

## **Course Work for Ph.D. Programme in Statistics of University of Calicut**

### **Syllabus of Core Course: Research Methodology in Statistics ( 4 Credits) (Common to all candidates)**

This course introduces some Statistical concepts and methods which potential students will find useful in preparing for work on a research degree in Statistics. Focus is on applications of state-of –the-art. Statistical techniques and their underlying theory.

**Unit. I.** 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 CD-ROMS-Reports etc. Thesis Writing – Computer Application in Scientific Research-www-Searching Scientific Articles-Statistical Data Base. History of Statistics. Statistical Heritage of India.

**Unit. II:** 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.

**Unit. III:** 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.

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

### **References**

1. Anderson, J., Durston, B.H., Poole, M. (1970) Thesis and Assignment Writing. Wiley Eastern. Ltd., New Delhi.
2. Beveridge, 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) Glimpses 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. (2005) Research Methodology. New Age International. Publishers, New York.
11. Lamport, L. (1999) LATEX: A Document Preparation System. Addison, Wesley, 2<sup>nd</sup> edition, New York
12. Pannerselvan,R. (2006) Research Methodology. Prentice-Hall of India. Pvt., NewDelhi.
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.

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**MODEL QUESTION PAPER**  
**Ph. D. Course Work Examination in Statistics**  
**Core Course: Research Methodologies in Statistics (4 credits)**

[Note: Answer any FIVE questions. Each question carries 14 marks.]

Time: **3 Hours**

Maximum marks: **70**

- I. (a) Briefly describe the different steps involved in a research problem.  
(b) Distinguish between research methods and research methodology. (7+7)
- II. (a) “Research is much concerned with proper fact finding, analysis and evaluation”. Do you agree with this statement? Give reasons in support of your answer.  
(b) Describe various modes of literature survey. (7+7)
- III. (a) Describe how do you make article, slides and reports using Latex.  
(b) What are the advantages of Latex as a scientific word processor than M.S. Word? (7+7)
- IV. (a) Explain how do you create matrices, array and vectors in R.  
(b) Explain how do you create your own function in R. Write an R function to find the Crammer-Rao Lower Bound of the parameter  $\theta$  given a sample from Poisson (  $\lambda$  ) (7+7)
- V. (a) What is simulation technique?  
(b) Explain briefly its limitations and advantages.  
(c) Discuss the simulation of continuous random variables. (4+3+7)
- VI. (a) Describe the procedure involved in Monte Carlo integration.  
(b) Elaborating the Monte-Carlo Markov-Chain principle, present the basic algorithm for generating random variable from a specified probability distribution.  
(c) Present a short note on Bootstrap methods. (4+7+3)

- VII. (a) Distinguish between the bisection method and false position method of finding the roots of an equation.
- (b) Explain Newton-Raphson's method to determine the roots of the equation  $f(x) = 0$ . Write an algorithm/program to find the solution of  $f(x) = \cos x - xe^x$  using Newton-Raphson's method with initial value  $x = 1.0$  and error tolerance = 0.0001.
- (c) Find the characteristic polynomial, eigen value and eigen vector of the Matrix,

$$A = \begin{bmatrix} 2 & 6 & -1 \\ 0 & 1 & 3 \\ 0 & 3 & 1 \end{bmatrix} \quad (3+7+4)$$

- VIII. (a) Write down Simpson's  $\frac{1}{3}$  rule for numerical integration, given seven ordinates  $x_0, x_1, \dots, x_6$ . Write an algorithm/program to find the value of  $\int_0^1 \frac{1}{(1+x)^2} dx$ , given

$$\frac{f}{4} = \int_0^1 \frac{1}{(1+x)^2} dx, \text{ using Simpson's } 1/3 \text{ rule.}$$

- (b) Write an algorithm/program to solve the linear non homogeneous system of equations involving k unknowns,  $AX = b$  using Gauss-Seidel iterative method.

(7+7)

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