UNIVERSITY OF KALYANI

SYLLABUS FOR THREE-YEAR B.Sc. DEGREE COURSE

HONOURS IN STATISTICS

(PART I, PART II & PART III)

WITH EFFECT FROM THE ACADEMIC SESSION 2016-2017

UNIVERSITY OF KALYANI
Syllabus of Statistics (Honours)
With effect from 2016-2017

PART I (Total 200 marks: Theo. 150 + Prac. 50)

Paper & Topic	No. of Class/week	Marks	No. of Periods Gross	Net	Examination time duration
Paper I					4 Hours
Probability I	3	45	6 x 4 x 3 = 72	60	
Mathematical Methods I (Lin Alg + Real Analysis I)	2	30	6 x 4 x 2 =48	40	
Paper II					4 Hours
Descriptive Statistics	4	75	6 x 4 x 4 = 96	80	
Paper III(Pr) Based on Lin Alg & Des. Stat	4	50	6 x 4 x 4 = 96	80	4 Hours
	13	200		260	

PART II (Total 200 marks: Theo. 150 + Prac. 50)

Paper & Topic	No. of Class/week	Marks	No. of Periods Gross	Net	Examination time duration
Paper IV					4 Hours
Probability II	2	30	6 x 4 x 2 = 48	40	
Mathematical Methods II (Numerical Ana.+ Real Analysis II)	3	45	6 x 4 x 3 =72	60	
Paper V					4 Hours
Sampling Distribution	2	30	6 x 4 x 2 = 48	40	
Statistical Inference (Parametric Estimation & Testing)	3	45	6 x 4 x 2 = 72	60	
Paper VI(Pr) Based on Num Ana. & Stat. Inf.	4	50	6 x 4 x 4 = 96	80	4 Hours
	14	200		280	

PART III (Total 400 marks: Theo. 240 + Prac. 160)

Paper & Topic	No. of Class/week	Marks	No. of Periods Gross	Net	Examination time duration
Paper VII (Applied Statistics)					4 Hours
Economic Statistics	2	40	6 x 4 x 2 = 48	40	
Demography	1½	30	6 x 4 x 1½ = 36	30	
Indian Statistical System	½	10	6 x 4 x½ = 12	10	
Paper VIII Design of Expts, & ANOVA	3	50	6 x 4 x 3 = 72	60	4 Hours
Sampling Techniques	2	30	6 x 4 x 2 = 48	40	
Paper IX Sequential Analysis & Nonparametric Inference	2	30	6 x 4 x 2 = 48	40	
Large Sample Methods	2	30	6 x 4 x 2 = 48	40	4 Hours
Statistical Quality Control	1	20	6 x 4 x 1 = 24	20	
Paper X (Pr) Gr A: Eco + Demo + SQC	2	40	6 x 4 x 2 = 48	40	2 Hours
Gr B: ANOVA + Design + Samp. Tech.+ Nonpar.	2	40	6 x 4 x 2 = 48	40	2 Hours
Paper XI (Pr) (Computer Application) C Programming, Statistical Software	4	80	6 x 4 x 4 = 96	80	4 Hours
	22	400		440	

DETAILED SYLLABUS

Part I

Paper I

Probability I (45 Marks, Maximum No. of Lectures: 60)

Random Experiment, sample point, sample space, event, classical definition of probability and its limitations, statistical regularity and meaning of probability, probability by relative frequency, related exercises. (11)
Operations on events, fields of events, Kolmogorov's axiomatic definition of probability (detailed discussion on discrete sample space only). (6)
Results on probabilities of union and intersection of events, conditional probability, independence, Bayes' theorem and its applications, related exercises. (10)
Random variable, cumulative distribution function, of a r.v. and its properties, p.m.f. and p.d.f., expectation, variance, moments, quantiles with their properties, p.g.f. and m.g.f, with their properties. (8)
Standard univariate discrete distributions,: degenerate, discrete uniform, Bernoulli, binomial. hypergeometric, Poisson, geometric, negative binomial with their possible reproductive properties. (8)
Standard univariate continuous distributions: rectangular, normal, Cauchy, gamma, beta, exponential, Laplace, logistic, Pareto, lognormal distributions and their properties. (12)
Geometric probability. (3)
Truncated distributions: both discrete and continuous cases involving binomial and normal distributions with one-sided truncation only. (2)

References

1. Feller, W.: An Introduction to Probability Theory and its Applications, Wiley.
2. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol I, World Press.
3. Rohatgi, V. K.: An Introduction to Probability Theory and Mathematical Statistics, Wiley.
4. Hoel, P. J., Port, S. C. & Stone, C. J.: Introduction to Probability Theory, Vol I, Houghton Miffin & UBS.
5. Parzen, E.: Modern probability Theory and its Applications, Wiley.
6. Uspensky, J. V.,: Introduction to Mathematical probability, McGraw Hill.
7. Cacoullos, T.: Exercises in Probability, Narosa.
8. Pitman, J.: Probability, Narosa.
9. Chandra, T. K. & Chatterjee, D,: A First Course in Probability, Narosa.
10. Mukhopadhyay, P.: Mathematical Statistics.
11. Mukhopadhyay, P.: Theory of Probability.
12. Wilks, S. S.: Mathematical Statistics, Wiley.
13. Bhat, B. R.: Modern Probability Theory, New Age International.

Mathematical Methods I (30 Marks, Maximum No. of Lectures: 60)

Linear Algebra:

Vector: Vector space with a field of real numbers, addition and scalar multiplication of vectors, linear combination and linear independence, basis, dimension, subspace, inner-product, orthogonality and Gram-Schmidt process. (10)

Matrix: Definition, various types of matrices, matrix operations, elementary matrices, rank of a matrix and related results, inverse of a matrix, determinants, cofactors, properties of determinants, Laplace expansion, determinant and inverse of a partitioned matrix, reduction of a matrix to normal form, sweep-out and pivotal condensation methods, triangular reduction. (23)

Homogeneous and non-homogeneous system of linear equations, consistency. (6)

Characteristic equation, eigenvalues and eigenvectors and simple related results regarding real symmetric matrices. (5)

Quadratic forms,: classification, canonical reduction, spectral decomposition. (6)

Real Analysis I:

Function of one variable: limit, continuity and differentiability, mean-value theorems, maxima and minima. (10)

References

1. Shanti Narayan: A Text Book on Matrices, S. Chand
2. Hadley, G: Linear Algebra, Addison Wesley, Narosa.
3. Rao, A. R. and Bhimasankaram, P.: Linear Algebra.
4. Goldberg, R. R.: Methods of Real Analysis, Oxford & IBH.
5. Apostle: Calculus & Mathematical Analysis (Vol I & II)
6. Biswas, S.: A Text Book of Matrix Algebra.
7. Rao, C. R.: Linear Statistical Inference & its Applications, Wiley.

Paper II

Descriptive Statistics (75 Marks, Maximum No. of Lectures: 80)

Types of data: basic concepts, individual, population, sample, qualitative and quantitative data, nominal and ordinal data, cross-sectional and time series data, discrete and continuous data, frequency and non-frequency type data. (3)
Collection and scrutiny of data: primary and secondary data, method of collection, scrutiny of data for internal consistency and detection of errors. (2)
Presentation of data: compilation, tabulation, diagrammatic representation, frequency distribution, stem-and-leaf displays, column and bar diagram, pie diagram, divided bar diagram, histogram, frequency polygon and ogives, Box-plot. (4)
Descriptive measures on quantitative data: univariate data – measures of location, dispersion, relative dispersion, moments, quantiles, skewness and kurtosis, statement for Sheppard's correction for moments, moment inequalities, Gini's coefficient, Lorenz curves, related problems. (14)
Fitting of theoretical distributions to observed data. (3)
Bivariate data – scatter diagram, correlation coefficient and its properties, intra-class correlation with equal and unequal group sizes, concept of regression, principle of least squares, regression curves and related results, correlation index, correlation ratio and related inequalities, fitting of curve reducible to polynomials by transformation e.g. log, inverse etc., fitting by the method of group averages, rank correlation – Spearman's and Kendall's measures including tie cases. (22)
Regression diagnostics – residual plots, outliers, leverages and influential data points, Cook's distance. (4)
Descriptive measures on multivariate data – data mean vector and covariance matrix, multiple regression, multiple correlation, partial correlation and related results. (15)
Categorical data analysis – consistency of categorical data, independence and association of attributes, various measures of association for two-way and three-way classified data, odds ratio. (6)
Scaling of data – motivation of scaling, types of scales, nominal. ordinal, ratio and interval scales, measurement of psychological traits, scaling of items according to difficulty, scaling of test scores, scaling of rates and ranks, scaling of judgments. (7)

References

1. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol I, World Press.
2. Agresti, A.: Analysis of Ordinal Categorical Data.
3. - : An Introduction to Categorical Data Analysis, Wiley.
4. Guilford, J. P., & Fruchter, B.: Fundamental Statistics in Psychology and Education, McGraw Hill.
5. Yule, G. U. & Kendall, M. G.: An Introduction to Theory of Statistics, C. Griffin.
6. Kendall, M. G. & Stuart, A.: Advanced Theory of Statistics, Vol I & II.
7. Hogg, R. V., Tanis, E. A. & Zimmerman, D. L.: Probability and Statistical Inference. Pearson

Paper III (Practical)

Based on Linear Algebra and Descriptive Statistics.

Part II

Paper IV

Probability II (30 Marks, Maximum No. of Lectures: 40)

Bivariate case: c.d.f, p.m.f. and p.d.f., marginal and conditional distributions, independence, conditional expectation, conditional variance, correlation and regression, m.g.f., bivariate normal distribution with properties and related exercises. (12)

Probability inequalities: Markov's and Chebyshev's inequalities, limit theorems, convergence in probability, weak law of large numbers and its applications, convergence in distribution, convergence of binomial to Poisson, Poisson to normal, Central Limit Theorem (statement of iid case only) and its applications, including DeMoivre-Laplace limit theorem. (12)

Multivariate case: Random vector, mean vector, dispersion matrix, marginal and conditional distributions, ellipsoid of concentration, multiple regression, multiple correlation, partial correlation. (11)
Multivariate distributions: multinomial, multivariate normal and their properties. (5)

References

1. Feller, W. An Introduction to Probability Theory and its Applications, Wiley.
2. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol I, World Press.
3. Rohatgi, V. K.: An Introduction to Probability Theory and Mathematical Statistics, Wiley.
4. Hoel, P. J., Port, S. C. & Stone, C. J.: Introduction to Probability Theory, Vol I, Houghton Miffin & UBS
5. Pitman, J.: Probability, Narosa
6. Chandra, T. K. & Chatterjee, D,: A First Course in Probability, Narosa.
7. Bhat, B. R.: Modern Probability Theory.
8. Mukhopadhyay, P.: Theory of Probability.
9. Cramer, H: Mathematical Methods of Statistics.
10. Wilks, S. S.: Mathematical Statistics.

Mathematical Methods II (45 Marks, Maximum No. of Lectures: 60)

Numerical Analysis (20 marks):
Approximation of numbers and functions, absolute and relative errors, Δ and E operators, separation of symbols using Δ and E operators. (3)
Difference table, interpolation by Newton's forward and backward formula with error terms, Lagrange's formula, divided difference table, Newton's divided difference formula, Stirling's and Bessel's central difference interpolation formula. (10)
Numerical differentiation and its applications. (1)
Numerical integration, quadrature formula, trapezoidal, Simpson's ⅓ rd and ⅜ th rules. (2)
Numerical solution of equations, bisection, iterative and Newton-Raphson methods in one unknown, conditions of convergence, extension to two unknowns. (4)
Euler-Maclaurin's sum formula, Stirling's approximation to n!. (2)

Real Analysis II (25 marks):
Sequences and series of real numbers, convergence, Cauchy criterion and simple tests for convergence, power series. (10)
Riemann integral, integration by parts, change of variables, improper integral, beta and gamma integrals. (10)
Sequences and series of functions, pointwise convergence, uniform convergence and absolute convergence, simple tests of convergence. (6)
Functions of several variables, partial derivatives, maxima and minima, applications of Lagrangian multipliers, multiple integrals, transformations and Jacobians (statement and examples), polar and orthogonal transformations, Dirichlet integral. (12)

References

1. Goldberg, R. R.: Methods of Real Analysis, Oxford & IBH.
2. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol I, World Press.
3. Shanti Narayan: Mathematical Analysis, S. Chand.
4. Scarborough, J. B.: Numerical Mathematical Analysis, Oxford University Press.
5. Jain, M. K., Iyenger, S. R. K. & Jain R. K.: Numerical Methods for Scientific and Engineering Computation, New Age.
6. Saxena, H. C.: The Calculus of Finite Differences, S. Chand.
7. Freeman, H.: Finite Differences for Actuarial Students, Cambridge University Press.
8. Malik, S. C. & Arora, S. S.: Mathematical Analysis.
9. Aitkinson, K.: Elementary Numerical Analysis, Wiley.

Paper V

Sampling Distribution (30 Marks, Maximum No. of Lectures: 40)

Concept of random sampling, statistics and sampling distribution of statistics, different methods for finding sampling distributions of statistics, derivation of the distribution of sample total of binomial and Poisson variables, and related conditional distributions of a single observation given the sum. (5)
Distributions of the sum of two i.i.d. rectangular and sum and ratio of two independent gamma variables and sum of two independent beta variables. (4)
Distribution of linear functions of independent normal variables, ratio of two independent normal variables, central χ^2, t and F distributions. (7)
Sampling distributions of mean and variance of a random sample from a normal population. (3)
Sampling distribution of the statistics related to testing the equality of means of k homoscaedastic normal populations. (5)
Sampling distributions of means, variances and correlation coefficient of a random sample from a bivariate normal distribution, distribution of sample regression coefficient for both stochastic and non-stochastic independent variable cases. (8)
Distribution of sample order statistics from continuous populations, sample range and quantiles. (8)

References

1. Hogg, R. V. & Craig, A. T.: Introduction to Mathematical Statistics, Collier.
2 Gun, A. M., Gupta, M. K. & Dasgupta, B.: An Outline of Statistical Theory, vol I, World Press.
3 Rao, C. R.: Linear Statistical Inference & its Applications, Wiley.
4 Rohatgi, V. K. & Saleh, A. K. M. E.: An Introduction to Probability Theory and Mathematical Statistics, 2nd Ed., Wiley.
5 Mukhopadhyay, P.: Theory of Probability.
6 Mukhopadhyay, P.: Mathematical Statistics.
7 David and Nadaraja: Order Statistics.

Statistical Inference: Parametric Estimation & Testing (45 Marks, Maximum No. of Lectures: 60)

Estimation - data reduction, sufficiency, factorization theorem (proof in discrete case only). (4)
Point estimation – properties of estimators, mean square error MSE) and minimum MSE estimator, unbiasedness and minimum variance unbiased estimator (MVUE), Rao-Cramer lower bound and related results, Rao-Blackwell theorem, relative efficiency of an estimator, amount of information. (10)
Consistency, notion of asymptotic efficiency. (2)
Methods of estimation – method of moments, method of maximum likelihood (including proof of large sample properties), method of minimum chi-square, method of least squares. (12)

Testing of hypothesis – statistical hypotheses, simple and composite hypotheses, statistical tests, two types of errors, level of significance, p-value, size of a test, power of a test, unbiased tests. (4)
Most powerful (MP), uniformly most powerful (UMP) and uniformly most powerful unbiased (UMPU) tests, randomized and non-randomized tests, Fundamental Neyman-Pearson lemma (proof of sufficiency part only) and its use in the construction of MP and UMP tests (single parameter with range independent of parameter), power curves. (10)
Tests of Significance related to a single binomial proportion and Poisson parameter; two binomial proportions and Poisson parameters; the mean(s) and variance(s) of a single univariate normal distribution, two independent normal distributions and a single bivariate normal distribution; regression and correlation coefficients of a single bivariate normal distribution, combination of probabilities in tests of significance, likelihood ratio test, its applications in connection with univariate normal and for the equality of means and variances of several univariate normal populations. (12)
Interval estimation: confidence intervals and confidence sets, confidence coefficient, confidence intervals for the parameters of univariate normal, two independent normal and one parameter exponential distribution. (4)

References

1 Hogg, R. V. & Craig, A. T.: Introduction to Mathematical Statistics, Collier.
2 Gun, A. M., Gupta, M. K. & Dasgupta, B.: An Outline of Statistical Theory, vol II, World Press.
3 Rao, C. R.: Linear Statistical Inference & its Applications, Wiley
4 Rohatgi, V. K. & Saleh, A. K. M. E.: An Introduction to Probability Theory and Mathematical Statistics, 2nd Ed., Wiley.
5 Mukhopadhyay, P.: Mathematical Statistics.
6 Santhakumaran, A.: Fundamentals of Testing Statistical Hypotheses.
7 Casella, E. & Berger, J. O.: Statistical Inference, Thompson.
8 Kale, B. K.: Parametric Inference.
9 Kendall, M. G. & Stuart, A.: The Advanced Theory of Statistics, Charles Griffin.

Paper VI (Practical)

Based on Numerical Analysis and Statistical Inference.

Part III

Paper VII

Economic Statistics (40 Marks, Maximum No. of Lectures: 40)

Index Numbers:
Price, quantity and value indices, problem of construction of index numbers: Laspeyre's, Paasches', Edgeworth-Marshall's and Fisher's ideal index number formulae, chain-base index numbers, tests for index numbers: time and factor reversal tests, circular test. (8)
Some important indices: consumer price index, wholesale price index – methods of construction and uses. (3)

Time Series:
Introduction: Examples of time series from various fields, components of a times series, additive and multiplicative models. (2)
Trend and seasonal components: estimation of trend by linear filtering (simple and weighted moving averages) and curve fitting (polynomial, exponential and Gompertz), detrending, estimation of seasonal component by ratio-to-moving-average method, ratio to trend method, deseasonalization.(8)
Stationary Time series: weak stationarity, autocorrelation function and correlogram. (3)
Some Special Processes: moving-average (MA) process and autoregressive (AR) process of orders one and two, estimation of the parameters of AR(1) and AR(2) – Yule-Walker equations. (6)
Exponential smoothing method of forecasting. (2)

Demand Analysis:
Theory and analysis of consumer demand: law of demand, price elasticity of demand, Engel curve – its different forms and properties, income elasticity of demand, estimation of Engel curves from family budget data by weighted least squares method. (8)

References

1. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol II, World Press.
2. Mukhopadhyay, P.: Applied Statistics.
3. Prais & Houthakker: Analysis of Family Budget Data.
4. Kendall. M. G. & Stuart, A.: The Advanced Theory of Statistics, Vol III, Charles Griffin.
5. Chatfield, C.: The Analysis of Time Series – An Introduction, Chapman & Hall.
6. Allen, R. G. D.: Index Numbers in Theory and Practice, Macmillan.
7. Brockwell, P. J. & Davis, R. A.: Introduction to Time Series and Forecasting, Springer-Verlag.

Demography (30 Marks, Maximum No. of Lectures: 30)

Sources of demographic data, errors in census and registration data and their adjustments. (2)
Measurement of morbidity and mortality, standardization of death rates, cause-of-death rate, infant mortality rate, maternal mortality rate, birth rates: CBR, GFR, age-specific birth rates, TFR, GRR and NRR. (10)
Complete life table – description, cohort, stable population and stationary population, notion of abridged life table and construction by Chiang's method. (12)
Graduation of mortality rates by Gompertz and Makeham's laws, logistic curve and its fitting by Rhodes' method for population forecasting. (5)

References

1. Gun, A. M., Gupta, M. K. & Dasgupta, B: Fundamentals of Statistics vol II, World Press.
2. Mukhopadhyay, P.: Applied Statistics.
3. Bhaskar D. Misra: An Introduction to the Study of Population, South Asian Publishers.
4. Biswas, S.: Demography.

Indian Statistical System (10 Marks, Maximum No. of Lectures: 10)

The statistical system in India: the central and state governmental organizations, functions of the Central Statistical Organization (CSO), The National Sample Survey Organization (NSSO) and West Bengal Bureau of Applied Economics and Statistics (WBBAES). (6)
Sources of official statistics in India and West Bengal relating to population, agriculture, industry, trade, price and employment. (2)
Brief ideas of National Income Statistics. (2)

References

1. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol II, World Press.
2. Saluja, M. P.: Indian Official Systems, Statistical Publishing Society.
3. Statistical System in India (1984) – CSO.

Paper VIII

Analysis of Variance & Design of Experiments (50 Marks, Maximum No. of Lectures: 60)

General introduction: linear models, linear parametric function, method of least squares, statement of Gauss-Markov theorem, SS due to linear function of observations, test of general linear hypothesis. (5)

Analysis of Variance (ANOVA):
Application of the ANOVA technique to one-way classified data, two-way classified data with equal number of observations per cell (fixed, random and mixed effects), testing simple regression coefficients, correlation ratio, linearity of simple regression and partial correlation coefficients. (10)

Design of Experiments:
Principles of experimental design: randomization, replication and local control, uniformity trials. (5)
Standard designs and their analyses: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Split plot design and strip arrangements, comparison of efficiencies, application of the ANOVA technique for the analysis of above designs. (16)
Group of experiments using RBD and LSD. (4)
Factorial experiments: advantages, 2^n – experiments, total and partial confounding: analysis and construction. (10)
Analysis of covariance (ANCOVA): Application of the ANCOVA technique to one-way classified data and to two-way classified data with equal number of observations per cell, use of ANCOVA to control the error in LSD. (5)
Missing plot technique: analysis of one missing plot in RBD and in LSD. (5)

References

1. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol II, World Press.
2. Mukhopadhyay, P.: Applied Statistics.
3. Scheffe, H.: The Analysis of Variance, Wiley.
4. Kempthorne, O.: The Design and Analysis of Experiments, Wiley.
5. Montgomery, D. C.: Design and Analysis of Experiments.
6. Cochran, W. G. & Cox, G. M.: Experimental Designs, Wiley.
7. Federer, W. T.: Experimental Designs – Theory and Applications, Oxford & IBH.
8. Das, M. N. & Giri, N. C.: Design and Analysis of Experiments, Wiley Eastern.

Sampling Techniques (30 Marks, Maximum No. of Lectures: 40)

Introduction: Concept of a finite population and a sample, need for sampling, complete enumeration and sample surveys. (3)
General ideas: planning and execution of sample surveys, analysis of data and reporting, biases and errors, judgment and probability sampling, tables of random numbers and their uses. (5)
Basic sampling and estimation procedures: simple random sampling with and without replacement, stratified random sampling, linear and circular systematic sampling, cluster sampling, two-stage (with equal –sized first stage units) sampling with equal selection probabilities at each stage, associated unbiased estimators of population total, mean and proportion, their variances and unbiased variance estimators, determination of sample size in simple random sampling, allocation problem in stratified random sampling and optimum choice of sampling and sub-sampling fractions in two-stage sampling. (21)
Ratio and regression methods of estimation in simple random sampling. (5)
Double sampling for ratio and regression estimators, PPSWR sampling. (2)
Interpenetrating sub-sampling technique for unbiased variance estimation and its applications. (2)
Randomized response technique: Warner's model. (2)

References

1. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol II, World Press.
2. Mukhopadhyay, P.: Theory and Methods of Survey Sampling, Prentice Hall.
3. Murthy, M. N.: Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
4. Des Raj & Chhandok, P.: Sample Survey Theory, Narosa.
5. Cochran, W. G.: Sampling Techniques 3rd ed., Wiley.
6. Sukhatme, P. V. & Sukhatme, B. V.: Sampling Theory of Surveys with Applications.

Paper IX

Sequential Analysis and Nonparametric Inference (30 Marks, Maximum No. of Lectures: 40)

Sequential Analysis:
Need for sequential inference, Wald's SPRT with illustrations, approximate determination of boundaries, expressions for OC and ASN functions (without proof) of tests regarding parameters of binomial. Poisson and normal distributions. (12)

Nonparametric Inference:
Need for nonparametric inference, sample median and interquartile range as point estimators of location and dispersion, distribution-free estimation of population quantiles, tolerance interval, sign test, run test, median test and test based on Kendall's t, test for randomness. (20)

References

1. Gibbons, J. D.: Nonparametric Statistical Inference, McGraw Hill.
2. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol I, World Press.
3. Gun, A. M., Gupta, M. K. & Dasgupta, B.: An Outline of Statistical Theory, vol II, World Press.
4. Rohatgi, V. K.: An Introduction to Probability Theory and Mathematical Statistics, Wiley.
5. Rohatgi, V. K.: Statistical Inference, Wiley.
6. Rao, C. R.: Linear Statistical Inference & its Applications, Wiley.

Large Sample Methods (30 Marks, Maximum No. of Lectures: 40)

Large Sample Methods:
Use of CLT for deriving large sample tests for binomial proportions, difference of two binomial proportions, mean of a population and difference of means of two independent populations, related confidence intervals. (5)
Large sample standard error: derivation of large sample standard error of an estimator (T_1, T_2, , T_k) of (θ_1, θ_2,., θ_k), sample moments, standard deviation, coefficient of variation, b_1 and b_2 and correlation coefficient, uses of these standard errors in large sample tests and interval estimation. (12)
Transformations of statistics to stabilize variance: derivation of $\sin^{-1}$, square-root, logarithmic and z transformations and their uses in large sample tests and interval estimation. (8)
Derivation of the large sample distribution of Pearsonian χ^2 statistic and its use in test of independence, homogeneity and goodness of fit. (8)

References

1. Cramer, H.: Mathematical Methods of Statistics, Princeton University Press.
2. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol I, World Press.
3. Gun, A. M., Gupta, M. K. & Dasgupta, B.: An Outline of Statistical Theory, vol II, World Press.
4. Rohatgi, V. K.: An Introduction to Probability Theory and Mathematical Statistics, Wiley.
5. Rao, C. R.: Linear Statistical Inference & its Applications, Wiley.
6. Kendall. M. G. & Stuart, A.: The Advanced Theory of Statistics, vol III, Charles Griffin.

Statistical Quality Control (20 Marks, Maximum No. of Lectures: 20)

Concepts of quality and quality control, process control and product control. (3)

Process Control: Control charts and their uses, choice of subgroup sizes, construction and interpretation of x, R and s.d., p, np and c charts with fixed and variable subgroup sizes, modified control charts. (6)

Product Control: Acceptance sampling plan, single and double sampling plans by attributes, OC, ASN (and ATI), AOQ curves, LTPD and AOQL, singe sampling plan for inspection by variables (one-sided specification, known and unknown σ cases), use of IS plans and tables. (11)

References

1. Gun, A. M., Gupta, M. K. & Dasgupta, B.: Fundamentals of Statistics vol II, World Press.
2. Duncan, A. J.: Quality Control and Industrial Statistics, 4th Ed., Richard D Irwin.
3. Montgomery, D. C.: Introduction to the Statistical Quality Control, 2nd Ed., Wiley.
4. Grant, E. L. & Leavenworth: Statistical Quality Control, McGraw Hill.

Paper X (Practical)

Group A: Based on Economic Statistics, Demography and SQC.

Group B: Based on ANOVA, Design of Experiments, Sampling Techniques and Nonparametric Inference.

Paper XI (Practical)

Computer Application

C Programming:
Programming preliminaries in C – structure of C language, lexical elements of C, programming environment in C, operators and modes of arithmetic operations.
Input-output in C – input-output functions and their format specifications, C control structure, unconditional (*go to*) control, conditional (*if-then-else*) control, loop control, *for* loop, *while* loop, *do-while* loop.
C functions – library functions, user-defined functions, functions declaration.

Some suggested problems:

(i) Interpolation by Newton's forward and Lagrange's formula.
(ii) Numerical integration by trapezoidal and Simpson's ⅓ rd rule.
(iii) Solution of transcendental equations by bisection, iteration and Newton-Raphson methods.
(iv) Factorial of a positive integer.
(v) Ordering of a given set of numbers.

(vi) Mean, variance and quantiles for ungrouped data.
(vii) Correlation coefficient for ungrouped data.
(viii) Fitting of straight line and exponential curve to given data.
(ix) Fitting of binomial and Poisson distributions.
(x) Calculating correlation coefficient for grouped data.
(xi) Inverting non-singular matrices (up to order 4).

Use of Statistical Software:

MS-EXCEL

(i) Use of Spreadsheet.
(ii) Drawing diagrams – bar, column, line, pie, scatter.
(iii) Use of functions – mathematical, statistical and logical.
(iv) Line diagrams showing different types of time series data, determination of trend by moving averages and curve fitting methods, plotting fitted values.
(v) Exponential smoothing of a time series.

MINITAB

Use of MINITAB using the options under `CALCULATION' and `STATISTICS'.

Some suggested problems:

(i) Basic statistics – display, descriptive measures (univariate ony), one-sample z and t tests, two-sample and paired t tests for proportion, tests for one and two variances and correlations.
(ii) Regression: Linear and multiple regression – fitted and residual plots.
(iii) ANOVA: one-way and two-way classified data.
(iv) Control charts: mean, mean-range, mean-s.d., proportion, number of defectives, number of defects charts.

References

1. Balagurusamy, E: Programming in ANSI C, 3rd Ed., Tata McGraw Hill.
2. Gottfried: Programming with C, Schaum's Outline Series.
3. Jayasri, The C Language Trainer with C Graphics and C++.
4. Kernighan and Ritchie: The C Programming Language.

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