Course title: Quantitative Methods				
Course code: MPE 171		**No. of credits:** 4	**L-T-P:** 40– 7–18	**Learning hours:** 56
Pre-requisite course code and title (if any): None				
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 provides introduction to the theory of probability and statistics. The course consists of 9 modules. The first module starts with some fundamental statistical concepts and discusses how to learn about data using descriptive statistics. Module 2 and 3 cover the basics of probability theory and random variables. Module 4 discusses the common theoretical distributions. Modules 5, 6 and 7 deal with methods of sampling, principles of statistical inference, techniques of estimation and hypothesis testing. Module 8 provides introduction to the linear regression model. Module 9 introduces special topics on simulation. In practical sessions, students will be given exercises in STATA/R software related to the application of statistical theory to the economic data.

Course objectives:

The main objective of this course is to provide solid foundation of statistical concepts that provide essential background to do econometric analysis of data. The course aims to provide students with techniques related to sampling from population and data production, exploratory data analysis through descriptive statistics, probability theory, estimation, hypothesis testing and confidence set construction that allows economists to draw inference about populations with the help of data from a sample.

In the practical sessions, students will be exposed to using STATA/R for summarising and plotting data,basic probability theory, testing hypotheses, correlation analysis and regression.

Course contents

S.No	Topic	L	T	P
1	**Module 1: Introduction** - Meaning of 'statistics'. - Data Basics - Observational versus Experimental studies - Exploratory data analysis - Starting with STATA/R	4	0	2
2	**Module 2: Probability Theory** - Kinds of Probability. - Probability-Axiomatic - Set Theory - Conditional Probability and Independence - Bayes Theorem	4	1	2
3	**Module 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	5	1	2
4	**Module 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	4	1	2

5	**Module 5: Sampling and Sampling Distributions** - Sampling Methods and techniques - Sampling Bias - Statistic and Sample moments - Sampling Distribution of an Estimator - Sampling from Normal Distribution - Order Statistics	6	1	2
6	**Module 6: 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	7	1	2
7	**Module 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 - Non Parametric Tests – Sign test, Wilcoxon signed rank Test; Mann-Whitney-Wilcoxon test, Kurskal- Wallis Test.	7	1	2
8	**Module 8: Introduction to Regression Analysis** - The Method of Least Squares Regression - Statistical Inference in Simple Linear Regression - The General Linear Model and Multiple Regression	2	1	2
9	**Module 9: Simulation** - What is Simulation? - Why is simulation useful? - Simulating specific distributions - Monte Carlo simulation - The Bootstrap	1	0	2
	Total	40	7	18

Evaluation criteria:

Test 1 - Minor Tests (Module 1-5)- 40%

Test 2- Practicals/Assignments (Module 1- 8)- 10%

Test 3- Major Exam(Module 6-8)- 50%

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 (Test 1)

2. Understand the principles, techniques and approaches used for statistical inferences (Test 3)

3. Apply statistical concepts to economic models (Test 2)

4. Solve problems of importance using statistical techniques (Test 2)

5. Use STATA/R for summarising and visualization of data, basic probability theory, testing hypotheses, correlation analysis, etc.(Test 2)

Materials:

Suggested readings

Required text

1. DeGroot, Morris H., and Mark J. Schervish. "Probability and statistics." (2012). Fourth edition

2. Introduction to the Theory of Statistics, 3rd Ed. A. M. Mood, F. A. Graybill and D. C. Boes, McGraw Hill (1974).

3. Introduction to Mathematical Statistics, 6th Ed. R. V. Hogg, J W. McKean and A. T. Craig, Prentice-Hall (2008).

4. Casella, George, and Roger L. Berger. Statistical inference. Vol. 2. Pacific Grove, CA: Duxbury, 2002.

5. Essentials of Statistics for the Behavioral Sciences, 8th Edition, Frederick J Gravetter and Larry B. Wallnau

6. Discovering Statistics using R, Andy Field, Jeremy Miles, Zoë Field, March 2012.

7. Crawley, M. J. (2014). Statistics: an introduction using R. John Wiley & Sons.

Additional information (if any):

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

Course reviewers: