

**DEPARTMENT OF STATISTICS
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhana Magdalla Road, Surat-395 007.**

Ph.D. (Full Time / Part Time) in Applied Statistics (Higher Payment)

SYLLABUS

FOR POSSIBLE IMPLIMENTATION FROM: 2021-2022

Paper	Title	Marks			Credits	Passing	Yearly Work Load
		Int.	Ext.	Total			
1	Research Methodology	30	70	100	4	50	60
Optional papers (Opt any two)							
2	Advanced Survey Sampling	30	70	100	4	50	60
3	Advanced Operations Research	30	70	100	4	50	60
4	Advanced Statistical Quality Control and Reliability	30	70	100	4	50	60
5	Applied Regression Analysis	30	70	100	4	50	60
Total		300				150	
Thesis	Evaluation of Thesis by Internal Examiner	100			9	50	
	Evaluation of Thesis by First External Examiner	100				50	
	Evaluation of Thesis by Second External Examiner	100				50	
Thesis		300				150	
Viva-		200			4	100	
		Total:	800		25	400	

Grand Total: 800 Marks

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PAPER-1

RESEARCH METHODOLOGY:

The sufficiency Principles, Likelihood Principles, Conditional Principles, their inter-relations, Birnbaums' results. The likelihood principles and the Law of likelihood. Critical study of various classical inference procedures in the light of the law of likelihood.

REFERENCES:

1. Anderson, J: Thesis and Assignment Writing
2. Birnbaum, A.: On the Foundations of Statistical Inference; Journal of the American Statistical Association, Vol.57.
3. DeGroot M. H. Optimal Statistical Decisions. McGraw Hill. Edition Springer- Verlag.
4. Edwards, A.W.F. : Likelihood; Cambridge Univ. Press
5. Ferguson, T. P. Mathematical Statistics: A decision Theoretic approach, Academic Press,
6. Fisher, R. A.: Statistical methods for Research Workers; Edinburgh: Oliver and Boyd.
7. Fisher, R.A.: Statistical methods and Scientific Inference; Edinburgh: Oliver and Boyd.
8. Hacking I.: Logic of Statistical Inference; Cambridge Univ. Press.
9. Hacking, I. : Logic of Statistical Inference; Cambridge Univ. Press
10. James O. Berger: Statistical Decision Theory and Bayesian Analysis: Second
11. Kerlinger, F.N.:Foundations of Behavioural Research

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PAPER-2

ADVANCED SURVEY SAMPLING

IPPS schemes of sampling due to Midzuno-Sen, Brewer, Durbin and JNK Rao (sample size 2 only), Rao-Hartley-Cochran sampling scheme for sample size n with random grouping.

Issues in small area estimation - synthetic and generalized regression estimators.

Non-sampling errors and biased responses, randomized responses for variables, errors in surveys, Nature of measurement errors, measurement models, modeling observational errors, estimation of variance components, application to longitudinal studies (repetitive surveys).

Randomized response: Estimation in the presence of unit response imputation.

Unified theory of finite population sampling, the basic model and non-existence of BLUE in the general class of estimators.

Criteria for judging estimators: Admissibility and Hyper admissibility, Minimax and invariant estimators.

Concepts of likelihood and sufficiency and short comings of the conventional theory of sampling, some alternative approaches: Royall's prediction approach and Erichson's Bayesian approach.

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Inference under a Super population set-up: Super population concept, various super population models, design-unbiased and model-unbiased predictions under different models.

REFERENCES:

1. Bolfarine, H & Zacks. S Prediction theory for finite population. Springer- Verlag, NY
2. Classel, C.M., Samdal, CE. and Wretman. J. Foundations of inference in survey sampling. John Wily: NY
3. Hedayet, A. S. and Sinha, B. K. Design and inference in finite population sampling, John Wiley: NY
4. Mukhopadhyay, P., Small area estimation in survey sampling, Narosa, London.
5. Mukhopadhyay, P., Theory and methods of survey sampling. Prentice Hall India, New Delhi.
6. Samdal, C. B., Swensson. B. and Wertman, J. Model assisted survey sampling, Springer - Verlag, NY.
7. Chaudhuri, A. and J.W.E. Vos: Unified Theory and Strategies of Survey Sampling. North-Holland, Amsterdam.
8. Chaudhuri, A. and R. Mukerjee: Randomized Response: Theory and Techniques, New York: Marcel Dekker Inc.
9. Cochran, W. G. : Sampling Techniques. 3rd Ed. Wiley.
10. Des Raj and Chandhok: Sampling Theory. Narosa.
11. Hedayat, A. S. and Sinha, B. K. Design and inference in finite population sampling. Wiley.
12. Mukhopadhyay, P. Inferential problems in survey sampling. New Age International (P).
13. Mukhopadhyay, P. Small area estimation in survey sampling. Narosa. Statistics 73
14. Murthy, M. N. Sampling theory and methods. Stat. Publ. House, Calcutta.
15. Sukhatme, P. V. et al. Sampling theory of surveys with applications. Iowa State Univ. Press.
16. Wolter, K. M. Introduction to variance estimation. Springer-Verlag.

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PAPER-3

ADVANCED OPERATIONS RESEARCH

1. Parametric Programming: Changes in requirement and cost vector.
2. 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.
3. Quadratic programming : Wolf's method and Beal's method
4. Non- Poisson Queues: Study of the systems $M/E^k/1$, $M/G/1$, $GI/M/1$, $GI/M/C$.
5. 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

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PAPER – 4:

ADVANCED STATISTICAL QUALITY CONTROL AND RELIABILITY

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

Capability indices C_p , C_{pk} and C_{pm} ; estimation, confidence intervals and tests of hypotheses relating to capability indices for Normally distributed characteristics.

Use of Design of Experiments in SPC; factorial experiments, fractional factorial designs, construction of such designs and analysis of data.

Multivariate quality control; use of control ellipsoid and of utility functions.

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.

Maintenance and replacement policies; availability of repairable systems; modeling of a repairable system by a non-homogeneous Poisson process.

Reliability growth models; probability plotting techniques; Hollander-Proschan and Deshpande tests for exponentiality; tests for HPP vs. NHPP with repairable systems.

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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.



PAPER-5

APPLIED REGRESSION ANALYSIS

Selection of variables: Formulation of the problem, All possible regressions and “Best Subset” regression, stepwise regression, Backward Elimination, Stepwise Method, Consequences of variable deletion, use of regression equations, Significance levels for selection procedures, Multicollinearity and Variable selection, Variable Selection Using Ridge Regression

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Residuals and their analysis, Influential observations, Power transformations for dependent and independent variables.

Non-linear regression models, Different methods of estimation (Least squares, Maximum Likelihood), Asymptotic properties of estimators.

Generalized linear models, Analysis of binary and grouped data by using logistic models, Log-linear models.

Random and mixed effect models, Maximum likelihood, MINQUE and restricted maximum likelihood estimators of variance components, Best linear unbiased predictors (BLUP), Growth curves. (15L)

REFERENCES:

1. Bates, D. M. and Watts, D. G.: Nonlinear Regression Analysis and its Application, Wiley, New York.
2. Chatterjee S., Hadi, A. S. and Price, B.: Regression Analysis by Examples, 3rd Ed., Wiley, New York.
3. Cook, R. D. and Weisberg, S.: Residuals and Inference in Regression, Chapman and Hall, London.
4. Draper, N. R. and Smith, H.: Applied Regression Analysis, 3rd Ed., Wiley, New York
5. Efron, B. and Tibsirani, J. R.: An Introduction to the Bootstrap, Chapman and Hall, New York
6. Kshirsagar, A. M.: Growth Curves, Marcel and Dekker, New York.
7. McCullagh, P. and Nelder, J. A.: Generalized Linear Models, 2nd Ed., Chapman and Hall, London.
8. Searle, S. R.: Linear Models for Unbalanced Data, Wiley, New York.
9. Seber, G. A. and Wild, G. J.: Nonlinear Regression, Wiley, New York.

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