BHAGWANT UNIVERSITY

Sikar Road, Ajmer

Rajasthan

Syllabus

Institute of Applied Sciences & Life Sciences

M. Phil I Semester

Statistics

Course Category

MSta : M.Phil in Statistics
CCC: Compulsory Core Course
ECC: Elective Core Course

Contact Hours:

L: Lecture
T: Tutorial
P: Practical or Other

Marks Distribution :

IA: Internal Assessment (Test/Classroom Participation/Quiz/Presentation/Assignment etc.)
EoSE: End of Semester Examination

M. Phil (Statistics)

(Course Structure)

Subject code	Subject Name	Teaching hours			Marks		
		L	T	P	External	Internal	Total
01MSta101	**Research Methods**	3	0	0	70	30	100
01MSta102	**ADVANCED STATISTICAL INFERENCE**	3	0	0	70	30	100
01MSta103	**ADVANCED APPLIED MULTIVARIATE ANALYSIS**	3	0	0	70	30	100
01MSta104	**Paper-IV: MARKOV CHAINS AND TIME SERIES** **Reforms**	3	0	0	100		100

Total	**12**	**0**	**0**	**280**	**120**	**400**

SEMESTER II

Subject code	**Subject Name**	**Teaching hours**			**Marks**		
		L	**T**	**P**	**External**	**Internal**	**Total**
02MSta101	**ADVANCED RESEARCH METHODOLOGY**	3	0	0	70	30	100
02MSta102	**ADVANCED OPERATIONS RESEARCH**	3	0	0	70	30	100
02MSta103	**ADVANCED STATISTICAL QUALITY CONTROL AND RELIABILITY**	3	0	0	70	30	100
02MSta201	**Dissertation**	3	0	0	50	50	100
Total		**12**	**0**	**0**	**260**	**140**	**400**

Paper I : RESEARCH METHODOLOGY

Paper code 01MSta101

Unit 1 Matrices

Introduction to Linear models – Quadratic forms in random variables - Canonical reduction –

generalized inverse and it properties– Moore Penrose inverse .

Unit 2 Probability Theory:

Convergence in sequence - Almost uniform convergence – Convergence in probability - Convergence in Measure – Convergence in Mean.

Law of large numbers: Weak and Strong Law of large numbers – various forms of Central limit theorems: Lindeberg – Liapounov and Lindeberg – Feller CLT.

Unit 3 Sampling Theory

Ratio and Regression methods of estimators – Bias of these estimators – Two stage sampling - Probability proportion sampling methods (PPS).

Unit 4 Data Analysis

Types of Data: Qualitative and Quantitative data: Cross sectional and time series data: Different types of scales nominal, ordinal, ratio and interval.

Basics of Statistical methods such as regression, principal component analysis, Discriminant analysis, cluster analysis (no derivations – applications understanding of procedures, concepts interpretation and assumptions) – Implementation of about techniques through statistical packages – Interpretation of computer outputs.

Unit 5 Research Methodology

Definition of Research – Stages in Research – Types of research – Research design and planning ,Thesis writing.

Writing a project proposal to a funding agency.

Books for Study:

1. Pauline V Young Research Methodology

2. Burrill C. W Measure theory and Probability,McGraw Hill, New York.

3. Billingsley : Probability and Measure, Wiley Interscience, 1984.

4. Rao, C.R. : Linear statistical inference and its applications, John Wiley & sons, 1983.

5. Biswas S: Topics in Algebra of Matrices, Academic Publication, 1984.

6. Bhat B.R. : Modern probability theory 3rd ed., New Age International, 1999.

7. Graybill, F.A.: An Introduction in to Linear Models, McGraw Hill, New York, 1961.

8. Rohatgi & Saleh (2002) – Introduction to probability and statistics – Asia Publications

9. Ash R.B : Real Analysis and Probability – Academic press, New York, 1972.

10. Sukhatme, P.V., Sukhatme, B.V. and others: Sampling theory of Surveys with applications, 3rd ed, ISAS Publication, 1997.

11. Johnson & - Applied Multivariate Techniques.

Paper II : ADVANCED STATISTICAL INFERENCE

Paper code 01MSta102

Unit I

Sufficient statistics – existence and construction of Minimal sufficient statistics – sufficiency and completeness – sufficiency and invariance – Minimum variance unbiased estimation – Unbiased estimation of location and scale parameters.

Unit II

Maximum likelihood estimators – properties – Strong consistency – asymptotic efficiency of maximum likelihood estimators – best asymptotically normal estimators – Inference based on

Censored data (concept only).

Unit III

Neymann – Pearson fundamental lemma – distributions with monotone likelihood ratio confidence bounds, UMP tests for the two sided hypothesis – tests for parameters in a normal distribution.

Unit IV

Unbiased tests: Concept of unbiasedness – application to one parameter exponential family – similarly and completeness – UMP unbiased tests for multi parameter exponential families – comparison of two Poisson and Binomial population - Application of unbiasedness.

Unit V

Invariant tests: Symmetry and invariance – maximal invariance - most powerful invariant tests – unbiasedness and invariance.

Reference:

1. Lehman E.L. and Casella: Theory of Point Estimation, Springer Verlag, 1988.

2. Lehman E.L. : Testing Statistical Hypothesis, John Wiley & Sons, 1986.

3. Rohatgi V.K. : Introduction to mathematical Statistics, Wiley Eastern, 1984.

4. Zacks S.: Theory of Statistical Inference, John Wiley & Sons, 1991

5. Ferguson T.S. : Mathematical Statistics - A decision theoretic approach, Academic Press, 1967.

6. Kale B.k : A first course on parametric inference, Narosa Publication, New Delhi, 1999.

Paper III: ADVANCED APPLIED MULTIVARIATE ANALYSIS

Paper code 01MSta103

Unit I

Introduction to Multivariate analysis – Data Reduction – Principle component analysis – Determination of number of principle components to be retained – component scores.

Unit II

Introduction to Factor analysis – Communalities – Comparison of Extraction procedures – Rotation of factors – Factor scores – Introduction to Multidimensional scaling – Proximities and data collection – Relationship with other data reduction procedures.

Unit III

Introduction to Cluster analysis – Similarity measures – Clustering techniques – Hierarchical and partitioning methods – Graphical methods – Peudograms – guidelines.

Unit IV

Introduction to canonical correlation analysis – Interpretation of canonical correlation results – Issues in interpretation.

Introduction to Discriminant analysis – Two group problem – variable contribution – Violation of assumptions Logistic discrimination – error rate estimation.

Unit V

Linear structural Relations (LISREL) – Path analysis – Testing casual model – Evaluating LISREL solutions.

Latent Structural analysis – Logic behind Latent structure analysis – Latent class models – Restricted Latent class models.

Books for study:

1. Dillon, W.R. and Goldstein, M.: Multivariate Analysis Methods and Applications, John Wiley & Sons 1984.

2. Hair J.F., Junior Anderson R. E and Tatham R.L, Multivariate Data Analysis with Readings, MacMillan Publications, New York, 1987.

Paper-IV: MARKOV CHAINS AND TIME SERIES

Paper code 01MSta104

Unit 1

Introduction of Stochastic Process: Definition – Examples - Classification of Stochastic process awarding to state space, index set and dependence among the random variablessome common stochastic processes (Bernoulli, Poisson Gaussion and wiener - concept only). Marko chain (MC): Chapman kolmogorov's equation - classification of states. A canonical representation of the transition probability matrix. Classification of the states using graph algorithms - Morkov chains as graphs – Martingales - Limiting Probabilities.

Unit 2

Finite Markov chains with recurrent and transient states - irreducible finite Markov chains with ergodic states - First passage times and occupation times - Two states MC (idea only). Reversed Makov chains - Limit theorems (No proof) - Application only.

Unit 3

Markov Processes (MP) – Detailed Study of Poisson process, Pure Birth process, Yule's process, Birth and death process-Application to queues.

Unit 4

Stochastic models for Time Series - General linear filter model-Autoregressive (AR(p)) models - Moving average model (MA(q)) - Autoregressive - Moving average (ARMA(p,q))

models - Autoregressive integrated moving average model (ARIMA(p,d,q)).

Unit 5

Analysing Time Series Model: Spectral Density of AR models, MA, ARMA, models. Relationship between Auto covariance and spectral density - Cyclical Behaviour finding Auto covariance, Auto correlation through Spectral Density. Analysing Spectral Graph-Analysing the Cyclic Behaviour of Time Series - Spectral Density and Linear Filters. Relationship between Markov Process and Time Series - Co integrated Time Series.

Books for study:

1. Bhat. U.N: Elements of Applied Stochastic Processes, Wiley 1972.

2. Karlin.S and Taylor: A first course in Stochastic Processes, Academic Press, New York. 1975.

3. Methi.J: Stochastic Processes, Wiley Eastern, 2nd ed, 1994.

SEMESTER II

PAPER I –ADVANCED RESEARCH METHODOLOGY(02MSta101)

Unit I - Types of Research and Report writing

Types of Research: Exploratory Research, Conclusive Research, Modelling Research, Algorthimic Research. Research Process: Problem Definition, Objectives of the Research, Research Design, Data Collection, Data Analysis, Interpretation of Results, Validation of Results. Report Writing and Presentation: Types of Report, Guidelines for Reviewing Draft, Report format, Typing Instructions and Oral Presentation.

Unit II – Modules

Free Modules – Project Modules – Tensor product – Flat Modules.

Unit III - Localization

Ideals, Local Rings, Localization.

Unit IV - The Calculus of variations

Introduction - Existence of minimizers.

Unit V - The Calculus of variations

Regularity, constraints, critical points, problems.

Text Books

"Research Methodology" R.Panneer Selvam,PHI,New Delhi,(Eleventh Printing) 2013. Unit I : Sections 1.4 and 1.5 in Chapter I, Chapter 16
2) Commutative Algebra – N. S. Gopalakrishnan (Oxonian Press, New Delhi), Second Printing 1988.

PAPER II ADVANCED OPERATIONS RESEARCH
UNIT I
Parametric Programming: Changes in requirement and cost vector.
UNIT II
. Nonlinear Programming: General nonlinear programming problem, constrained optimization with equality and inequality constraints. Necessary and sufficient conditions (Kuhn-Tucker conditions) for solving a nonlinear programming problem.
UNIT III
Quadratic programming : Wolf's method and Beal's method
UNIT IV
Non- Poisson Queues: Study of the systems M/Ek/1, M/G/1, GI/M/1, GI/M/C.
UNIT V
EOQ models with price change, EOQ model with varying demand, EOQ models with uncertain demand. Dynamic version of Economic Lot –size model.
REFERENCES:
1. Kanti Swarup, P.K.Gupta Mohan: Operations Research
2. K.G. Murthy: Nonlinear programming.
3. Donald Waters: Inventory Control and Management; Wiley.
4. Rao, S.S.: Optimization: Theory and Applications
PAPER-III
ADVANCED STATISTICAL QUALITY CONTROL AND RELIABILITY

UNIT I

Continuous sampling plans of Dodge type and Wald-Wolfiwitz type and their properties. Bayesian sampling plans.

UNIT II

Capability indices Cp, Cpk and Cpm; estimation, confidence intervals and tests of hypotheses relating to capability indices for Normally distributed characteristics.

UNIT III

Use of Design of Experiments in SPC; factorial experiments, fractional factorial designs, construction of such designs and analysis of data. (10L)
Multivariate quality control; use of control ellipsoid and of utility functions.

UNIT IV

Reliability estimation based on failure times in variously censored life tests and in tests with replacement of failed items; stress-strength reliability and its estimation.

UNIT V

Maintenance and replacement policies; availability of repairable systems; modeling of a repairable system by a non-homogeneous Poisson process. (5L)
Reliability growth models; probability plotting techniques; Hollander-Proschan and Deshpande tests for exponentiality; tests for HPP vs. NHPP with repairable systems.

REFERENCES:

1. Montgomery, D.C. Introduction to Statistical Quality Control; Wiley
2. Montgomery, D.C. Design and Analysis of Experiments; Wiley
3. Ott, E.R. Process Quality Control; McGraw Hill
4. Phadke, M.S. Quality Engineering through Robust Design; Prentice Hall
5. Wetherill, G.B. Sampling Inspection and Quality Control; Halsted Press
6. Wetherill, G.B. and Brown, D.W. Statistical Process Control, Theory and Practice; Chapman and Hall
7. Barlow R.E. and Proschan F. Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.

8. Lawless J.F. Statistical Models and Methods of Life Time Data; John Wiley.
9. Bain L.J. and Engelhardt Statistical Analysis of Reliability and Life Testing Models; Marcel Dekker.
10.Nelson, W: Applied Life Data analysis; John Wiley.
11.Zacks S. : Reliability Theory, Springer

12.Martz. M. F. and Wailer. R. A. Bayesian Reliability Analysis. John Wiley and Sons.