Department of Statistics

(School of Physical and Decision Sciences)

SYLLABUS

FOR

M. Phil. in Statistics

(2019 onwards)

Babasaheb Bhimrao Ambedkar University
(A Central University)
Vidya Vihar, Raibareli Road,
Lucknow-226025

Prof. Madhulika Dube
Head

DEPARTMENT OF STATISTICS

(SCHOOL OF PHYSICAL AND DECISION SCIENCES)

Babasaheb Bhimrao Ambedkar University Lucknow-226025

Course Details (M. Phil. in Statistics)

Course	**-**	**M. Phil.**
Semester	**-**	**Two**
Nature of Course	**-**	**Regular**
Total Intake	**-**	**20**
Total Credit	**-**	**36**
Teaching/ Contact Hours	**-**	**180 per semester**
Course Fee	**-**	**10,000 per Semester**
Faculty Requirement	**-**	**Two**

DEPARTMENT OF STATISTICS

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COURSE STRUCTURE FOR M. PHIL. IN STATISTICS 2019 ONWARDS

SEMESTER I

S/N	COURSE CODE	PAPER TITLE	Credit
1	MPS 101	RESEARCH METHODOLOGY	Credit-06
2	MPS 102-109	**OPTIONAL PAPER** (Every eligible guide of a department shall offer one course related to his/her field to specialization. Students shall be free to choose one of these courses as per their research interest)	Credit-06
3	MPS 110	STATISTICAL SOFTWARE & LAB SESSIONS	Credit-06

SEMESTER II

S/N	COURSE CODE	PAPER TITLE	Credit
1	MPS 201	DISSERTATION	Credit-14
2	MPS 202	SEMINAR PRESENTATION & VIVA-VOCE	Credit-04

Each paper shall carry 100 marks the breakup of which is as follows.

a. Written Examination: 70 marks

b. Internal Assessment (Class performance/ Presentation): 30 marks.

SEMESTE- I

PAPER I. RESEARCH METHODOLOGY (MPS 101) (6 credits)

Introduction to Statistical Research, Statistical Research Process, Statistical Research Design and Implementation, Measurement Concepts in Statistical Research, Secondary Data, Survey Research, Types of Measurement Scales: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale – Criteria For Good Measurement, Concept of Scaling, Introduction of Qualitative Data Analysis.

Definition of Research, Characteristics of Research, Criteria of good Research, Research in Statistics, Meaning of Statistical Research, Need of Statistical Research, Area of Research, Advantages of Statistical Research, Limitations of Statistical Research.

Research Proposal, Meaning of Research Proposal, Need and Importance of Research Proposal, Types of Research Proposal, Benefits of Research Proposal.

Heuristic Research Approach, Phenomenological Research Approach, Interdisciplinary Research Approach, Ethnographical Research Approach.

Research Design, Informal Research Design, Formal Research Design

Research Problem, Meaning of Research Problem, Importance of Research Problem, Steps in identifying Research Problem, Criteria of selecting Research Problem, Evaluation of Research Problem, Characteristics of Good Research Problem, Research Questions.

Meaning of Hypothesis, Criteria for Hypothesis Construction, Importance of Hypothesis, Types of Hypothesis, Testing of Hypotheses, Assumptions.

Review of Related Literature, Meaning of Review of Related Literature, Objectives of Review of Literature, Need of Review of Literature, Impact Factor.

Concept of Research Tools and Techniques, Types of Research Tools and Techniques, Questionnaire, Check list, Interview Schedule, Observation.

Research Report and Research Paper, Concept of Research Report and Research Paper, Purpose of Research Report and Research Paper, Norms of Research Report and Research Paper, Format of Research Report and Research Paper, Style and Language of Research Report and Research Paper, Technical aspects of Thesis/ Dissertation, Evaluation of Research Report and Research Paper, References, Appendix.

REFERENCES:

1. Pauline V Young Research Methodology
2. Kothari C. R. Research Methodology, New Age Publications, New Delhi

PAPER II. ADVANCE GENERAL PAPER (OPTIONAL PAPER) (6 credits)

STATISTICAL INFERENCE (MPS 102):

Properties of good estimators, Unbiasedness, Consistency, Efficiency, Sufficiency Minimal sufficient statistics and Completeness. Cramer-Rao, Bhattacharya bounds. Minimum variance unbiased estimators, Rao-Blackwell Theorem. Lehman-Scheffe theorem and their applications. Method of Estimation, Method of Maximum Likelihood, Method of Moments, Method of Chi-Square, properties of M.L.E. Location Invariance, scale invariance. Pitmann's estimators for location and scale parameters.

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.

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.

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

REFERENCES:

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.

SAMPLING TECHNIQUES (MPS 103):

Unequal probability sampling: ppswr and wor methods (including Lahiri's scheme) and related estimators of a finite population mean (Hansen-Hurwitz and Desraj estimators for general sample size and Murthy's estimator for a sample of size 2).

Horvitz-Thompson estimator, its variance and unbiased estimator of variance, IPPS schemes of sampling due to Midzuno-Sen, Rao-Hartley-Cochran and Samphord.

The Jackknife and Bootstrap : estimate of bias, estimate of variance. Ratio Estimation in reference to Jackknife and bootstraps, Relationship between the jackknife and the bootstrap. Interpenetrating sub sampling.

Resampling techniques for variance-estimation; estimation of the population variance using auxiliary information

Successive Sampling, sampling for two occasion for estimation of population mean, population ratio etc., estimation of change in mean.

Non-sampling errors. Non response errors, Hansen Hurwitz method for tackling non response, Randomized Response techniques (Warner's method: related and unrelated questionnaire methods).

REFERENCES:

1. Chaudhuri, A. and Mukerjee, R. (1988): Randomized Response: Theory and Techniques, New York: Marcel Dekker Inc.
2. Cochran, W.G.: Sampling Techniques (3rd Edition, 1977). Wiley.
3. Des Raj and Chandok (1998): Sampling Theory, Narosa.
4. Murthy, M. N. (1977): Sampling Theory & Methods, Statistical Publishing Society, Calcutta.
5. Sukhatme et al (1984): Sampling Theory of Surveys with Applications. lowa state University Press & IARS.
6. Singh, D. and Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey Designs. New Age International Publishers.
7. Gray, H.L., and Schucany(1972) : The generalized jackknife statistic. New York. Marcel Dekker, Inc.

BAYESIAN INFERENCE (MPS 104):

Regular exponential families, conjugate and canonical conjugate analysis, weighted average form of posterior expectation, Conjugate families for samples from a multivariate normal distribution, mixtures of priors, maximal data information prior, Jeffrey's noninformative invariant priors.

Posterior distribution of correlation coefficient, bivariate regression, general linear model, one-way model and its relationship to ANOVA.

Loss functions, estimation of functions of population means and regression coefficient, Linear Bayes estimation, Emperical Bayes point estimation, estimation of the prior distribution.

Informative prediction; Regulation, optimization, calibration and diagnosis problems.

Bayesian analysis of changing sequence of random variables, detection of a change and estimation of a change point, predication. Large sample posterior distribution; Approximate evaluation of Bayesian integrals; Lindleys approximation, Tierney-Kadane approximation.

REFERENCES:

I. Aitchison, J. and Dunsmore, I.R. (1975): Statistical Prediction Analysis, Cambridge University Press.

2. Berger, J.O. (1985): Statistical Decision Theory and Bayesian Analysis, Second Edition, Springer Verlag, New York.

3. Bemardo, J.M. and Smith, A.F.M. (1994): Bayesian Theory, John Wiley and Sons, New York.

4. Broemeling, L.D. and Tsurmi, M. (1987): Econometrics and Structural Change, Marcel Dekker, Inc. New York.

5. Lee, P.M. (1989): Bayesian Statistics; an Introduction, Oxford University Press.

6. Mariz, J.S. and Lwin, T. (1989): Empirical Bayes Methods, II Edition, Chapman and Hall, London.

7. Press, S. J. (1989): Bayesian Statistics: Principles, Models and Application, John Wiley and Sons.

8. Zellner, A. (1984): Bassic Issues in Econometrics, The University of Chicago Press, Chicago.

RELIABILITY THEORY AND SEQUENTIAL TESTING (MPS 105):

Reliability, hazard-rate 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.

Gamma and Weibuil distributions. Estimation of parameters and reliability function with complete and censored samples. Estimation with regression approach. Normal and lognormal distributions-estimation of parameters and reliability with complete samples.

Tests of hypotheses and confidence intervals for the reliability function of exponential, gamma,Weibull, normal and lognormal distributions.

Sequential Analysis: Need of Sequential probability Ratio test and it's properties, Wald's fundamental identity, OC and ASN function, Optimality of SPRT. Applications to Normal, Binomial and Poisson Distribution. Sequential estimation – Basic idea, Stein's two stage procedure.

REFERENCES:

I. Bain, L.J. and Engelhardt, M. (1991): Statistical Analysis of Reliability and Life- Testing Models. Marcel Dekker Inc., U.S.A. -

2. Cohen, A.C. and Whitten, B.J. (1988): Parameter estimation in Reliability and Life Span Models. Marcel Dekker Inc., U.S.A.

3. Gerstbakh, I.B. (1989): Statistical Reliability Theory. Marcel Dekker Inc., New York.

4. Hoyland, A. and Rausand, M. (1994): System Reliability Theory: Models and Statistical Theory. Marcel Dekker Inc., New York.

5. Kalbfleisch, J.D. and Prentice, R.L. (1980): The Statistical Analysis of Failure Time Data. John Wiley and Sons, New York.

6. Lawless, J.F. (1982): Statistical Models and Methods for Lifetime Data. John Wiley and Sons Jnc.,.U.S.A.

7. Mann, N.R., Schafer, R.E. and Singpurwala, N.D. (1974): Methods for Statistical Analysis of Reliability and Life Data. John Wiley, New York.

8. Martz, H.F. and Wailer, R.A. (1982): Bayesian Reliability Analysis. John Wiley and Sons, Inc., New York.

9. Sinha, S.K. (1986): Reliability and Life-Testing. Wiley Eastern Ltd., New Delhi.

10. Sinha, S.K. (1998): Bayesian Estimation. New Age Publication.

11. Zacks, S. (1992): Introduction to Reliability Analysis. Springer-Verlag, U.S.A.

12. Wald A. (1947): Sequential Analysis. John Willy and sons, New York.

ECONOMETRICS AND TIME SERIES (MPS 106):

Models containing function of the predictors, including polynomial models, Use of orthogonal models, Hypotheses for one and more than one linear parametric functions, Confidence regions, Analysis of Variance, Power of F-test. Multiple comparison tests due to Tukey and Scheffe, Simultaneous confidence intervals.

The general linear model (GLM) and its extensions, Use of dummy variables and seasonal adjustment, Generalized least squares (GLS) estimation and prediction, Heteroscedastic disturbances, Pure and mixed estimation, Grouping of observations and of equations.

Auto correlation, its consequences and tests, Theil BLUS procedure: estimation and prediction, Multicollinearity problem, its implications and tools for handling the problem, Ridge regression.

Linear regression with stochastic regressors, Instrumental variable estimation, Errors in variables, Autoregressive linear regression, Distributed lag models.

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))

REFERENCES:

1. Cook, R.D. and Weisberg, S. (1982): Residual and Influence in Regression. Chapman and Hall.
2. Draper, N.R.and Smith, H. (1998): Applied Regression Analysis, Third Edition Wiley.
3. Guest, R.F. and Mason, R.L. (1980): Regression analysis and its Applications - A Data Oriented Approach. Marcel and Dekker.
4. Rao, C.R. (1973): Linear statistical inference and its Applications. Wiley Eastern.
5. Weisberg, S. (1985): Applied Linear Regression. Wiley.
6. Anderson, T.W. (1971). The Statistical Analysis of Time Series, John Wiley, New York.
7. Box, G.E.P. and Jenkins, G.M. (1976). Time Series Analysis- Forecasting and Control, Holden-day, San Francisco.
8. Kendall, Sir Maurice and Ord, J.K. (1990), Time Series, Edward Arnold, London.
9. Fuller, W.A. (1976). Introduction to Statistical Time Series, John Wiley, New York.
10. Montgomery, D.C. and Johnson, L.A. (1977) Forecasting and Time Series Analysis, McGraw Hill, New, York.

SAMPLING DESIGN & MATHEMATICAL PROGRAMMING TECHNIQUES (MPS 107):

Estimation of population mean, total and proportion in SRS and Stratified sampling, estimation of gain due to stratification, methods of allocation with more than one characteristics: Chatterjee and Cochran methods, ratio and regression methods of estimation, optimality of ratio estimate, cluster sampling: estimation of population mean and their variances based on cluster of equal sizes, variance in terms of intra-class correlation coefficient, two stage sampling: estimation of population total and mean with equal first stage units, variances and their estimation, optimum sampling and sub-sampling fractions, double sampling, double sampling for stratification.

Integer Programming: Gomory's f-cut, Branch and Bound method: Branching, bounding and fathoming.

Dynamic Programming: Bellman's principle of optimality, the general characteristics of Dynamic Programming Problems, Solutions of L.P. problems by D.P.

The general Nonlinear Programming Problem, difficulties introduced by nonlinearity, the Kuhn-Tucker necessary conditions for optimality, solution of simple NLPP using K-T conditions, Quadratic Programming: Wolfe's method and Beale's method.
Multi-objective Programming Problems, solutions by various distance based methods, Goal Programming, Lexicographic Goal Programming.

REFERENCES:

Bazara, M.S., Sherali, H.D. and Shetty, C.M. (2006): Nonlinear Programming: theory and algorithms, Wiley, New York.

Cochran, W.G. (1977): Sampling Techniques, 3rd edition, John Wiley & Sons, New York.

Hillier, F.S. and Leiberman, G.J. (2001): Introduction to operations research; McGraw-Hill, New York.

Murthy, M.N. (1977): Sampling theory and methods, Statistical Publishing Society, Calcutta.

Rao, S.S. (1984): Optimization: theory and applications: how Michael 'selected' Amy. Kluwer Academic Publishers, Dordrecht.

Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. and asok, C. (1984): Sampling theory of surveys with applications. 3rd edition, Iowa State University Press, Iowa and Indian Society of Agriculture Statistics, New Delhi.

Taha, H.A. (2011): Operations research: an introduction, Ninth edition Pearson, India.

Wagner, H.M. (1975): Principles of Operations research: with applications to managerial decisions: Prentice Hall Inc., N.J.

STOCHASTIC ORDERS (MPS 108):

Univariate Stochastic Orders: The usual stochastic order, the hazard (reserved hazard) rate order, the likelihood ratio order, the mean residual life order, the convex (concave) order, the dispersive order, the monotone convex (concave) order, star and super-additive order.
Closure properties of these orders, different characterization and properties of these orders.
Applications of these orders in reliability theory, economics, etc.
Multivariate Stochastic Orders: The usual multivariate stochastic order. The multivariate hazard rate order, the multivariate likelihood ratio order, the multivariate reversed hazard rate order. Properties and applications of these orders.
Relation between stochastic ageing and stochastic orders.

REFERENCES:

Barlow, R.E. and Proschan, F. (1975). Statistical Theory of Reliability and Life Testing. Holt, Rinehart and Winston, New York.

Lai, C.D. and Xie, M. (2006). Stochastic Ageing and Dependence for Reliability. Springer, New York.

Marshall, A.W. and Olkinn, I. (2007). Life Distributions, Springer, New York.

Muller, A. and Stoyan, D. (2002). Comparison Methods for Stochastic Models and Risk,. John Wiley.

Shaked, M. and Shantikumar, J.G. (2007). Stochastic Orders. Springer, New York.

SOFT COMPUTING (MPS 109):

Introduction to Soft Computing, Historical Development, Definitions, advantages and disadvantages.

Neural Networks: Fundamentals, Neural Network Architectures, Feedforward Networks, Backpropagation Networks.

Fuzzy Logic: Fuzzy Sets, Fuzzy numbers, Fuzzy Systems, membership functions, fuzzification, defuzzification

Application of Soft Computing Techniques.

REFERENCES:

Klir, G. J. and Yuan, B.: "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall. 1995

Rajasekaran, S. and Vijayalakshmi Pai, G.A.: "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications", Prentice Hall of India. 2003

Sinha, N.K. and Gupta, M. M. : "Soft Computing and Intelligent Systems - Theory and Applications", Academic Press. 2000

Tettamanzi, A., Tomassini, M.: "Soft Computing: Integrating Evolutionary, Neural, and Fuzzy Systems", Springer.

PAPER III. STATISTICAL SOFTWARE &LAB SESSIONS (MPS 110) (6 credits)

Historical evolution of computers, Generations of Computers, Classification of Computers, Hardware : CPU, I/O Devices, Block diagram. System Software.

Windows : The user Interface, The Desk Top, The Task Bar, The Control Panel, The Find Features, Properties, Font Management, Systems Tools, Character Map, Note Pad, The My Computer ICON, Folders, Short-Cuts. Word Processing : Creating and Saving a document, Editing the text; Printing Documents.

Working with Software Packages : MS-Office, SPSS, FORTRAN and R-Language.

1. Classification, Tabulation and Frequency Tables.
2. Bar Graphs, DOT Diagram and Histogram
3. Stem-and-Leaf Plots.
4. Box Plots.N
5. Summary Statistics
6. Two-way tables and plots.
7. Product moment correlation coefficient, Rank Correlation coefficient.
8. Curve setting by method of least squares: Exponential and polynomial (upto three degree) equations.
9. Fitting Regression lines
10. Correlation ratios.
11. Multiple and partial correlation coefficients. Regression equations (for three variables only).
12. Rank and Inverse of a matrix
13. Fitting of Binomial, Poisson, Negative Binomial, Normal and Gamma Distributions.

Programming with R-Language. Interpretation of Software output.

SEMESTER II

PAPER 1 DISSERTATION (MPS 201) (14 credits)

PAPER 2 SEMINAR PRESENTATION & VIVA-VOCE (MPS 202) (4 credits)

Each paper shall carry 100 marks the breakup of which is as follows.

c. Written Examination: 70 marks
d. Internal Assessment (Class performance/ Presentation): 30 marks.