DEPARTMENT OF STATISTICS
सांख्यिकी विभाग
UNIVERSITY OF DELHI / दिल्ली विश्वविधालय
DELHI-110007 / दिल्ली ११०००७

M. PHIL. COURSE IN STATISTICS W.E.F. October, 2016.

1. **Objectives:**

To provide course of study to postgraduates in Statistics with a view to strengthen their foundations for under taking Ph. D. work in both theoretical and Applied Statistics.

2. **Course Structure**

The M. Phil. Course will consist of two parts:

(i) M. Phil. Part I

(ii) M. Phil. Part II

(1) **M.Phil. Part I:** The M. Phil. Committee of the Department will assign three Courses (including Research Methodology which is compulsory) to each candidate on the basis of the preferences indicated by the candidate out of the following courses:

Sl. No.	Course Code	Course Name
(i)	M.Phil. - 01	Research Methodology
(ii)	M.Phil. - 02	Design of Experiments
(iii)	M.Phil. - 03	Applied Bayesian Inference
(iv)	M.Phil. - 04	Order Statistics
(v)	M.Phil. - 05	Bio-Statistics
(vi)	M.Phil. - 06	Reliability and Life Testing

(ii) **M. Phil Part II:** Every M. Phil. student will write a dissertation on a topic pertaining to one of the courses assigned by the M. Phil. Committee subject to the condition that, as far as possible, at most two candidates will be allowed under any supervisor. In assigning the topic for dissertation, the M. Phil. Committee will be guided by the preferences of the candidate coupled with his/her performance in M. Phil. Part-I Examination.

3. **Duration of the M. Phil. Course:**

The duration of the M. Phil. Course will be 18 Months.

4. **Seats:**

Number of candidates to be admitted to the course will be restricted to 10.

5. **Eligibility for admission:**

Good academic record with first or High Second Class Master Degree in Statistics of the University of Delhi or an Examination recognized as equivalent thereto.

6. **Contact Periods:**

With a view to encourage self study by the students themselves two contact periods per week will be assigned to each course

7. **Attendance:**

A student admitted to the M. Phil. course shall be required to attend not less than 2/3rds of the number of contact periods assigned in M. Phil. Part-I.

8. **Scheme of Examination**

A student admitted to M. Phil. course will be evaluated on the basis of

(a) Written examination in **three** courses offered by him/her in M. Phil. Part-I and INTERNAL ASSESSMENT.*

(b) Dissertation and Viva-Voce.

The weightage (in terms of Marks) shall be as follows:

(a)	**Courses**	**Written**	**Internal Assessment**	**Total**
	Course I	75	25	100
	Course I	75	25	100
	Course III	75	25	100
(b) **Dissertation**				
(i) Written				150
(ii) Viva-Voce				50
			Grand Total:	500

The written examination will be held at the end of the period stipulated for M. Phil. Part-I.

9. *** Internal Assessment:**

The students will be assessed on the basis of their assignments and Seminars in each course.

M.Phil. – 01 Research Methodology

Concept of Research in Statistics-Importance and Need for Research Ethics, Selection of Topic for Research-Research schedules, Review of Literature and its Use in Designing a Research Work-Mode of Literature Survey-Books and Monographs, Journals, Conference Proceedings, Abstracting and Indexing Journals, E-Journals/Books and CDROMS-Reports etc. Thesis Writing – Computer Application in Scientific Research-www- Searching Scientific Articles-Statistical Data Base. History of Statistics. Statistical Heritage of India.

Scientific Word Processing with LaTeX and MS-Word: Article, Thesis Report and Slides Making-Power Point Features, Slide Preparation. Statistical Programming with R: Simple Manipulations Using Numbers and Vectors-Objects & Their Attributes-Arrays and Matrices-Lists and Data Frames-Grouping, Loops and Conditions-User Defined Functions- Probability Distributions and Statistical Models in R.

Simulation: Concepts and Advantages of Simulation-Event Type Simulation-Random Variable Generation-U(0,1), Exponential, Gamma and Normal Random Variables–Monte Carlo Integration. The MCMC Principle, Algorithms and its Variants, Bootstrap Methods.

Computer Oriented Numerical Methods-Algorithms for Solving Algebraic and Transcendental Equations-Numerical Integration-Matrix operations.

Suggested Readings:

1. Anderson, J., Durston, B.H., Pooole, M. (1970). Thesis and Assignment Writing, Wiley Eastern. Ltd., New Delhi.
2. Beveridege, B. (1979). The Art of Scientific Investigation, W.E. Norton & Co., New York.
3. Braun, J., Duncan, W. and Murdock, J. (2008). A First Course in Statistical Programming with R, Cambridge University Press, London.
4. Chambers, J. (2008). Software for Data Analysis: Programming with R, Springer, New York.
5. Crewley, M.J. (2007). The R-.Book, John Wiley, New York.
6. Dalgaard, P. (2008). Introductory Statistics with R, Springer Science, New York.
7. Ghosh, J.K., Mitra, S.K. and Parthasarathy, K. R. (1992). Glilmpses of India's Statistical Heritage, Wiley Eastern Limited, New Delhi.
8. Hald, A. (1998). A History of Mathematical Statistics from 1750 to 1930, John Wiley & Sons, New York.
9. Kantiswarup, S., Gupta P.K. and Man Mohan (2008). Operations Research, Sultan Chand & Sons, New Delhi.
10. Kothari, C.R. and Garg, G. (2014). Research Methodology: Methods and Techniques, 3rd Edn., New Age International Publishers.
11. Lamport, L. (1999). LATEX: A Document Preparation System, Addison, Wesley, 2nd edition, New York.
12. Pannerselvan, R. (2006). Research Methodology, Prentice-Hall of India Pvt., New Delhi.
13. Robert, C.P. and Casella, G. (2004). Monte Carlo Statistical Methods, Springer Science, New York.
14. Venkataraman, M.K. (1998). Numerical Methods in Science and Engineering, The National Publishing Company, Chennai.

M.Phil. – 02 Design of Experiments

Galois Fields, Quadratic Residues, Hadamard Martices, Plackett Burman Designs and their properties, Orthogonal Arrays and their constructions, Designs for fitting response surfaces, Design criterion involving bias and variance. Mixture Experiments, Constraints on component proportions, Designs for Constrained Mixture Regions, Crossover Designs.

Suggested Readings:

1. Bose, M. and Dey, A. (2009). Optimal Crossover Designs. World Scientific.
2. Cornell, John A. (2002). Experiments with Mixtures, John Wiley & Sons.
3. Dey, A. and Mukerjee, R. (1999). Fractional Factorial Plans, John Wiley & Sons.
4. Hedayat, A. S., Sloane, N. J.A. and Stufken, J. (1999). Orthogonal Arrays: Theory and Applications, Springer.
5. Hinkelmann, K. and Kempthorne, O. (2005). Design and Analysis of Experiments, Vol. 2: Advanced Experimental Design, John Wiley & Sons.
6. Lin, D.K. J. and Draper, N.R. (1999). Projection Properties of Plackett and Burman Designs. Technometrics, 34, 423-428.
7. Myers, R. H. and Montgomery, D. C. (2002). Response Surface Methodology: Process and Product Optimization using Designed Experiments, John Wiley & Sons.
8. Raghavarao, D. (1970). Construction and Combinatorial Problems in Design of Experiments, John Wiley & Sons.

M.Phil. – 03 Applied Bayesian Inference

Some simple consequences of Axioms of probability, Bayes Theorem. Conjugate analysis for count data, waiting times, Normal likelihood, multivariate normal distribution, normal linear regression model. Behrens-Fisher Controversy.

Informative, non-informative, hybrid and nonparametric priors. Loss functions. Bayes factor, Information theoretic measures for model selection, sensitivity and robust analysis. Bayes point estimation: one parameter, Bayes decisions between k simple hypothesis and between two composite hypothesis. Lindley's method.

Hierarchial models - Poisson-gamma, Gaussian, linear mixed, nonlinear mixed.

Empirical Bayes : asymptotic optimality and robustness with respect to prior distribution.

Spatial and spatio-temporal Bayesian models.

Monte Carlo Sampling from the posterior, Comparing Bayesian Inference from Numerical posterior and posterior random samples.

Suggested Readings

1. Congdon, P. (2003). Applied Bayesian Modelling. Wiley.
2. Congdon, P. (2010). Applied Bayesian Hierarchical Methods. Chapman & Hall.

3. Thompson, J. (2014). Bayesian analysis with STATA. (2014). State Press.
4. Albert, J. (2007). Bayesian Computation with R. Springer.
5. Gelman, A. , Carlin, J. , Stern, H. , Vehtari, D.D.A. and Rubin, D. (2004). Bayesian Data Analysis. Chapman & Hall, 2nd ed.
6. Upadyaya, S.K. , Singh, U. and Dey, D.K. eds. (2007). Bayesian Statistics and its applications. Anamaya, Delhi.
7. Kruschke, J.K. (2015). Doing Bayesian Data Analysis. Elsevier AP.
8. Koch, K. R. (2010). Introduction to Bayesian Statistics, 2nd ed. Springer.
9. French, S. and Smith, J. Q. eds. (1997) The Practice of Bayesian analysis (1997). Arnold Publisher.

M.Phil. – 04 Order Statistics

Basic distribution theory, conditional distributions, order statistics as a Markov Chain, order statistics for independent non-identically distributed variates; Discrete order statistics, Joint probability mass function, Dependence structure; Expected values and moments; Order statistics from some specific distributions; Recurrence relations, bounds and approximations for moments of order statistics; Concomitants of order statistics; Order statistics in statistical inference; Order statistics from a sample containing a single outlier; Asymptotic theory; Record values; Generalized order statistics.

Suggested Readings:

1. Ahsanullah, M., Nevzorov, V.B. and Shakil, M. (2013). An Introduction to Order Statistics. Atlantis Studies in Probability and Statistics, Vol. 3, Atlantis Press.
2. Arnold, B.C. and Balakrishnan, N. (1989). Relations, Bounds and Approximations for Order Statistics. Lecture Notes in Statistics, Vol.53, Springer-Verlag.
3. Arnold, B.C. Balakrishnan, N. and Nagaraja, H.N. (1992). A first course in Order Statistics, John Wiley.
4. Arnold, B.C., Balakrishnan, N. and Nagaraja, H.N. (1998). Records, John Wiley.
5. David, H.A. and Nagaraja, H.N. (2003). Order Statistics, Third Edition, John Wiley.
6. Galambos, J. (1987). The Asymptotic Theory of Extreme Order Statistics, Second Edition, Krieger, F.L.
7. Kamps, U. (1995). A Concept of Generalized Order Statistics, B.G. Teubner Stuttgart.

M.Phil. – 05 Bio-Statistics

Nelson –Aalen estimator of cumulative hazard function along with its variance, Its applications in survival analysis, Markov illness death model and epidemic model, Graphical methods for survival distribution fitting and goodness of fit tests, Parametric and non-parametric methods of comparing survival distributions, Mantel -Haenszel test, Estimation of mean residual lifetime with applications, Likelihood construction for censored and truncated data, Cox PH model along with its likelihood construction, Construction of clinical life table, Carrier Borne epidemic model. Competing risk theory with censoring.

Suggested Readings:

1. Biswas, Suddhendu (1995). Applied Stochastic Processes, New Central Book Agency.
2. Collett, David (2015). Modelling Survival Data in Medical Research, CRC press.
3. Klein, John P., and Moeschberger, Melvin L. (2005). Survival Analysis: Techniques for Censored and Truncated Data, Springer Science & Business Media.
4. Kleinbaum, David G., and Mitchel Klein (2006). Survival Analysis: A Self-learning Text, Springer Science & Business Media.
5. Lee, Elisa T., and Wang, John W. (2003). Statistical Methods for Survival Data Analysis, John Wiley & Sons.
6. Pintilie, Melania (2006). Competing Risks: A Practical Perspective, John Wiley & Sons.

M.Phil. – 06 Reliability and Life Testing

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.

Bayes estimation for the parameters and reliability function (under different losses) of exponential, gamma, Weibull, normal and lognormal distributions. Lindley's expansion and its application in Bayesian reliability estimation. Bayesian credible intervals for the parameters and reliability function for exponential, gamma, Weibull, normal and lognormal distribution

Suggested Readings:

1. 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.