GENERAL ELECTIVE COURSE – 7B: INTRODUCTION TO BAYESIAN INFERENCE

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Introduction To Bayesian Inference	4	3	0	1	Class XII pass with Mathematics	Knowledge of Probability Distribution and Statistical Inference

Learning Objectives:
The learning objectives of this course is

- To introduce students to the Bayesian approach to statistics
- To make students understand the basic difference between the commonly taught
- Frequentist approach and the Bayesian Paradigm.
- To demonstrate the benefits of using a Bayesian approach and obtaining results that are
- more interpretable

Learning Outcomes:
After completion of this course, students should have developed a clear understanding of:

- Bayes theorem for random variables
- Prior and posterior distributions
- Conjugate prior
- Non-informative priors
- Bayesian point estimation
- Bayesian Credible intervals
- Bayes factor

SYLLABUS OF GE-7b

Theory

UNIT I: **(5 Hours)**
Bayes Theorem for Random Variables
Revision of some basic distributions; Bayes theorem for events; Bayes theorem for random variables; Concept of likelihood function, prior distribution and posterior distribution.

UNIT II: **(12 Hours)**
Conjugate Prior and Non-Informative Priors
Thumb rule for constructing a conjugate prior; Conjugate families for samples from various standard distributions: Uniform prior; Jeffreys' non-informative priors.

UNIT III: **(15 Hours)**

Bayes Estimation and Credible Interval

Elements of Bayes Decision Theory; Loss Functions; Squared error loss function; Bayes risk; Normal and Extensive form of analysis; Bayesian credible intervals.

UNIT IV: **(13 hours)**

Hypothesis Testing

Prior and posterior odds; Bayes factor for simple versus simple hypothesis; Lindley's procedure for test of significance.

PRACTICAL/LAB WORK: (30 HOURS)

List of Practical

1. Plotting of Prior and posterior distributions for Binomial distribution case.
2. Plotting of Prior and posterior distributions for Poisson distribution case.
3. Bayes Estimation using Normal distribution and Squared error loss function.
4. Bayes Estimation using Binomial distribution and Absolute error loss function.
5. Construction of credible intervals and their comparison with corresponding classical confidence interval for Normal distribution case.
6. Construction of credible intervals and their comparison with corresponding classical confidence interval for Binomial distribution case.
7. Normal Approximation to Posterior Distribution.
8. Construction of HPD credible interval for Normal distribution case.

Practical work to be conducted using electronic spreadsheet / EXCEL/ Statistical Software Package/ SPSS/ calculators.

ESSENTIAL READINGS:

- Barnett, V. (1999). Comparative Statistical Inference, J. Wiley, New York.
- Bansal, A.K. (2007). Bayesian Parametric Inference, Narosa Publishing House.
- Berger, J.O. (1985). Statistical Decision Theory and Bayesian analysis, Second Edition, Springer-Verlag, New York.

SUGGESTED READINGS:

- Box, G.E.P. and Tiao, G.C. (1992). Bayesian Inference in Statistical Analysis, Addison-Wesley.
- Lee, P. M. (2012). Bayesian Statistics: An Introduction, Arnold Press.
- O'Hagan, A. and Forster, J. (2010). Kendall's Advanced theory of Statistics, Volume 2B, Bayesian Inference, Oxford University Press, New York.
- Robert, C.P. (2007). The Bayesian Choice: A Decision Theoretic Foundations to Computational Implementation, Second Edition, Springer-Verlag, New York.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch University of Delhi, from time to time.