Course title: Probability and Statistics			
Course code: MPE 115	**No. of credits:** 4	**L-T-P:** 54-0-4	**Learning hours:** 56
Pre-requisite course code and title (if any): Statistics and Mathematics courses of BA (Hons) in Economics or equivalent or instructor's consent.			
Department: Department of Policy Studies			
Course coordinator: Dr. Seema Sangita		**Course instructor:** Dr. Seema Sangita	
Contact details: seema.sangita@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 1	

Course description:

This course introduces the theories of probability and statistics and provides an insight into their applications to economic problems. The course starts with fundamental concepts of probability theory and random variables. This is followed by a discussion of several special families of distributions that are widely used in applications of probability and statistics. The subsequent modules elaborate on sampling, principles of statistical inference, estimators and their properties, etc. Finally, the students are introduced to confidence intervals and hypothesis testing. The students are also introduced to statistical analyses using software such as STATA and R. This course also creates a foundation for introductory and advanced econometrics and research methods.

Course objectives:

1. To provide a foundation of statistical concepts for undertaking data analysis in Economics.
2. An exposure to various theories of probability and statistics, listed below, along with a demonstration of their applications.
3. To provide hands-on training in the use of statistical softwares for data description, graphical depiction of data, basic probability theory, testing hypotheses, correlation analysis, etc.

Course contents

Module	Topic	L	T	P
1	**Introduction** Meaning of 'statistics' Data Basics Observational versus Experimental studies Exploratory data analysis Practicals: Starting with STATA/R	4	0	2
2	**Probability Theory** Set Theory Kinds of Probability. Probability-Axiomatic Conditional Probability and Independence Bayes Theorem Stata/R based application	6	0	0
3	**Random Variable and Distributions** Random Variables Distribution Functions Density and Mass Functions Distributions of Functions of a Random Variable Expected Values Moments Covariance and Correlation Law of Large Numbers and Central Limit Theorem Stata/R based application	12	0	0

4	**Special Distributions** Normal distribution Uniform distribution The Binomial and related distributions Poisson distribution Geometric & Hyper-geometric distributions Exponential distribution Gamma Chi-square Beta distributions Stata/R based application	8	0	0
5	**Estimation** Point estimate, interval estimate Properties of estimators – unbiased, consistency, minimum variance, efficiency, sufficiency; Estimation of model parameters – mean, proportion, variance, difference of means, ratio of variances Stata/R based application	8	0	0
6	**Sampling Distributions of Estimators** Sampling Distribution of a Statistic Sampling from Normal Distribution Confidence Intervals Stata/R based application	8	0	0
7	**Hypothesis Testing** Introduction to hypothesis testing procedure Simple and composite hypothesis Type I and type II errors and the power function Parametric tests- t-test, $\chi 2$- test, F-test ANOVA Stata/R based application	8	0	0
	Total (in hours)	**48**	**0**	**2**

Evaluation criteria:

1. Test 1 (Modules 1, 2 and 3) 25%
2. Test 2 (Modules 4, 5, 6 and 7) 40%
3. Practical exam (software based) 25%
4. Assignments (Across all modules) 10%

Learning outcomes:

At the end of this course, students will be able to

1. Understand the fundamental principles of Mathematical Statistics and techniques of proving theorems (Evaluation criteria 1,2 and 4)
2. Understand the principles, techniques and approaches used for statistical inferences (All evaluation critieria)
3. Apply statistical concepts to economic models (All evaluation criteria)
4. Solve problems of importance using statistical techniques (All evaluation criteria)
5. Use STATA/R for summarising and visualization of data, basic probability theory, testing hypotheses, correlation analysis, etc. (Evaluation criteria 3)

Study Materials:

1. DeGroot, M. H., and M.J. Schervish. 2012. *Probability and Statistics*. 4th Ed., Mass: Addison-Wesley.
2. Mood, A. M., F. A. Graybill, and D. C. Boes. 1974., *Introduction to the Theory of Statistics*. 3rd Ed., New York: McGraw Hill.
3. Casella, G, and R.L. Berger. 2002. *Statistical inference*. 2nd Ed., Pacific Grove, Calif: Duxbury.
4. Crawley, M. J. 2014. *Statistics: An Introduction Using R*. 2nd Ed. Chichester: John Wiley & Sons.
5. Frain, J. C. 2010. "Introduction to STATA with Econometrics in Mind," *Trinity Economics Papers tep0210*, Trinity College Dublin, Department of

Economics.https://ideas.repec.org/p/tcd/tcduee/tep0210.html

6. Dayal, V. 2015. *An Introduction to R for Quantitative Economics*, New Delhi: Springer.

Pedagogical Approach:

- Classroom teaching, problem solving, quizzes
- Hands-on introduction to software applications

Additional information: None

Student responsibilities: Attendance, feedback, discipline: as per university rules.

Course reviewers:

1. Prof. Bharat Ramaswamy, Indian Statistical Institute, Delhi Center, 7, S. J. S. Sansanwal Marg, New Delhi, Delhi. 110016.
2. Dr. Sourabh Paul, Indian Institute of Technology Delhi, Hauz Khas, New Delhi.-110 016.