

UNIVERSITY OF KALYANI

SYLLABUS

FOR THREE YEARS B.Sc. DEGREE COURSE

(HONOURS)


IN

STATISTICS

**According to the New Examination Pattern
Part – I, Part- II & Part- III**

WITH EFFECT FROM THE SESSION

2008 - 2009



27/05/2008
**Secretary, Faculty Councils (U.G.)
University of Kalyani
Kalyani, Nadia**

University of Kalyani
Syllabus of Statistics
w.e.f. the session 2008-2009

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Honours Course

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Part - I : (Theo. 150+ Prac. 50)

	Marks	No. of Periods		
		Gross	Net(for course preparation)	
Paper – I: Prob I (3)	45	$6 \times 4 \times 3 = 72$	60	
Mathematical Methods I (2) (Linear Alg.+ Real Ana. I)	30	$6 \times 4 \times 2 = 48$	40	
Paper- II: Descriptive Statistics (4)	75	$6 \times 4 \times 4 = 96$	80	
	150			
Paper- III (Prac.): Based on Linear Alg. & Descriptive Statistics (2+2=4)	50	$6 \times 4 \times 4 = 96$	80	
	13	200	$6 \times 4 \times 13 = 312$	260

Part – II : (Theo. 150 + Prac. 50)

Paper – IV : Prob II (2)	30	$6 \times 4 \times 2 = 48$	40	
Mathematical Methods II. (3) (Numerical Ana. + Real Ana. II)	45	$6 \times 4 \times 3 = 72$	60	
Paper – V : Sampling distribution (2)	30	$6 \times 4 \times 2 = 48$	40	
Statistical Inference : Parametric Estimation & Testing (3)	45	$6 \times 4 \times 3 = 72$	60	
	150			
Paper – VI (Prac.) : Numerical Ana. & Estimation and Testing(4)	50	$6 \times 4 \times 4 = 96$	80	
	14	200	$6 \times 4 \times 14 = 336$	280


(i)

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Part – III (Theo. 240 + Prac. 160)

		Marks	No. of Periods	
			Gross	Net (for course preparation)
Paper – VII : Appl. Statistics :				
Economic Statistics	(2)	40	$6 \times 4 \times 2 = 48$	40
Demography	(1 ½)	30	$6 \times 4 \times 1\frac{1}{2} = 36$	30
Indian Statistical System	(½)	10	$6 \times 4 \times \frac{1}{2} = 12$	10
Paper –VIII : Design of Expts. & ANOVA (3)				
	(3)	50	$6 \times 4 \times 3 = 72$	60
Sampling Techniques	(2)	30	$6 \times 4 \times 2 = 48$	40
Paper IX : Sequential Analysis & Non-parametric Inference (2)				
	(2)	30	$6 \times 4 \times 2 = 48$	40
Large Sample Methods	(2)	30	$6 \times 4 \times 2 = 48$	40
SQC	(1)	20	$6 \times 4 \times 1 = 24$	20
Paper X (Prac.) :				
Gr. A : Econ. + Demo. +SQC	(2)	40	$6 \times 4 \times 2 = 48$	40
Gr. B : ANOVA + Design + Sample Survey + Non-Para	(2)	40	$6 \times 4 \times 2 = 48$	40
Paper XI (Prac.) : Computer Application : C Programming & Statistical Softwares. (4)				
	(4)	80	$6 \times 4 \times 4 = 96$	80
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	22	400	$6 \times 4 \times 22 = 528$	440


(ii)


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Honours Course in Statistics

Part I

Paper I, II & III


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Part - I

Paper I

Prob I (45 marks)

Max : 60 L

Random Experiment, sample point, sample space, event, classical definition of prob. and limit ations, Statistical regularity and meaning of probability, prob. by rel. freq., geometric prob., related exercises. (11)

Operation on events, field of events, Kolmogorov's axiomatic definition of prob. (detailed discussion on discrete space only). (6)

Results on prob. of union and intersection of events, conditional prob., independence, Bayes' theo. and its applications. Related exercises. (10)

Random variable,(Cumulative)distribution function (c.d.f.) 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, hyper - geometric, Poisson, geometric, negative binomial with their possible reproductive properties. (8)

Standard univariate continuous distributions : Rectangular, Normal, Cauchy, gamma, beta, exponential, Laplace , logistic, Pareto, log – normal distributions and their properties. (12)

Geometric probability. (3)

Truncated distribution – both discrete and cont. cases involving binomial and normal distributions with one sided truncation only. (2)

60

References :

- 1) Feller W. (1968) ; An Introduction to probability Theory & its Applications, John Willy
- 2) Goon,A.M., Gupta, M.K. & Dasgupta, B : Fundamentals of Statistics, Vol. 1 – World Press.
- 3) Rohatgi, V.K.(1984) : An Intro. to Prob. Theory and Mathematical Statistics, John Wiley.
- 4) Hoel, P.J., Port, S.C. & Stone, C.J. () : Introduction to Probability Theory (Vol -1)
Houghton Mifflin & UBS.
- 5) Prazen, E. (1972) : Modern Probability Theory and its Applications, John Wiley
- 6) Uspensky, J.V. (1937) : Introduction to Mathematical Probability, Mc Graw Hill
- 7) Cacoullos, T. (1973) : Exercises in Probability, Narosa
- 8) Pitman, J. (1993) : Probability , Narosa
- 9) Chandra, T.K. & Chatterjee, D. (2001) : A First Course In Probability, Narosa
- 10) Mukhopadhyay, P. (1996) : Mathematical Statistics
- 11) Mukhopadhyay, P. () : Theory of Probability
- 12) Wilks, S.S. (1962) : Mathematical Statistics , Wiley.
- 13) Bhat, B.R. () : Modern Probability Theory

Mathematical Methods I (Marks : 30)**Max. 60 L****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 partitied matrix, reduction of matrix to a norma l form, sweep-out and pivotal condensation methods, triangular reduction. (23)

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

Characteristic equation , eigenvalues and eigenvectors and simple related results r egarding real symmetric matrix. (5)

Quadratic forms : Classification, Canonical reductio n, spectral decomposition (6)

Real Analysis I :

Function of one variable : Limits, continuity and differentiability. Mean value theorems, maxima, minima. (10)

References :-----
60 L

1. Shanti Narayan : A text book on Matrices.
2. Hadley, G.(1995) : Linear Algebra Addison Wisley, Narosa
3. Rao, A.R. & Bhimasankaram, P. (1996) : Linear Algebra
4. Goldberg, R.R. (1970) : Methods of Real Analysis, Oxford & IBH
5. Apostle (1968) : Vol I & II, Calculus and Mathematical Analysis
6. Biswas, S. : A text book on Matrix algebra
7. Rao, C.R. (1973) : Linear Statistical Inference
8. Lay, David , C. : Linear Algebra and its application, Addison and Wesley.

Paper II

Descriptive Statistics (75 marks)

Max. : 80 L

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 data. (3)

Collection and Scrutiny of data : Primary and secondary data, method of collection, scrutiny of data for internal Consistency and detection of errors. (1)

Presentation of data : Compilation ,tabulation, diagrammatic representation, frequency distribution , stem - and -leaf displays , column or bar diagram , pie diagram , divided bar diagram , histogram , frequency polygon and ogives , Box Plot. (6)

Descriptive Measure on Quantitative data : **Univariate data** : Measures of location , dispersion , relative dispersion , moments , quantiles , skewness and kurtosis , statement of Sheppard's correction for moments , moment inequalities , Gini's coefficient , Lorenze curves , related problems. (16)

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 curves reducible to polynomials by transformation e.g. log , in verse etc. Fitting by the method of group averages, rank correlation – Spearman's and Kendall's measures including tie cases. (26)

Descriptive Measure 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)

80 L

References :

- 1) Goon,A.M., Gupta, M.K. & Dasgupta, B : Fundamentals of Statistics, Vol. 1 – World Press, Kolkata
- 2) Agresti, a. (1984) : Analysis of Ordinal Categorical data
- 3) _____ (1996) : An Introduction to Categorical Data Analysis. John Wiley & Sons
- 4) Guilford, J.P. and Fruchter, B. (1980) : Fundamental Statistics in Psychology and Education, Mc Graw Hill.
- 5) Yule, G.U. & Kendall, M.G. ; An Introduction to the Theory of Statistics. C. Griffin
- 6) Kendall, M.G. and Stuart, A. : Advanced Theory of Statistics, Vol -I & Vol-II


Paper- III (Prac.)

Based on Linear Alg.& Descriptive Statistics

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Part II

Paper IV , V & VI


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Part – II

Paper IV

Prob II (30 marks)

Max : 40 L

Bivariate case : cdf, pmf and pdf, marginal and conditional distributions, independence, conditional expectation, conditional variance, correlation and regression, mgf, bivariate normal distribution with its properties and related exercises. (12)

Probability inequalities : Markov's and Chebyshev's inequalities, limit theorems : Convergence in prob., weak law large numbers and its applications, convergence in distribution, convergence of binomial to Poisson, Poisson to normal, central limit theorem(statement of i.i.d. case only) and its application (including De Moivre - 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)

40 L

References :

- 1) Feller, W. (1968) ; An Introduction to probability Theory & its Applications, John Willy
- 2) Goon,A.M., Gupta, M.K. & Dasgupta, B : An Outline of Statistics theory , Vol. 1 – World Press.
Roatgi, V.K.(1984) : An Intro. To Prob. Theory and Mathematical Statistics, John Wiley
- 3) Hoel, P.J., Port, S.C. & Stone, C.J. () : Introduction to Probability Theory (Vol -1)
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- 4) Cacoullous, T. (1973) : Exercises in Probability. Narosa
- 5) Pitman, J. (1993) : Probability , Narosa
- 6) Chandra, T.K. & Chatterjee, D. (2001) : A First Course in Probability, Narosa
- 7) Bhat, B.R. (1999) : Modern Probability Theory, New Age International
- 8) Mukhopadhyay, P. (1996) : Mathematical Statistics
- 9) Mukhopadhyay, P. (1996) : The ory of Probability
- 10) Cramer, H. (1962) : Mathematical Statistics
- 11) Wilks, S.S. : Mathematical Statistics


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Mathematical Methods II (45 marks)**Max. 60 L****Numerical Analysis : (20 marks)**

1. Approximation of numbers and functions, Absolute and relative errors, and E operators, separation of symbols using and E operators. (3)
2. Difference table, Interpolation by Newton's forward, backward formula with error terms, Lagrange's formula, Divided difference table, Newton's divided diff. formula, Stirling's and Bessel's Central interpolation formulae. (10)
3. Numerical differentiation and its application. (1)
4. Numerical Intergration : Quadrature Formula ; Trapizoidal, Simpson 1/3rd and 3/8th rules. (2)
5. Numerical solution of equations : Bisection ; iterative and Newton - Raphson methods in one unknown. Conditions of convergence, Extension to two unknowns. (4)
6. Euler- Maclaurin's sum formula, Stirling's approximation to factorial. (2)

 22 L
Real Analysis II (25 Marks)

Sequences and Series of real numbers, convergence, Cauchy criterion and simple test for convergence, power series. (10 L)

Reimann Intergral; Integration by parts, change of variables, Improper Integral; beta and gamma integrals. (10 L)

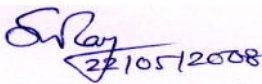
Sequences and series of functions, pointwise convergence, uniform convergence and absolute convergence, simple tests of convergence. (6 L)

Function of several variables , partial derives, maxima and minima, applications of Lagrangian multiplies, multiple integrals, transformations and Jacobians (Statement and examples), Polar and Orthogonal transformations, Dirichlet integral. (12L)

 38 L

 60 L
References:

1. Goldberg, R.R. (1970) : Methods of Real Analysis, Oxford & IBH
2. Shanti Narayan (1993) : Mathematical Analysis, S. Chand and co.
3. J.B. Scarborough : Numerical Analysis
4. Jain, M.K., Iyenger, S.R.K. & Jain, R.K. : Numerical Methods for Scientific and Engineering Computation. New Age international.Apostle
5. Saxena , H.C. : The Calculus of Finite Differences. S.Chand & Comp., New Delhi.
6. Goon,A.M., Gupta, M.K. & Dasgupta, B : Fundamenta ls of Statistics, Vol. 1 – World Press
7. Freeman , H. (1962) : Finite Differences for Actuarial Students, Cambridge University Press.
8. Malik and Arora
9. Aitkinson, K. : Elementary Numerical Analysis, Wiley


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Paper V

Sampling Distributions (30 marks)

Max. 40 L

Concept of Random sampling, Statistics and sampling distribution of statistics. Different methods for finding sampling distributions of statistics. Derivation of the distribution of the 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 iid rectangular and sum & ratio of two independent Gamma variables and sum of two independent beta variables. (3)

Distribution of linear function of independent normal variables, ratio of two independent normal variables; central χ^2 , t & 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 homoscedastic normal populations. (5)

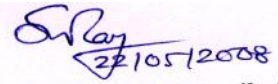
Sampling distributions of means, variances and correlation co-efficient of a random sample from a bivariate normal distribution. Distribution of sample regression co-efficient for both stochastic and non-stochastic independent variable cases. (8)

Distribution of sample order statistics from continuous populations, sample range and coverage. (8)

39 L

References:

1. Hogg, R.V. & Craig, A.T. (1978): Introduction to Mathematical Statistics, Collier Macmillan Pub.
2. Goon,A.M., Gupta, M.K. & Dasgupta, B : An Outline of Statistical Theory, Vol.2, world Press, Kolkata
3. Rao, C.R.: Linear Statistical Inference and Its applications, Wiley Eastern..
4. Rohatgi, V.K.(1986) : An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern
5. Mukhopadhyay, P. () : Theory of Probability
6. Mukhopadhyay, P. : Mathematical Statistics.
7. David and Nadaraja : Order Statistics


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Estimation and Testing (45 marks)**Max 60 L****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 estimators (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 (excluding proof of large-sample properties), method of minimum chi -square, method of least- squares. (12)

Testing of hypotheses: statistical hypotheses – simple and composite 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 (NP) 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 curve. (10)

Exact tests of significance relating to binomial, Poisson and normal parameters. (3)

Likelihood ratio test, its applications in connection with univariate normal and for the quality of means and variances of several univariate normal populations. (6)

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. (5)

56 L**References:**

1. Goon,A.M., Gupta, M.K. & Dasgupta, B : An Outline of Statistical Theory , Vol. 2 – World Press, Kolkata.
2. Rohatgi, V.K.& Saleh, A.K.M.E. : An Intro. To Prob. Theory and Mathematical Statistics, 2nd Ed., John Wiley.
3. Mukhopadhyay, P. : Mathematical Statistics.
4. Santhakumaran, A. (2001) : Fundamentals of Testing Statistical Hypotheses, Pub.
5. Rao, C.R.: Linear Statistical Inference and Its applications, Wiley Eastern .
6. Casella & Berger : Stat. Inf., Thompson
7. Kale, B.K. : Parametric Inference
8. Hogg & Craig : Introduction to Mathematical Statistics.
9. Kendall, M.G. & Stuart, A. (vol-2): The Adv. Theo. of Stat., Charles Griffin.


Paper VI (Prac.)**Numerical Ana. & Estimation and Testing (4)**

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University of Kalyani
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Part III

Paper VII, VIII, IX & X


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Part – III**Paper VII****Economic Statistics: (40 marks)****Max 40L****Index Numbers****(10L)**

Price, Quantity and value indices, Problem of Construction of index numbers: Laspeyre's, Paasche's, Edgeworth-Marshall's, Fisher's ideal formulae, chain base index number, Test for index numbers: Time and Factor reversal tests, Circular test. (8L)

Some important indices: consumer prices index, wholesale price index- methods of construction and uses. (2L)

Total (10L)**Time Series****(22L)**

Economic Time series, different components, additive and multiplicative models, determination of trend, by moving average and mathematical curve fitting, Slutsky-Yule effect, analysis of seasonal fluctuation, construction of seasonal indices. (11L)

Stationary Time Series - Weak stationary, definition of Auto Regression (AR), Moving Average (MA) processes ; Discrimination between AR(1) AR(2), MA(1), and MA(2) processes by Correlogram analysis. Sample autocorrelation, Estimation of parameters of AR(1) and AR(2) processes. (8L)

Forecasting : Exponential smoothing and Holt -Winter's method. (3L)

Demand Analysis**(10L)**

Theory and analysis of consumer's 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. (10L)

References:

1. Goon,A.M., Gupta, M.K. & Dasgupta, B : Fundamentals of Statistics, Vol. II – World Press, Kolkata.
2. Parimal Mukhopadhyay : Applied Statistics.
3. Prais & Houthakker – Analysis of family budget data.
4. Kendall, M.G. & Stuart, A : The Advanced Theory of Statistics, Vol. III.
5. Chatfield, C. (1980) : The Analysis of Time Series – An Introduction , Chapman & Hall.
6. Allen, R.G.D. : Index Numbers in Theory and Practice, Mc. Millon Press Ltd.
7. Brokwell, P.J. & Davis R.A. : Intro. To Time Series and Forecasting, Springer -Verlag.
8. Nagar & Das.

Demography (30 marks)**Max : 30 L**

Sources of demographic data, errors in census and registration data and their adjustment. (2L)
 Measurement of morbidity and mortality , standardization of death rates, cause of death rate, infant mortality rate, maternal mortality rate. Birth rates : CBR, GFR, Age -sp. birth rates, TFR, GRR and NRR. (10)

Complete life table – description, Cohort stable population and stationary population . (12L)
 Notion of abridged life table and construction by Chiang's method

Graduation of mortality rates by Gompertz and Makeham's laws. Logistic curve and its fitting by Rhode's method for population forecasting. (5L)

29 L**References:**

1. Bhaskar D. Misra : An Intro. to the study of populati on , South Asian Publishers Pvt. Ltd.,New Delhi.
2. Mukhopadhyay, P. : Applied Statistics.
3. Goon,A.M., Gupta, M.K. & Dasgupta, B : Fundamentals of Statistics, Vol. 2 – World Press, Kolkata.
4. Biseas, S. : Demography

INDIAN STATISTICAL SYSTEM (10 marks)**Max. 10 L**

The Statistical system in India : The Central and State Govt. Organizations, the functions of the Central Statistical Organization (CSO), the National Sample Survey Organization (NSSO) and West Bengal Bureau of Applied Economics and Statistics. (6L)

Sources of official Statistics in India and West Bengal relating to : Population, agriculture, industry, trade, price and employment. (2L)

Brief ideas of National Income Statistics. (2L)

10 L**References:**

1. Saluja, M.P. : Indian Official Systems, Statist ical Publishing Society, Kolkata
2. Goon,A.M., Gupta, M.K. & Dasgupta, B : Fundamentals of Statistics, Vol. 2 – World Press, Kolkata
3. Statistical system in India (1984) – C.S.O.

Paper VIII

Analysis of Variance & Design of Experiments (50 marks) Max. 60 L

Linear models, Linear parametric function, Method of Least squares, statement of Gauss - Markov theorem, s.s. due to linear function of observations, test of general linear hypothesis. (4L)

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), testing simple regression coefficients, correlation ratio, linearity of simple regression, multiple correlation and partial correlation coefficients. (10 L)

Design of Experiments :

Principles of experimental design : Randomization, Replication and Local Control, Uniformity Trials (4L)

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 techniques of analysis of variance for the analysis of the above designs. (16 L)

Group of Experiments using RBD and LSD. (3L)

Factorial Experiments : Advantages, 2^n – experiments, Total and Partial Confounding analysis; and construction. (10L)

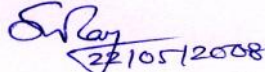
Analysis of covariance (ANCOVA) : Application of the ANCOVA technique to one -way classified data and to two-way classified data with equal number of observations per cell, use of ANCOVA to control the error in LSD. (5L)

Missing Plot Technique : Analysis with one missing plot in a RBD and in a LSD. (4L)

56 L

References:

1. Scheffe, H.(1959) : The analysis of Variance, John Wiley.
2. Kempthorn, O. (1965) : The Design and Analysis of Experiments, Wiley Eastern.
3. Das, M.N. & Giri, N.C. (1986) : Design and Analysis of Experiments, Wiley Eastern.
4. Montgomery, D.C. (1976) : Design and Analysis of Experiments, Wiley Eastern.
5. Cochran, W.G. & Cox, G.M. (1957) : Experimental Designs , John Wiley.
6. Federer, W.T. (1975) : Experimental Designs -Theory and Application, Oxford & IBH.
7. Goon,A.M., Gupta, M.K. & Dasgupta, B(2001) : Fundamentals of Statistics, Vol. 2 – World Press.
8. Mukhopadhyay, P.(1999) : Applied Statistics.


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Sampling Techniques (30 marks)**Max. 40 L**

Introduction : Concepts of a Finite Population and a Sample , Need for Sampling, Complete Enumeration and Sample Surveys. (3 L)

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. (5L)

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 stages. 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. (21L)

Ratio and Regression method of estimation in simple random sampling. (5L)
Double sampling for ratio and regression estimators. PPSWR sampling. (2L)

Interpenetrating sub-sampling technique for unbiased variance estimation and its application. (2L)

Randomized Response Technique : Warner's Model (2L)

40 L
References:

1. Goon,A.M., Gupta, M.K. & Dasgupta, B(2001) : Fundamentals of Statistics, Vol. 2 – World Press.
2. Murthy, M.N. (1977) : Sampling Theory and Methods, Statistical Pub. Soc., Calcutta.
3. Des Raj & Chandhok, P. (1988) : Sample survey Theory, Narosa publishing House.
4. Cochran, W.G.(1984) : Sampling Techniques(3rd Ed.), Wiley Eastern.
5. Mukhopadhyay, P. (1998) : Theory and Methods of survey Sampling, Prentice Hall.
6. Sukhatme, P.V. & Sukhatme, B.V. (1970) : Sampling Theory of surveys with applications.

Paper IX

Sequential Analysis and Non-parametric inference (30 marks)

Max. 40 L

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

Non parametric inference : Need for non- parametric inference, sample median and inter-quartile range as point estimates of location and dispersion, distribution – free interval estimation of population quantile, tolerance interval, sign, Run test, Median test, and test based on Kendall's T Test of randomness. (20L)

32 L

References:

1. Gibbons, J.D. ; Non-Parametric Statistical Inference, Mc Graw Hill
2. Goon, A.M., Gupta, M.K. & Dasgupta, B : An Outline of Statistical Theory , Vol. 2 – World Press, Kolkata .
3. Goon, A.M., Gupta, M.K. & Dasgupta, B : Fundamentals of Statistical Theory , Vol. 1 – World Press, Kolkata.
4. Rohatgi, V.K. : An Intro. to Prob. Theory and Mathematical Statistics, John Wiley.
5. Rohatgi, V.K. :Statistical Inference.
6. Rao, C.R.: Linear Statistical Inference.

Large Sample Methods (30 marks)

Max. : 40 L

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 inter. (5 L)

Large sample standard error ;derivation of large sample standard error of an estimator (T_1, T_2, \dots, T_K) of $f(x_1, x_2, \dots, x_K)$, sample moments, standard deviation, coefficient of variation, b_1 and b_2 measures and correlation coefficient. Uses of these standard errors in large sample tests and interval estimation, test of normality. (12L)

Transformation of statistics to stabilize variance : derivations of \sin^{-1} , square-root, logarithmic and z – transformation and their uses in large sample tests and interval estimation. (8L)

Derivation of the large sample distribution of Pearsonian X^2 – statistic and its uses in test of independence, homogeneity and goodness of fit. (8L)

33 L

References:

1. Cramer, H. : Mathematical Methods of Statistics, Prince ton University Press.
2. Goon,A.M., Gupta, M.K. & Dasgupta, B : An Outline of Statistical Theory , Vol. 2 – World Press, Kolkata .
3. Goon,A.M., Gupta, M.K. & Dasgupta, B(2001) : Fundamentals of Statistic s, Vol. 1– World Press.
4. Rao, C.R. : Advanced Statistical Methods for Biometric Research.
5. Rao, C.R.: Linear Statistical Inference and its application.
6. Kendall, M.G. & Stuart, A. (Vol. 1)

Statistical Quality Control (20 marks)**Max. : 20 L**

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

Process control : Charts and their uses, choice of subgroup sizes, construction and interpretation of \bar{x} , R, s.d., p, np and c charts with fixed and variable subgroup sizes. Modified control charts. (6L)

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

20 L
References:

1. Goon,A.M., Gupta, M.K. & Dasgupta, B(2001) : Fundamentals of Statistics, Vol. II – World Press, Kolkata.
2. Duncan, A.J. : Quality Control and Industrial Statistics. 4th edition, Taraporewale & sons.
3. Montgomery, D.C. : Introduction to the Statistical quality control. 2nd edition. John Wiley & Sons.

Paper X (Prac.)

Gr. A : Econ. + Demo. +SQC

Gr. B : ANOVA + Design + Sample Survey + Non -Para

Paper XI(Prac.)

Computer Application

A: C – Programming :

Programming preliminaries in C : Structure of the language, lexical elements of C, Programming environment in C, operators and modes of arithmetic expressions.

Input-Output in C : Input – output functions and their format specifications, C control structure : unconditional (go to) control, conditional (if else) control, loop control for loop, while loop, do-while loop.

C functions ; library functions, user -defined functions, functions declaration.

Problems by C-Programming

- i) Interpolation by Newton's forward and Lagrange's formula.
- ii) Numerical integration by Trapezoidal and Simpson's 1/3 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 (upto order 4).

B : Use of Statistical Software :

Max. 20 L

1. MS- Excel

- i) Use of Spreadsheet.
- ii) Drawing of diagrams – bar, columns, line, pie, scatter.
- iii) Use of function : 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.

2. MINITAB

Use of MINITAB package using the option under ‘CALCULATION’ and ‘STATISTICS’

Some Suggested problems :

- i) Basic statistics – Display, descriptive measures (univariate only), 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 & Multiple regression – fitted and residual plots.
- iii) ANOVA – one- way and two-way classified data.
- iv) Control charts – Mean- Range, Mean –SD, proportion, no. of defectives, number of defects charts.

References:

- 1. E.Balagurusamy: Programming in ANSI C , 3rd Ed., Tata Mc Graw Hill Publishing Co.
- 2. Gottfried : Programming with C
- 3. Jayasri ; The C language trainer with C graphics and C++.
- 4. Kernighan and Ritchie : The C programming language.