

**MODULAR COURSE IN QUANTITATIVE ECONOMICS**

**2016-2017**

**Centre for Quantitative Learning and Applications**

**Symbiosis School of Economics**

**Symbiosis International University, Pune**

**Course Description**

Total Class Hours: Seventy Five (75)

Tentative Session: 11<sup>th</sup> July 2016 – October 2016

**Module 1:** Foundations of Mathematics and Statistics– 35 Hrs.

**Module 2:** Econometrics– 25 Hrs.

**Module 3:** Mathematical Economics: Fundamental and Advance– 15 Hrs.

## **Module 1: Syllabus: Foundations of Mathematics and Statistics (35 hours)**

Determinants and Matrices: Determinants, Solution of Two or Three Simultaneous Equations by Cramer's Rule, Higher Order Determinants, Minor and Co-factor, Elementary Algebra of Matrices, types of matrices, Rank of a Matrix, Inverse of a Matrix, Application of Matrices to Linear Systems. Fundamentals of Vector Spaces. (5)

Functions and Limits: Functions, Graphs of Functions, Odd and Even Functions, Logarithmic and Exponential Functions, Limits, Theorems on Limits of Functions, Limits and Continuity of Functions.(2)

Real Number System, Sequence and Series. Convergence and Divergence of Series. (4)

Differentiation: Rules of Differentiation, Implicit Differentiation, Logarithmic Differentiation, Derivatives of Trigonometric Functions, Partial Differentiation, Maxima and Minima. L'Hospital's Rule. (4)

Integral Calculus: The Indefinite Integral, Some Standard Forms, Integration by Substitution, Integration by Parts, Trigonometric Functions, Fundamental Properties of Definite Integrals. Improper Integrals. Beta and Gamma Functions (4)

Frequency Distribution and Tabulation, Measures of Central Tendency: Average, Arithmetic Mean, Geometric Mean, Harmonic Mean, Quadratic Mean or the Root Mean Square, Median, Median and Quartiles, Mode. (2)

Measures of Dispersion, Range, Quartile Deviation, Mean Deviation, Variance, Moments of Distribution (2)

Probability: The Concept of Probability, Definitions related to Probability, Different Approaches, Conditional Probability, Fundamental Laws, Random Variable and Expectation.(4)

Probability Distribution: Theoretical Distribution, Binomial Distribution, Poisson Distribution, Normal Distribution, Outline of Special Distributions like Chi-square, F and t, Law of Large Numbers, Central Limit Theorem. (4)

Correlation and Regression: Concept of Correlation and Regression, Pearson's Coefficient of Correlation, Scatter Diagram, Method of Least Squares, Regression Equation, Equivalent Forms, Coefficient of Determination, Multiple Correlation. (4)

## **REFERENCES**

- Schaum's Outline on Beginning Calculus – Elliot Mendelson – McGraw Hill
- Schaum's Outline on Advanced Calculus – Robert C. Wrede and Murray R. Spiegel – McGraw Hill
- Schaum's Outline on Statistics – Murray R. Spiegel and Larry J. Stephens – McGraw Hill
- Fundamentals of Applied Statistics – S. C. Gupta and V. K. Kapoor – Sultan Chand & Sons
- Mathematics for Economists – B.C. Mehta and G.M.K. Madnani.
- Mathematics for Management and Economics – G. S. Monga.
- Basic Statistics – A. L. Nagar and R.K. Das.
- Business Mathematics – V. K. Kapoor.
- Engineering Mathematics – B.S. Grewal.

## **Module 2: Econometrics (25 hours)**

**Classical Linear Regression Model:** simple & multiple Regressions analysis (8 hours)

**Generalised regression Model:** violations of classical assumptions including measurement error, omitted variables, simultaneity, missing data, instrumental variables. (10 hours)

**Specialised Econometric Methods:** topics on time series, single equation theory for non-stationary variables, serially correlated errors with lagged dependent variables; unit roots; simultaneous equations for non-stationary variables; co-integration; and ARCH and GARCH models, Panel data models – fixed and random effects, Least square dummy variable models, Limited Dependent Variables. (7hours)

### **REFERENCES**

- J. Wooldrige, *Introduction to Econometrics –A Modern Approach*.
- D. Gujarati, *Basic Econometrics*, McGraw Hill.
- G. Maddala, *Econometrics*, McGraw Hill, 1977
- Johnston, *Econometrics*
- C. Dougherty, *Introduction to Econometrics*
- A. H. Studenmund, *Using Econometrics – A Practical Guide*
- Greene, *Econometric Analysis*
- Kmenta, *Elements of Econometrics*
- Hamilton, *Time Series Analysis*
- M. Arellano, *Panel Data Econometrics*
- Baltagi, *Panel Data Econometrics -Theoretical Contributions and Empirical Applications*

### **Module 3: Mathematical Economics (15 hours)**

Introduction ---- Functions ---- Composite, Exponential and Logarithmic Functions ---- Graphs and Equations ---- Sequence and Convergence of sequence ---- Vector Functions --- Linear and Affine Functions ---- Rate of Change of a Function --- Derivative of a Function ----- Derivative of Composite and Inverse Function and Vector Derivatives ---- Maxima and Minima of Function ---- Concept of 'Arg Max' ---Working Out Economic Problems with Aforementioned Concepts.

(5)

Optimisation Problems ---- Problems on Markets and Profit Maximization --- Critical Points --- Local and Global Maxima and Minima --- Saddle points ---- Constrained Optimization ---- Lagrangian --- Applications in Consumer Theories and Firm. (4)

Envelope Theorem ----Proof--- Viner-Wong Envelope Theorem --- Economic Applications. (2)

First order and Second Order Difference Equations ---- Economic Applications. (2)

Optimal Control --- Maximum Principle --- Hamiltonian ---- Transversality conditions ---- Economic Examples. (2)

### **REFERENCES**

- A.C. Chiang: Mathematical Economics
- A.C. Chiang: Dynamic Analysis
- Varian: Microeconomics
- Anthony and Biggs: Mathematics for Economics and Finance
- Intriligator: Mathematical Optimisation and Economic Theory
- Silberberg: Mathematical Economics.
- Sydsaeter and Hammond: Mathematics for Economic Analysis