \leq 2000$$
$$x_1 + x_2 \leq 1500$$
$$x_2 \leq 600$$
$$x_1 \geq 0 \quad x_2 \geq 0$$

19. Explain assignment problem. Describe any method to solve it.
20. What is meant by a control charts? Explain the applications of these charts.
21. Describe procedure or drawing X bar and R charts.
22. Explain AQL and ASN.
23. Explain the main control charts for attributes and obtain their control limits.

Maximum Mark = 35

PART C

Each question carries 10 marks (Answer any **TWO** Questions)

24. Find the initial basic feasible solution of the following transportation problem. There are four origins three destinations. The availabilities are 9, 10, 8, 7 and the requirements are 17,10,7 respectively.

	A	**B**	**C**
D	2	3	2
E	1	3	4
F	2	3	1
G	2	4	3

25. What are the computational procedures of dual simplex method, explain with an example?

26. Distinguish between double and single sampling plans.

27. Draw the OC curve of the single sampling plan showing the consumers and producers risks.

$2 \times 10 = 20$

STATISTICS: COMPLEMENTARY

SYLLABUS FOR B.Sc. (MATHEMATICS MAIN)

CBCSSUG 2019 (2019 admission onwards)

Sem No	Course Code	Course Title	Instructional Hours/week	Credit	Exam Hours	Ratio Ext: Int
1	STA 1C 01	INTRODUCTORY STATISTICS	4	3	2	4:1
2	STA 2C 02	PROBABILITY THEORY	4	3	2	4:1
3	STA 3C 03	PROBABILITY DISTRIBUTIONS AND SAMPLING THEORY	5	3	2	4:1
4	STA 4C 04	STATISTICAL INFERENCE AND QUALITY CONTROL	5	3	2	4:1

Question Paper Pattern

Question number (From….. To …..)	Type of Questions and Marks
01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**
13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Mark 10)**
01 to 21	**Total Marks: 60**

STA 1C 01- INTRODUCTORY STATISTICS

Contact Hours per week: 4
Number of credits: 3
Number of Contact Hours: 72
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Blue Print for Question Paper Setting / Scrutiny						
Max. Marks: 60						
Question Paper			Syllabus			
Sections or Parts	Mark	Question Numbers	MODULE 1	MODULE 2	MODULE 3	MODULE 4
			7 Hrs	30 Hrs	15 Hrs	20 Hrs
			7 Marks	30 Marks	19Marks	21 Marks
Expected mark `>>>>`						
A	2	1	2			
		2		2		
		3		2		
		4		2		
		5		2		
		6		2		
		7		2		
		8			2	
		9			2	
		10				2
		11				2
		12				2
B	5	13	5			
		14		5		
		15		5		
		16			5	
		17			5	
		18			5	
		19				5
C	10	20		10		
		21				10
Actual Mark `>> >>`			**7**	**32**	**19**	**21**

Question Paper setter has to give equal importance to both theory and problems in section B and C.

I. INTRODUCTORY STATISTICS
(CODE: STA1C01)

Module 1: *Official statistics*: The Statistical system in India: The Central and State Government organizations, functions of the Central Statistical Office (CSO), National Sample Survey Organization (NSSO) and the Department of Economics and Statistics.

7 hours

Module 2: *Introduction to Statistics*: Nature of Statistics, Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics. Concept of primary and secondary data. Designing a questionnaire and a schedule. Concepts of statistical population and sample from a population, quantitative and qualitative data, Nominal, ordinal and time series data, discrete and continuous data. Presentation of data by table and by diagrams, frequency distributions by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and ogives. Measures of central tendency (mean, median, mode, geometric mean and harmonic mean) with simple applications. Absolute and relative measures of dispersion (range, quartile deviation, mean deviation and standard deviation) with simple applications. Co-efficient of variation, Box Plot. Importance of moments, central and non-central moments, and their interrelationships. Measures of skewness based on quartiles and moments; kurtosis based on moments.

30 hours

Module 3: *Correlation and Regression:* Scatter Plot, Simple correlation, Simple regression, two regression lines, regression coefficients. Fitting of straight line, parabola, exponential, polynomial (least square method).

15 hours

Module 4: *Time series*: Introduction and examples of time series from various fields, Components of times series, Additive and Multiplicative models. Trend: Estimation of trend by free hand curve method, method of semi averages, method of moving averages and fitting various mathematical curves. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend.
Index numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's.

20 hours

References:

1. S.C. Gupta and V.K. Kapoor. *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
3. Mukhopadhyay P. (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied
4. Hoel P.G. *Introduction to mathematical statistics*, Asia Publishing house.
5. Chatfield.C. *The Analysis of Time Series: An Introduction*, Chapman & Hall
6. *Guide to current Indian Official Statistics*, Central Statistical Office, GOI, New Delhi.
7. www.mospi.gov.in
8. www.ecostat.kerala.gov.in

SEMESTER II

STA 2C 02- PROBABILITY THEORY

Contact Hours per week: *4*
Number of credits: *3*
Number of Contact Hours: 72
Course Evaluation: *External 60 Marks+ Internal 15 Marks*
Duration of Exam: *2 Hours*

<table>
<tr><th colspan="7">Blue Print for Question Paper Setting / Scrutiny</th></tr>
<tr><td colspan="7">Max. Marks: 60</td></tr>
<tr><td colspan="3">Question Paper</td><td colspan="4">Syllabus</td></tr>
<tr><td rowspan="3">Sections or Parts</td><td rowspan="3">Mark</td><td rowspan="3">Question Numbers</td><td>MODULE 1</td><td>MODULE 2</td><td>MODULE 3</td><td>MODULE 4</td></tr>
<tr><td>25Hrs</td><td>12Hrs</td><td>15 Hrs</td><td>20 Hrs</td></tr>
<tr><td>28 Marks</td><td>16 Marks</td><td>16 Marks</td><td>19 Marks</td></tr>
<tr><td colspan="3">Expected mark ˃˃˃˃</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="12">A</td><td rowspan="12">2</td><td>1</td><td>2</td><td></td><td></td><td></td></tr>
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<tr><td>12</td><td></td><td></td><td></td><td>2</td></tr>
<tr><td rowspan="7">B</td><td rowspan="7">5</td><td>13</td><td>5</td><td></td><td></td><td></td></tr>
<tr><td>14</td><td>5</td><td></td><td></td><td></td></tr>
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<tr><td>18</td><td></td><td></td><td>5</td><td></td></tr>
<tr><td>19</td><td></td><td></td><td></td><td>5</td></tr>
<tr><td rowspan="2">C</td><td rowspan="2">10</td><td>20</td><td>10</td><td></td><td></td><td></td></tr>
<tr><td>21</td><td></td><td></td><td></td><td>10</td></tr>
<tr><td colspan="3">Actual Mark ˃˃ ˃˃</td><td>28</td><td>16</td><td>16</td><td>19</td></tr>
</table>

Question Paper setter has to give equal importance to both theory and problems in section B and C.

II. PROBABILITY THEORY
(CODE: STA2C02)

Module 1: *Introduction to Probability:* Random experiment, Sample space, events, classical definition of probability, statistical regularity, field, sigma field, axiomatic definition of probability and simple properties, addition theorem (two and three events), conditional probability of two events, multiplication theorem, independence of events-pair wise and mutual, Bayes theorem and its applications.

25 hour

Module 2: *Random variable*s: Discrete and continuous, probability mass function (pmf) and probability density function (pdf)-properties and examples, Cumulative distribution function and its properties, change of variables (univariate case only)

12 hours

Module 3: *Mathematical expectations (univaraite):* Definition, raw and central moments(definition and relationships), moment generation function and properties, characteristic function (definition and use only), Skewness and kurtosis using moments

15 hours

Module 4: *Bivariate random variables*: Joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

20 hours

References :

1. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
2. S.C.Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. John E Freund, *Mathematical Statistics*, Pearson Edn, New Delhi
5. Hoel P.G. *Introduction to mathematical statistics*, Asia Publishing house.

SEMESTER III

STA 3C 03- PROBABILITY DISTRIBUTIONS AND SAMPLING THEORY

Contact Hours per week: 4
Number of credits: 3
Number of Contact Hours: 90
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Blue Print for Question Paper Setting / Scrutiny						
Max. Marks: 80						
Question Paper			Syllabus			
Sections or Parts	Mark	Question Numbers	MODULE 1	MODULE 2	MODULE 3	MODULE 4
			30Hrs	25Hrs	10Hrs	25 Hrs
			28 Marks	21 Marks	9 Marks	21 Marks
Expected mark ››››						
A	2	1	2			
		2	2			
		3	2			
		4	2			
		5		2		
		6		2		
		7		2		
		8			2	
		9			2	
		10				2
		11				2
		12				2
B	5	13	5			
		14	5			
		15		5		
		16		5		
		17		5		
		18			5	
		19				5
C	10	20	10			
		21				10
Actual Mark ›› ››			**28**	**21**	**9**	**21**

Question Paper setter has to give equal importance to both theory and problems in section B and C.

III.   PROBABILITY DISTRIBUTIONS AND SAMPLING THEORY.
(CODE:STA3C03)

Module 1: *Standard distributions:* Discrete type-Bernoulli, Binomial, Poisson, Geometric, Negative Binomial (definition only), Uniform (mean, variance and mgf).
Continuous type-Uniform, exponential and Normal (definition, properties and applications); Gamma (mean, variance, mgf); Lognormal, Beta, Pareto and Cauchy (Definition only)

30 hours

Module 2: *Limit theorems:* Chebyshev's inequality, Sequence of random variables, parameter and Statistic, Sample mean and variance, Convergence in probability (definition and example only), weak law of large numbers (iid case), Bernoulli law of large numbers, Convergence indistribution (definition and examples only), Central limit theorem (Lindberg levy-iid case)

25 hours

Module 3: Sampling methods: Simple random sampling with and without replacement, systematic sampling (Concept only), stratified sampling (Concept only), Cluster sampling(Concept only)

10 hours

Module 4: Sampling distributions: Statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chi-square distribution, t-distribution, and F distribution (definition, derivations and relationships only).

25 hours

References:

1.   Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
2.   S.C.Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand and   Sons.
3.   Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4.   John E Freund, *Mathematical Statistics*, Pearson Edn, NewDelhi
5.   Cochran W.G. (1984):Sampling Techniques(3rdEd.), Wiley Eastern.

SEMESTER IV

STA 4C 04 - STATISTICAL INFERENCE AND QUALITY CONTROL

Contact Hours per week: 4
Number of credits: 3
Number of Contact Hours: 90
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

**Blue Print for Question Paper Setting / Scrutiny**

| Max. Marks: 60 |

\multicolumn{3}{c}{Question Paper}	\multicolumn{4}{c}{Syllabus}
Sections or Parts	Mark	Question Numbers	MODULE 1	MODULE 2	MODULE 3	MODULE 4
			30 Hrs	35 Hrs	10 Hrs	15Hrs
			26 Marks	30Marks	9 Marks	14 Marks
Expected mark ＞＞＞＞				
A	2	1	2			
		2	2			
		3	2			
		4		2		
		5		2		
		6		2		
		7		2		
		8		2		
		9			2	
		10			2	
		11				2
		12				2
B	5	13	5			
		14	5			
		15		5		
		16		5		
		17			5	
		18				5
		19				5
C	10	20	10			
		21		10		
\multicolumn{3}{l}{Actual Mark ＞＞ ＞＞}	**26**	**30**	**9**	**14**

Question Paper setter has to give equal importance to both theory and problems in section B and C.

IV: STATISTICAL INFERENCE AND QUALITY CONTROL.
(CODE: STA4C04)

Module 1: *Estimation theory*: Parametric space, sample space, point estimation. Nayman Factorization criteria, Requirements of good estimator: Unbiasedness, Consistency, Efficiency, Sufficiency and completeness. Minimum variance unbiased (MVU) estimators. Cramer-Rao inequality (definition only). Minimum Variance Bound (MVB) estimators.
Methods of estimation: Maximum likelihood estimation and Moment estimation methods (Detailed discussion with problems); Properties of maximum likelihood estimators (without proof); Least squares and minimum variance (concepts only).
Interval estimation: Confidence interval (CI);CI for mean and variance of Normal distribution; Confidence interval for binomial proportion and population correlation coefficient when population is normal.

30 hours

Module 2: *Testing of Hypothesis*: Level of significance, Null and Alternative hypotheses, simple and composite hypothesis ,Types of Errors, Critical Region, Level of Significance, Power and p-values. Most powerful tests, Neyman-Pearson Lemma (without proof), Uniformly Most powerful tests. Large sample tests: Test for single mean, equality of two means, Test for single proportion, equality of two proportions. Small sample tests: t-test for single mean, unpaired and paired t-test.
Chi-square test for equality of variances, goodness of fit, test of independence and association of attributes. Testing means of several populations: One Way ANOVA, Two Way ANOVA (assumptions, hypothesis, ANOVA table and problems)

35 hours

Module 3: *Non-parametric methods*: Advantages and drawbacks; Test for randomness, Median test, Sign test, Mann-Whiteny U test and Wilcoxon test; Kruskal Wallis test (Concept only)

10 hours

Module 4: *Quality Control:* General theory of control charts, causes of variations in quality, control limits, sub-grouping, summary of out-of-control criteria. Charts of variables - X bar chart, R Chart and sigma chart. Charts of attributes – c-charts, p-chart and np-chart.(Concepts and problems).

15 hours

References:

1. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
2. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
3. S.C.Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics,* Sultan Chand and Sons
4. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rdEdn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
5. John E Freund, *Mathematical Statistics,* Pearson Edn, NewDelhi
6. Grant E L, *Statistical quality control*, McGraw Hill
7. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.

STATISTICS: COMPLEMENTARY Syllabus for B.Sc.

CBCSSUG 2019 (2019 admission onwards)

SYLLABUS FOR B.Sc. (PSYCHOLOGY MAIN)

Sem No	Course Code	Course Title	Instructional Hours/week	Credit	Exam Hours	Ratio Ext: Int
1	STA 1C 02	**DESCRIPTIVE STATISTICS**	4	3	2	4:1
2	STA 2C 02	**REGRESSION ANALYSIS AND PROBABILITY THEORY**	4	3	2	4:1
3	STA 3C 02	**PROBABILITY DISTRIBUTIONS AND PARAMETRIC TESTS**	5	3	2	4:1
4	STA 4C 02	**STATISTICAL TECHNIQUES FOR PSYCHOLOGY**	5	3	2	4:1

SEMESTER I

STA 1C 02- DESCRIPTIVE STATISTICS

Contract Hours per week: 4
Number of credits: 3
Number of Contact Hours: 72
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Question Paper Pattern

Type of Questions	Question number (From….. To …..)	Marks
Short Answer	01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**
Paragraph/ Problems	13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
Essay	20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Marks 10)**
Total	**01 to 21**	**60**

Question Paper setter has to give equal importance to both theory and problems in sections B and C.

Objectives
1. To generate interest in Statistics
2. To equip the students with the concepts of basic Statistics
3. To provide basic knowledge about Statistical methods

Module 1: *A basic idea about data*- collection of data, primary and secondary data, organization, planning of survey and diagrammatic representation of data
                                                                10 Hours

Module 2: *Classification and tabulation*- Classification of data, frequency distribution, formation of a frequency distribution, Graphic representation *viz*. Histogram, Frequency Curve, Polygon, Ogives, Bar diagram and Pie diagram
                                                                10 Hours

Module 3: *Measure of central tendency*- Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean, Combined Mean, Advantages and disadvantages of each average

20 Hours

Module 4: *Measures of dispersion*- Range, Quartile Deviation, Mean Deviation, Standard Deviation, Combined Standard Deviation, Percentiles, Deciles, Relative Measures of Dispersion, Coefficient of variation

16 Hours

Module 5: *Skewness and Kurtosis*- Pearson's and Bowley's coefficient of skewness, Percentile Measure of Kurtosis

16 Hours

References

1. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
2. Gupta, S.C., & Kapoor, V.K. *Fundamentals of Applied Statistics*. New Delhi: Sultan   Chand and Sons.
3. Garret, H.E., &Woodworth, R.S. *Statistics in Psychology and Education*. Bombay: Vakila,   Feffex and Simens Ltd.
4. Mood, A.M., Graybill, F.A and Boes, D.C. *Introduction to Theory of Statistics*. 3rd   Edition   Paperback – International Edition.
5. Mukhopadhyay,P. *Mathematical Statistics*. New central Book Agency (P) Ltd: Calcutta.

Assignments/ Seminar

Assignments/Seminar are to be given to students. The purpose of the assignments/seminar is to provide practical exposure to the students.

SEMESTER II
STA 2C 02- REGRESSION ANALYSIS AND PROBABILITY THEORY

Contract Hours per week: 4
Number of credits: 3
Number of Contact Hours: 72
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Question Paper Pattern

Type of Questions	Question number (From..... To .....)	Marks
Short Answer	01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**
Paragraph/ Problems	13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
Essay	20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Marks 10)**
Total	**01 to 21**	**60**

Question Paper setter has to give equal importance to both theory and problems in sections B and C.

Objectives

1. To make the students aware of various Statistical tools
2. To create awareness about probability

Module 1: *Bivariate data*- relationship of variables, correlation analysis**,** methods of studying correlation, Scatter Diagram, Karl Pearson's Coefficient of Correlation, Calculation of Correlation from a 2-way table, Interpretation of Correlation Coefficient, Rank Correlation

11 Hours

Module 2: *Regression analysis*- linear regression, Regression Equation, Identifying the Regression Lines properties of regression coefficients, numerical problems

9 Hours

Module 3: *Partial and Multiple Correlation Coefficients*- Multiple Regression Equation, Interpretation of Multiple Regression Coefficients (three variable cases only)

16 Hours

Module 4: *Basic probability*- Sets, Union, Intersection, Complement of Sets, Sample Space, Events, Classical, Frequency and Axiomatic Approaches to Probability, Addition and Multiplication Theorems, Independence of Events (Up-to three events)

20 Hours

Module 5: *Random Variables and their probability distributions*- Discrete and Continuous Random Variables, Probability Mass Function, Distribution Function of a Discrete Random Variable

16 Hours

References
1. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
2. Gupta, S.C., &Kapoor, V.K. *Fundamentals of Applied Statistics*. New Delhi: Sultan   Chand and Sons.
3. Garret, H.E., &Woodworth, R.S. *Statistics in Psychology and Education*. Bombay: Vakila,
        Feffex and Simens Ltd.
4. Mood, A.M., Graybill, F.A and Boes, D.C. *Introduction to Theory of Statistics*. 3rd   Edition   Paperback – International Edition.
5. Mukhopadhyay, P. *Mathematical Statistics*. New central Book Agency (P) Ltd: Calcutta.

Assignments/ Seminar

Assignments/Seminar are to be given to students. The purpose of the assignments/seminar is to provide practical exposure to the students.

SEMESTER III

STA 3C 02- PROBABILITY DISTRIBUTIONS AND PARAMETRIC TESTS

Contract Hours per week: 5
Number of credits: 3
Number of Contact Hours: 90
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Question Paper Pattern

Type of Questions	Question number (From….. To …..)	Marks
Short Answer	01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**
Paragraph/ Problems	13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
Essay	20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Marks 10)**
Total	**01 to 21**	**60**

Question Paper setter has to give equal importance to both theory and problems in sections B and C.

Objectives

1. To get a general understanding on various probability distributions
2. To familiarize the uses of Statistical test.

Module 1: *Distribution Theory-* Binomial, Poisson and Normal Distributions, Mean and Variance (without derivations), Numerical Problems, Fitting, Importance of Normal Distribution, standard normal distribution, simple problems using standard normal tables, Central Limit Theorem (Concepts only)

25 Hours

Module2: *Methods of Sampling-* Random Sampling, Simple Random Sampling, Stratified, Systematic and Cluster Sampling, Non Random

sampling, Subjective sampling, Judgment sampling and convience sampling

20 Hours

Module 3: *Fundamentals of Testing-* Type-I & Type-II Errors, Critical Region, Level of Significance, Power, *p* value, Tests of Significance

15 Hours

Module 4: *Large Sample Tests* – Test of a Single, Mean Equality of Two Means, Test of a Single Proportion, and Equality of Two Proportions

10 Hours

Module 5: *Small Sample tests-*Test of a Single Mean, Paired and Unpaired t-Test, Chi-Square Test of Variance, F-Test for the Equality of Variance, Tests of Correlation

20 Hours

References

1. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
2. Gupta, S.C., &Kapoor, V.K. *Fundamentals of Applied Statistics*. New Delhi: Sultan   Chand and Sons.
3. Garret, H.E., &Woodworth, R.S. *Statistics in Psychology and Education*. Bombay: Vakila,   Feffex and Simens Ltd.
4. Mood, A.M., Graybill, F.A and Boes, D.C. *Introduction to Theory of Statistics*. 3rd   Edition   Paperback – International Edition.
5. Mukhopadhyay, P. *Mathematical Statistics*. New central Book Agency (P) Ltd: Calcutta.

Assignments/ Seminar
Assignments/Seminar are to be given to students. The purpose of the assignments/seminar is to provide practical exposure to the students.

SEMESTER IV

STA 4C 02- STATISTICAL TECHNIQUES FOR PSYCHOLOGY
Contract Hours per week: 5
Number of credits: 3
Number of Contact Hours: 90
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Question Paper Pattern

Type of Questions	Question number (From….. To …..)	Marks
Short Answer	01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**

	13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
Paragraph/ Problems		
Essay	20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Marks 10)**
Total	**01 to 21**	**60**

Question Paper setter has to give equal importance to both theory and problems in sections B and C.

Objectives

1. To make the students aware of various Statistical test in different areas of Psychology
2. To give knowledge about applications of Statistics in different areas of Psychological   studies.

Module 1: *Analysis of Variance*- assumptions, One-way and Two-way Classification with Single Observation per Cell, Critical Difference
                                                                        20 Hours

Module 2: *Non Parametric tests*- Chi-square Test of Goodness of Fit, Test of Independence of Attributes, Test of Homogeneity of Proportions
                                                                        20 Hours

Module 3: *Sign Test*- Wilcoxon's Signed Rank Test, Wilcoxon's Rank Sum Test, Run Test and Krushkal-Wallis Test
                                                                        20 Hours

Module 4: *Factorial Design*- Basics of factorial Design, Factorial experiments and their uses in Psychological studies, Concepts of 2^2, 2^3 factorial experiments (without derivation), simple problems
                                                                        15 Hours

Module 5: *Preparation of Questionnaire*- Scores and Scales of Measurement, Reliability and Validity of Test Scores
                                                                        15 Hours

References

1. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
2. Gupta, S.C., &Kapoor, V.K. *Fundamentals of Applied Statistics*. New Delhi: Sultan   Chand and Sons.
3. Garret, H.E., &Woodworth, R.S. *Statistics in Psychology and Education*. Bombay: Vakila, Feffex and Simens Ltd.
4. Mood, A.M., Graybill, F.A and Boes, D.C. *Introduction to Theory of Statistics*. 3rd   Edition   Paperback – International Edition.

5. Douglas C. Montgomery. *Design and Analysis of Experiments.* 9th Edition.

 Assignments/ Seminar

Assignments/Seminar are to be given to students. The purpose of the assignments/seminar is to provide practical exposure to the students.

FIRST SEMESTER B.Sc DEGREE EXAMINATION
(UG-CBCSSUG)
Statistics- Complementary
STA 1C 02 –DESCRIPTIVE STATISTICS

Time: 2 Hours   **Max Marks: 60**

SECTION-A
Each question carries 2 Marks.
Maximum Marks that can be scored in this section is 20.

1. Compare less than and greater than Ogives.
2. What do you mean by percentiles?
3. Define geometric mean
4. What is the variance of the observations 8, 10, 12?
5. How will you find range of a grouped frequency distribution?
6. What is meant by relative measure of dispersion?
7. Define quartile deviation
8. Distinguish between discrete and continuous data. Give examples
9. The average pulse rate of 40 males was found to be 78 and that of a group of 60 females   was 69. Find the combined mean pulse rate of the 100 patients.
10. What is combined standard deviation?
11. What are the advantages of median?
12. Draw a bar diagram depicting the following data

Year	1992	1993	1994	1995
Export (in crore)	55	63	60	70

SECTION-B
Each question carries 5 Marks.
Maximum Marks that can be scored in this section is 30.

13. Explain Kurtosis. What are the different types of Kurtosis?
14. Discuss the graphical methods used for representing a frequency distribution
15. The blood serum cholesterol levels of 10 patients are given below. Calculate the S.D.   and C.V.
               220, 230, 240, 250, 260, 270, 280, 255, 265, 290
16. Write the importance of diagrams and graphs for data analysis
17. Define classification. What are the different types of classification?
18. Explain Quartile deviation. What are the advantages and disadvantages of quartile   deviation?
19. Calculate AM and SD for the following data

Class	10-14	14-18	18-22	22-26	26-30
frequency	20	30	11	3	5

SECTION-C
(Answer *any one* Question and carries 10 marks)

20. Calculate the mean deviation about the mean for the given data.

Class	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	4	8	12	15	12	6	3

21.

(a) Define Skewness. What are the different types of Skewness?

(b) Calculate Karl Pearson's Coefficient of skewness for the following frequency distribution

Class	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100-104
frequency	8	15	18	25	14	9	6	5

[END]

SECOND SEMESTER B.Sc DEGREE EXAMINATION

(UG-CBCSSUG)
Statistics- Complementary
STA 2C 02–REGRESSION ANALYSIS AND PROBABILITY THEORY

Time: 2 Hours   **Max Marks: 60**

SECTION-A
Each question carries 2 Marks.
Maximum Marks that can be scored in this section is 20.

1. Define Spearman's rank correlation coefficient
2. Distinguish between discrete and continuous variables
3. What is meant by a scatter diagram?
4. State the Multiplication theorem of probability for two events
5. Define probability mass function
6. Define sample space. Give one example
7. Define the following
   - (a) Disjoint set
   - (b) Universal set
   - (c) Null set
8. If $P(A)=0.2, P(B)=0.6, P(A \cap B)=0.3$, then $P(AUB)=$ _____
9. If $f(x)=k\,x, \; x=1,2,3$ and zero elsewhere is a p.m.f. Find $P(X \geq 2.5)$.
10. If $r_{12}=0.93$, $r_{13}=0.99$ and $r_{23}=0.92$. Calculate $r_{12.3}$
11. Consider the following p.m.f

x	1	0	2
$f(x)$	k	$2k$	$3k$

   Find the value of k .

12. Distinguish between mutually exclusive events and mutually exhaustive events

SECTION-B
Each question carries 5 Marks.
Maximum Marks that can be scored in this section is 30.

13. Distinguish between partial correlation and multiple correlations
14. What is meant by linear regression? What are two regression lines? Give their equations
15. Explain the different approaches to the theory of probability.
16. State addition theorem in probability. A problem in mathematics is given two students A and B. Whose chances of solving it are 1/3 and 2/3 respectively. What is the probability that the problem will be solved?
17. If $\sigma_x=6$, $\sigma_y=10$ and $\text{cov}(x,y)$ = -30, find the correlation between X and Y . Comment on the same. Also find the regression coefficients.
18. In a box there are 8 white, six blue and 10 pink balls. If 3 balls are drawn at random from the box, what is the probability that

(a) Two balls are white
(b) None of 3 is pink
(c) 3 balls are blue

19. Define the distribution function of a discrete random variable. Also write its properties

SECTION-C
(Answer *any one* Question and carries 10 marks)

20. A random variable X has the following probability function

x	-1	0	2
$f(x)$	k	$2k$	$3k$

(a) Determine the value of k

(b) Find $P(X<2)$ and $P(X\leq2)$

(c) Write down the distribution function of X

21.   (i) State the important properties of Karl Pearson's coefficient of correlation.

(ii) Calculate the correlation coefficient for the following data

X	7	15	13	3	10	12
Y	27	45	51	9	33	51

[END]

THIRD SEMESTER B.Sc DEGREE EXAMINATION
(UG-CBCSSUG)
Statistics- Complementary
STA 3C 02– PROBABILITY DISTRIBUTIONS AND PARAMETRIC TESTS

Time: 2 Hours   **Max Marks: 60**

SECTION-A
Each question carries 2 Marks.
Maximum Marks that can be scored in this section is 20.

1. What is meant by a Statistical test? Give an example
2. Write down the test Statistic for testing the equality of means of two normal population whose variance are equal and when the sample sizes are small
3. Distinguish between Null and Alternative hypothesis
4. Give two instances where binomial distribution can be applied
5. What is sampling frame?
6. What is convience sampling?
7. Define sampling distribution
8. A binomial distribution has $n=$ 500 and $p=$ 0.1. Find the mean and variance of this distribution
9. State central limit theorem

10. Define power of a test
11. What is standard error
12. Write down the p.d.f of standard normal distribution

SECTION-B
Each question carries 5 Marks.
Maximum Marks that can be scored in this section is 30.

13. What are the main features of Normal distribution
14. If 3% electric bulbs manufactured by a company are defective. Find the probability that in a sample of 100 bulbs, exactly five bulbs are defective (*Given* $e^{-3}=0.0492$)

15. Describe Paired sample t test

16. Distinguish between systematic sampling and stratified sampling
17. A sample of 25 items were taken from a population with SD 10 and the sample mean is found to be 65. Can it be regarded as a sample from a normal population with mean $\mu=60.$ (use $\alpha=5$)
18. The customer accounts at a certain departmental store have an average balance of Rs. 120 and SD of Rs. 40. Assume that the account balance are normally distributed
    - (a) What proportion of the accounts as over Rs. 150
    - (b) What proportion of accounts in between Rs. 100 and Rs. 150
19. Sample sizes 10 and 18 taken from two normal population gave standard deviation

14 and 20 respectively. Test the hypothesis that the samples have come from population
with the same standard deviation at 5% level of significance

SECTION-C
(Answer *any one* Question and carries 10 marks)

20. Explain the test procedure for test the equality of variance of two normal

    populations with known mean

21. The screws produced by certain machine were checked by examining samples. The

    following table shows the distribution of 128 sample according to the number of

    defective items they contained

No. of defective	0	1	2	3	4	5	6	7	Total
No of samples	7	6	19	35	30	23	7	1	128

Fit a binomial distribution to the data

[END]

FOURTH SEMESTER B.Sc DEGREE EXAMINATION
(UG-CBCSSUG)
Statistics- Complementary
STA 4C 02– STATISTICAL TECHNIQUES FOR PSYCHOLOGY

Time: 2 Hours   **Max Marks: 60**

SECTION-A
Each question carries 2 Marks.
Maximum Marks that can be scored in this section is 20.

1. What is meant by validity
2. What are contingency tables
3. Write down the test statistic of chi- square test for testing homogeneity
4. What are the advantages of non- parametric test
5. What is meant by Ratio scale
6. State three assumptions of ANOVA technique
7. State the null hypothesis of one way ANOVA
8. Define the term reliability
9. Write down the test statistic of chi- square test for testing goodness of fit
10. What is meant by interval scale
11. Write any three assumptions associated with non parametric test
12. What do you mean by pilot survey

SECTION-B
Each question carries 5 Marks.
Maximum Marks that can be scored in this section is 30.

13. What are the steps in preparing a questionnaire?
14. Write a short note on Krushkal- Wallis test
15. Describe the importance of factorial experiments in psychological studies
16. Briefly explain Wilcoxon's Rank sum test
17. The following are the marks obtained by 10 students in a certain examination

    Marks: 43   48   65   57   31   60   37   48   78   59
    Test the hypothesis that population variance is 100 (Test at 5% level of significance)

18. The following data give the number of lesions on halves of eight tobacco leaves

Pair number	1	2	3	4	5	6	7	8
Proportion 1, X_1	31	20	18	17	9	8	10	7
Proportion 2, X_2	18	17	14	11	10	7	5	6

Use Wilcoxon's signed rank test to test whether the two samples are significantly different

19. Explain the chi- square test for independence of attribute

SECTION-C
(Answer *any one question and* carries 10 marks)

20. A trucking company wishes to test the average life of each of the three brands of tyres. The company uses all branches on randomly selected trucks. The records showing the lives (thousands of miles) of tyres are as given. Using ANOVA, test the hypothesis that the average life for each brand is the same

Brand I	*Brand II*	*Brand III*
6	6	2
1	3	5
5	4	6
2	3	7

21. (i) Define the term validity
    (ii) Explain various types of validity

[END]

STATISTICS: COMPLEMENTARY Syllabus for B.Sc.

CBCSSUG 2019 (2019 admission onwards)

SYLLABUS FOR B.Sc. (GEOGRAPHY MAIN)

Sem No	Course Code	Course Title	Instructional Hours/week	Credit	Exam Hours	Ratio Ext: Int
1	STA 1C 03	**DESCRIPTIVE STATISTICS**	4	3	2	4:1
2	STA 2C 03	**REGRESSION ANALYSIS AND TIME SERIES**	4	3	2	4:1
3	STA 3C 03	**PROBABILITY THEORY**	5	3	2	4:1
4	STA 4C 03	**STATISTICAL TECHNIQUES FOR GEOGRAPHY**	5	3	2	4:1

SEMESTER I

STA 1C 03- DESCRIPTIVE STATISTICS
Contract Hours per week: 4
Number of credits: 3
Number of Contact Hours: 72
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Question Paper Pattern

Type of Questions	Question number (From….. To …..)	Marks
Short Answer	01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**
Paragraph/ Problems	13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
Essay	20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Marks 10)**
Total	**01 to 21**	**60**

Question Paper setter has to give equal importance to both theory and problems in sections B and C.

Objectives

1. To generate interest in Statistics
2. To equip the students with the concepts of basic Statistics
3. To provide basic knowledge about Statistical methods

MODULE 1: *Meaning, scope and limitations of Statistics* – collection of data, conducting a statistical enquiry- preparation of questionnaire- primary and secondary data – classification and tabulation – formation of frequency distribution – diagrammatic and graphic presentation of data (Only a brief summary of the above topics is intended to be given by the teacher. Detailed study is expected from the part of students).
Population and sample – advantages of sampling over census, sampling unit and sampling frame– types of sampling, random and non-random sampling methods, simple random sampling, stratified, cluster and multi-stage sampling (brief description of these methods and their merits and demerits), Non Random sampling, Subjective, Convience and judgment sampling

15 Hours

MODULE 2: *Measures of central tendency* – Arithmetic mean, weighted arithmetic mean, median, mode – Partition values – quartiles, deciles and percentiles

21 Hours

MODULE 3: *Measures of dispersion* – range, quartile deviation, mean deviation, standard deviation, relative measures of dispersion and advantages, coefficient of variation- simple problems only, Lorenz curve

18 Hours

MODULE 4: *Raw and central moments*- (formula and inter-relationships only up to order 4, derivations not required), Skewness and kurtosis, Bowley's and Pearson's coefficient of skewness, Measures of skewness and kurtosis based on moments

18 Hours

References

1. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
2. Gupta, S.C., &Kapoor, V.K. *Fundamentals of Applied Statistics*. New Delhi: Sultan   Chand and Sons.
3. Mood, A.M., Graybill, F.A and Boes, D.C. *Introduction to Theory of Statistics*. 3rd   Edition   Paperback – International Edition.
4. Mukhopadhyay, P. *Mathematical Statistics*. New central Book Agency (P) Ltd: Calcutta.

Assignments/ Seminar
Assignments/Seminar are to be given to students. The purpose of the assignments/seminar is to provide practical exposure to the students.

SEMESTER II
STA 2C 03- REGRESSION ANALYSIS AND TIME SERIES
Contract Hours per week: 4
Number of credits: 3
Number of Contact Hours: 72
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Question Paper Pattern

Type of Questions	Question number (From..... To .....)	Marks
Short Answer	01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**
Paragraph/ Problems	13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
Essay	20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Marks 10)**
Total	**01 to 21**	**60**

Question Paper setter has to give equal importance to both theory and problems in sections B and C.

Objectives
1. To make the students aware of various Statistical tools
2. To give knowledge about applications of Statistics in different areas

MODULE 1: *Bivariate data*- relationships of variables, Correlation analysis, methods of studying correlation – scatter diagram, Karl Pearson's coefficient of correlation, concept of rank correlation – Spearman's rank correlation coefficient, tied ranks, rank correlation for tied ranks
                                                                                    19 Hours
MODULE 2: *Regression analysis* - linear regression, regression equations (derivations not required), two lines of regression, properties of regression coefficients, numerical problems
                                                                                    19 Hours
MODULE 3: *Non-linear regression*-quadratic and polynomial (concept only), exponential and power curves (numerical problems)
                                                                                    15 Hours
MODULE 4: *Time series analysis*- components of time series, measurement of secular trend – graphical method, semi-average and

moving average methods, least square method (linear function only), concepts of seasonal, cyclical and irregular variations with examples

19 Hours

References
1. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
2. Gupta, S.C., &Kapoor, V.K. *Fundamentals of Applied Statistics*. New Delhi: Sultan   Chand and Sons.
3. Box, G.E.P. and Jenkins, G.M. *Time Series Analysis*, Holden –Day
4. Mood, A.M., Graybill, F.A and Boes, D.C. *Introduction to Theory of Statistics*.   3rd   Edition Paperback – International Edition.

Assignments/ Seminar
Assignments/Seminar are to be given to students. The purpose of the assignments/seminar is to provide practical exposure to the students.

SEMESTER III
STA 3C 03- PROBABILITY THEORY
Contract Hours per week: 5
Number of credits: 3
Number of Contact Hours: 90
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours
Question Paper Pattern

Type of Questions	Question number (From….. To …..)	Marks
Short Answer	01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**
Paragraph/ Problems	13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
Essay	20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Marks 10)**
Total	**01 to 21**	**60**

Question Paper setter has to give equal importance to both theory and problems in sections B and C.

Objectives
1. To create awareness about probability
2. To get a general understanding on various probability distributions

MODULE 1: *Probability theory* – concept of random experiment, sample point, sample space and events – mathematical and statistical definitions of probability, limitations, axiomatic approach to probability – addition and

multiplication theorems, concept of conditional probability, independence of two events, numerical problems on probability in discrete sample space
28 Hours

MODULE 2: *Random variable*- discrete and continuous type with examples, probability mass function, distribution function, properties and simple problems for discrete case only, mathematical expectation-numerical problems for discrete case only
18 Hours

MODULE 3: *Discrete Probability distributions*- One point, two point, Bernoulli, Binomial, Poisson and Uniform distributions (definitions only, derivations not required), properties and simple numerical problems
23 Hours

MODULE 4: *Continuous Probability distributions*- Standard uniform distribution (definition only), Normal distribution, properties, standard normal distribution, simple problems using standard normal tables
21 Hours

References

1. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
2. Gupta, S.C., &Kapoor, V.K. *Fundamentals of Applied Statistics*. New Delhi: Sultan   Chand and Sons.
3. Mood, A.M., Graybill, F.A and Boes, D.C. *Introduction to Theory of Statistics*. 3rd Edition   Paperback – International Edition.
4. Mukhopadhyay, P. *Mathematical Statistics*. New central Book Agency (P) Ltd: Calcutta.

Assignments/ Seminar
Assignments/Seminar are to be given to students. The purpose of the assignments/seminar is to provide practical exposure to the students.

SEMESTER IV
STA 4C 03- STATISTICAL TECHNIQUES FOR GEOGRAPHY
Contract Hours per week: 5
Number of credits: 3
Number of Contact Hours: 90
Course Evaluation: External 60 Marks+ Internal 15 Marks
Duration of Exam: 2 Hours

Question Paper Pattern

Type of Questions	Question number (From..... To	Marks

	.....)	
Short Answer	01 to 12	Short answer type carries 2 marks each - 12 questions **(Maximum Marks 20)**
Paragraph/ Problems	13 to 19	Paragraph/ Problem type carries 5 marks each – 7 questions **(Maximum Marks 30)**
Essay	20 to 21	Essay type carries 10 marks (1 out of 2) **(Maximum Marks 10)**
Total	**01 to 21**	**60**

Question Paper setter has to give equal importance to both theory and problems in sections B and C.
Objectives
1. To familiarize the uses of Statistical test
2. To give knowledge about applications of Statistics in different areas of Geography

MODULE 1: *Testing of statistical hypothesis*- null and alternative hypotheses, types of errors, level of significance and power of a test (definitions only), basic idea of sampling distribution, large and small sample tests for testing of single mean and difference of means, tests for variance based on chi-square and F

28 Hours

MODULE 2: *Analysis of variance*- Assumptions, One way and Two way classifications, null hypotheses, total, between and within sum of squares, ANOVA table, numerical problems

23 Hours

MODULE 3: *Non-parametric tests* – advantages, sign test, run test, signed rank test, rank-sum test, Kolmogorov-Smirnov goodness of fit test, chi-square goodness of fit test, chi-square test for independence of attributes and homogeneity

21 Hours

MODULE 4: *Patterns*- Point patterns, random and systematic point patterns, test of uniformity based on chi-square, quadrat analysis with VMR test for randomness, Area patterns: Lattice patterns – regular and irregular (elementary level), contiguity test (only for regular patterns at elementary level), concept of spatial data, autocorrelation structure

18 Hours

References
1. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
2. Gupta, S.C., &Kapoor, V.K. *Fundamentals of Applied Statistics*. New Delhi: Sultan   Chand and Sons.

3. Mood, A.M., Graybill, F.A and Boes, D.C. *Introduction to Theory of Statistics*. 3rd `Edition Paperback – International Edition.
4. Gibbons, J.D. *Non parametric Methods for Quantitative Analysis*. Mc Graw Hill.
5. John Silk. *Statistical Concepts in Geography*. Boston: Allen and Unwin: London.

Assignments/ Seminar
Assignments/Seminar are to be given to students. The purpose of the assignments/seminar is to provide practical exposure to the students.

FIRST SEMESTER B.Sc DEGREE EXAMINATION
(UG-CBCSSUG)
Statistics- Complementary
STA 1C 03– DESCRIPTIVE STATISTICS

Time: 2 Hours   **Max Marks: 60**

SECTION-A
Each question carries 2 Marks.
Maximum Marks that can be scored in this section is 20.

1. Compare less than and greater than Ogives.
2. What do you mean by percentiles?
3. Define geometric mean
4. What is the variance of the observations 8, 10, 12?
5. What do you mean by random sampling?
6. What is meant by relative measure of dispersion?
7. What is convience sampling
8. What are the advantages of sampling over census
9. The average pulse rate of 40 males was found to be 78 and that of a group of 60 females   was 69. Find the combined mean pulse rate of the 100 patients.
10. What is sampling frame
11. What are the advantages of median?
12. Draw a bar diagram depicting the following data

Year	1992	1993	1994	1995
Export (in crore)	55	63	60	70

SECTION-B
Each question carries 5 Marks.
Maximum Marks that can be scored in this section is 30.

13. Explain Kurtosis. What are the different types of Kurtosis?
14. Calculate Karl Pearson's Coefficient of skewness for the following frequency distribution

Class	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100-104
frequency	8	15	18	25	14	9	6	5

15. The blood serum cholesterol levels of 10 patients are given below. Calculate the S.D.   and C.V.
                220, 230, 240, 250, 260, 270, 280, 255, 265, 290
16. Distinguish between systematic sampling and stratified sampling
17. What are the steps in preparing a questionnaire?
18. Define classification. What are the different types of classification?

19. Explain Quartile deviation. What are the advantages and disadvantages of quartile   deviation?

SECTION-C
(Answer *any one* Question and carries 10 marks)
20. Calculate the mean deviation about the mean for the given data.

Class	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	4	8	12	15	12	6	3

21. (a) Distinguish between raw moments and central moments
      (b) Write the inter- relationship between raw moment and central moment

[END]

SECOND SEMESTER B.Sc DEGREE EXAMINATION
(UG-CBCSSUG)
Statistics- Complementary
STA 2C 03– REGRESSION ANALYSIS AND TIME SERIES

Time: 2 Hours   Max Marks: 60

SECTION-A
Each question carries 2 Marks.
Maximum Marks that can be scored in this section is 20.

1. Define Spearman's rank correlation coefficient
2. Distinguish between linear correlation and non linear correlation
3. What is meant by a scatter diagram?
4. What are normal equations?
5. Write notes on direct and inverse correlations
6. Define time series
7. Write the properties of regression coefficient
8. What is meant by perfect correlation?
9. Define coefficient of determination
10. What is non linear regression?
11. The two regression coefficients are 1.5 and 0.2. Find r
12. Give an example of a seasonal variation in business data.

SECTION-B
Each question carries 5 Marks.
Maximum Marks that can be scored in this section is 30.

13. Define correlation between two variables. What are its applications?
14. What is meant by linear regression? What are two regression lines? Give their equations
15. Briefly explain the different components of time series
16. If $\sigma_x = 6$, $\sigma_y = 10$ and $\text{cov}(x,y)$ = -30, find the correlation between X and Y. Comment on the same. Also find the regression coefficients.
17. Give any two merits of Rank correlation coefficient. Calculate the Rank correlation coefficient between the Educational status (X) and age at marriage (Y) Rank of (X ,Y)= (1,5), (2,4), (4,1), (5,3), (3,2).
18. If the two regression lines are $5y = 6x + 22$ and $4y = 9x + 5$, find $\bar{x}, \bar{y}$ and r
19. Describe briefly the various methods of determining trend in a time series

SECTION-C
(Answer *any one* question and carries 10 marks)
20. (a) Explain the method of moving averages of obtaining trend. What are the `merits and demerits of this method?

(b) Obtain the trend values by finding three yearly moving averages for the following   data.

Year	1982	1983	1984	1985	1986	1987	1988	1989
Quantity	310	332	317	357	392	402	405	410

21. (a) What is the principle of least squares

(b) For the following data fit a linear trend of the form $y=ax+b$

x	1	2	3	4	5
y	6	12	25	47	90

[END]

THIRD SEMESTER B.Sc DEGREE EXAMINATION
(UG-CBCSSUG)
Statistics- Complementary
STA 3C 03– PROBABILITY THEORY

Time: 2 Hours   **Max Marks: 60**

SECTION-A
Each question carries 2 Marks.
Maximum Marks that can be scored in this section is 20.

1. Define a random variable with an example

2. A binomial distribution has $n=$ 500 and $p=$ 0.1. Find the mean and variance of this distribution

3. Write down the p.m.f of Uniform distribution

4. State the Multiplication theorem of probability for two events

5. Define probability mass function

6. If $P(A)=0.2, P(B)=0.6, P(A\cap B)=0.3$, then $P(AUB)=$ ----------

7. If $f(x)=k\,x,\ x=1,2,3$ and zero elsewhere is a p.m.f. Find $P(X\geq 2.5)$.

8. Consider the following p.m.f

x	1	0	2
$f(x)$	k	$2k$	$3k$

Find the value of k .

9. Define the term random experiment. Cite one example

10. Distinguish between mutually exclusive events and mutually exhaustive events

11. Define conditional probability

12. Distinguish between discrete and continuous variable

SECTION-B
Each question carries 5 Marks.
Maximum Marks that can be scored in this section is 30.

13. If 3% electric bulbs manufactured by a company are defective. Find the probability that in a sample of 100 bulbs, exactly five bulbs are defective ($Given\ e^{-3}=0.0492$)

14. Distinguish between one point and two point distributions. Give the p.d.f. of each of them

15. Two coins are tossed simultaneously. What is the probability of getting (i) Two heads; (ii) Two tails; (iii) at least one head?

16. State addition theorem in probability. A problem in mathematics is given two students A and B. Whose chances of solving it are 1/3 and 2/3 respectively. What is the probability that the problem will be solved?

17. In a box there are 8 white, six blue and 10 pink balls. If 3 balls are drawn at random from the box, what is the probability that

    (a) Two balls are white

    (b) None of 3 is pink

(c) 3 balls are blue

18. Define mathematical expectation of a random variable. Two unbiased dice are thrown.   Find the expected value of the sum of the numbers thrown

19. The customer accounts at a certain departmental store have an average balance of Rs.   120 and SD of Rs. 40. Assume that the account balance are normally distributed

(i) What proportion of the accounts as over Rs. 150

(ii) What proportion of accounts in between Rs. 100 and Rs. 150

SECTION-C

(Answer *any one* question *and* carries 10 marks)

20. Describe Binomial, Poisson and Normal distributions. Give the properties of each   of them

21. A random variable X has the following probability function

x	-1	0	2
$f(x)$	k	$2k$	$3k$

(a) Determine the value of k

(b) Find $P(X<2)$ and $P(X \leq 2)$

(c)   Write down the distribution function of X

[END]

FOURTH SEMESTER B.Sc DEGREE EXAMINATION
(UG-CBCSSUG)
Statistics- Complementary
STA 4C 03– STATISTICAL TECHNIQUES FOR GEOGRAPHY

Time: 2 Hours   Max Marks: 60

SECTION-A
Each question carries 2 Marks.
Maximum Marks that can be scored in this section is 20.

1. What are the advantages of non- parametric test
2. What are contingency tables
3. Write down the test statistic of chi- square test for testing homogeneity
4. State three assumptions of ANOVA technique
5. Write any three assumptions associated with non parametric test
6. What is meant by a Statistical test? Give an example

7. Write down the test Statistic for testing the equality of means of two normal population
    whose variance are equal and when the sample sizes are small
8. Distinguish between Null and Alternative hypothesis
9. Define a quadrat
10. Distinguish between simple and composite hypothesis with example

11. What are the uses of t test
12. Define point pattern and area pattern

SECTION-B
Each question carries 5 Marks.
Maximum Marks that can be scored in this section is 30.

13. Briefly explain Kolmogorov- Smirnov goodness of fit test
14. Distinguish between random and systematic point pattern
15. The following are the marks obtained by 10 students in a certain examination

    Marks: 43   48   65   57   31   60   37   48   78   59
    Test the hypothesis that population variance is 100 (Test at 5% level of significance)

16. Write a short note on Run test

17. A sample of 25 items were taken from a population with SD 10 and the sample mean is
    found to be 65. Can it be regarded as a sample from a normal population with mean
    $\mu = 60.$ (use $\alpha = 5$)
18. Explain the chi- square test for independence of attribute

19. Sample sizes 10 and 18 taken from two normal population gave standard deviation
    14 and 20 respectively. Test the hypothesis that the samples have come from population
    with the same standard deviation at 5% level of significance

SECTION-C
(Answer *any one* question and carries 10 marks)

20. Explain variance mean ratio test

21. A trucking company wishes to test the average life of each of the three brands of tyres. The company uses all branches on randomly selected trucks. The records showing the lives (thousands of miles) of tyres are as given. Using ANOVA, test the hypothesis that the average life for each brand is the same

Brand I	Brand II	Brand III
6	6	2
1	3	5
5	4	6
2	3	7

[END]

COMPLEMENTARY COURSES OF B.Sc STATISTICS

Complementary 1: Mathematics
Complementary 2(A): Computer Science
        2(B): Mathematical Economics
        2(C): Actuarial Science