BHARATHIAR UNIVERSITY: COIMBATORE-641046
M.Phil. / Ph.D. STATISTICS
[From October 2011 batch onwards]
PAPER-I
RESEARCH METHODOLOGY IN STATISTICS

UNIT – 1 : Research Methodology: Concept of Research in Statistics – Selection of Topic for Research – Importance of Literature survey – Reports, Thesis and Assignment writing

UNIT – 2 : Computer Oriented Numerical Methods – Algorithms for solving Numerical Algebraic and Transcendental Equations – Method of Bisection – Method of Iteration – Method of Regula Falsi – Newton-Raphson's Method – Rate of Convergence. Numerical Integration: Trapezoidal and Simpson's Rule to evaluate the definite integral.

UNIT – 3 : Statistical Studies – Significance – Data Measurement Scales, Nominal, Ordinal, Ratio and Interval Scales – Sources of error in Measurement – Tests of Measurement – Technique of Developing Measurement Tools – Scaling Technique – Likert type Scaling – Cumulative Scaling

UNIT – 4 : Simulation: Concept and Advantages of Simulation – Event type Simulation – Generation of Random Numbers – Monte-Carlo Simulation Technique – Generation of Random Numbers using uniform (0,1), Exponential, Gamma and Normal random variables – Simulation Algorithm

UNIT –5 :R Language and its simple applications – Computation of Probabilities and cumulative Probabilities using Binomial and Poisson models. Evaluation area and ordinate under normal distribution using R Software.

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PAPER- II-STATISTICAL INFERENCE

UNIT - 1 : Some examples and definition concerning testing of Statistical hypothesis. An Outline for hypothesis testing. Randomized tests and critical functions. Sufficient Statistics and most powerful tests. Uniformly most powerful tests. Neyman – Pearson fundamental lemma. Distributions with monotone likelihood ratio. Unbiased tests. Likelihood ratio tests.

UNIT - 2 : Loss function, Risk function, Bayes and Minimax estimators, Pitman estimator, Admissibility of estimators

UNIT - 3 : Derivation of expected mean squares in analysis of variance of fixed, random and mixed models.

UNIT - 4: Incompletely specified models. Theoretical background for pooling procedures. Review of literature. Examples illustrating the use of preliminary tests of significance. Formulation (only) of sometimes pool test procedures in analysis of variance of two-stage and three-stage nested designs.

UNIT-5: Pooling means in normal populations and Behrens-Fisher problem under conditional specification, Confidence limits for Mean and Variance using preliminary tests of significance

REFERENCES

Para in the Syllabus	PORTIONS	Reference material (representation by numbers)
a.	Some Examples and Definiations concerning testing Statistical Hypothesis : An Outline for Hypothesis Testing	(1), (2)
b.	Randomised Tests and Critical Function	(3)
c.	Sufficient Statistics and most Powerful Tests, Uniformly Most Powerful Tests, Neyman-Pearson Fundamental Lemma, Distributions with Monotone likelihood ratio .	(2), (3), (4)
d.	Unbiased Tests, Likelihood Ratio Tests	(5)
e.	Loss Function: Risk Function, etc (II Para)	(3)
f.	Derivation of Expected Mean Squares in Analysis of Variance of Fixed, Random and Mixed Models	(6), (7)
g.	Incompletely Specified Models, Theoretical background for Pooling Procedures	(8)
h.	Review of Literature	(9) (10)
i.	Examples illustrating the use of PTS	(8) (9)
j.	SPT Procedures in ANOVA of two-stage and three-stage Nested Design	(11), (12),(13),(14), (15)
k.	Pooling means in normal population and Behrens-Fisher problem under conditional specification	(16)
l.	Confidence Limits for Mean and Variance using PTS	(17)

References relating to numbers:

(1) Gunther, W.C(1973): Concepts of Statistical Inference , McGraw-Hill, Inc.

(2) Hogg.R.V. and Craig,A.T.(1970): Introduction of Mathematics Statistics, The Macmillon Co, New York.

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PAPER- III
STATISTICAL METHODS IN BIOMETRICS RESEARCH

UNIT- 1 Genetic constitution of a population **,** Frequencies of genes and genotypes Hardy – Weinberg Equilibrium, Change in gene frequencies due to mutation, Change in gene frequencies due to selection

UNIT-2 : Metric characters – Phenotypic and genotypic value Breeding value of an Individual, Dominance and Interaction Deviations, Genetic and Environment components of variance, Partitioning into Additive, Dominance and Interaction variance

UNIT-3 : Diallel crosses for estimation of genetic parameters,Analysis of variance of diallel experiments – Hayman's approach,General and Specific Combining Abilities – Griffing's approach, Heritability Co-efficient – broad and narrow senses Estimation of heritability coefficient

UNIT-4 : Genotype x Environment interaction, Concept of Stability of a variety or genotype Analysis of G x E interaction effects using finlay-Wilkinson method, Stability analysis of Eberhart Russel and interpretation of the results

UNIT-5 : Use of multivariate analysis in biometrical research Concept of distance or Similarity between populations, Measurement of distance – Mahanobis' Distance Discriminant functions Selection index for selection a genotype using multiple measurements Genetic advance

REFERENCES

S.No.	PORTIONS	Reference material Materials (represented by Symbols**)**
1 a.	Frequencies of genes and genotypes in a population	A
b.	Hardy –weinberg Equilibrium	A
c.	Changes in gene frequencies due to selected and mutation	A
d.	Estimation of gene frequencies – Maximum likelihood- Example of blood groups	B
2 a.	Metric characters- values and means	A
b.	Dominance and interaction deviations	A
c.	Variance components – Phenotypic, genotype and environmental and their implications	A,B

d. Estimation of genotype and phenotypic correlations and analyzing causal relationships using path coefficient analysis	F
3a. Analyzing of Diallel experiments – Estimation of genetic components of variation using Hayman's approach	O,P,R
b. Estimation of general and specific combining ability of a genotype- Griffing's approach	Q,R
c. Using sib analysis of estimating heritability coefficient	A,R
d. Using parent- offspring regression for estimating heritability	A,R
4a. Genotype x Envorinment I interactions and implications	I,J
b. Stability analysis of multilocation varietal trials	K, L
c. Analysis of G x E interactions- Finlay – Wilkinson's approach	K
d. Stability parameters and their interpretation - odel of Ederhart Russel	L
5a. Mahalobis D-square statistics	C,M
b. Fisher's Discrimant Function	C
c. Discriminant functions for selecting genetically desirable types	C.N
d. Construction of selection index for identifying superior gentotypes using multiple measurements	C,G,N
e. Genetic advance	C

References relating to symbols

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PAPER- III : ADVANCED ACCEPTANCE SAMPLING

UNIT 1: Basic Concepts of Acceptance Sampling

Attributes Sampling Plans Single, Double, Multiple and item by item Sequential Sampling Plans , Dodge and Romig LTPD and AOQL Tables, ABC Standard, Philip's System, Golub's Minimization Approach, Sampling Plans for Isolated Lots MAPD Plans, MAAOQ Plans, Incentive Index Plans.

UNIT 2: Variable Sampling Plans:

Known and Unknown – Sigma Plans, MIL-STD- 414 .

UNIT 3: Continuous Sampling Plans:

CSP-1, CSP-2, CSP-3 and Multilevel Continuous Sampling Plans MIL-STD-1235(ORD)

UNIT 4: Special Purpose Plans:

Chain Sampling Plans, Skip-lot Plans, Demerit Rating Plans, Cumulative Results Plan.

UNIT 5:

OQPL Plans, RGS Plans, Plans based on the Theory of Runs, Indian Standards, Lot Sensitive Sampling Plans , Tightened-Normal – Tightened Plan with Fixed and Different s and t, Quick Switching System, Administration of Sampling Inspection Plan.

REFERENCES

S.No.	PORTIONS	Reference material Materials (represented by symbols)
1	Basic Concepts of Acceptance Sampling	(A)
2	Attribute Sampling Plans	

a. Single, Double, Multiple, Item by Item Sequential Sampling Plans (B)
b. Dodge and Romig LTPD and AOQL Tables (C)
c. ABC Standards (D)
d. Philip's System (E)
e. Golub's Minimization Approach (F)
f. Sampling Plans for Isolated Lots (G)
g. MAPD Plans (H)
h. MAAOQ Plans (I)
i. Incentive Index Plans (J)

3 Variables Sampling Plans (K)

4 Continuous Sampling Plans (L)

5 Special Purpose Plans

a. Chain Sampling Plans (M)
b. Skip-Lot Plans (N)
c. Demerit Rating Plans (O)
d. Cumulative Results Plans (P)
e. OQPL Plans (Q)
f. RGS Plans (R)
g. Plans Based on theory of Runs (S)
h. Indian Standards (T)
i.Lot Sensitive sampling Plan, Tightened- Normal- Tightened plan with Fixed and Different s and t (U)
Quick Switching System
j. Administration Sampling Inspection Plan (V)

References relating to symbols:

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(B) Burr Irving, W., (1976), Statistical Quality Control Methods, Marcel Dekker, Inc., New York

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Single Sampling Plans, Industrial Quality Control, Vol.9, pp.37-39.
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Inspection by Attributes Plans, Journal of Quality Technology, Vol 7., No.4, pp. 173-182.
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allowable Average Outgoing Quality, Journal of Applied Statistics, Vol.23, No.6, pp.645-654.

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Inspection by Attributes, Department of Defence, Washington DC.

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PAPER- III-Psychometrics

Unit- ***I :*** Functions and Origins of Psychometrics Testing:

Current used of Psychological tests – The contributions of francis Galton. Cattell and the early" Mental tests". Grouping testing. Tests of special aptitudes. Differential aptitude batteries. The measurement of personality. Principal characteristics of Psychological tests. What is a Psychological test? Varieties of Psychological tests. Sources of information about tests.

Unit – II: The use of Psychological Tests:

Code of Professional ethics pertaining to psychological tests. Principal reasons for controlling the use of
Psychological tests. Motivation and rapport. The influence of practice and coaching upon test
performance. Mallingering and cheating.
Practical problems of test administration. Problems of scoring. Norms: Their nature and interpretation: Age
scores – percentiles, standard scores. The specificity of Norms.

UNIT- III Test Reliability (characteristics of tests)

Test-retest reliability – parallel forms reliability : split-half reliability Inter-rater reliability. Interpreting the

reliability coefficient. Forms of reliability and forms of error. Validity. Face validity, content validity,

predictive validity.

Construct validity standardization to Zscores, Standardization to Tscores. Standardization to stanine scores.

Standardization to IQ format scores. Normalization. Algebraic normalization Graphical normalization.

UNIT-IV : Item Analysis:

Item analysis statistics for knowledge based tools tests. Item facility, item discriminiation, item analysis for person based tests. Item analysis in criterion referenced testing. Psychological traits, true scores,and internal test structure. Item analysis for more complex situations. The use of factor analysis. Latent trait models and item response theory. Item and the Rasch one parameter model.

UNIT- V : Factor Analysis:

The correlation coefficient, the correlation m,atrix. The application of factor analysis to test construction. Finding the starting values for estimates of item error. Identifying the number of factors. The Kaiser criterion for selecting the number of factors. The cattell-Scree technique for identifying the number of factors. Factor rotation. Rotation on simple structure. Orthogonal rotation, Oblique rotation. Special uses of factor analysis in test construction.

REFERENCES

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3. Theory and Practice of Psychological testing - Frank S. Freeman
4. An Easy guide to Factor Analysis - Paul Klines
5. The Handbook of Psychological testing - Paul Klines
6. Statistical Analysis in Psychology and Education - Ferguson.G.A.
7. Psychometrics Methods - Guilford.J.P
8. Statistics in Psychology and Education - Garreff H.E & Wood worth R.S

PAPER –III
BIOMETRIC TECHNIQUES AND THEIR APPLICATIONS

UNIT I:

Introduction to Biostatistics-Examples on statistical problems in Biomedical Research-Biological data-Principles of Biostatistical design of medical studies

UNIT II:

Introduction to Bioassays-Structure of Bioassays-Types of Bioassays-Direct assays,Indirect assays-Parellel line assays,-Fellers theorem-Regression approaches to estimating dose-response-Quantal response assays-Dragstedt-Behren's method-Spearman-karber method, Basics of Probit and logit analyses.

UNIT III:

Introduction to Survival analysis-Concept of life time distribution-Continuous models-Discrete models-Models relating to Exponential,Gamma,Weibull,Log-Logistic, Inverse-Gaussion lognormal distributions)-Hazard function-Censoring and statistical methods-Type of censoring-Type I censoring-Type II censoring-Random censoring. – The Kaplan-Meier procedure – Cox regression model.

UNIT IV:

HIV virus and its clinical effects-Measuring the Epidemic-Studies of AIDS patients-Statistical methods for partner studies-infectivity-Models for the infectivity-Random effects model for infectivity- Incubation period -Mathematical models for the incubation period distribution-Introduction to Back calculation-Deterministic deconvolution-Statistical deconvolution-Analysis in Discrete time.

UNIT V:

The Mathematical Biology and Human Infections- Antigenic variation and Diversity Threshold, -Antigenic Diversity Thresholds and hazard functions – Viral load and Antigenic Diversity.

References:

Para in syllabus	Portions	References and study materials (Represented by numbers)
a.	UNIT I	(1),(2)
b.	UNIT II	(3),(4)
c.	UNIT III	(5),(6)
d.	UNIT IV	(7)
e.	UNIT V	(8),(9),(10)

References in order :

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PAPER - III

ADVANCED STATISTICAL INFERENCE

UNIT I

Concepts of sufficiency, Completeness, Loss and Risk functions, Location Invariance, Scale Invariance, Equivariant Estimation.

UNIT II

LRT, SPRT, Testing of hypothesis for Multivariate cases: Hotelling T^2 and Mahalanobis D^2 test – Locally and asymptotically minimax tests – Sphericity Test–Behrens's-fisher testing problem.

UNIT III

Distribution free Inference: Binomial test – Wilcoxon signed rank test –Mann whitney U test-Rank sum test – Rank correlation test of Independence–Fisher-Irwin test–McNemer test – Kruskal-Wallis Test.

UNIT IV

Bayesian Inference: Notation of prior and posterior distribution-Inference for the Normal distribution – Normal prior and likelihood – several normal observations with a normal prior – Binomial distribution – Reference prior for the binomial likelihood – Jeffrey's rule – Poisson distribution – niform distribution – Reference prior for the uniform distribution.

UNIT V

Robust Estimation-characteristics of Robustness – M-estimators – L-estimators – R-estimators – interrelationships of M- , L- , and R-estimators – Minimaximally Robust Estimators-Applications to linear and non-linear regression.

REFERENCES:

Syllabus	Reference Material
Unit I	(1),(3),(7)
Unit II	(4),(5),(6),(8)
Unit III	(1),(2),(8)
Unit IV	(9),(10)
Unit V	(11) to (17)

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2. Jean D.Gibbons (1992): *Non parametric Statistics*. Sage publications.
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4. Narayan C.Giri (2004): *Multivariate statistical Analysis*, Marcel Dekker, Inc.Newyork.
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PAPER - III

STOCHASTIC PROCESSES AND THEIR APPLICATIONS

UNIT – I

Classification of Stochastic processes, stationary processes, martingales, Markov chains, Markov processes with discrete discrete state space, Markov processes with continuous state space: Brownian motion, Wiener process, Ornstein –Uhlenbeck process.

UNIT – II

Renewal process, Renewal equation , Wald's equation, Delayed and equilibrium processes, Residual and excess life times process, cumulative renewal process, Renewal theorems : Blackwell's theorem, Smith's theorem, equilibrium renewal process

UNIT – III

Branching processes, properties of generating functions of Branching processes, Probability of Extinction, Galton–Watson process, yaglom's theorem, Generalisations of the Galton-Watson process.

UNIT – IV

Concept of Queueing Theory, steady state behaviour and transient behaviour of the model M / M / 1, Pure Birth process, Birth and Death processes, Non-Birth and Death Queueing processes, Net work of Markovian Queueing system, Non-Markovian models : G1 / M / 1 and M / G (a, b) / 1.

UNIT – V

Diffusion process, Diffusion equations for the Wiener process, first passage time, Boundary conditions for homogeneous diffusion process, Jump process, Ruin probability, Levy process

REFERENCES

S.No	PORTIONS	Reference material (Represented by Numbers)
1.	Concept of Stochastic process	(1) , (2) ,(3)
2.	stationary processes, martingales, Markov chains	(2), (4)
3.	Markov processes with discrete discrete state space	(4), (5)
4.	Brownian motion, Wiener process, Ornstein –Uhlenbeck process	(1), (2),(8)
5.	Renewal process, Renewal equation	(3), (5)

6.	Blackwell's theorem, Smith's theorem, equilibrium renewal process	(3) ,(9)
7.	Branching processes, properties of generating functions	(3), (6)
8.	Galton–Watson process, yaglom's theorem	(3), (6),(7)
9.	Concept of Queueing Theory, steady state behaviour	(10), (11)
10.	M / M / 1 Model, Pure Birth process, Birth and Death processes, Non-Birth and Death Queueing processes	(3), (11)
11.	Net work of Markovian Queueing system, Non-Markovian models	(3), (10), (11)
12.	Diffusion process, Diffusion equations for the Wiener process	(1), (2)
13.	Boundary conditions for homogeneous diffusion process	(2),(13),(15)
14.	Ruin Theory	(1), (13),(14)
15.	Jump process, Levy process	(2), (13),(14),(15)

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PAPER - III

RELIABILITY THEORY AND SURVIVAL ANALYSIS

Unit I

Basic concepts in Reliability: Hazard-rate, Mean Residual Life and Mean time to failure and their inter-relationships. Exponential distribution, memory less property. Maximum likelihood estimation and uniformly minimum variance unbiased estimation for the parameter and reliability function.

Unit II

Gamma and Weibull distributions, Estimation of parameters and reliability function with complete and censored samples. Tests of hypotheses and confidence intervals for the reliability function of exponential, gamma and Weibull distributions.

Unit III

Bayes estimation for the parameters and reliability function (under different losses) of exponential, gamma and Weibull distributions. Bayesian credible intervals for the parameters and reliability function for exponential, gamma and Weibull distributions.

Unit IV

Introduction to Survival Analysis, survival distributions and their applications viz. exponential, gamma, weibull, Death density function for a distribution having Bath-Tub shape hazard function.

Unit V

Tests of goodness of fit for survival distributions, parametric methods for comparing two survival distributions viz. L.R test, Cox’s F-test, Non-parametric methods for estimating survival function and variance of the estimator using Kaplan –Meier method.

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