

Centre for the Studies of the World Economy

School of International Studies

**Course (MA/PhD):** MA level

**Course Title:** Introduction to Statistics and Econometrics

**Course Code:** IE 408

**Course Type:** Core

**Course Teacher:** Prof. Mandira Sarma

**Credits:** 4

**Contact Hours:** 4 hours per week

**Course Objectives:**

- To provide a theoretical foundation on Mathematical Statistics and Econometrics
- To equip students with empirical skills

**Learning Outcomes:** Upon completion of this course, students will be able to

- Understand other areas of economics that apply statistical concepts
- Develop statistical skills to conduct empirical work
- Opt for advanced courses in Econometrics

**Evaluation:** Mid-term and end term examinations, graded assignments and project work.

**Course Content**

**1. Probability and Random Variables:**

- a. Definitions and axioms of probability, probability set functions; random variables and probability distributions,
- b. transformation of random variables,
- c. moments and moment generating function;
- d. Well-known probability distributions - Binomial, Poisson, Geometric, Uniform, exponential, Normal etc.
- e. Bivariate and Multivariate random vectors and associated probability concepts, Transformation of variable technique for bi-variate case, Distribution of functions of random variables, Chi-square, t-, F distributions

**2. Asymptotic Theory:** Convergence in Probability, Convergence in Distribution, Weak Law of Large Numbers, Central Limit Theorem.

**3. Statistical Inference:**

- a. Sampling and associated concepts, Concept of sampling distribution;
- b. Estimation - Unbiasedness, asymptotic unbiasedness, consistency, and efficiency of estimators.



- c. Method of Moments, Method of maximum likelihood and properties of MLE estimators;
- d. Testing of hypotheses, errors of first and second kind, power of the test, Neyman Pearson Theorem, likelihood ratio test.

#### 4. **Linear Regression Analysis**

- a. Simple Linear Regression - Method of least squares, properties of OLS estimators and goodness of fit. Gauss Markov Theorem.
- b. Multiple Linear Regression Analysis: General case (k-explanatory variables); examples with k=2 & 3; multiple correlation coefficient and goodness of fit. Problem of multicollinearity.
- c. Inference in the Multiple Regression Model: Hypothesis testing for significance of a subset of coefficients; and overall significance.
- d. Generalized Least Squares and Feasible Least Squares: Violation of assumption on spherical errors (problems of autocorrelation and heteroscedasticity), GLS and FGLS. Tests to detect autocorrelation and heteroskedasticity. Problem of autocorrelation in lagged dependent variable models.

### **Readings**

Robert Hogg, Joseph W. McKean and Allen T. Craig: *Introduction to Mathematical Statistics* (8<sup>th</sup> edition, 2005), Pearson Education

John A. Rice: *Mathematical Statistics and Data Analysis* (3<sup>rd</sup> Edition, 2007), Cengage Learning.

Robert Hogg and Eliot Tanis: *Probability and Statistical Inference* (7<sup>th</sup> edition, 2006)

James Stock and R.W. Watson: *Introduction to Econometrics* (International edition 2007)

Jeffrey Wooldridge: *Introductory Econometrics: A Modern Approach* (2006).

Additional reading list will be provided in class as and when required.