



CENTRAL UNIVERSITY OF TAMIL NADU

**DETAILED SYLLABI AND CURRICULUM
OF**

**the post graduate programmes in
General Economics / Financial Economics/ Actuarial
Economics/ Applied Quantitative Finance/ Environmental
Economics**

offered

at

MADRAS SCHOOL OF ECONOMICS

April 2016

General Economics - Core Courses

| | | |
|-----------------|-----------------------------|---|
| First Semester | Microeconomics I | |
| | Macroeconomics I | |
| | Statistical Methods | |
| | Mathematical methods | |
| Second Semester | Microeconomics II | |
| | Macroeconomics II | |
| | Econometric Methods | |
| | Public Economics | |
| Third Semester | Applied Econometrics | |
| | Development Economics | |
| | Elective 1 | |
| | Elective 2 | |
| | Elective 3 | |
| Fourth Semester | Institutional Economics | |
| | Indian Economic Development | |
| | Elective 3 | Dissertation instead of electives 3 & 4 worth 8 credits |
| | Elective 4 | |

Financial Economics - Core Courses

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|-----------------|--|---|
| First Semester | Microeconomics I | |
| | Macroeconomics I | |
| | Statistical Methods | |
| | Mathematical methods | |
| Second Semester | Financial Mathematics | |
| | Microeconomics II | |
| | Econometric Methods | |
| | Financial Economics I | |
| Third Semester | Applied Macro and Financial Econometrics | |
| | Financial Economics II | |
| | Elective 1 | |
| | Elective 2 | |
| | Elective 3 | |
| Fourth Semester | International Finance | |
| | Risk Management - Theory & Practice | |
| | Elective 3 | Dissertation instead of electives 3 & 4 worth 8 credits |
| | Elective 4 | |

Actuarial Economics - Core Courses

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|-----------------|---------------------------------|---|
| First Semester | Microeconomics I | |
| | Macroeconomics I | |
| | Statistical Methods | |
| | Mathematical methods | |
| Second Semester | Financial Mathematics | |
| | Actuarial Mathematics | |
| | Econometric Methods | |
| | Financial Economics I | |
| Third Semester | Applied Econometrics | |
| | Economics of Insurance I | |
| | Elective 1 | |
| | Elective 2 | |
| Fourth Semester | Elective 3 | |
| | Economics of Insurance II | |
| | Finance and Financial Reporting | |
| | Elective 3 | Dissertation instead of electives 3 & 4 worth 8 credits |
| Elective 4 | | |

Applied Quantitative Finance - Core Courses

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|-----------------|--|---|
| First Semester | Microeconomics I | |
| | Macroeconomics I | |
| | Statistical Methods | |
| | Mathematical methods | |
| Second Semester | Microeconomics II | |
| | Econometric Methods | |
| | Financial Mathematics | |
| | Financial Economics I | |
| Third Semester | Applied Macro and Financial Econometrics | |
| | Risk Analysis and Management | |
| | Elective 1 | |
| | Elective 2 | |
| Fourth Semester | Elective 3 | |
| | Financial Instruments and Markets | |
| | Interest rate Calculation and Option Pricing | |
| | Elective 4 | Dissertation instead of electives 3 & 4 worth 8 credits |

Environmental Economics - Core Courses

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|-----------------|---------------------------------------|---|
| First Semester | Microeconomics I | |
| | Macroeconomics I | |
| | Statistical Methods | |
| | Mathematical methods | |
| Second Semester | Microeconomics II | |
| | Econometric Methods | |
| | Introduction to Environmental Systems | |
| | Resource and Environmental Economics | |
| Third Semester | Applied Econometrics | |
| | Environmental Valuation | |
| | Elective 1 | |
| | Elective 2 | |
| | Elective 3 | |
| Fourth Semester | Sustainable Development | |
| | Environmental Policy | |
| | Elective 3 | Dissertation instead of electives 3 & 4 worth 8 credits |
| | Elective 4 | |

List of elective courses

| | | |
|--|--|---|
| Development Economics | Stochastic Models | Public Economics |
| Games and Information | Fixed Income Securities | Advanced techniques in Finance |
| Industrial Development and Industrial organization | Economics of Insurance | Risk Models |
| International Trade | Investment Banking | Programming and Computational Languages |
| Indian Economic Development | Financial Regulation and Banking Supervision | Artificial Neural Networks |
| Agricultural Economics | Empirical Methods in Finance | Topics in Behavioral Finance |
| Health Economics | Financial Market Microstructure | Social Cost Benefit Analysis |
| Financial Economics | Trade and Environment | Energy Economics and Environment |
| Environmental and Resource Economics | Health Economics | Economics of Global Climate Change |
| Multinational Enterprises and Industrial Policy | Survival Models | Ecological Economics |
| Agricultural Development and Policy | Environment and Health | Regional Economics |

- Note:**
- 1. All Core and elective courses are worth 4 credits each.**
 - 2. Dissertation in fourth semester is worth 8 credits in lieu of two elective courses.**
 - 3. Total credits = 72 for all programmes**

GENERAL ECONOMICS

GE 01 MICROECONOMICS I

1. Consumer Behaviour and Demand Consumer preferences

opportunity sets, optimum choices, indirect utility demand functions, income and substitution effects, Slutsky equation, normal versus inferior goods, types of demand functions, elasticity, welfare evaluation, consumer surplus, equivalent variation and compensating variation, revealed preference (weak and strong axioms)

2. Utility Functions and Expected Utility Theorem

Expected utility function, measures of risk aversion, state-preference approach, portfolio theory and pricing of risk, present discounted value approach to investment decisions, adjustments for risk

3. Production and Cost

Production functions, types of production functions (Cobb-Douglas, CES, etc.), marginal products, rate of technical substitution, technical progress, cost functions, average and marginal costs, short run versus long run costs, economies of scale and scope, profit maximization, cost minimization, derivation of input demand

4. Competitive Markets

Assumptions of perfect market, competitive markets – demand and supply, demand and supply curves of individual firms, short-run versus long-run, competitive market equilibrium, tax incidence analysis, price-controls and shortages.

5. Imperfect Competition

Market failure, imperfect markets, sources of monopoly power, monopoly market equilibrium, price discrimination – first, second and third degree, tax incidence, oligopoly, Cournot Model, Stackelberg model, Bertrand Model, Monopolistic Competition.

Reference Books

- Varian, H. R., Microeconomic Analysis, third edition, W.W. Norton and Co., 1992
- Mas-Collel, Whinston and Green (1995): Micro-economic Theory, OUP
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Koutsoyiannes. A. “Modern Microeconomics” (Macmillan Press Limited, New York)

Review Books

- Varian, H. R., Intermediate Microeconomics: A Modern Approach, third edition, 2010.
- Nicholson, W., Microeconomic Theory: Basic Principles and Extensions, eighth edition, South Western Thomson Learning, 2002

GE 02 MACROECONOMICS I

1. National Income Accounting

Accounting structure, key concepts in accounting for both closed and open economies – gross national product, gross domestic product, net national product, national income, savings and investment, balance of payments, circular flow of income, computational problems – expenditure approach, income approach and value added approach for measurement, input-output tables

2. Keynesian Models

Simple Keynesian Model, assumptions, concepts of involuntary unemployment, liquidity preference, paradox of thrift, investment function, IS-LM model – two sector model, goods and money market equilibrium, multiplier, liquidity trap, complete Keynesian model – three sector model, role of government in terms of monetary and fiscal policy

3. Keynesian Models versus Classical Models

Says Law, quantity theory of money, price flexibility and full employment, Clowers and Patinkin's money demand functions, equilibrium concept in classical model, synthesis between classical models and Keynesian models, interpretation and policy analysis

4. Expectations and Macroeconomic Adjustments

Expectations formations – Adaptive and rational expectations hypothesis, partial adjustment model, Lucas critique, Phillips curve, rules versus discretion, time consistency, inflation targeting, interest rate rules, effects of spending and taxes in models with flexible and sticky prices, perverse effects of fiscal expansion

5. Macroeconomics: Open Economy Aspects

Market for foreign exchange, devaluation and depreciation, real and nominal exchange rate, factors affecting exchange rate, Mundell-Fleming model, fixed versus floating exchange rate, price adjustment, role of fiscal and monetary policies under alternative exchange rate regimes, purchasing power parity concept

Books

- Scarth, W., *Macroeconomics: An Introduction to Advanced Methods*, third edition, Thomson, 2007
- Mankiw, N. G., *Macroeconomics*, fifth edition, Worth Publishers, 2002
- Hall, E. and Taylor, J. B. *Macroeconomics*. W. W. Norton and Company, 1986
- Barro, R.J. *Macroeconomics*, Fifth edition, MIT Press 1997

GE 03 MATHEMATICAL STATISTICS

1. Probability Theory

Concept of probability, conditional probability and Bayes' theorem; Random variables –discrete and continuous, Density and distribution functions, joint, marginal and conditional distribution, moment generating function, law of large numbers and Central Limit theorem

2. Probability Distributions

Discrete versus continuous distribution, uniform, binomial, negative binomial, Poisson, geometric and hyper-geometric, exponential, normal, log-normal and gamma; joint, marginal and conditional distribution, characteristic function and moment generating function, functions of random variables.

3. Sampling Methods and Sampling distributions

Simple random sampling: with and without replacement, stratified random sampling, probability and non-probability sampling, statistic and sample moments, sampling distributions: Student's-t, Chi-square and F-distribution, determinants of sample size, law of large numbers and Central Limit theorem

4. Estimation

Point estimation of population mean for large sample and small sample, estimation of population proportion and population variance, Maximum likelihood and method of moment estimation, properties of good estimators: unbiasedness, consistency, efficiency, sufficiency, Interval estimation.

5. Hypothesis Testing

Statistical hypothesis, simple versus composite hypothesis, critical region, types and size of error – type-I and type-II error, power of a test, p-value, Hypothesis test about: a population mean, population proportions, difference between two population means, difference between two proportions, a population variance, the ratio of two population variances, Tests of goodness of fit, the analysis of contingency tables (Chi-square test for testing independence of two-classification criteria), test for correlation, Rao-Blackwell Theorem, Cramer-Rao Identity

Books

- DeGroot, M.H. and M.J. Schervish, *Probability and Statistics*,
- Hogg, R. and A. Craig, J., *Introduction to Mathematical Statistics*, McGraw-Hill, 1965.
- Miller, I. and M. Miller, *Mathematical Statistics*, sixth edition, Prentice Hall International, 1999.
- Mood, A. M., R. A. Graybill and R.C. Boes, *Introduction to the Theory of Statistics*, McGraw-Hill, 1974.
- Ramachandran, K. M and C. P. Tsokos, *Mathematical Statistics with Applications*, 2009.

GE 04 MATHEMATICAL METHODS

1. Differential Calculus

Introduction to Functions and Real Analysis; Derivatives – partial and total, economic applications, marginal and elasticity concepts, functions of several variables, implicit function theorem, higher order derivatives and Young's theorem, Taylor's approximation, convex sets, convex and concave functions, properties of linear homogenous functions, Euler's theorem

2. Linear Algebra

Vectors, matrices, inverse, simultaneous linear equations, Cramer's rule for solving system of linear equations, input-output model, Hawkin - Simon condition, open and closed models quadratic equation, characteristic (eigen) roots and vectors

3. Classical Optimization and Applications

Introduction to quadratic forms, unconstrained optimization, constrained optimization with equality constraints, Lagrangian method, Hessian and Jacobian matrices, applications – utility maximization, cost minimization, profit – output maximization

4. Linear and Non-linear Optimization

Duality theory, constrained optimization with inequality and non-negativity constraints, Kuhn-Tucker formulation, linear programming – formulation, primal and dual, solutions using graphical and Simplex methods, applications from economics and finance

5. Dynamics

Definite and indefinite integrals, applications – measuring consumer and producer surplus, continuous interest – discount calculations, difference and differential equations, phase diagrams, Cobweb model, multiplier accelerator, Harrod-Domar and Solow model

Books:

- Simon, C. and L. Blume, *Mathematics for Economists*, Norton, London, 1994
- Chiang, A. C., *Fundamental Methods of Mathematical Economics*, McGraw-Hill, 1984
- Ok, E.A., *Real Analysis with Economic Applications*, Princeton University Press, 2007
- Knut Sydsaeter and Peter J. Hammond, *Mathematics for Economic Analysis*, Pearson Education Asia, 1995
- M.D. Intriligator, *Mathematical Optimization and Economic Theory*, Prentice-Hall, 1971
- Roberts B. and D.L. Schultze, *Modern Mathematics and Economic Analysis*, W.W. Norton and Company, 1973.

GE 05- MICROECONOMICS II

1. General Equilibrium and Welfare Economics

Absolute versus relative prices, perfectly competitive price and general equilibrium models – with and without production, uniqueness and determinacy, Edgeworth box, Pareto improvement and efficiency, Walrasian equilibrium, money in general equilibrium

2. Welfare Economics

Arrow-Debreu economy, welfare theorems, existence of Walrasian equilibrium, fixed-point theorem, core and core convergence, general equilibrium with time and uncertainty, Jensen's Inequality, social welfare function, transfer efficiency; Kaldor-Hicks-Samuelson criterion, Rawl's theory of social justice

3. Market Failure and Public Goods

Reasons for market failure – market imperfections, public goods, externality, macro-economic factors; types of public goods, theory of public goods – provision and pricing, government intervention, second-best solution, free riding, types of externalities – production and consumption externalities, Pigovian and Coasian solutions

4. Asymmetric Information

Moral hazard problem, adverse selection, principal agent problem, theory of lemon, credit market, implications of asymmetric information, market signaling, hidden information modeling, efficiency wage model, information and insurance

5. Game Theory

Sequential and simultaneous games, extensive forms and normal forms, dominant strategies and elimination of dominated strategies, Nash equilibrium, Dynamic games, backward induction, sub-game perfect equilibrium, applications with oligopoly markets: Cournot, Bertrand, Stackleberg and cartel

Books

- Varian, H.: Microeconomic Analysis, W.W. Norton, 3rd Edition, 1992
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004.
- Mas-Colell, A. , M. Whinston and J Green: Microeconomic Theory, Oxford University Press, 1995
- Gibbons(1992): Game Theory for Applied Economists, Princeton University Press
- Mukherji, A.: Walrasian and Non-Walrasian Equilibria: An Introduction to General Equilibrium Analysis, Claredon Press, Oxford, 1990.
- Recent research papers in Microeconomics will be discussed

GE:06 MACROECONOMICS II

1. Growth Theory

Economic growth and economic development, Harrod-Domar model, Solow model, empirics of economic growth, technological progress, growth accounting and total factor productivity

2. Neoclassical Model of Economic Growth

Foundation of neoclassical growth, dynamic programming and optimum growth, the Ramsey-Cass-Koopmans model, growth with overlapping generations, applications of neoclassical growth model, social security: pay-as-you-go and unfunded, models with bequest motives

3. Endogenous Growth Theory

Basics of endogenous growth, the AK-Model, Putty-Clay model, human capital and economic growth, product variety and innovation, learning by doing, role of R&D and economic growth

4. Rational Expectations and Economic Policy

Policy Invariance result, Lucas Critique, Overlapping wage contracts models, New Keynesian Phillips curve (Menu cost models etc), supply-side distortions and the equilibrium unemployment, Time Inconsistency problem, Barro-Gordon model, Central Bank Independence, Inflation Targeting and Unconventional monetary policy (QE, forward guidance etc)

5. Government Solvency and Constraints on Fiscal Policy

Government Solvency condition, Debt Dynamics, Barro-Ricardo equivalence result, OLG models and pay-as-you-go pension system, Unpleasant monetarist arithmetic etc.

Books

- Romer, D., *Advanced Macroeconomics*, second edition, McGraw-Hill, 2001
- Blanchard and Fischer, *Lectures on Macroeconomics*, MIT Press, 1989
- Barro, R.J., *Macroeconomics*, Fifth edition, MIT Press 1997
- Sargent, T., *Macroeconomic Theory*, Academic Press, 1987.
- Pandit, V.N. and K. Krishnamurty, *Macroeconometric Models for India*, Oxford University Press, 2005

GE:07 ECONOMETRIC METHODS

1. Simple Regression Analysis

Specification of the two variable regression model, Ordinary Least Squares estimation, Assumptions, BLUE property, General and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, ANOVA

2. Multiple Regression Analysis

Motivation, Assumptions and OLS estimation, Interpretation of OLS estimation, Goodness of fit, matrix approach to linear regression models, testing of hypothesis for a single parameter, for linear combination of parameters, for multiple linear restrictions.

3. Transformation of Variables and Dummy Variables

Choice of function forms: linear, log-linear, log-log, quadratic functional forms, Box-Cox test, models with quadratics and interaction terms.

Regression on dummy (qualitative) variables with two categories, with more than two categories- intercept shifters, dummy variable trap, interaction of two categorical variables, interaction of categorical and continuous (quantitative) variables- slope shifters, piecewise linear regression model, Chow test for cross-section data and for time-series data (test structural stability of regression models)

4. Extensions of Linear Models and Non-Linear Estimation

Method of maximum likelihood and its properties (including consistency), trinity of classical tests (Wald test, Lagrange multiplier, likelihood ratio), Consequences, detection and remedial measures of multicollinearity, heteroskedasticity (WLS, MLE), and autocorrelation (GLS), Specification error (omitted variable, inclusion of irrelevant variables, measurement error in dependent and independent variables), method of moments (IV method)

5. Multi-Equation Models

Seemingly unrelated regression and its application.

Structural equation models-specification, endogenous, exogenous and predetermined variables, structural versus reduced form, simultaneity bias, identification: rank versus order condition, exact and over identifications, methods of estimation: indirect least squares, instrumental variable estimation, two-stage least squares and three-stage least squares.

Books

- Gujarati and Porter, *Basic Econometrics*, Fifth Edition, McGraw Hill/Irwin, 2009.
- Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997. Greene
- Ramanathan, Ramu, *Introductory Econometrics with Applications*, 5th edition, 2002, Thomson Asia Pte Ltd., Singapore.
- Stock, James H., and Mark W. Watson (2006): *Introduction to Econometrics*, Second Edition, (Addison-Wesley Series in Economics).
- Wooldridge, J., *Introductory Econometrics: A Modern Approach*, 2015, Nelson Education.

GE:08 PUBLIC ECONOMICS

1. Theory of Public Good and Public Choice

Public goods and externalities, merit goods, Samuelson theory, free rider problem, Lindahl solution, Coasian theory, theory of clubs, median voter theorem, theory of rent seeking

2. Taxation: Key Concepts

Direct and indirect taxes, efficiency and equity, dead weight loss (income tax, commodity tax, wealth tax and subsidy), taxation and monopoly; measurement of income and expenditure, tax incidence: partial (income tax, input tax, commodity tax etc.), measuring progressivity of taxation, user charges

3. Theory of Taxation and Tax Reforms

Taxation and labour supply, taxation and savings, risk-taking and wealth, general equilibrium (Herberger) models of tax incidence, theory of optimal taxation, recent developments in theory of taxation, Taxation in a Federal system: assignment issues, vertical and horizontal imbalances and externalities, evolution of tax structures, tax evasion and avoidance, designing of modern tax system, reform in direct taxes, reform in indirect taxes: the value-added tax, taxation of property, Laffer curve analysis

4. Public Expenditure and the Macro-economy

Determining optimal size of government, financing of public expenditure: debt versus tax financing, impact of public expenditure on the level and composition of output, fiscal federalism: central and sub-national expenditures, Impact of government expenditure on output and employment, designing optimal government expenditure policy: issues of size and composition, designing subsidy policy: health and education expenditure policy in India

5. Fiscal Policy Issues

Budget deficit and public debt: Keynesian, neo-classical, and Ricardian equivalence, debt dynamics, interdependence of fiscal and monetary policies, theory of inter-governmental transfers, theory and policy of subsidies, Theory of fiscal federalism, issues of equity and efficiency, designing equalisation transfers, conditional and unconditional grants, fiscal federalism in India: transfer mechanisms, role of planning and finance commission, Goods and services tax in India, new direct tax code, role of central and state FRBMs

Books

- Atkinson, A. and Stiglitz, J., *Lectures in Public Economics*, McGraw Hill, 1980
- Aurbach, A. and Feldstein, M., *Handbook of Public Economics*, Vol. 3, North Holland, 2002
- Hillman A. L., *Public Finance and Public Policy*, Cambridge University Press, 2003
- Boadway, *Public Sector Economics*, Cambridge University Press, 1979

- Chelliah, R.J., *Towards Sustainable Growth: Essays in Fiscal and Financial Sector Reforms in India*, Oxford University Press, 1996
- Govinda Rao M. and T. K. Sen, *Fiscal Federalism in India: Theory and Practice*, 1996
- Srivastava, D. K. (Ed.) *Fiscal Federalism in India: Contemporary Challenges and Issues before Eleventh Finance Commission*, NIPFP and Har-Anand, 2001
- Shome, P. (Ed.) *Handbook of Indirect Taxes*, IMF Publications, 1996
- Srivastava, D.K., T.K. Sen et al. *Government Subsidies in India*, NIPFP, 1997

GE:09 APPLIED ECONOMETRICS

1. Discrete Response Models

Introduction to binary variables, limitation of LPM, logistic curve, Probit and Logit models, Multinomial models, Ordinal models, Count data models

2. Limited Dependent Variables, Sample Selection and Duration Models

Censored versus truncation, TOBIT model, Truncated regression, Heckman selection model, Duration (hazard) models

3. Panel Data Models

Introduction to panel data, pooled repeated cross-section model, within and between estimators, fixed effects, random effects, Hausman test, one way and two way models, random coefficient model (Hierarchical /multi-level models)

4. Average Treatment Effects

Counterfactuals and self-selection, Methods to control selection: Regression versus Matching and Propensity Score, Difference in Difference Methodology, Regression Discontinuity Research Design, Quantile regression, Randomised Experiments-Use and Abuse

5. Multivariate Statistical Models

Discriminant Analysis, Principal Component Analysis, Factor Analysis, Cluster Analysis, Structural Equation Models

Books

1. Angrist, J. D., & Pischke, J. S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
2. Baltagi, Badi. *Econometric analysis of panel data*. John Wiley & Sons, 2008
3. Cameron, C.A. and Trivedi, P.K. *Microeconometrics: Methods and Applications*. Cambridge U.P., 2005.
4. Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
5. Johnson, R.A. and D.W. Wichern, *Applied Multivariate Statistical Analysis*, 6th Edition
6. Tacq, Jacques. *Multivariate Analysis Techniques in Social Science Research: From Problem to Analysis* Sage International, 1997.
7. Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, 2nd edition, 2010.

GE:10 DEVELOPMENT ECONOMICS

1. Economic Development – an Overview

Concepts, approaches and dimensions of development and their indicators; measurement issues; income growth as development, factors influencing growth - human capital and demographic characteristics, structure and openness of the economy, path dependence-expectations-complementarities, political institutions and governance; distribution of income – economic inequality, its measurement and interrelationship income growth, poverty measures and underdevelopment

2. Theories of Economic Growth

Balanced versus imbalanced growth, Harrod-Domar model, Solow model, technical progress, growth convergence; new growth theories – human capital and growth, total factor productivity; comparative analysis; role of resources, technology and institutions

3. Human Resources & Labour Markets

Impact of nutrition, health, education, population growth on human capital; segmented labour markets, migration, unemployment (Harris-Todaro model, labour turnover model, efficiency wage hypothesis) sub-optimal employment, disguised unemployment, informal labour markets

4. Agriculture – Markets for land, credit and water

Land size & productivity, ownership, tenancy, contractual arrangements, risk sharing mechanisms, improvements in land; formal and informal rural credit markets, lender's risk hypothesis, collateral, default and enforcement, limits to credit and insurance access, micro-finance; formal and informal water markets

5. Role of State, Political Economy, Corruption and Development

Economic Effects of constitutions – policy and economic consequences of different forms of government and electoral rules, empirical strategies of comparative political economy; role of state in provision of public goods – allocation of property rights for decision-making across different governance modes and their implications for economic efficiency & equity, political economy aspects of such property rights; corruption - sources of corruption, channels through which it impacts economic development directly and indirectly, critical analysis of potential strategies to tackle corruption

Books

- Ray, D., Development Economics, Princeton University Press, 1998
- Basu, K., Analytical Development Economics, MIT Press, 2003
- Bardhan, P. and C. Udry, Development Microeconomics, Oxford University Press, 1999
- Agenor, P-R., and P. J. Montiel, Development Macroeconomics, Princeton University Press, 2008
- Hendrik Van Den Berg and Joshua J Lewer: International Trade and Economic Growth, Prentice Hall of India
- Perkins, Radelet, Lindauer and Block, Economics of Development (seventh edition), W.W.Norton & Company, 2012

GE:11 GAMES AND INFORMATION

1. Games of Complete Information

Static games; solution concept: Nash equilibrium, mixed and pure strategies, maximin principle; extensive forms, backward induction, subgame perfection, repeated games; applications

2. Games of Incomplete Information

Incomplete and imperfect information; static games of incomplete information, solution concepts, Bayes-Nash equilibrium; dynamic games of incomplete information, equilibrium refinements: weak perfect Bayesian equilibrium, sequential equilibrium and trembling hand perfect equilibrium, forward induction; applications

3. Cooperative Games

Elements of cooperative games, transferable utility games, core, Shapley-Value, coalition structure, credibility and core, matching games, examples

4. Bargaining

Bargaining with complete information, bargaining as an extensive game: Rubinstein model, axiomatic bargaining: Nash bargaining solution, relation between strategic and axiomatic models, outside options, inside options, bargaining with incomplete information, one-sided and two-sided uncertainty, private and correlated values, applications

5. Differential Game

Repeated and differential game, commitment and sub-game perfection, solution concept: open and closed loop solutions, Markov-Perfect equilibrium, hierarchical game and Stackleberg solution, applications

Books

- Osborne, M. J., *An Introduction to Game Theory*, Oxford University Press, 2003
- Gibbons, R., *A Primer in Game Theory*, Harvester-Wheatsheaf, 1992
- Fudenberg, D and J. Tirole, *Game Theory*, MIT Press, 1991
- Osborne, M. J. and A. Rubinstein, *A Course in Game Theory*, MIT Press, 1994
- Muthoo, A., *Bargaining Theory with Applications*, Cambridge University Press, 1999

GE:12 APPLIED FINANCIAL ECONOMETRICS

1. Univariate Stationary Time-series Models

Introduction to stochastic process, stationary processes, Wold representation theorem, autocovariance functions, autocorrelation and partial autocorrelation, auto regressive and moving average models, conditions for stationary and invertible process, Box-Jenkins approach, forecasting. Seasonal models, de-seasonalization of time series (classical decompositions).

2. Univariate Nonstationary processes

Nonstationary process, deterministic and stochastic trends, Integrated process and random walk, random walk with drift, Unit root process- Martingale process, test for unit root- Dicky Fuller tests, other unit roots tests –PP, KPSS, ARIMA process. Fractional integrated process

3. Modeling volatility clustering

Volatility-Meaning and measurement, Volatility clustering, Econometric models of volatility, ARCH model, GARCH model and its various extensions, testing for ARCH/GARCH effects, Stochastic volatility models, multivariate GARCH modeling

4. Multivariate Stationary and Non-stationary processes

ARDL Models and its applications, vector autoregressive model, Granger causality, impulse response function, variance decomposition, introduction to cointegration, testing for cointegration: Single-equation approaches: ARDL and Engle Granger method, Johansen test for cointegration, Vector error correction model

5. Dynamic (Stationary and Non-Stationary) Panel Data Models

Arellano and Bond Estimator, Arellano and Bover Estimator and Blundell and Bond System GMM Estimator, Nonstationarity and Panel data, Panel unit root and cointegration tests, Panel VAR models

Books

- Baltagi, Badi. *Econometric Analysis of Panel Data*, 5th Edition, Wiley, 2013.
- Brooks, C., *Introductory Econometrics for Finance*, 3rd Edition, Cambridge University Press, 2014.
- Enders, W., *Applied Econometric Time Series*, second edition, John Wiley and Sons, 2006.
- Hamilton, J. D., *Time Series Analysis*, Princeton University Press, 1994.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997.
- Maddala G.S. and In-Moo Kim, *Unit Roots, Cointegration, and Structural Change*, 1998.
- Pesaran, H.M. *Time Series and Panel Data Econometrics*, Oxford University Press, 2015.

GE 13: Industrial Development and Industrial Organisation

1. Market Structure, Entry Deterrence

Seller concentration measures, Entry conditions and market structure, Pricing to deter entry, Non-price entry deterrence strategies, The theory of contestable markets, Empirical studies of entry and exit

2. Industry Development

Geography and industrial dynamics, innovation, Firm survival and the evolution of industries, Industry life cycle, Turnover and mobility of firms, Regulation: regulation of firms with market power under symmetric information; regulation under asymmetric information; liberalization and regulation; empirical evidence, Efficiency and Productivity Analysis (Tutorials)

3. Growth of Firms

Robbin Marris Model, Size and growth of the firm, MNEs and growth, Growth and diversification –both product and geographical diversification, Globalisation of small and medium enterprises, Strategic alliances, Networking and growth, Mergers and acquisitions

4. Determinants of R&D

Monopoly and perfect competition, Development and growth, Market structure and R&D, Innovation, learning and R&D, in-house R&D and import of technology, R&D cooperation and innovative activities

5. Information Technology Industry

Economic theory with respect to IT industry and products, Concepts including network externalities, switching cost, lock in and standards, file sharing, open source, e-commerce, role of IT in economic development

Books

- Chris Freeman and Luc Soefe., The Economics of Industrial Innovation, 1998
- Martin, S., Industrial Economics- Economic Analysis and Public Policy, Englewood Cliffs, New Jersey: Prentice Hall, 1993
- Shy, Oz., Industrial Organization: Theory and Applications, MIT Press, 1995
- Tirole, J., The Theory of Industrial Organization, MIT Press, 1988

GE 14 INTERNATIONAL TRADE

1. Introduction

Production function, cost function, Comparative advantage, Ricardian trade model, gains from trade with homogenous and heterogeneous agents, Trade and growth, Immiserising growth

2. General Equilibrium Trade Theory

Heckscher-Ohlin model, Stolper-Samuelson, Rybcznski theorem and factor-price equalization theorem, Leontief paradox, empirical validity, specific-factor model as a short-run approximation

3. Trade Policy under Perfect Competition

Tariffs and welfare for small and large countries; Tariffs versus quantitative restrictions; The concept of the optimum tariff; Empirical modelling of trade policy; Domestic factor distortions and the effects of trade policy, Multilateral trade agreements and political economy: World Trade Organisation.

4. Trade under Imperfect Competition

Monopolistic competition models of trade, Love-for-Variety preferences, Gains from trade, Tariff versus quota under monopoly, Alternative to standard theories including the product cycle and technology gap models, Intra-industry and intra-firm trade; Strategic trade policy: Cournot and Bertrand competition, Voluntary import expansion and export restrictions

5. Recent Issues in Trade Theory and Policy

Outsourcing, Labor and environmental Standards, FDI and role of multinationals, Trade and technology

Books

Feenstra. R., Advanced International Trade: Theory and Evidence, Princeton University Press, 2009 .

Bhagwati, J., A. Panagariya, and T. Srinivasan. Lectures on International Trade (2nd edition), MIT Press, 1998

Van Marrewijk, C., International Economics, Oxford University Press, 2007.

Caves, R, R. Jones, and J. Frankel, World Trade and Payments: an Introduction, Addison-Wesley, 1993.

GE:15 INDIAN ECONOMIC DEVELOPMENT

1. Development Phases and Indian Economy

The Colonial Legacy - State of the economy at independence - policy of planned development – growth and structural change till the ‘eighties – evolution of controls and obstacles to fast growth – new economic policy – performance of the economy since 1991 – major aspects of transformation – recent developments.

2. Agricultural and Rural Sector

Review of agricultural growth – land reforms – agricultural research and green revolution, policy initiatives, diversification and exports – impact of liberalisation and WTO - investment in agriculture and irrigation – water policy – food security – agrarian distress-agricultural subsidies

3. Industrial Sectors

The growth and maturing of Indian industry since liberalisation – productivity growth and rise in competitiveness – exports – rise of service industry – India and I.T. – policy regarding public enterprises – disinvestment and privatisation – impact of WTO and trade liberalisation

4. Infrastructure Sector

State of infrastructure – reforms: restructuring, pricing and regulation – promoting investment in infrastructure – public – private partnership – Sectoral Issues –energy, transport, telecom, urban infrastructure

5. Social Development

Human development indicators: review of change since early fifties – wide regional variations – measurement of poverty and inequality – extent of reduction in poverty – demographic transition-health services, health policy; education policy; financing of health and education; – employment and unemployment trends; employment guarantee scheme – environmental protection – Sustainable Development Goals

Text Books

- Basu, Kaushik India's Emerging Economy: Performance and Prospects in the 1990s and Beyond, The MIT Press, 2004
- Jalan, B. (ed.), The Indian Economy: Problems and Prospects, Penguin Books, 1992
- Krueger A. (ed.), Economic Policy Reforms and the Indian Economy, Oxford University Press, 2003
- Panagariya, Arvind, India the Emerging Giant, Oxford University Press, 2008

Reference Books

- Economic Survey, Government of India, Various Issues
- India Development Report, Oxford University Press, Various Issues
- Kapila, U. (ed.), Indian Economy since Independence, Academic Foundation, Various Issues
- Nayak, Pulin, Economic Development of India (Critical Concepts in Economics), London & New York, Routledge, 2015
- Roy, Tirthankar, The Economic History of India 1857-1947, 3rd edition, Oxford University Press India, Delhi, India, 2011

GE:16 AGRICULTURAL ECONOMICS

1. Production Economics and Farm Management

Production Process; Economic principles of Farm Management; Resource management and allocation; basic concepts-marginal returns, yield gap, returns to scale, economics of scale, technology and input use; law of comparative advantages

2. Farm Resources and Optimization

Factor-product, product-product relations; Estimation of different forms of production functions using farm level data; Estimation of iso-quant and least cost combinations of crops; production in dynamic setting policy impact on production - cost concepts, cost of cultivation of principal crops

3. Risk and Uncertainty in Agriculture

Decision theory and elements of risk and uncertainty in agriculture; measurement of risk, adjustment to risk; types of risk - estimation of risk - management response to risk – linear programming and risk programming models.

4. Farm Efficiency and Total Factor Productivity and Agricultural growth

Farm efficiency – economic, allocative and technical efficiency measures; Concept of total factor productivity, variations in technical efficiency and total factor productivity and implications to production growth in India

5. Economics of Natural Resources and Sustainability

Natural resources: Renewable and non-renewable - land use pattern - land degradation
land use planning - optimal management of land, water, forests and fisheries – energy management
- common property resources , development dynamics of resource use planning for economic growth and sustainability - resource mapping: GIS and remote sensing data

Books

- Heady, Earl O., and John L. Dillon, "Agricultural Production Functions" (Ames : Iowa State University Press), 1961 and Heady, Earl O., "Economics of Agricultural Production and Use" (Prentice Hall), 1952
- Beattie, Bruce R. and C. Robert Taylor, "The Economics of Production", (New York: John Wiley and Sons), 1985
- Soni, R.N., "Leading Issues in Agricultural Economics" (Vishal Publishing House), 2008.
- Doll, John P. and Frank Orazem, "Production Economics - Theory and Applications", (New York: John Wiley and Sons), 1978.
- Manjunatha, A. V., et al. "Impact of land fragmentation, farm size, land ownership and crop diversity on profit and efficiency of irrigated farms in India." *Land Use Policy* 31 (2013): 397-405.
- Ramesh Chand and Pradumna Kumar, "Total factor productivity and contribution of Research investment to agricultural growth in India" National Council for agricultural Economics and policy Research (NCAEP) policy paper 25, 2011

GE:17 INSTITUTIONAL ECONOMICS

1. The Big Picture

Old institutional economics – Veblen & Commons, institutions as rules of the game – North, informal and formal institutions, institutions as game theoretic equilibria – Aoki, institutions and economic development – interlinkages, role of the state – anarchy and order, agency problem

2. Theories of the Firm

Why firms exist – Coase, nature of markets and market imperfections, information costs, transaction costs, governance modes as responses to minimize costs, contractual arrangements, enforcement of contracts, role of uncertainty, bounded rationality, opportunism & incomplete contracts, unified governance, agency issues and mechanisms to minimize agency costs

3. Property Rights

Development of property rights – externalities, norms and politics, determinants and impacts of property rights, monitoring and enforcement costs and nature of property rights, property rights – incentives – behavioural strategies – economic outcomes, allocation and rent seeking

4. Organizational Arrangements

Embedding organizational arrangements, meso-institutions, cooperative versus competitive arrangements, social organization, role of state, markets & communities in organizational structures, organizations for common pool resources

5. Institutional Evolution

Institutional change through learning and feedback, accidents of history, path dependence, incremental versus abrupt & discontinuous change, politics, political economy and institutional change, choosing institutions, measuring institutional quality and its effect on economic development

Books

- Malcolm Rutherford - Institutions in Economics: the Old and the New Institutionalism, Cambridge University Press, 1996.
- Ronald H Coase - The Firm, the Market and the Law, University of Chicago Press, 1998.
- Douglass C North - Institutions, Institutional Change and Economic Performance, Cambridge University Press, 1990
- Thrainn Eggertsson - Economic Behavior and Institutions, Cambridge University Press, 1990
- Claude Menard Mary Shirley, Handbook of Institutional Economics, Springer, 2008

GE:18 HEALTH ECONOMICS

1. Introduction, Demand for Health and Health Care

Welfare economics of medical care, production of health, demand for health and health care, equity, efficiency and the need, link between development and health, investing in health for economic development, public-private partnership and the role of state

2. Health Production Function

Nature of production function, different types of production function and their applications, national and international perspective, distributional inequities in opportunity and commercialization of medical and para-medical education, cost escalation in the health care system, easy access and availability to appropriate technology, need for regulation and control

3. Health Care Incentives and Financing

Goals of health care provision and financing, competitive health insurance and risk adjustment, demand and supply of health insurance, asymmetric information and agency, market insurance, self-insurance and protection, employment based insurance, health insurance in India

4. Measuring and Valuing Health Outcomes

Measurement of health state utilities, QALYs and its alternatives- different approaches of valuing health, multi-attribute utility instruments and their development

5. Health Care in India

Various health indicators and its recent trend, health care expenditures, target of health care and achievements, different options for financing healthcare, taxation, user fees, health insurance, role of urban and rural local bodies, role of non-governmental organizations, economic impact of HIV/AIDS in India and gender issues

Books

- Folland, S., A.C. Goodman and M. Stano, *Economics of Health and Health Care*, fifth edition, Pearson Prentice Hall, 2006
- Culyer, A. J. and J.P. Newhouse (eds.), *Handbook of Health Economics*, Volumes 1A & B, North-Holland, 2000
- Zweifel, P., *Health Economics*, Oxford University Press, 1997
- CII-Mckinsey Report, *Healthcare in India: The Road Ahead*, 2004.

GE:19 FINANCIAL ECONOMICS

1. Introduction to Financial Markets

Capital markets, consumption and investments with and without capital markets, market places and transaction costs and the breakdown of separation; Fisher separation theorem; the agency problem; maximization of shareholder's wealth

2. Financial Statement Analysis and Capital Budgeting:

Balance Sheet and Income statement, Cash Flow Statement, Financial Ratio Analysis, Common-Size, Du Pont Analysis, Capital Budgeting Techniques.

3. Theory of Uncertainty

Axioms of choice under uncertainty; utility functions; expected utility theorem; certainty equivalence, measures of risk-absolute and relative risk aversions; stochastic dominance-first order, second order and third order; measures of investment risk-variance of return, Mean - Variance as choice criteria.

4. Mean-Variance Portfolio Theory

Measuring portfolio return and risks, effect of diversification, minimum variance portfolio, perfectly correlated assets, minimum variance opportunity set, optimal portfolio choice; mean-variance frontier of risky and risk-free asset, optimum portfolio weights choice.

5. Index Models, CAPM & APT

Models of asset returns, single index model, systematic and specific risk, equilibrium models-capital asset pricing model, capital market line, security market line, estimation of beta,; multi index models - arbitrage pricing theory

Books

- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997.
- Elton, E.J and M.J. Gruber, *Modern Portfolio Theory & Investment Analysis*, (fourth edition) John Wiley & Sons 1991.
- Houthakker, H.S. and P.J. Williamson, *Economics of Financial Markets*, Oxford University Press, 1996

GE:20 ENVIRONMENTAL AND RESOURCE ECONOMICS

1. Issues in environmental economics

An introduction to environmental economics, economy-environment interaction, market failure, property rights, open access resources, collective action, environment and development trade-off – environmental Kuznet's curve

2. Economics of Exhaustible and Renewable Resources

Hotelling's rule, Solow-Harwick's rule, market structure and optimal extraction policy, uncertainty and the rate of resource extraction, resource scarcity; economic models of forestry and fisheries, economics of biodiversity

3. Environmental Valuation

Market and non-market valuation; Physical linkage methods; Revealed and stated preference methods

4. Environmental Policy

Command and control versus market mechanisms; Uncertainty and instrument choice; regulatory compliance and enforcement; Eco-taxes and other fiscal measures

5. Global Environmental Issues

Transboundary pollution, economics of global warming, impact of trade on environment and environment on trade, Porter's hypothesis, Pollution havens hypothesis, case studies

Books

- Kolstad, C., *Environmental Economics*, Oxford University Press, 2000
- Baumol, W.J, and W.E. Oates, *The Theory of Environmental Policy*, Cambridge University Press, 1988
- Freeman, A. M., *The Measurement of Environmental and Resource Values*, 2nd Edition, Resources for the Future, 2003
- Hanley, N., J.F. Shogren, and B. White, *Environmental Economics: In Theory and Practice*, Macmillan India Ltd., 1997

GE:21 MULTINATIONAL ENTERPRISES (MNEs) AND POLICY

1. Determinants of Foreign Direct Investments (FDI)

FDI and Industrial Organisation; MNEs are mutual invaders: S-C-P framework; choice between exports, licensing and FDI; market seeking FDI and efficiency seeking FDI; ownership – location – internalisation advantages paradigm; transactions costs and internalisation advantages; inter-industry studies; inter-country studies, WTO regime and FDI; MNEs from Emerging Economies like China and India; foreign portfolio investments and FDI.

2. MNEs and Productivity and Efficiency Spillovers

Impact of FDI on host country firms, productivity spillovers, efficiency spillovers; heterogeneity of firms and spillovers; vertical and horizontal spillovers; changing policy regimes and spillovers; Global spillovers; information technology (IT) and globalization.

3. FDI and Growth

Size and growth of the firm; MNEs and growth; growth and diversification – both product and geographical diversification; globalisation of small and medium enterprises; strategic alliances, networking and growth; mergers and acquisitions; policy reforms for growth; institutional constraints for growth; role of FDI in manufacturing for growth; information technology, FDI and exports.

4. FDI in R&D

Determinants of R&D; market Structure and R&D; innovation, learning and R&D; In-house R&D and Import of Technology; R&D Cooperation and innovative activities; FDI in R&D two motives – access to market and access to science; home base augmenting and home base exploiting FDI; FDI in R&D – India and China

5. MNEs: Socio Economic Dimensions

Impact on poverty, regional imbalances; skill bias; impact on employment; differential impact of FDI on services and manufacturing.

Books

- Caves, R.E. (2007). *Multinational Enterprise and Economic Analysis*, (Third Edition), Cambridge Survey of Economic Literature, Cambridge University Press, Cambridge.
- John Dunning and Sarianna M Lundan (2008), *Multinational Enterprises and the Global Economy*, Second Edition, Edward Elgar Publishing Limited
- N S Siddharthan and Y S Rajan (2002), *Global Business, Technology and Knowledge Sharing*, Macmillan.

- Reddy, Prasada (2011), *Global Innovation in Emerging Economies*, Routledge, New York and Oxon, i-xxv, 1-294.
- Stiglitz, Joseph and Andrew Charlton (2010). *Fair Trade for All*, Penguin, pp. i-xxvii, 1-315
- *Science, Technology and Society*, 18(3), November 2011, Special Issue on “*Innovation and Enterprise Development*”.
- N S Siddharthan and K Narayanan, (Eds), (2010), *Indian and Chinese Enterprises: Global trade, Technology and Investment regimes*, Routledge, New Delhi and London, 2010, i-xiv, 1-311.
- Akifumi Kuchiki and Masatsugu Tsuji (eds.) (2008). *The Flowchart Approach to Industrial Cluster Policy*, London: Palgrave-Macmillan
- Mario Cimoli, Giovanni Dosi, Joseph E. Stiglitz, (2009), *Industrial Policy and Development: The Political Economy of Capabilities Accumulation*, Oxford University Press,
- Subir Gokarn, Anindya Sen, Rajesh R.Vaidya (2004), *The Structure of Indian Industry*, Oxford University Press, New Delhi.

GE 22: AGRICULTURAL DEVELOPMENT AND POLICY

1. Agricultural transformation Economic Development and public policy

Role of agriculture in Economic development, Trends in agricultural growth trends in terms of trade between agriculture and industry, Farm size and productivity and poverty alleviation, role of technology and institutions in agricultural growth in India

2. Indian Agricultural policies and programs

Indian agricultural policies- Input and output policies, subsidies and support prices, agricultural diversification, Production supports- technology, extension, seed water, power, fertilizer pesticides – credit policy, Contract farming, organic farming, agricultural markets, forward markets, commodity exchanges

3. Agriculture, Food security and sustainability

Food production, Imports, Food consumption and calorie consumption Food prices and affordability, Food policy, dual pricing for producers and consumers, buffer stock operation, public distribution, Food security act- self sufficiency in production and imports, Issues of food and nutritional security; climate change and food security, bio-fuels and food security, food safety and excess use of pesticides, Sustainable water resource use and land use

4. Agriculture and World trade organization

International trade and Indian agriculture, Agricultural exports and imports, Importance of World Trade organization disadvantages and advantages, International subsidies to agriculture and implications to India

5. Tamil Nadu agriculture and water management

Tamil Nadu agriculture, major crops, productivity, dairy and poultry production, agricultural schemes and price supports to field crops and horticulture, Water use in agriculture, canal water issues and ground water management, soil conservation programs, agricultural market support and credit disbursements, Tamil Nadu export zones for agriculture

Books

- Timmer, C. Peter. "Agriculture and economic development." *Handbook of agricultural economics* 2 (2002): 1487-1546
- A. Vaidyanathan, India's agricultural Development in a regional perspective, Oxford university press 2012
- C.H. Hanumatha Rao, Agricultural growth, farm size and rural Poverty Alleviation in India : selected papers, 2005
- C. H. Hanumantha Rao. *Agriculture, food security, poverty, and environment: essays on post-reform India*. Oxford University Press, 2005
- K.P., G. Mythili and U.Sankar, Accelerating Growth through Globalization of Indian Agriculture, Macmillan, 2001.
- MSSRF and UN World Food Program, "Sustainability of Food Security, 2004.
- Planning Commission, Tamil Nadu State Development Report (Academic Foundation), 2005.

GE:23 REGIONAL ECONOMICS

1. Introduction

Need for study of Regional Economics, Definition of a region, Different types of regions, Differences between region and a nation, Regional income, Problems of estimation, Indicators of regional development, A City Model, Systems of Cities, Monocentric city model, Suburbanization, Hotelling's model

2. Models of Regional Growth:

Export Base Models, Neoclassical Models, Cumulative Causation Models, Econometric Models, Input Output Models, Multi sector Models and Regional Development Planning, Elements in a Spatial Growth Theory, Locational constants, Measurements of Agglomeration economies, and Location Preferences, Social and Political factors in regional growth, New economic geography, Rank-size rule

3. Factor Mobility in Regional Economy:

Inter-regional Migration, Mobility of Capital, Spatial diffusion of innovation and technical progress, The mobility of Managerial talent, Inter-Regional Trade, The basis of interregional trade, Regional trade and factor price equalization, Regional trade and factor migration, Regional balance of payments problems

4. Theories of Spatial Development

Integration of regional and Urban Economics, Regional dispersions of National growth, Intra-regional concentration, Urban Decentralization, Housing market, Urban transportation

5. Urban and Regional Economic Policy Analysis

Urban Policy, Regional Policy, Intra-regional concentration, Urban Decentralization, Regional trade and factor migration

Books

- Harry W Richardson (1969), Regional Economics Location Theory, urban structure and regional change, Weidenfeld and Nicolson, 5 Winsley Street London W1
- Harry W Richardson (1973), Regional Growth Theory, Macmillan
- Harry W Richardson- Elements of Regional Economics, Penguin Modern Economic Text
- Harvey Armstrong and Jim Taylor (1978), Regional Economic Policy and its Analysis, First Edition, Philip Allan Publishers Limited, Oxford OX5 4SE
- O'Sullivan, Urban Economics, Sixth Edition, McGraw-Hill 2006. [ISBN (0072984767)]

- Hoover and Giarratani, Regional Economics, Online Edition.
<http://www.rrl.wvu.edu/WebBook/Giarratani/contents.htm>

FINANCIAL ECONOMICS

FE:01 MICROECONOMICS I

1. Consumer Behaviour and Demand Consumer preferences

opportunity sets, optimum choices, indirect utility demand functions, income and substitution effects, Slutsky equation, normal versus inferior goods, types of demand functions, elasticity, welfare evaluation, consumer surplus, equivalent variation and compensating variation, revealed preference (weak and strong axioms)

2. Utility Functions and Expected Utility Theorem

Expected utility function, measures of risk aversion, state-preference approach, portfolio theory and pricing of risk, present discounted value approach to investment decisions, adjustments for risk

3. Production and Cost

Production functions, types of production functions (Cobb-Douglas, CES, etc.), marginal products, rate of technical substitution, technical progress, cost functions, average and marginal costs, short run versus long run costs, economies of scale and scope, profit maximization, cost minimization, derivation of input demand

4. Competitive Markets

Assumptions of perfect market, competitive markets – demand and supply, demand and supply curves of individual firms, short-run versus long-run, competitive market equilibrium, tax incidence analysis, price-controls and shortages.

5. Imperfect Competition

Market failure, imperfect markets, sources of monopoly power, monopoly market equilibrium, price discrimination – first, second and third degree, tax incidence, oligopoly, Cournot Model, Stackelberg model, Bertrand Model, Monopolistic Competition.

Reference Books

- Varian, H. R., Microeconomic Analysis, third edition, W.W. Norton and Co., 1992
- Mas-collel, Whinston and Green (1995): Micro-economic Theory, OUP
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Koutsoyiannes. A. “Modern Microeconomics” (Macmillan Press Limited, New York)

Review Books

- Varian, H. R., Intermediate Microeconomics: A Modern Approach, third edition, 2010.
- Nicholson, W., Microeconomic Theory: Basic Principles and Extensions, eighth edition, South Western Thomson Learning, 2002

FE:02 MACROECONOMICS

1. National Income Accounting

Accounting structure, key concepts in accounting for both closed and open economies – gross national product, gross domestic product, net national product, national income, savings and investment, balance of payments, circular flow of income, computational problems – expenditure approach, income approach and value added approach for measurement, input-output tables

2. Keynesian Models

Simple Keynesian Model, assumptions, concepts of involuntary unemployment, liquidity preference, paradox of thrift, investment function, IS-LM model – two sector model, goods and money market equilibrium, multiplier, liquidity trap, complete Keynesian model – three sector model, role of government in terms of monetary and fiscal policy

3. Keynesian Models versus Classical Models

Says Law, quantity theory of money, price flexibility and full employment, Clowers and Patinkin's money demand functions, equilibrium concept in classical model, synthesis between classical models and Keynesian models, interpretation and policy analysis

4. Expectations and Macroeconomic Adjustments

Expectations formations – Adaptive and rational expectations hypothesis, partial adjustment model, Lucas critique, Phillips curve, rules versus discretion, time consistency, inflation targeting, interest rate rules, effects of spending and taxes in models with flexible and sticky prices, perverse effects of fiscal expansion

5. Macroeconomics: Open Economy Aspects

Market for foreign exchange, devaluation and depreciation, real and nominal exchange rate, factors affecting exchange rate, Mundell-Fleming model, fixed versus floating exchange rate, price adjustment, role of fiscal and monetary policies under alternative exchange rate regimes, purchasing power parity concept

Books

- Scarth, W., *Macroeconomics: An Introduction to Advanced Methods*, third edition, Thomson, 2007
- Mankiw, N. G., *Macroeconomics*, fifth edition, Worth Publishers, 2002
- Hall, E. and Taylor, J. B. *Macroeconomics*. W. W. Norton and Company, 1986
- Barro, R.J. *Macroeconomics*, Fifth edition, MIT Press 1997

FE:03 MATHEMATICAL STATISTICS

1. Probability Theory

Concept of probability, conditional probability and Bayes' theorem; Random variables –discrete and continuous, Density and distribution functions, joint, marginal and conditional distribution, moment generating function, law of large numbers and Central Limit theorem

2. Probability Distributions

Discrete versus continuous distribution, uniform, binomial, negative binomial, Poisson, geometric and hyper-geometric, exponential, normal, log-normal and gamma; joint, marginal and conditional distribution, characteristic function and moment generating function, functions of random variables.

3. Sampling Methods and Sampling distributions

Simple random sampling: with and without replacement, stratified random sampling, probability and non-probability sampling, statistic and sample moments, sampling distributions: Student's-t, Chi-square and F-distribution, determinants of sample size, law of large numbers and Central Limit theorem

4. Estimation

Point estimation of population mean for large sample and small sample, estimation of population proportion and population variance, Maximum likelihood and method of moment estimation, properties of good estimators: unbiasedness, consistency, efficiency, sufficiency, Interval estimation.

5. Hypothesis Testing

Statistical hypothesis, simple versus composite hypothesis, critical region, types and size of error – type-I and type-II error, power of a test, p-value, Hypothesis test about: a population mean, population proportions, difference between two population means, difference between two proportions, a population variance, the ratio of two population variances, Tests of goodness of fit, the analysis of contingency tables (Chi-square test for testing independence of two-classification criteria), test for correlation, Rao-Blackwell Theorem, Cramer-Rao Identity

Books

- DeGroot, M.H. and M.J. Schervish, *Probability and Statistics*,
- Hogg, R. and A. Craig, J., *Introduction to Mathematical Statistics*, McGraw-Hill, 1965.
- Miller, I. and M. Miller, *Mathematical Statistics*, sixth edition, Prentice Hall International, 1999.
- Mood, A. M., R. A. Graybill and R.C. Boes, *Introduction to the Theory of Statistics*, McGraw-Hill, 1974.
- Ramachandran, K. M and C. P. Tsokos, *Mathematical Statistics with Applications*, 2009.

FE:04 MATHEMATICAL METHODS

1. Differential Calculus

Introduction to Functions and Real Analysis; Derivatives – partial and total, economic applications, marginal and elasticity concepts, functions of several variables, implicit function theorem, higher order derivatives and Young's theorem, Taylor's approximation, convex sets, convex and concave functions, properties of linear homogenous functions, Euler's theorem

2. Linear Algebra

Vectors, matrices, inverse, simultaneous linear equations, Cramer's rule for solving system of linear equations, input-output model, Hawkin - Simon condition, open and closed models quadratic equation, characteristic (eigen) roots and vectors

3. Classical Optimization and Applications

Introduction to quadratic forms, unconstrained optimization, constrained optimization with equality constraints, Lagrangian method, Hessian and Jacobian matrices, applications – utility maximization, cost minimization, profit – output maximization

4. Linear and Non-linear Optimization

Duality theory, constrained optimization with inequality and non-negativity constraints, Kuhn-Tucker formulation, linear programming – formulation, primal and dual, solutions using graphical and Simplex methods, applications from economics and finance

5. Dynamics

Definite and indefinite integrals, applications – measuring consumer and producer surplus, continuous interest – discount calculations, difference and differential equations, phase diagrams, Cobweb model, multiplier accelerator, Harrod-Domar and Solow model

Books:

- Simon, C. and L. Blume, *Mathematics for Economists*, Norton, London, 1994
- Chiang, A. C., *Fundamental Methods of Mathematical Economics*, McGraw-Hill, 1984
- Ok, E.A., *Real Analysis with Economic Applications*, Princeton University Press, 2007
- Knut Sydsaeter and Peter J. Hammond, *Mathematics for Economic Analysis*, Pearson Education Asia, 1995
- M.D. Intriligator, *Mathematical Optimization and Economic Theory*, Prentice-Hall, 1971
- Roberts B. and D.L. Schultze, *Modern Mathematics and Economic Analysis*, W.W. Norton and Company, 1973

FE: 05 FINANCIAL MATHEMATICS

1. Basic Financial Calculations

Introduction: financial securities- zero coupon bond, fixed interest, index linked securities etc.; the time value of money; nominal Vs. real interest, deflationary conditions; accumulating factors, force of interest, compound interest functions.

2. Annuities and Equation of Value

Discounting and Accumulation: discrete and continuous cash flows; level annuities, deferred and increasing/decreasing annuities, equation of value and yield on transaction, probability of cash flows, higher discount, loan schedules; consumer credit: flat rate and APRs.

3. Capital Budgeting Techniques and Compound Interest Problems

Introduction to financial statement, assessing financial performance, net present value, internal rate of return, payback period; projects with different lives; money and time weighed rate of return; fixed interest securities, uncertain income securities, equities, valuing a loan with allowance for capital gains and indexation.

4. Arbitrage, Forward Contracts, and Term Structure of Interest

Rationale for no arbitrage assumption; forward contracts, calculating the forward price for a security with known dividend yield; hedging, fixed cash income; Discrete time and continuous time rates; continuous time spot rates and forward rates; instantaneous forward rates; theories of time; term structure of interest rates; yield curve; yields to maturity; convexity and immunization; interest rate risk..

5. Stochastic Interest Models and Investments

Simple stochastic interest rate models, fixed and varying interest model, log normal distribution; fixed interest government borrowings, government bonds, tax, security, marketability and return; government bills: corporate debt, debentures, unsecured loan stocks, eurobonds, certificates of deposit, convertibles, property, derivatives, future, range of futures, clearing house, margin, bond futures, short interest futures, stock index futures etc.,

Books:

- Ross, S.M., *An Introduction to Mathematical Finance*, Cambridge University Press, Norton, London, 1999
- Watsham, T.J. and Perramore, K., *Quantitative Methods in Finance*, International Thomson Business Press, 1997
- Karatzas, L. and S.E. Shreve, *Methods of Mathematical Finance*, Springer, 1998.
- Martin, P.G. and B.Michael, *Applied Financial Mathematics*, Prentice Hall, 1991.
- Baxter, M. and A. L. Rennie, *Financial Calculus*, Cambridge University Press, 1996.

FE:06 MICROECONOMICS II

1. General Equilibrium and Welfare Economics

Absolute versus relative prices, perfectly competitive price and general equilibrium models – with and without production, uniqueness and determinacy, Edgeworth box, Pareto improvement and efficiency, Walrasian equilibrium, money in general equilibrium

2. Welfare Economics

Arrow-Debreu economy, welfare theorems, existence of Walrasian equilibrium, fixed-point theorem, core and core convergence, general equilibrium with time and uncertainty, Jensen's Inequality, social welfare function, transfer efficiency; Kaldor-Hicks-Samuelson criterion, Rawl's theory of social justice

3. Market Failure and Public Goods

Reasons for market failure – market imperfections, public goods, externality, macro-economic factors; types of public goods, theory of public goods – provision and pricing, government intervention, second-best solution, free riding, types of externalities – production and consumption externalities, Pigovian and Coasian solutions

4. Asymmetric Information

Moral hazard problem, adverse selection, principal agent problem, theory of lemon, credit market, implications of asymmetric information, market signaling, hidden information modeling, efficiency wage model, information and insurance

5. Game Theory

Sequential and simultaneous games, extensive forms and normal forms, dominant strategies and elimination of dominated strategies, Nash equilibrium, Dynamic games, backward induction, sub-game perfect equilibrium, applications with oligopoly markets: Cournot, Bertrand, Stackleberg and cartel

Books

- Varian, H.: Microeconomic Analysis, W.W. Norton, 3rd Edition, 1992
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004.
- Mas-Colell, A. , M. Whinston and J Green: Microeconomic Theory, Oxford University Press, 1995
- Gibbons(1992): Game Theory for Applied Economists, Princeton University Press
- Mukherji, A.: Walrasian and Non-Walrasian Equilibria: An Introduction to General Equilibrium Analysis, Clarendon Press, Oxford, 1990.
- Recent research papers in Microeconomics will be discussed

FE:07 ECONOMETRIC METHODS

1. Simple Regression Analysis

Specification of the two variable regression model, Ordinary Least Squares estimation, Assumptions, BLUE property, General and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, ANOVA

2. Multiple Regression Analysis

Motivation, Assumptions and OLS estimation, Interpretation of OLS estimation, Goodness of fit, matrix approach to linear regression models, testing of hypothesis for a single parameter, for linear combination of parameters, for multiple linear restrictions.

3. Transformation of Variables and Dummy Variables

Choice of function forms: linear, log-linear, log-log, quadratic functional forms, Box-Cox test, models with quadratics and interaction terms.

Regression on dummy (qualitative) variables with two categories, with more than two categories- intercept shifters, dummy variable trap, interaction of two categorical variables, interaction of categorical and continuous (quantitative) variables- slope shifters, piecewise linear regression model, Chow test for cross-section data and for time-series data (test structural stability of regression models)

4. Extensions of Linear Models and Non-Linear Estimation

Method of maximum likelihood and its properties (including consistency), trinity of classical tests (Wald test, Lagrange multiplier, likelihood ratio),

Consequences, detection and remedial measures of multicollinearity, heteroskedasticity (WLS, MLE), and autocorrelation (GLS), Specification error (omitted variable, inclusion of irrelevant variables, measurement error in dependent and independent variables), method of moments (IV method)

5. Multi-Equation Models

Seemingly unrelated regression and its application.

Structural equation models-specification, endogenous, exogenous and predetermined variables, structural versus reduced form, simultaneity bias, identification: rank versus order condition, exact and over identifications, methods of estimation: indirect least squares, instrumental variable estimation, two-stage least squares and three-stage least squares.

Books

- Gujarati and Porter, *Basic Econometrics*, Fifth Edition, McGraw Hill/Irwin, 2009.
- Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997. Greene
- Ramanathan, Ramu, *Introductory Econometrics with Applications*, 5th edition, 2002, Thomson Asia Pte Ltd., Singapore.
- Stock, James H., and Mark W. Watson (2006): *Introduction to Econometrics*, Second Edition, (Addison-Wesley Series in Economics).
- Wooldridge, J., *Introductory Econometrics: A Modern Approach*, 2015, Nelson Education.

FE-08- FINANCIAL ECONOMICS I

1. Introduction to Financial Markets

Capital markets, consumption and investments with and without capital markets, market places and transaction costs and the breakdown of separation; Fisher separation theorem; the agency problem; maximization of shareholder's wealth

2. Financial Statement Analysis and Capital Budgeting:

Balance Sheet and Income statement, Cash Flow Statement, Financial Ratio Analysis, Common-Size, Du Pont Analysis, Capital Budgeting Techniques.

3. Theory of Uncertainty

Axioms of choice under uncertainty; utility functions; expected utility theorem; certainty equivalence, measures of risk-absolute and relative risk aversions; stochastic dominance-first order, second order and third order; measures of investment risk-variance of return, Mean - Variance as choice criteria.

4. Mean-Variance Portfolio Theory

Measuring portfolio return and risks, effect of diversification, minimum variance portfolio, perfectly correlated assets, minimum variance opportunity set, optimal portfolio choice; mean-variance frontier of risky and risk-free asset, optimum portfolio weights choice.

5. Index Models, CAPM & APT

Models of asset returns, single index model, systematic and specific risk, equilibrium models-capital asset pricing model, capital market line, security market line, estimation of beta,; multi index models - arbitrage pricing theory

Books

- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997.
- Elton, E.J and M.J. Gruber, *Modern Portfolio Theory & Investment Analysis*, (fourth edition) John Wiley & Sons 1991.
- Houthakker, H.S. and P.J. Williamson, *Economics of Financial Markets*, Oxford University Press, 1996

FE: 09 Applied Financial Econometrics

1. Univariate Stationary Time-series Models

Introduction to stochastic process, stationary processes, Wold representation theorem, autocovariance functions, autocorrelation and partial autocorrelation, auto regressive and moving average models, conditions for stationary and invertible process, Box-Jenkins approach, forecasting. Seasonal models, de-seasonalization of time series (classical decompositions).

2. Univariate Nonstationary processes

Nonstationary process, deterministic and stochastic trends, Integrated process and random walk, random walk with drift, Unit root process- Martingale process, test for unit root- Dicky Fuller tests, other unit roots tests –PP, KPSS, ARIMA process. Fractional integrated process

3. Modeling volatility clustering

Volatility-Meaning and measurement, Volatility clustering, Econometric models of volatility, ARCH model, GARCH model and its various extensions, testing for ARCH/GARCH effects, Stochastic volatility models, multivariate GARCH modeling

4. Multivariate Stationary and Non-stationary processes

ARDL Models and its applications, vector autoregressive model, Granger causality, impulse response function, variance decomposition, introduction to cointegration, testing for cointegration: Single-equation approaches: ARDL and Engle Granger method, Johansen test for cointegration, Vector error correction model

5. Dynamic (Stationary and Non-Stationary) Panel Data Models

Arellano and Bond Estimator, Arellano and Bover Estimator and Blundell and Bond System GMM Estimator, Nonstationarity and Panel data, Panel unit root and cointegration tests, Panel VAR models

Books

- Baltagi, Badi. *Econometric Analysis of Panel Data*, 5th Edition, Wiley, 2013.
- Brooks, C., *Introductory Econometrics for Finance*, 3rd Edition, Cambridge University Press, 2014.
- Enders, W., *Applied Econometric Time Series*, second edition, John Wiley and Sons, 2006.
- Hamilton, J. D., *Time Series Analysis*, Princeton University Press, 1994.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997.
- Maddala G.S. and In-Moo Kim, *Unit Roots, Cointegration, and Structural Change*, 1998.
- Pesaran, H.M. *Time Series and Panel Data Econometrics*, Oxford University Press, 2015.

FE:10 FINANCIAL ECONOMICS II

1. Future Contracts and Markets: Option Pricing Models

Forward and future contracts and markets; European and American options; pricing futures, wasp and synthetic futures; bounds for option prices, put-call parity; derivation of option pricing formula-Binomial approach; Black-Scholes option pricing models, option to expand, valuation of a real option

2. Capital Structure Choice

The value of firm with tax, Modigliani-Miller irrelevance hypothesis, choices in financing-debt and equity, the financing mix: trade-offs and theory; signalling hypothesis; effect of agency cost on capital structure, cost of capital, empirical determinants of capital structure choice

3. Dividend Policy

Irrelevance of dividend policy without tax; valuation, growth and dividend policy, dividend policy with taxes; theory of optimal dividend policy; other issues-stock dividends and share repurchase, empirical determinants of optimal dividend policy

4. Market Microstructure

Defining capital market efficiency, relationship between the value of information and efficient capital markets, rational expectations and market efficiency, market efficiency with costly information, efficient capital market theory and empirical models

5. Special Topics

- a. Value at risk – Theory of VaR and estimation techniques
- b. Acquisitions and takeovers – mergers activities as growth strategies, theories of mergers, implications and empirical evidence
- c. Indian capital market and financial sector reforms

Books

- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Hull, J. *Options, Futures and other Derivatives*, fifth edition, Prentice Hall, 2002
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997.
- Panjer, H.H. *Financial Economics: with applications to Investments, Insurance and Pensions*, Actuarial Foundation, 1998.
- Houthakker, H.S. and P.J. Williamson, *Economics of Financial Markets*, Oxford University Press, 1996

FE:11 APPLIED ECONOMETRICS

1. Discrete Response Models

Introduction to binary variables, limitation of LPM, logistic curve, Probit and Logit models, Multinomial models, Ordinal models, Count data models

2. Limited Dependent Variables, Sample Selection and Duration Models

Censored versus truncation, TOBIT model, Truncated regression, Heckman selection model, Duration (hazard) models

3. Panel Data Models

Introduction to panel data, pooled repeated cross-section model, within and between estimators, fixed effects, random effects, Hausman test, one way and two way models, random coefficient model (Hierarchical /multi-level models)

4. Average Treatment Effects

Counterfactuals and self-selection, Methods to control selection: Regression versus Matching and Propensity Score, Difference in Difference Methodology, Regression Discontinuity Research Design, Quantile regression, Randomised Experiments-Use and Abuse

5. Multivariate Statistical Models

Discriminant Analysis, Principal Component Analysis, Factor Analysis, Cluster Analysis, Structural Equation Models

Books

1. Angrist, J. D., & Pischke, J. S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
2. Baltagi, Badi. *Econometric analysis of panel data*. John Wiley & Sons, 2008
3. Cameron, C.A. and Trivedi, P.K. *Microeconometrics: Methods and Applications*. Cambridge U.P., 2005.
4. Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
5. Johnson, R.A. and D.W. Wichern, *Applied Multivariate Statistical Analysis*, 6th Edition
6. Tacq, Jacques. *Multivariate Analysis Techniques in Social Science Research: From Problem to Analysis* Sage International, 1997.
7. Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, 2nd edition, 2010.

FE:12 STOCHASTIC MODELS

1. Stochastic Process and Simple Markov Processes

Principles of actuarial modeling, stochastic vs. deterministic models; short run and long-run properties; stochastic process and counting process; analyzing the output of a model; sensitivity testing; types of stochastic processes: discrete state spaces with discrete and continuous time changes, continuous state space, sample paths, stationary, increments, Markov property, filtrations, white noise, general random walk, Poisson process and compound Poisson process

2. Markov Chains

Chapman-Kolmogorov equations; time homogeneous Markov chains, time-inhomogeneous Markov chains; Models- no claims discount policy model, NCD model, simple random walk on $Z=\{\dots,-2,-1,0,1,2,\dots\}$ and on $\{0,1,2,\dots,b\}$; accident proneness model; long-term distribution and behaviours of a Markov chain, stationary probability distribution, modelling using Markov chains; estimating transition probabilities, assessing the fit and simulation

3. Two-State Markov Model

Assumptions, probabilities, joint density function, ML estimator; alternative approach, applications, two state model of a single decrement and comparison with those of a random lifetime model

4. General Properties of Markov Process

Poisson processes, deriving and solving the Kolmogorov equations for Markov process-time and age dependent and time independent transition intensities; birth and death problems; simple survival models, sickness and marriage models in terms of Markov process and duration dependent Markov process; Kolmogorov's backward differential equations, Markov jump process, the jump chain, simple two decrement model, calculation of total waiting time

5. Time-inhomogeneous Markov Jump Process

Chapman-Kolmogorov equations, transition rates, time inhomogeneous HSD model, Kolmogorov' backward and forward differential equations; a two state survival model; integrated form of Kolmogorov equations, applications-marriage, sickness and death; time homogeneous Poisson process models, time homogeneous and inhomogeneous Markov models

Books

- Ross, S.M., *An Introduction to Mathematical Finance*, Cambridge University Press, 2003
- Parzen, E. *Stochastic Processes*, Society for Industrial and Applied Mathematics, 1999.
- Kulkarni, V. *Modeling and Analysis of Stochastic Systems*, G. Thomson Science and Professional, 1995
- Bhat U.N.and G.K.Miller, *Elements of Applied Stochastic Processes*, Wiley, 2002.

FE:13 FIXED INCOME SECURITIES

1. Introduction to Fixed Income Securities

Time value of money, discount factors, the law of one price, arbitrage, bond prices, spot prices, STRIPS, coupon bonds, definition and interpretation of yield-to-maturity, coupon effect, yield-to-maturity and spot rates and forward rates

2. Measure of Price Sensitivity and Hedging

One-factor measure of price sensitivity, modified and Macaulay duration and convexity, par bonds and perpetuities, measure of price sensitivity based on parallel yield shift, bond immunization, hedging strategies, volatility weighted hedging and regression based hedging

3. Term Structure Models

The science of term structure models, normally distributed rates and zero drift models, time dependent drift - Ho-Lee model, the mean reversion model: Vasicek model, the volatility models: the Cox-Ingersoll-Ross model

4. Multi-Factor Term Structure Models

Motivation for principal component models, the two factor models, properties of the two factor models, multi-factor models, trading with term structure models and case studies, hedging to the model versus hedging to the market

5. Fixed Income Market in India

An introduction to the Indian debt market, the government securities market, bond, T-bills, the corporate bonds, commercial papers, repos, the trading mechanism in the NSE-WDM, regulations in the bond market

Books

- Fabozzi, F. *Bond Markets, Analysis and Strategies*, Prentice Hall, 2004
- Tuckman, B. *Fixed Income Securities*, Willey Finance, 2002
- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997.

FE:14 ECONOMICS OF INSURANCE

1. Principles of General Insurance

Nature of general insurance-classification-effects of different marketing strategies; effects of regulatory and fiscal regimes; the adjustment coefficient-Lindberg's inequality; areas of risk and uncertainty in general insurance business (solvency)

2. Basic Methodology Used in Insurance Business

Basic methodologies applied to practical problems relating to: rating, reserving, reinsurance programme performance, financial planning, monitoring the asset / liability position. Future life time random variable, its distribution function and density function, concept of force of mortality, curtate future life time random variable its probability mass function, deferred probabilities, all these functions in terms of international actuarial notation, analytical laws of mortality such as Gompertz and Makeham, single decrement life table, select and ultimate life table.

3. Fundamental Concepts of the Empirical Approach to Credibility Theory

Empirical Bayes approach to credibility theory, credibility premium formulae and standard elementary models, credibility premiums, the aggregate claim distribution for short term insurance contracts, aggregate claim distribution and application of binomial, Poisson, negative binomial distribution and normal distribution

4. Reserving Bases for General Insurance Business

Different reasons for calculating reserves, assumptions, timing of the run-off of reserves, allowance for future inflation, discount for investment income and likely sources of uncertainty, developing appropriate reinsurance programme structures for a general insurer, appropriate models for the purpose of financial planning to enable general insurer to develop and monitor its strategic objectives at either the corporate or product level

5. Insurance Pricing

Insurance cost and fair premium, basic definition rate making, rate making in property and liability insurance, investment income and the timing of claim payment; assurance and annuity contracts with level and varying benefits, Net premiums for insurance products and annuity schemes; automobile insurance, homeowners insurance, life insurance and annuities, employee benefits and group medical coverage, retirement plans.

Books

- Harrington and G. Niehaus, *Risk Management and Risk*, Tata McGraw-Hill, second edition, 2004.
- Rajeda, G. *Principles of Risk Management and Insurance*, eighth edition, Pearson Education, 2004
- Harriett, E.J. and L.L. Dani, *Principles of Insurance: Life, Health, and Annuities*, second edition, Life Office Management Association, 1999
- Black, K. and H. Skipper, *Life and Health Insurance*, Pearson Education, thirteenth edition, 2004

FE-15 INVESTMENT BANKING

1. Introduction: Overview of Investment Banking

Corporate debt and underwriting procedures securitization and asset backed debt securities, high yield debt investment bankers as traders and market-makers, private placements

2. Innovation and New Products in Fixed Income Instruments

equity issues; valuing an initial public offering, international equity issues, GDR, ADR, convertible securities, innovation and new equity securities, derivative securities

3. Mergers & Acquisitions

Introduction to valuation of companies; the law of mergers & acquisitions, markets for takeover stocks and risk arbitrageurs restructuring: theory of adding value, LBOS, practice of adding value

4. How Investment Bankers Compete

Developing new business, international business, professional standards and management

5. Structure of the Investment Banking

Structure of banking industry, major developments in India, and in international capital markets 1975-1997: legal basis of corporate finance and investment banking

Books

- Bodie, Z., A Kane and A.J. Marcus, *Investments*, Irwin McGraw-Hill, 2005.
- Sharpe, W.F., J.A. Gordon, and J.V. Bailey, *Investments*, Prentice-Hall, 1999.
- Liaw, T. *The Business of Investment Banking*, John-Wiley, 1999.
- Subramanyam, P. *Investment Banking*, TATA McGraw-Hill, 2005

FE:16 GAMES AND INFORMATION

1. Games of Complete Information

Backward induction, sub game perfection; repeated games; applications

2. Games of Incomplete Information

Bayesian equilibrium; equilibrium refinements: perfect Bayesian equilibrium, sequential equilibrium and trembling hand perfect equilibrium: applications

3. Bargaining

Bargaining with Complete and Incomplete Information, applications

4. Uncertainty

Global Games and Equilibrium Selection, Rationalization and Incomplete Information, Applications with special reference to Financial Crisis

5. Cooperative Games

Elements of Cooperative Games, Core, Shapley-Value, Applications

Books

- Osborne, M. J., *An Introduction to Game Theory*, Oxford University Press, 2003
- Gibbons, R., *A Primer in Game Theory*, Harvester-Wheatsheaf, 1992
- Fudenberg, D and J. Tirole, *Game Theory*, MIT Press, 1991
- Osborne, M. J. and A. Rubinstein, *A Course in Game Theory*, MIT Press, 1994

FE:17 INTERNATIONAL FINANCE

1. The Balance of Payments and Foreign Exchange Market

Balance of payment accounts Foreign exchange market , Demand & supply of foreign exchange, Effects of exchange rate changes on domestic prices and terms of trade, Marshall-Lerner condition, J-curve effect

2. Theories Exchange Rates

Parity conditions,-Purchasing power parity and interest rate parity, The monetary theory of exchange rates, Sticky price models- theories of overshooting, Portfolio-balance approach to exchanges rates, Currency substitution.

3. Exchange rates models with uncertainty

Market efficiency and rational expectations, The 'news' model and exchange rate volatility, Models of risk premium

4. International capital flows and financial crises

Financial crises, varieties, definitions. Models of currency and financial crisis. Crisis in emerging countries

5. Institutional Structure of International Finance

History of exchange rate regimes (Classical gold-standard system, Bretton woods, Post Bretton woods era) Different Exchange Rate Regimes, Monetary unions, Role and functions of International Monetary Fund

Books

- Krugman, Paul R., Maurice Obstfeld and Marc J. Melitz, International Economics: Theory & Policy, 9th edition, Addison-Wesley, 2012.
- Copeland, Laurence S. Exchange Rates and International Finance, 4th edition Pearson Education Limited, 2005.
- Hallwood, C. Paul, and Ronald MacDonald. International Money and Finance. Blackwell Publishing, 2009.
- Levi, M.D. International Finance: The Markets and Financial Management of Multinational Business, 5th Edition, McGraw Hill International Editions, Finance Series, 2009.
- Maurice Obstfeld and Kenneth Rogoff. Foundations of International Macroeconomics, 1st Edition, MIT Press, 1996.
- Pilbeam, Keith. International Finance, 4th Edition, Palgrave Macmillan, 2013.

FE: 18 RISK MANAGEMENT-THEORIES AND PRACTICE

1. Introduction to Risk Management

Sources of risk, currency risk, fixed income risk, equity risk, commodity risk, market risk measurement, VaR as downside risk, definition, parameter, elements of VaR system, stress testing

2. VaR Methods

An overview of VaR methods, VaR local and full valuation, delta normal methods, historical simulation, Monte Carlo simulation, examples of VaR applications.

3. Hedging

Hedging liner risk, optimal hedging, hedge ratio as regression coefficient, duration hedging, beta hedging, non-linear risk hedging, delta and dynamic hedging

4. Credit Risk Management

Settlement risk, introduction to credit risk, measuring credit risk, credit exposure, types of credit derivatives, credit default swap, pricing and hedging credit derivatives, measuring credit VaR, credit risk models, Basel accord, the Basel market risk charges

5. Operation & Integrated Risk Management

Introduction to operational risk, identifying operational risk, managing operational risk, risk capital, RAROC, risk capital, RAROC methodology, legal accounting, tax risk management

Books

- Jorion, P. *Financial Risk Manager Handbook*, Wiley, 2002
- Holton, G.A. *Value-at-Risk- Theory and Practice*, Academic Press, 2003
- Alexander, C. *Market Models: A Guide to Financial Data Analysis*, Wiley 2004
- Dubofsky, D.A. and Miller, T.W. *Derivatives: Valuation and Risk Management*, Oxford University Press, 2003.

FE: 19 FINANCIAL REGULATIONS AND BANKING SUPERVISION

1. Financial Regulation

Asymmetric information and the rationale for regulation of securities market, financial market fragility, review of regulatory policies in US, UK, Japan and Asian emerging markets.

2. Indian Capital Markets

Structure of primary and secondary markets, dematerialization, depositories, credit rating of financial instruments, financial institutions: development financial institutions, non-banking financial intermediaries, LIC of India and UTI, mutual funds, venture capital, bank-assurance

3. Financial Sector Reforms

Indian capital market integration, foreign institutional investors, impact of exchange rate variability in a liberalized regime, Issues of GDRs, ADRs

4. Banking Regulation

Banking regulation act 1949, financial stability, basics of public debt management issue of government securities conduct of monetary policy- role of gilt market

5. Bank of International Settlement

Capital adequacy regulations Basel accord I & II. accounting standard, disclosure and relationship banking mark-to-market accounting, liquidity risk and contagion market discipline: issues and evidence market discipline in emerging economies: beyond bank fundamentals

Books

- Houthakker, H.S. and Williamson, P.J. *The Economics of Financial Markets*, Oxford University Press, 1996.
- Krugman, P. and Obstfeld, M. *International Economics, Theory and Policy*, sixth edition, Addison - Wesley, 2003.
- Herring, R. and Litan, R.E. *Financial Regulation in the Global Economy*, Brookings Institution Press, 1995.
- Howells, P. and Bain, K. *Financial Markets and Institutions*, Fifth Edition, Pearson Education, 2007

FE: 20 EMPIRICAL METHODS IN FINANCE

1. The Random Character of Stock Market Prices

Unconditional distributions, conditional distributions, conditional means - mean reversion, conditional means - instrumental variable, conditional variances, relationship between means and variances, stock prices and volume

2. Efficient Markets Hypothesis

Various approaches to efficient market hypothesis, variance bounds tests, anomalies, cross-asset relationships, over-reaction hypothesis

3. Event Study Methodology

Various approaches to event study methodologies, measurement abnormal returns and test statistics

4. Pricing Options, Futures and Other Derivative Assets

Option pricing models, Black and Scholes model, real option pricing, futures and forward prices, pricing of other derivatives, numerical solution for derivative pricing.

5. Fixed Income Securities

Portfolio performance evaluation, term structure of interest rates, pricing debt with default risk, immunization strategies.

Books

- Campbell, J. Y. Lo, A. W. and Mackinlay, A. C. *The Econometrics of Financial Markets*, Princeton University Press, 1997
- Brooks, C. *Introductory Econometrics for Finance*, Cambridge University Press, 2002.
- Joel Hasbrouck, *Empirical Market Microstructure*, Oxford University Press, 2007

FE: 21 FINANCIAL MARKET MICROSTRUCTURE

1. Institutions and Market Structure

The nature of markets, prices and markets, the investigation of the economic forces affecting trades, quotes and prices, trading mechanisms, order data, quote data

2. Inventory Models

Sources for Short-run Price Deviation from Fundamentals, transaction costs, order handling costs, Roll's model, inventory models, the dealers problem, prices and inventories in competitive markets, market maker behaviour

3. Information Based Models

Informed traders and uninformed traders, the information content, the Glosten-Milgrom model, trade quantities and price behaviour, sequential trade models and price behaviour, long-lived information

4. Strategic Trader Models

Strategic behaviour of informed and uninformed traders, price behaviour and multiple informed traders, trading mechanism and strategic trading, strategic behaviour and security returns, the robustness of strategic models

5. Price Discovery and Market Stability

Information and sequence of prices, the volume critique, the role of time in price adjustment, information and market viability, order form and price behaviour, market transparency, trader anonymity, market design, market structure policies

Books

- Maureen O'Hara, *Market Microstructure Theory*, Blackwell, 1995
- Frank de Jong and Barbara Rindi, *The Microstructure of Financial Markets*, Cambridge University Press, 2009
- Joel Hasbrouck, *Empirical Market Microstructure*, Oxford University Press, 2007

ACTUARIAL ECONOMICS

AE:01 MICROECONOMICS

1. Consumer Behaviour and Demand Consumer preferences

opportunity sets, optimum choices, indirect utility demand functions, income and substitution effects, Slutsky equation, normal versus inferior goods, types of demand functions, elasticity, welfare evaluation, consumer surplus, equivalent variation and compensating variation, revealed preference (weak and strong axioms)

2. Utility Functions and Expected Utility Theorem

Expected utility function, measures of risk aversion, state-preference approach, portfolio theory and pricing of risk, present discounted value approach to investment decisions, adjustments for risk

3. Production and Cost

Production functions, types of production functions (Cobb-Douglas, CES, etc.), marginal products, rate of technical substitution, technical progress, cost functions, average and marginal costs, short run versus long run costs, economies of scale and scope, profit maximization, cost minimization, derivation of input demand

4. Competitive Markets

Assumptions of perfect market, competitive markets – demand and supply, demand and supply curves of individual firms, short-run versus long-run, competitive market equilibrium, tax incidence analysis, price-controls and shortages.

5. Imperfect Competition

Market failure, imperfect markets, sources of monopoly power, monopoly market equilibrium, price discrimination – first, second and third degree, tax incidence, oligopoly, Cournot Model, Stackelberg model, Bertrand Model, Monopolistic Competition.

Reference Books

- Varian, H. R., Microeconomic Analysis, third edition, W.W. Norton and Co., 1992
- Mas-collel, Whinston and Green (1995): Micro-economic Theory, OUP
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Koutsoyiannes. A. “Modern Microeconomics” (Macmillan Press Limited, New York

Review Books

- Varian, H. R., Intermediate Microeconomics: A Modern Approach, third edition, 2010.
- Nicholson, W., Microeconomic Theory: Basic Principles and Extensions, eighth edition, South Western Thomson Learning, 2002

AE: 02 MACROECONOMICS

1. National Income Accounting

Accounting structure, key concepts in accounting for both closed and open economies – gross national product, gross domestic product, net national product, national income, savings and investment, balance of payments, circular flow of income, computational problems – expenditure approach, income approach and value added approach for measurement, input-output tables

2. Keynesian Models

Simple Keynesian Model, assumptions, concepts of involuntary unemployment, liquidity preference, paradox of thrift, investment function, IS-LM model – two sector model, goods and money market equilibrium, multiplier, liquidity trap, complete Keynesian model – three sector model, role of government in terms of monetary and fiscal policy

3. Keynesian Models versus Classical Models

Says Law, quantity theory of money, price flexibility and full employment, Clowers and Patinkin's money demand functions, equilibrium concept in classical model, synthesis between classical models and Keynesian models, interpretation and policy analysis

4. Expectations and Macroeconomic Adjustments

Expectations formations – Adaptive and rational expectations hypothesis, partial adjustment model, Lucas critique, Phillips curve, rules versus discretion, time consistency, inflation targeting, interest rate rules, effects of spending and taxes in models with flexible and sticky prices, perverse effects of fiscal expansion

5. Macroeconomics: Open Economy Aspects

Market for foreign exchange, devaluation and depreciation, real and nominal exchange rate, factors affecting exchange rate, Mundell-Fleming model, fixed versus floating exchange rate, price adjustment, role of fiscal and monetary policies under alternative exchange rate regimes, purchasing power parity concept

Books

- Scarth, W., *Macroeconomics: An Introduction to Advanced Methods*, third edition, Thomson, 2007
- Mankiw, N. G., *Macroeconomics*, fifth edition, Worth Publishers, 2002
- Hall, E. and Taylor, J. B. *Macroeconomics*. W. W. Norton and Company, 1986
- Barro, R.J. *Macroeconomics*, Fifth edition, MIT Press 1997

AE: 03 MATHEMATICAL STATISTICS

1. Probability Theory

Concept of probability, conditional probability and Bayes' theorem; Random variables –discrete and continuous, Density and distribution functions, joint, marginal and conditional distribution, moment generating function, law of large numbers and Central Limit theorem

2. Probability Distributions

Discrete versus continuous distribution, uniform, binomial, negative binomial, Poisson, geometric and hyper-geometric, exponential, normal, log-normal and gamma; joint, marginal and conditional distribution, characteristic function and moment generating function, functions of random variables.

3. Sampling Methods and Sampling distributions

Simple random sampling: with and without replacement, stratified random sampling, probability and non-probability sampling, statistic and sample moments, sampling distributions: Student's-t, Chi-square and F-distribution, determinants of sample size, law of large numbers and Central Limit theorem

4. Estimation

Point estimation of population mean for large sample and small sample, estimation of population proportion and population variance, Maximum likelihood and method of moment estimation, properties of good estimators: unbiasedness, consistency, efficiency, sufficiency, Interval estimation.

5. Hypothesis Testing

Statistical hypothesis, simple versus composite hypothesis, critical region, types and size of error – type-I and type-II error, power of a test, p-value, Hypothesis test about: a population mean, population proportions, difference between two population means, difference between two proportions, a population variance, the ratio of two population variances, Tests of goodness of fit, the analysis of contingency tables (Chi-square test for testing independence of two-classification criteria), test for correlation, Rao-Blackwell Theorem, Cramer-Rao Identity

Books

- DeGroot, M.H. and M.J. Schervish, *Probability and Statistics*,
- Hogg, R. and A. Craig, J., *Introduction to Mathematical Statistics*, McGraw-Hill, 1965.
- Miller, I. and M. Miller, *Mathematical Statistics*, sixth edition, Prentice Hall International, 1999.
- Mood, A. M., R. A. Graybill and R.C. Boes, *Introduction to the Theory of Statistics*, McGraw-Hill, 1974.
- Ramachandran, K. M and C. P. Tsokos, *Mathematical Statistics with Applications*, 2009.

AE: 04 MATHEMATICAL METHODS

1. Differential Calculus

Introduction to Functions and Real Analysis; Derivatives – partial and total, economic applications, marginal and elasticity concepts, functions of several variables, implicit function theorem, higher order derivatives and Young's theorem, Taylor's approximation, convex sets, convex and concave functions, properties of linear homogenous functions, Euler's theorem

2. Linear Algebra

Vectors, matrices, inverse, simultaneous linear equations, Cramer's rule for solving system of linear equations, input-output model, Hawkin - Simon condition, open and closed models quadratic equation, characteristic (eigen) roots and vectors

3. Classical Optimization and Applications

Introduction to quadratic forms, unconstrained optimization, constrained optimization with equality constraints, Lagrangian method, Hessian and Jacobian matrices, applications – utility maximization, cost minimization, profit – output maximization

4. Linear and Non-linear Optimization

Duality theory, constrained optimization with inequality and non-negativity constraints, Kuhn-Tucker formulation, linear programming – formulation, primal and dual, solutions using graphical and Simplex methods, applications from economics and finance

5. Dynamics

Definite and indefinite integrals, applications – measuring consumer and producer surplus, continuous interest – discount calculations, difference and differential equations, phase diagrams, Cobweb model, multiplier accelerator, Harrod-Domar and Solow model

Books:

- Simon, C. and L. Blume, *Mathematics for Economists*, Norton, London, 1994
- Chiang, A. C., *Fundamental Methods of Mathematical Economics*, McGraw-Hill, 1984
- Ok, E.A., *Real Analysis with Economic Applications*, Princeton University Press, 2007
- Knut Sydsaeter and Peter J. Hammond, *Mathematics for Economic Analysis*, Pearson Education Asia, 1995
- M.D. Intriligator, *Mathematical Optimization and Economic Theory*, Prentice-Hall, 1971
- Roberts B. and D.L. Schultze, *Modern Mathematics and Economic Analysis*, W.W. Norton and Company, 1973

AE: 05 FINANCIAL MATHEMATICS

1. Basic Financial Calculations

Introduction: financial securities- zero coupon bond, fixed interest, index linked securities etc.; the time value of money; nominal Vs. real interest, deflationary conditions; accumulating factors, force of interest, compound interest functions.

2. Annuities and Equation of Value

Discounting and Accumulation: discrete and continuous cash flows; level annuities, deferred and increasing/decreasing annuities, equation of value and yield on transaction, probability of cash flows, higher discount, loan schedules; consumer credit: flat rate and APRs.

3. Capital Budgeting Techniques and Compound Interest Problems

Introduction to financial statement, assessing financial performance, net present value, internal rate of return, payback period; projects with different lives; money and time weighed rate of return; fixed interest securities, uncertain income securities, equities, valuing a loan with allowance for capital gains and indexation.

4. Arbitrage, Forward Contracts, and Term Structure of Interest

Rationale for no arbitrage assumption; forward contracts, calculating the forward price for a security with known dividend yield; hedging, fixed cash income; Discrete time and continuous time rates; continuous time spot rates and forward rates; instantaneous forward rates; theories of time; term structure of interest rates; yield curve; yields to maturity; convexity and immunization; interest rate risk..

5. Stochastic Interest Models and Investments

Simple stochastic interest rate models, fixed and varying interest model, log normal distribution; fixed interest government borrowings, government bonds, tax, security, marketability and return; government bills: corporate debt, debentures, unsecured loan stocks, eurobonds, certificates of deposit, convertibles, property, derivatives, future, range of futures, clearing house, margin, bond futures, short interest futures, stock index futures etc.,

Books:

- Ross, S.M., *An Introduction to Mathematical Finance*, Cambridge University Press, Norton, London, 1999
- Watsham, T.J. and Perramore, K., *Quantitative Methods in Finance*, International Thomson Business Press, 1997
- Karatzas, L. and S.E. Shreve, *Methods of Mathematical Finance*, Springer, 1998
- Martin, P.G. and B.Michael, *Applied Financial Mathematics*, Prentice Hall, 1991
- Baxter, M. and A. L. Rennie, *Financial Calculus*, Cambridge University Press, 1996

AE: 06 ACTUARIAL MATHEMATICS

1. Life Assurance and Annuity Contracts

Pricing of life insurance contracts, equations of value, allowance for investment income, present value random variable, expected present value, variance of the present value random variable for life assurance contracts; life assurance benefits payable immediately on death; claim acceleration approximation; life annuity contracts: immediate annuity; annuity-due; temporary annuity; temporary annuity-due; deferred annuities; deferred annuities-due; and continuous annuities

2. Mathematical Theory of Life Contingencies

Advance Problems in mathematical theory of life contingencies; force of mortality; laws of mortality; premiums and reserves for insurance and annuities based on a single life- sums and integrals for mean and variance of present value of benefit payments; annuities payable in advance and in arrears; temporary and deferred and whole lifetime annuities; net premiums and reserves-prospective and retrospective reserves; Gross and net premium reserves; profit contracts

3. Joint Life Probabilities

Joint life probabilities, annuities and insurances; cash flow dependent upon death or survival of either or both of two lives; competing risks; transition intensities for given dependent probability

4. Multiple-Decrement Theory and Pension fund Mathematics

Multiple decrement theory; pension fund mathematics-techniques of discounting emerging cost, for use in pricing, reserving and assessing profitability for all contract types and for pensions; expected cash flow dependent upon more than one decrement; expected cash flow contingent upon risks other than human risks

5. Principal Forms of Heterogeneity within a Population

Variations in mortality and morbidity; main forms of selection-temporary initial selection, time and class selections, spurious and adverse selection, different mortality tables for different lives; risk classification of life insurance, genetic information of risk classification in life insurance, directly and indirectly standardized mortality rates

Books

- Gerber, H.U., *Life Insurance Mathematics*, Springer, third edition, 1997.
- Booth, P.M. (et al.), *Modern Actuarial Theory and Practice*, Chapman and Hall, 1999.
- Neil, A., *Life Contingencies*, Heinemann, 1977.
- Newton bowers (et al.), *Actuarial Mathematics*, Society of Actuaries, second edition, 1997.

AE: 07 ECONOMETRIC METHODS

1. Simple Regression Analysis

Specification of the two variable regression model, Ordinary Least Squares estimation, Assumptions, BLUE property, General and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, ANOVA

2. Multiple Regression Analysis

Motivation, Assumptions and OLS estimation, Interpretation of OLS estimation, Goodness of fit, matrix approach to linear regression models, testing of hypothesis for a single parameter, for linear combination of parameters, for multiple linear restrictions.

3. Transformation of Variables and Dummy Variables

Choice of function forms: linear, log-linear, log-log, quadratic functional forms, Box-Cox test, models with quadratics and interaction terms.

Regression on dummy (qualitative) variables with two categories, with more than two categories- intercept shifters, dummy variable trap, interaction of two categorical variables, interaction of categorical and continuous (quantitative) variables- slope shifters, piecewise linear regression model, Chow test for cross-section data and for time-series data (test structural stability of regression models)

4. Extensions of Linear Models and Non-Linear Estimation

Method of maximum likelihood and its properties (including consistency), trinity of classical tests (Wald test, Lagrange multiplier, likelihood ratio),

Consequences, detection and remedial measures of multicollinearity, heteroskedasticity (WLS, MLE), and autocorrelation (GLS), Specification error (omitted variable, inclusion of irrelevant variables, measurement error in dependent and independent variables), method of moments (IV method)

5. Multi-Equation Models

Seemingly unrelated regression and its application.

Structural equation models-specification, endogenous, exogenous and predetermined variables, structural versus reduced form, simultaneity bias, identification: rank versus order condition, exact and over identifications, methods of estimation: indirect least squares, instrumental variable estimation, two-stage least squares and three-stage least squares.

Books

- Gujarati and Porter, *Basic Econometrics*, Fifth Edition, McGraw Hill/Irwin, 2009.
- Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997. Greene
- Ramanathan, Ramu, *Introductory Econometrics with Applications*, 5th edition, 2002, Thomson Asia Pte Ltd., Singapore.
- Stock, James H., and Mark W. Watson (2006): *Introduction to Econometrics*, Second Edition, (Addison-Wesley Series in Economics).
- Wooldridge, J., *Introductory Econometrics: A Modern Approach*, 2015, Nelson Education.

AE: 08 FINANCIAL ECONOMICS I

1. Introduction to Financial Markets

Capital markets, consumption and investments with and without capital markets, market places and transaction costs and the breakdown of separation; Fisher separation theorem; the agency problem; maximization of shareholder's wealth

2. Financial Statement Analysis and Capital Budgeting:

Balance Sheet and Income statement, Cash Flow Statement, Financial Ratio Analysis, Common-Size, Du Pont Analysis, Capital Budgeting Techniques.

3. Theory of Uncertainty

Axioms of choice under uncertainty; utility functions; expected utility theorem; certainty equivalence, measures of risk-absolute and relative risk aversions; stochastic dominance-first order, second order and third order; measures of investment risk-variance of return, Mean - Variance as choice criteria.

4. Mean-Variance Portfolio Theory

Measuring portfolio return and risks, effect of diversification, minimum variance portfolio, perfectly correlated assets, minimum variance opportunity set, optimal portfolio choice; mean-variance frontier of risky and risk-free asset, optimum portfolio weights choice.

5. Index Models, CAPM & APT

Models of asset returns, single index model, systematic and specific risk, equilibrium models-capital asset pricing model, capital market line, security market line, estimation of beta,; multi index models - arbitrage pricing theory

Books

- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997.
- Elton, E.J and M.J. Gruber, *Modern Portfolio Theory & Investment Analysis*, (fourth edition) John Wiley & Sons 1991.
- Houthakker, H.S. and P.J. Williamson, *Economics of Financial Markets* Oxford University Press, 1996

AE: 9 APPLIED ECONOMETRICS

1. Discrete Response Models

Introduction to binary variables, limitation of LPM, logistic curve, Probit and Logit models, Multinomial models, Ordinal models, Count data models

2. Limited Dependent Variables, Sample Selection and Duration Models

Censored versus truncation, TOBIT model, Truncated regression, Heckman selection model, Duration (hazard) models

3. Panel Data Models

Introduction to panel data, pooled repeated cross-section model, within and between estimators, fixed effects, random effects, Hausman test, one way and two way models, random coefficient model (Hierarchical /multi-level models)

4. Average Treatment Effects

Counterfactuals and self-selection, Methods to control selection: Regression versus Matching and Propensity Score, Difference in Difference Methodology, Regression Discontinuity Research Design, Quantile regression, Randomised Experiments-Use and Abuse

5. Multivariate Statistical Models

Discriminant Analysis, Principal Component Analysis, Factor Analysis, Cluster Analysis, Structural Equation Models

Books

1. Angrist, J. D., & Pischke, J. S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
2. Baltagi, Badi. *Econometric analysis of panel data*. John Wiley & Sons, 2008
3. Cameron, C.A. and Trivedi, P.K. *Microeconometrics: Methods and Applications*. Cambridge U.P., 2005.
4. Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
5. Johnson, R.A. and D.W. Wichern, *Applied Multivariate Statistical Analysis*, 6th Edition
6. Tacq, Jacques. *Multivariate Analysis Techniques in Social Science Research: From Problem to Analysis* Sage International, 1997.
7. Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, 2nd edition, 2010.

AE: 10 RISK MODELS

1. Decision Theory and Loss Distributions

Prior and posterior distributions; sequential decision procedure and its risk functions; minimax and Bayes criterion; MGFs of loss distributions: gamma, exponential, Pareto and generalized Pareto, Normal and log Normal, Weibull and Burr; deductibles and retention limits; reinsurance; excess of loss insurance; estimation of parameters of failure time using MLE and MOM

2. Bayesian Statistics and Credibility Theory

Bayes theorem; Posterior Distribution; loss function to derive Bayesian estimates of parameters; credibility theory; Bayesian credibility-Poisson/gamma model; Baye's thermo, a Bayesian approach to the updating of claim frequency rates; no claim discount; the credibility premium

3. Rating Systems

Credit rating for mortgages; experience rating system based on claim frequency; delay triangle techniques, chain ladder method, inflation adjustment, development factors, estimating outstanding claims

4. Construction of Risk Models

Models for short term insurance contracts, calculations of MGFs and moments for risk models: the sum of N independent random variables when N has a binomial, Poisson and geometric distributions; compound binomial, Poisson and negative binomial random variables; aggregate claim distribution for short term insurance contracts

5. Ruin for a Risk Model

Ruin for a risk model, aggregate claim process, probability of ruin in infinite/finite and continuous and discrete time and state; relation between different probabilities of ruin; adjustment coefficients and Lundberg's inequality

Books

- Ross, S.M., *Introduction to Probability Models*, Academic Press, seventh edition, 2000
- Berject, J. *Statistical Decision Theory and Bayesian Analysis*.
- Hossack, P. and Zehnirith, *Introductory Statistics with Applications in General Insurance*, Cambridge University Press
- Hogg, R.V. and S.A. Klugman, *Loss Distributions*.

AE: 11 STOCHASTIC MODELS

1. Stochastic Process and Simple Markov Processes

Principles of actuarial modeling, stochastic vs. deterministic models; short run and long-run properties; stochastic process and counting process; analyzing the output of a model; sensitivity testing; types of stochastic processes: discrete state spaces with discrete and continuous time changes, continuous state space, sample paths, stationary, increments, Markov property, filtrations, white noise, general random walk, Poisson process and compound Poisson process

2. Markov Chains

Chapman-Kolmogorov equations; time homogeneous Markov chains, time-inhomogeneous Markov chains; Models- no claims discount policy model, NCD model, simple random walk on $Z = \{\dots, -2, -1, 0, 1, 2, \dots\}$ and on $\{0, 1, 2, \dots, b\}$; accident proneness model; long-term distribution and behaviours of a Markov chain, stationary probability distribution, modelling using Markov chains; estimating transition probabilities, assessing the fit and simulation

3. Two-State Markov Model

Assumptions, probabilities, joint density function, ML estimator; alternative approach, applications, two state model of a single decrement and comparison with those of a random lifetime model

4. General Properties of Markov Process

Poisson processes, deriving and solving the Kolmogorov equations for Markov process-time and age dependent and time independent transition intensities; birth and death problems; simple survival models, sickness and marriage models in terms of Markov process and duration dependent Markov process; Kolmogorov's backward differential equations, Markov jump process, the jump chain, simple two decrement model, calculation of total waiting time

5. Time-inhomogeneous Markov Jump Process

Chapman-Kolmogorov equations, transition rates, time inhomogeneous HSD model, Kolmogorov's backward and forward differential equations; a two state survival model; integrated form of Kolmogorov equations, applications-marriage, sickness and death; time homogeneous Poisson process models, time homogeneous and inhomogeneous Markov models

Books

- Ross, S.M., *An Introduction to Mathematical Finance*, Cambridge University Press, 2003
- Parzen, E. *Stochastic Processes*, Society for Industrial and Applied Mathematics, 1999.
- Kulkarni, V. *Modeling and Analysis of Stochastic Systems*, G. Thomson Science and Professional, 1995
- Bhat U.N. and G.K. Miller, *Elements of Applied Stochastic Processes*, Wiley, 2002.

AE: 12 APPLIED FINANCIAL ECONOMETRICS

1. Univariate Stationary Time-series Models

Introduction to stochastic process, stationary processes, Wold representation theorem, autocovariance functions, autocorrelation and partial autocorrelation, auto regressive and moving average models, conditions for stationary and invertible process, Box-Jenkins approach, forecasting. Seasonal models, de-seasonalization of time series (classical decompositions).

2. Univariate Nonstationary processes

Nonstationary process, deterministic and stochastic trends, Integrated process and random walk, random walk with drift, Unit root process- Martingale process, test for unit root- Dicky Fuller tests, other unit roots tests –PP, KPSS, ARIMA process. Fractional integrated process

3. Modeling volatility clustering

Volatility-Meaning and measurement, Volatility clustering, Econometric models of volatility, ARCH model, GARCH model and its various extensions, testing for ARCH/GARCH effects, Stochastic volatility models, multivariate GARCH modeling

4. Multivariate Stationary and Non-stationary processes

ARDL Models and its applications, vector autoregressive model, Granger causality, impulse response function, variance decomposition, introduction to cointegration, testing for cointegration: Single-equation approaches: ARDL and Engle Granger method, Johansen test for cointegration, Vector error correction model

5. Dynamic (Stationary and Non-Stationary) Panel Data Models

Arellano and Bond Estimator, Arellano and Bover Estimator and Blundell and Bond System GMM Estimator, Nonstationarity and Panel data, Panel unit root and cointegration tests, Panel VAR models

Books

- Baltagi, Badi. *Econometric Analysis of Panel Data*, 5th Edition, Wiley, 2013.
- Brooks, C., *Introductory Econometrics for Finance*, 3rd Edition, Cambridge University Press, 2014.
- Enders, W., *Applied Econometric Time Series*, second edition, John Wiley and Sons, 2006.
- Hamilton, J. D., *Time Series Analysis*, Princeton University Press, 1994.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997.
- Maddala G.S. and In-Moo Kim, *Unit Roots, Cointegration, and Structural Change*, 1998.
- Pesaran, H.M. *Time Series and Panel Data Econometrics*, Oxford University Press, 2015.

AE: 13 FINANCIAL ECONOMICS II

1. Future Contracts and Markets: Option Pricing Models

Forward and future contracts and markets; European and American options; pricing futures, wasp and synthetic futures; bounds for option prices, put-call parity; derivation of option pricing formula-Binomial approach; Black-Scholes option pricing models, option to expand, valuation of a real option

2. Capital Structure Choice

The value of firm with tax, Modigliani-Miller irrelevance hypothesis, choices in financing-debt and equity, the financing mix: trade-offs and theory; signalling hypothesis; effect of agency cost on capital structure, cost of capital, empirical determinants of capital structure choice

3. Dividend Policy

Irrelevance of dividend policy without tax; valuation, growth and dividend policy, dividend policy with taxes; theory of optimal dividend policy; other issues-stock dividends and share repurchase, empirical determinants of optimal dividend policy

4. Market Microstructure

Defining capital market efficiency, relationship between the value of information and efficient capital markets, rational expectations and market efficiency, market efficiency with costly information, efficient capital market theory and empirical models

5. Special Topics

- a. Value at risk – Theory of VaR and estimation techniques
- b. Acquisitions and takeovers – mergers activities as growth strategies, theories of mergers, implications and empirical evidence
- c. Indian capital market and financial sector reforms

Books

- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Hull, J. *Options, Futures and other Derivatives*, fifth edition, Prentice Hall, 2002
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997.
- Panjer, H.H. *Financial Economics: with applications to Investments, Insurance and Pensions*, Actuarial Foundation, 1998.
- Houthakker, H.S. and P.J. Williamson, *Economics of Financial Markets*, Oxford University Press, 1996

AE: 14 ECONOMICS OF INSURANCE I

1. Economic Foundations

Expected utility, St. Petersburg paradox, Bernoulli's solution, Von Neumann Morgenstern Expected utility theorem, Risk preference, Demand for full insurance, maximum premium, Insurance at Fair Odds, Partial Insurance, Insurance Market-State Space Approach, contingent commodities, zero profit constraint, odd price ratio,

2. Asymmetric Information and Insurance

Moral Hazard and Insurance, Insurance and Selection Problems, single Crossing Property; Imperfect information: pooling, contract, separate insurance, self selection constraint, separating equilibrium,

3. Risk Management and Insurance

The concept of risk; Business risks and Individual risks; Risk management methods-loss control, loss financing and internal risk reduction methods; frequency of loss, magnitude and severity of loss; Important distributions of claim costs; diversification and pooling arrangement; contract costs; diversification of underwriting risk; reinsurance; proportional and non proportional contracts; Insolvency issues;

4. Insurance Pricing and Selective Insurance Products

Fundamentals – fair premium; fair profit loading; Actuarial Science pricing techniques-individual risk theory and collective risk theory; financial pricing of Insurance-insurance capital asset pricing model; present value model and option pricing model; types of insurance products; life and health insurance- term, endowment and whole life policies; universal and variable life; group insurance; annuity contracts with level and varying benefits; future life time random variable, its distribution function, force of mortality, curtate future life time; deferred probabilities; analytical laws of mortality-Gompertz, Maheham, single decrement life table, select and ultimate life table.

5. Experience Rating and Credibility Theory

Experience or merit rating, risk classification, Bonus Malus System; Credibility theorem-Empirical Bayes approach to credibility theory, credibility premium formulae and standard elementary models, credibility premiums, full and partial credibility; the aggregate claim distribution for short term insurance contracts, aggregate claim distribution and application of binomial, Poisson, negative binomial distribution and normal distribution

Books

1. Harrington and G. Niehaus, *Risk Management and Risk*, Tata McGraw-Hill, second edition, 2004.
2. Black, K. and H. Skipper, *Life and Health Insurance*, Pearson Education, thirteenth edition, 2004
3. Brian Hillier, *Economics of Asymmetric Information*
4. Walter Nicholson, *Microeconomic Theory* (8th Edition)
5. Hun Seog S. *Economics of Risk and Insurance*, Wiley-Blackwell .
6. Hans U. Gerber, *Life Insurance Mathematics*, Springer.

AE: 15 FIXED INCOME SECURITIES

1. Introduction to Fixed Income Securities

Time value of money, discount factors, the law of one price, arbitrage, bond prices, spot prices, STRIPS, coupon bonds, definition and interpretation of yield-to-maturity, coupon effect, yield-to-maturity and spot rates and forward rates

2. Measure of Price Sensitivity and Hedging

One-factor measure of price sensitivity, modified and Macaulay duration and convexity, par bonds and perpetuities, measure of price sensitivity based on parallel yield shift, bond immunization, hedging strategies, volatility weighted hedging and regression based hedging

3. Term Structure Models

The science of term structure models, normally distributed rates and zero drift models, time dependent drift - Ho-Lee model, the mean reversion model: Vasicek model, the volatility models: the Cox-Ingersoll-Ross model

4. Multi-Factor Term Structure Models

Motivation for principal component models, the two factor models, properties of the two factor models, multi-factor models, trading with term structure models and case studies, hedging to the model versus hedging to the market

5. Fixed Income Market in India

An introduction to the Indian debt market, the government securities market, bond, T-bills, the corporate bonds, commercial papers, repos, the trading mechanism in the NSE-WDM, regulations in the bond market

Books

- Fabozzi, F. *Bond Markets, Analysis and Strategies*, Prentice Hall, 2004
- Tuckman, B. *Fixed Income Securities*, Willey Finance, 2002
- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997

AE: 16 ADVANCED TECHNIQUES IN FINANCE

1. Kalman Filters

Introduction to Kalman filters, local level model, local linear trend model, local level model with explanatory variable and intervention variable, confidence interval, filtering and prediction, forecasting

2. Estimation, Testing and Resampling

Smoother and simulation smoother techniques, linear Gaussian state space model, choice of simulation method, Wavelet estimation, goodness of fit tests, tests for cycles, re-sampling in state space models, Bayesian parameter estimation, applications

3. Bootstrap

Introduction, estimation of standard error, parametric bootstraps, number of bootstrap replications, application of bootstrap in regression models, bootstrap pairs, bootstrap residuals, examples, confidence intervals based on bootstrap

4. Hypothesis Testing and Bootstrap Computation

Testing hypothesis with bootstrap, two sample problems, testing multimodality, cross validation, post sampling adjustment, bootstrap bias, bootstrap variance, applications of bootstrap computations

5. Bootstrap Bioequivalence

Confidence intervals, power calculations, Fieller's interval

Books

- Harvey, A., S.J. Koopman, and N. Shephard, *State Space and Unobserved Components Model, Theory and Applications*, Cambridge University Press, 2004
- Efron, B., and R. Tibshirani, *An Introduction to Bootstrap*, Chapman Hall, 1993
- Mooney, C. and R. D. Duval, *Bootstrapping: A Nonparametric Approach to Statistical Inference*, Sage, 1993
- Friedman, J., T. Hastie, and R. Tibshirani, *Additive Logistic Regression- A Statistical View of Boosting*, Annals of Statistics, 2000

AE: 17 FINANCE AND FINANCIAL REPORTING

1. Principles of Finance

Basic concepts, investment and asset management; objectives of an organization; Role and effects of capital markets, agent theory; theory of maximization of shareholder wealth; types of business entity; private and public companies; joint stock company; pros and cons of limited company; medium (hire purchase, credit sale, leasing and bank loans) and short (bank ODs, trade credit, factoring, bills of exchange, commercial paper) term company finance

2. Principles of Taxation and Investment Analysis

Basic principles of corporate and personal taxation, taxation of capital gains, double taxation relief, principle forms of financial instruments issued and used by companies-debenture stocks, unsecured loan stocks, Eurobonds, preference shares; ordinary and convertible shares, floating rate notes, options issued by companies etc.; corporate and private debt, credit derivatives, financial futures, options and currency swaps used by non-financial company; methods of obtaining quotation for securities; effect of taxation on capital structure used by a company, dividend policy on the market valuation of a company; venture capital and hedge funds

3. Capital Structure and Financial Accounts

Capital structure, weighted average cost of capital, Project evaluation methods, methods to evaluate risky investments: profitability tress, simulation and certainty equivalents

4. Financial Reporting

Fundamental accounting concepts, balance sheets, profit and loss account, cash flow statement; insurance company accounts, consolidated accounts, depreciation used in company account, reserves-share premium account, revaluation reserves; effects of interest rat movements on a highly geared company; capital structure and financial leverage; ratio analysis- price earnings ratio, profitability; liquidity and efficiency; short coming historical cost accounting

5. Assessment of Capital Investment Projects

Methods to determine the viability of capital investment projects, choice discount rate; methods for identifying risks, techniques for ascertaining the profitability of occurrence of different risks over varying timescales and financial impact of occurrence; techniques for ascertaining distribution of financial outcomes of a capital project

Books

- Brealey, R.A. and S.C Myres, *Principles of Corporate Finance*, McGraw-Hill, sixth edition, 1999
- Geoffrey Holmes, and A. Sugden, *Interpreting Company Reports and Accounts*, Prentice Hall, seventh edition, 1999
- Samuels, J.M., F.M. Wilkes and B. Shaw, *Management of Company Finance*, International Thomson, sixth edition, 1995.

AE: 18 HEALTH ECONOMICS

1. Introduction, Demand for Health and Health Care

Welfare economics of medical care, production of health, demand for health and health care, equity, efficiency and the need, link between development and health, investing in health for economic development, public-private partnership and the role of state

2. Health Production Function

Nature of production function, different types of production function and their applications, national and international perspective, distributional inequities in opportunity and commercialization of medical and para-medical education, cost escalation in the health care system, easy access and availability to appropriate technology, need for regulation and control

3. Health Care Incentives and Financing

Goals of health care provision and financing, competitive health insurance and risk adjustment, demand and supply of health insurance, asymmetric information and agency, market insurance, self-insurance and protection, employment based insurance, health insurance in India

4. Measuring and Valuing Health Outcomes

Measurement of health state utilities, QALYs and its alternatives- different approaches of valuing health, multi-attribute utility instruments and their development

5. Health Care in India

Various health indicators and its recent trend, health care expenditures, target of health care and achievements, different options for financing healthcare, taxation, user fees, health insurance, role of urban and rural local bodies, role of non-governmental organizations, economic impact of HIV/AIDS in India and gender issues

Books

- Folland, S., A.C. Goodman and M. Stano, *Economics of Health and Health Care*, fifth edition, Pearson Prentice Hall, 2006
- Culyer, A. J. and J.P. Newhouse (eds.), *Handbook of Health Economics*, Volumes 1A & B, North-Holland, 2000
- Zweifel, P., *Health Economics*, Oxford University Press, 1997
- CII-Mckinsey Report, *Healthcare in India: The Road Ahead*, 2004.

AE: 19 SURVIVAL MODELS

1. Survival Modeling

Survival models, survival probabilities, model of life time, consistency condition, distribution and density functions of random failure lifetime, survival function and force of mortality rate; integral formula of ${}_t p_x$, and ${}_t q_x$; Compertz and Makehan laws of mortality; expected value and variance of the complete and curtate future lifetimes, two-state model of a single decrement and its comparison with random life time model.

2. Estimating Life Time Distributions

Censoring life-time data; life tables, estimation of survival functions with and without censoring, estimating life time distribution function; Kaplan-Meier and Nelson-Aalen models; censoring mechanisms, Kaplan-Meier (product-limit) estimator, MLE, extending the force of mortality to discrete distributions; comparing lifetime distributions; Nelson-Aalen estimate, integrated hazard function; relationship between the Kaplan-Meier and Nelson-Aalen estimates

3. The Cox Regression, Binomial and Poisson Models

Fully parametric models for the hazard function; Covariates, Cox model, time-dependent covariates, hazards of different lives, utility of Cox model; maximizing the partial likelihood, properties; effect of the covariates; Binomial-type models, estimating q_x from the data, generalization of the model, Poisson models, estimating the force of mortality, links to the two-state Markov model, multiple-state, binomial and Poisson models

4. Exposed to Risk

Calculating the exposed to risk, principle of correspondence; working with complete and incomplete data; census approximations; different definitions of age, deaths using different definitions of age; calendar year rate intervals; deaths classified by calendar year and policy year; distribution of policy anniversaries over the year

5. Graduation and Statistical Tests

Features of a graduation, smoothness versus Adherence to data; suitability for purpose in hand, comparison with other tables; testing the smoothness of a graduation, statistical tests, continuity correction; chi-square tests; tests of mortality experience, standardized deviations test; signs test; grouping of sign Test, serial corrections tests; testing actual vs. expected rates; methods of graduation: graduation by parametric formula, graduation process, graphical graduation, statistical test of graduation, effect of duplicate polices,

Books

- Bowers N (et al.), *Actuarial Mathematics*, Society of Actuaries, 1986
- Parzen, E., *Stochastic Processes*, Society for Industrial and Applied Mathematics, 1999
- Cox, D.R. and D. Oakes, *Analysis of Survival Data*, Chapman and Hall, 1984
- Johnson, E. R.E. and N.L. Johnson, *Survival Models and Data Analysis*, John Wiley and Sons, 1980

AE: 20 ENVIRONMENT AND HEALTH

1. Introduction

Review of market failures; statistical value of life and health – empirical estimates of statistical value of life; disability adjusted life years

2. Environmental Effects on Health

Health production function; exposure, dose and response; indoor and outdoor air pollution; effects of air pollution on children, adults; effects of climate variability and climate change on mortality and morbidity; environmental toxicology; environmental carcinogenesis; water-borne diseases; municipal, industrial and hazardous waste – health implications

3. Medical Production of Health

Individual as producer of health; characteristics of health services and production; design of health-related insurances; role of the physician as a producer of health; healthcare organisation and funding; effects of health care expenditure on health; market for pharmaceuticals

4. Market Failure in the Provision of Health Care

Adverse selection in insurance markets; moral hazards, externalities, and other market failures in health care; problems of risk and uncertainty; unequal information; imperfect competition; equality in health care

5. Health and Environmental Policy – Inter-linkages

Global policy initiatives: Earth Summit – social, economic and environmental pillars for sustainable development; UN Millennium Development goals – environment and health linkages; national environmental and health action plans – case studies from developing countries in Africa and Asia

Books

- Yassi, A., T. Kiellstrom, T. de Kok, and T.L. Guidotti, *Basic Environmental Health*, Oxford University Press, 2001
- Phelps, C. *Health Economics*, 4th edition, Pearson Education, 2009
- Nadakavukaren, A. *Our Global Environment: A Health Perspective*, Waveland Press, 2005.
- Holgate, S.T., Maynard, R.L. and Koren, H.S., *Air Pollution and Health*, Academic Press, 1999.

AE: 21 PUBLIC ECONOMICS

1. Theory of Public Good and Public Choice

Public goods and externalities, merit goods, Samuelson theory, free rider problem, Lindahl solution, Coasian theory, theory of clubs, median voter theorem, theory of rent seeking

2. Taxation: Key Concepts

Direct and indirect taxes, efficiency and equity, dead weight loss (income tax, commodity tax, wealth tax and subsidy), taxation and monopoly; measurement of income and expenditure, tax incidence: partial (income tax, input tax, commodity tax etc.), measuring progressivity of taxation, user charges

3. Theory of Taxation and Tax Reforms

Taxation and labour supply, taxation and savings, risk-taking and wealth, general equilibrium (Herberger) models of tax incidence, theory of optimal taxation, recent developments in theory of taxation, Taxation in a Federal system: assignment issues, vertical and horizontal imbalances and externalities, evolution of tax structures, tax evasion and avoidance, designing of modern tax system, reform in direct taxes, reform in indirect taxes: the value-added tax, taxation of property, Laffer curve analysis

4. Public Expenditure and the Macro-economy

Determining optimal size of government, financing of public expenditure: debt versus tax financing, impact of public expenditure on the level and composition of output, fiscal federalism: central and sub-national expenditures, Impact of government expenditure on output and employment, designing optimal government expenditure policy: issues of size and composition, designing subsidy policy: health and education expenditure policy in India

5. Fiscal Policy Issues

Budget deficit and public debt: Keynesian, neo-classical, and Ricardian equivalence, debt dynamics, interdependence of fiscal and monetary policies, theory of inter-governmental transfers, theory and policy of subsidies, Theory of fiscal federalism, issues of equity and efficiency, designing equalisation transfers, conditional and unconditional grants, fiscal federalism in India: transfer mechanisms, role of planning and finance commission, Goods and services tax in India, new direct tax code, role of central and state FRBMs

Books

- Atkinson, A. and Stiglitz, J., *Lectures in Public Economics*, McGraw Hill, 1980
- Aurbach, A. and Feldstein, M., *Handbook of Public Economics*, Vol. 3, North Holland, 2002
- Hillman A. L., *Public Finance and Public Policy*, Cambridge University Press, 2003
- Boadway, *Public Sector Economics*, Cambridge University Press, 1979

AE: 22 ECONOMICS OF INSURANCE II

1. Life Insurance

Basic mechanism, types of life insurance: permanent, whole, universal, endowment, joint, group; premium principles and their properties; life tables, different forms: cohort, current, single and multiple decrements, functions of life tables, survival distribution, DeMoivre law, curtate future life time, uniform distribution of deaths and constant force of mortality, aggregate table, select and ultimate table, Gompertz-Makeham mortality laws.

2. Life Insurance Products I

Cash flow valuation, annuities, amortization, and sinking funds, valuing contingent payments, status, joint life status, survival function, the life status, net premium and the insurances payable at the time of death, n- year endowment and pure endowment, term insurance, whole life, deferred term insurance, whole life increasing monthly, n-year term increasing annually, n-year term decreasing annually, n year term decreasing monthly, uniform distribution of death assumption and the insurance products at curtate age

3. Life Insurance Products II

Insurance models including expenses, expense loaded premium (or the gross premium), modified equivalence principle, multiple lives, common shock model, multiple decrement models, with and without-profits endowment assurance, unit-linked products and policies, Group endowment assurances, withdrawal risk, contract design, group term assurance, surrender values, unit pricing, internal unit-linked fund, equity principle of unit pricing, appropriation and expropriation prices, offer and bid basis, asset shares for life insurance contracts, actuarial funding, conditions for and aim of actuarial funding, actuarial funding factors and unit fund profits

4. Health Insurance I

Principal terms in health care, types of health insurance contracts: critical illness, income protection and disability income insurance, long term care insurance, hospital cash, private medical insurance, group and individual covers, state's role in the provision of alternative or complementary health care; lump sums and regular incomes, flat-rated and earnings related, different viewpoints for the retired, for the employed, for children, simpler methods of funding

5. Pricing Health Care Insurance

Data availability, assumptions, underwriting, standard and sub-standard risk, group risk assessments, applications of mortality tables for health insurance, rating process, measures of morbidity experience, continuance tables, net level premiums, loss ratios, factors affecting premiums, provider payment arrangements, calculations of claim costs, accidental death and dismemberment, premium rate variables, managed care pricing, HMO rating, policy reserves

Books

- Institute of Actuaries (2008), *Life insurance*, Reading for the Subject ST2, London.
- Institute of Actuaries (2008), *Health and Care*, Reading for the Subject ST1, London.
- Harrington, S. and G. Niehaus, *Risk Management and Insurance*, second edition, Tata McGraw-Hill, 2004.
- Rajeda, G., *Principles of Risk Management and Insurance*, eighth edition, Pearson Education, 2004

APPIED QUAUNTITATIVE FINANCE

QF: 01 MICROECONOMICS-1

1. Consumer Behaviour and Demand Consumer preferences

opportunity sets, optimum choices, indirect utility demand functions, income and substitution effects, Slutsky equation, normal versus inferior goods, types of demand functions, elasticity, welfare evaluation, consumer surplus, equivalent variation and compensating variation, revealed preference (weak and strong axioms)

2. Utility Functions and Expected Utility Theorem

Expected utility function, measures of risk aversion, state-preference approach, portfolio theory and pricing of risk, present discounted value approach to investment decisions, adjustments for risk

3. Production and Cost

Production functions, types of production functions (Cobb-Douglas, CES, etc.), marginal products, rate of technical substitution, technical progress, cost functions, average and marginal costs, short run versus long run costs, economies of scale and scope, profit maximization, cost minimization, derivation of input demand

4. Competitive Markets

Assumptions of perfect market, competitive markets – demand and supply, demand and supply curves of individual firms, short-run versus long-run, competitive market equilibrium, tax incidence analysis, price-controls and shortages.

5. Imperfect Competition

Market failure, imperfect markets, sources of monopoly power, monopoly market equilibrium, price discrimination – first, second and third degree, tax incidence, oligopoly, Cournot Model, Stackelberg model, Bertrand Model, Monopolistic Competition.

Reference Books

- Varian, H. R., Microeconomic Analysis, third edition, W.W. Norton and Co., 1992
- Mas-collel, Whinston and Green (1995): Micro-economic Theory, OUP
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Koutsoyiannes. A. “Modern Microeconomics” (Macmillan Press Limited, New York

Review Books

- Varian, H. R., Intermediate Microeconomics: A Modern Approach, third edition, 2010.
- Nicholson, W., Microeconomic Theory: Basic Principles and Extensions, eighth edition, South Western Thomson Learning, 2002

QF: 02 MACROECONOMICS-1

1. National Income Accounting

Accounting structure, key concepts in accounting for both closed and open economies – gross national product, gross domestic product, net national product, national income, savings and investment, balance of payments, circular flow of income, computational problems – expenditure approach, income approach and value added approach for measurement, input-output tables

2. Keynesian Models

Simple Keynesian Model, assumptions, concepts of involuntary unemployment, liquidity preference, paradox of thrift, investment function, IS-LM model – two sector model, goods and money market equilibrium, multiplier, liquidity trap, complete Keynesian model – three sector model, role of government in terms of monetary and fiscal policy

3. Keynesian Models versus Classical Models

Says Law, quantity theory of money, price flexibility and full employment, Clower and Patinkin's formulation, equilibrium concept in classical model, synthesis between classical models and Keynesian models, interpretation and policy analysis

4. Expectation and Macroeconomic Adjustments

Expectations formations – Adaptive and rational expectations hypothesis, partial adjustment model, Lucas critique, Phillips curve, rules versus discretion, time consistency, inflation targeting, interest rate rules, effects of spending and taxes in models with flexible and sticky prices, perverse effects of fiscal expansion

5. Foreign Exchange

Market for foreign exchange, devaluation and depreciation, real and nominal exchange rate, factors affecting exchange rate, Mundell-Fleming model, fixed versus floating exchange rate, price adjustment, role of fiscal and monetary policies under alternative exchange rate regimes, purchasing power parity concept

Books

- Scarth, W., *Macroeconomics: An Introduction to Advanced Methods*, third edition, Thomson, 2007
- Mankiw, N. G., *Macroeconomics*, fifth edition, Worth Publishers, 2002
- Hall, E. and Taylor, J. B. *Macroeconomics*. W. W. Norton and Company, 1986
- Barro, R.J. *Macroeconomics*, Fifth edition, MIT Press 1997

QF: 03 MATHEMATICAL STATISTICS

1. Probability Theory

Concept of probability, conditional probability and Bayes' theorem; Random variables –discrete and continuous, Density and distribution functions, joint, marginal and conditional distribution, moment generating function, law of large numbers and Central Limit theorem

2. Probability Distributions

Discrete versus continuous distribution, uniform, binomial, negative binomial, Poisson, geometric and hyper-geometric, exponential, normal, log-normal and gamma; joint, marginal and conditional distribution, characteristic function and moment generating function, functions of random variables.

3. Sampling Methods and Sampling distributions

Simple random sampling: with and without replacement, stratified random sampling, probability and non-probability sampling, statistic and sample moments, sampling distributions: Student's-t, Chi-square and F-distribution, determinants of sample size, law of large numbers and Central Limit theorem

4. Estimation

Point estimation of population mean for large sample and small sample, estimation of population proportion and population variance, Maximum likelihood and method of moment estimation, properties of good estimators: unbiasedness, consistency, efficiency, sufficiency, Interval estimation.

5. Hypothesis Testing

Statistical hypothesis, simple versus composite hypothesis, critical region, types and size of error – type-I and type-II error, power of a test, p-value, Hypothesis test about: a population mean, population proportions, difference between two population means, difference between two proportions, a population variance, the ratio of two population variances, Tests of goodness of fit, the analysis of contingency tables (Chi-square test for testing independence of two-classification criteria), test for correlation, Rao-Blackwell Theorem, Cramer-Rao Identity

Books

- DeGroot, M.H. and M.J. Schervish, *Probability and Statistics*,
- Hogg, R. and A. Craig, J., *Introduction to Mathematical Statistics*, McGraw-Hill, 1965.
- Miller, I. and M. Miller, *Mathematical Statistics*, sixth edition, Prentice Hall International, 1999.
- Mood, A. M., R. A. Graybill and R.C. Boes, *Introduction to the Theory of Statistics*, McGraw-Hill, 1974.
- Ramachandran, K. M and C. P. Tsokos, *Mathematical Statistics with Applications*, 2009.

QF: 04 MATHEMATICAL METHODS

1. Differential Calculus

Introduction to Functions and Real Analysis; Derivatives – partial and total, economic applications, marginal and elasticity concepts, functions of several variables, implicit function theorem, higher order derivatives and Young's theorem, Taylor's approximation, convex sets, convex and concave functions, properties of linear homogenous functions, Euler's theorem

2. Linear Algebra

Vectors, matrices, inverse, simultaneous linear equations, Cramer's rule for solving system of linear equations, input-output model, Hawkin - Simon condition, open and closed models quadratic equation, characteristic (eigen) roots and vectors

3. Classical Optimization and Applications

Introduction to quadratic forms, unconstrained optimization, constrained optimization with equality constraints, Lagrangian method, Hessian and Jacobian matrices, applications – utility maximization, cost minimization, profit – output maximization

4. Linear and Non-linear Optimization

Duality theory, constrained optimization with inequality and non-negativity constraints, Kuhn-Tucker formulation, linear programming – formulation, primal and dual, solutions using graphical and Simplex methods, applications from economics and finance

5. Dynamics

Definite and indefinite integrals, applications – measuring consumer and producer surplus, continuous interest – discount calculations, difference and differential equations, phase diagrams, Cobweb model, multiplier accelerator, Harrod-Domar and Solow model

Books:

- Simon, C. and L. Blume, *Mathematics for Economists*, Norton, London, 1994
- Chiang, A. C., *Fundamental Methods of Mathematical Economics*, McGraw-Hill, 1984
- Ok, E.A., *Real Analysis with Economic Applications*, Princeton University Press, 2007
- Knut Sydsaeter and Peter J. Hammond, *Mathematics for Economic Analysis*, Pearson Education Asia, 1995
- M.D. Intriligator, *Mathematical Optimization and Economic Theory*, Prentice-Hall, 1971
- Roberts B. and D.L. Schultze, *Modern Mathematics and Economic Analysis*, W.W. Norton and Company, 1973

QF: 05 MICROECONOMICS-II

1. General Equilibrium and Welfare Economics

Absolute versus relative prices, perfectly competitive price and general equilibrium models – with and without production, uniqueness and determinacy, Edgeworth box, Pareto improvement and efficiency, Walrasian equilibrium, money in general equilibrium

2. Welfare Economics

Arrow-Debreu economy, welfare theorems, existence of Walrasian equilibrium, fixed-point theorem, core and core convergence, general equilibrium with time and uncertainty, Jensen's Inequality, social welfare function, transfer efficiency; Kaldor-Hicks-Samuelson criterion, Rawl's theory of social justice

3. Market Failure and Public Goods

Reasons for market failure – market imperfections, public goods, externality, macro-economic factors; types of public goods, theory of public goods – provision and pricing, government intervention, second-best solution, free riding, types of externalities – production and consumption externalities, Pigovian and Coasian solutions

4. Asymmetric Information

Moral hazard problem, adverse selection, principal agent problem, theory of lemon, credit market, implications of asymmetric information, market signaling, hidden information modeling, efficiency wage model, information and insurance

5. Game Theory

Sequential and simultaneous games, extensive forms and normal forms, dominant strategies and elimination of dominated strategies, Nash equilibrium, Dynamic games, backward induction, sub-game perfect equilibrium, applications with oligopoly markets: Cournot, Bertrand, Stackleberg and cartel

Books

- Varian, H.: Microeconomic Analysis, W.W. Norton, 3rd Edition, 1992
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004.
- Mas-Colell, A. , M. Whinston and J Green: Microeconomic Theory, Oxford University Press, 1995
- Gibbons(1992): Game Theory for Applied Economists, Princeton University Press
- Mukherji, A.: Walrasian and Non-Walrasian Equilibria: An Introduction to General Equilibrium Analysis, Clarendon Press, Oxford, 1990.
- Recent research papers in Microeconomics will be discussed

QF: 06 ECONOMETRIC METHODS

1. Simple Regression Analysis

Specification of the two variable regression model, Ordinary Least Squares estimation, Assumptions, BLUE property, General and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, ANOVA

2. Multiple Regression Analysis

Motivation, Assumptions and OLS estimation, Interpretation of OLS estimation, Goodness of fit, matrix approach to linear regression models, testing of hypothesis for a single parameter, for linear combination of parameters, for multiple linear restrictions.

3. Transformation of Variables and Dummy Variables

Choice of function forms: linear, log-linear, log-log, quadratic functional forms, Box-Cox test, models with quadratics and interaction terms.

Regression on dummy (qualitative) variables with two categories, with more than two categories- intercept shifters, dummy variable trap, interaction of two categorical variables, interaction of categorical and continuous (quantitative) variables- slope shifters, piecewise linear regression model, Chow test for cross-section data and for time-series data (test structural stability of regression models)

4. Extensions of Linear Models and Non-Linear Estimation

Method of maximum likelihood and its properties (including consistency), trinity of classical tests (Wald test, Lagrange multiplier, likelihood ratio),

Consequences, detection and remedial measures of multicollinearity, heteroskedasticity (WLS, MLE), and autocorrelation (GLS), Specification error (omitted variable, inclusion of irrelevant variables, measurement error in dependent and independent variables), method of moments (IV method)

5. Multi-Equation Models

Seemingly unrelated regression and its application.

Structural equation models-specification, endogenous, exogenous and predetermined variables, structural versus reduced form, simultaneity bias, identification: rank versus order condition, exact and over identifications, methods of estimation: indirect least squares, instrumental variable estimation, two-stage least squares and three-stage least squares.

Books

- Gujarati and Porter, *Basic Econometrics*, Fifth Edition, McGraw Hill/Irwin, 2009.
- Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997. Greene
- Ramanathan, Ramu, *Introductory Econometrics with Applications*, 5th edition, 2002, Thomson Asia Pte Ltd., Singapore.
- Stock, James H., and Mark W. Watson (2006): *Introduction to Econometrics*, Second Edition, (Addison-Wesley Series in Economics).
- Wooldridge, J., *Introductory Econometrics: A Modern Approach*, 2015, Nelson Education.

QF: 07 FINANCIAL MATHEMATICS

1. Basic Financial Calculations

Introduction: financial securities- zero coupon bond, fixed interest, index linked securities etc.; the time value of money; nominal Vs. real interest, deflationary conditions; accumulating factors, force of interest, compound interest functions.

2. Annuities and Equation of Value

Discounting and Accumulation: discrete and continuous cash flows; level annuities, deferred and increasing/decreasing annuities, equation of value and yield on transaction, probability of cash flows, higher discount, loan schedules; consumer credit: flat rate and APRs.

3. Capital Budgeting Techniques and Compound Interest Problems

Introduction to financial statement, assessing financial performance, net present value, internal rate of return, payback period; projects with different lives; money and time weighed rate of return; fixed interest securities, uncertain income securities, equities, valuing a loan with allowance for capital gains and indexation.

4. Arbitrage, Forward Contracts, and Term Structure of Interest

Rationale for no arbitrage assumption; forward contracts, calculating the forward price for a security with known dividend yield; hedging, fixed cash income; Discrete time and continuous time rates; continuous time spot rates and forward rates; instantaneous forward rates; theories of time; term structure of interest rates; yield curve; yields to maturity; convexity and immunization; interest rate risk.

5. Stochastic Interest Models and Investments

Simple stochastic interest rate models, fixed and varying interest model, log normal distribution; fixed interest government borrowings, government bonds, tax, security, marketability and return; government bills: corporate debt, debentures, unsecured loan stocks, eurobonds, certificates of deposit, convertibles, property, derivatives, future, range of futures, clearing house, margin, bond futures, short interest futures, stock index futures etc.

Books:

- Ross, S.M., *An Introduction to Mathematical Finance*, Cambridge University Press, Norton, London, 1999
- Watsham, T.J. and Perramore, K., *Quantitative Methods in Finance*, International Thomson Business Press, 1997
- Karatzas, L. and S.E. Shreve, *Methods of Mathematical Finance*, Springer, 1998.
- Martin, P.G. and B.Michael, *Applied Financial Mathematics*, Prentice Hall, 1991.
- Baxter, M. and A. L. Rennie, *Financial Calculus*, Cambridge University Press, 1996.

QF: 08 FINANCIAL ECONOMICS I

1. Introduction to Financial Markets

Capital markets, consumption and investments with and without capital markets, market places and transaction costs and the breakdown of separation; Fisher separation theorem; the agency problem; maximization of shareholder's wealth

2. Financial Statement Analysis and Capital Budgeting:

Balance Sheet and Income statement, Cash Flow Statement, Financial Ratio Analysis, Common-Size, Du Pont Analysis, Capital Budgeting Techniques.

3. Theory of Uncertainty

Axioms of choice under uncertainty; utility functions; expected utility theorem; certainty equivalence, measures of risk-absolute and relative risk aversions; stochastic dominance-first order, second order and third order; measures of investment risk-variance of return, Mean - Variance as choice criteria.

4. Mean-Variance Portfolio Theory

Measuring portfolio return and risks, effect of diversification, minimum variance portfolio, perfectly correlated assets, minimum variance opportunity set, optimal portfolio choice; mean-variance frontier of risky and risk-free asset, optimum portfolio weights choice.

5. Index Models, CAPM & APT

Models of asset returns, single index model, systematic and specific risk, equilibrium models-capital asset pricing model, capital market line, security market line, estimation of beta,; multi index models - arbitrage pricing theory

Books

- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997.
- Elton, E.J and M.J. Gruber, *Modern Portfolio Theory & Investment Analysis*, (fourth edition) John Wiley & Sons 1991.
- Houthakker, H.S. and P.J. Williamson, *Economics of Financial Markets*, Oxford University Press, 1996

QF: 09 Applied Financial Econometrics

1. Univariate Stationary Time-series Models

Introduction to stochastic process, stationary processes, Wold representation theorem, autocovariance functions, autocorrelation and partial autocorrelation, auto regressive and moving average models, conditions for stationary and invertible process, Box-Jenkins approach, forecasting. Seasonal models, de-seasonalization of time series (classical decompositions).

2. Univariate Nonstationary processes

Nonstationary process, deterministic and stochastic trends, Integrated process and random walk, random walk with drift, Unit root process- Martingale process, test for unit root- Dicky Fuller tests, other unit roots tests –PP, KPSS, ARIMA process. Fractional integrated process

3. Modeling volatility clustering

Volatility-Meaning and measurement, Volatility clustering, Econometric models of volatility, ARCH model, GARCH model and its various extensions, testing for ARCH/GARCH effects, Stochastic volatility models, multivariate GARCH modeling

4. Multivariate Stationary and Non-stationary processes

ARDL Models and its applications, vector autoregressive model, Granger causality, impulse response function, variance decomposition, introduction to cointegration, testing for cointegration: Single-equation approaches: ARDL and Engle Granger method, Johansen test for cointegration, Vector error correction model

5. Dynamic (Stationary and Non-Stationary) Panel Data Models

Arellano and Bond Estimator, Arellano and Bover Estimator and Blundell and Bond System GMM Estimator, Nonstationarity and Panel data, Panel unit root and cointegration tests, Panel VAR models

Books

- Baltagi, Badi. *Econometric Analysis of Panel Data*, 5th Edition, Wiley, 2013.
- Brooks, C., *Introductory Econometrics for Finance*, 3rd Edition, Cambridge University Press, 2014.
- Enders, W., *Applied Econometric Time Series*, second edition, John Wiley and Sons, 2006.
- Hamilton, J. D., *Time Series Analysis*, Princeton University Press, 1994.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997.
- Maddala G.S. and In-Moo Kim, *Unit Roots, Cointegration, and Structural Change*, 1998.
- Pesaran, H.M. *Time Series and Panel Data Econometrics*, Oxford University Press, 2015.

QF: 10 RISK ANALYSIS AND MANAGEMENT

1. Project Risk Management

Overview, different dimensions of risk, nature of risk management, definition, benefits of risk management, concepts and processes, identification and assessment of risks: operational, strategic, hazard, economic and financial risks, possible threats to risk management

2. Phases of Risk Management and Identification

Definitions: process and stages of risk management, success criteria, stakeholder and stakeholder analysis, constraint analysis, SWOT analysis, Delphi technique, qualitative risk management: definition, probability and impact assessment, risk description and breakdown, uses of various techniques

3. Risk Analysis

Introduction: exposures of human assets, hazard risk management, crime risks, exposures of property/physical assets, strategic risk management, managing international risks, economic risk management, integrating risk types and exposures

4. Financial Risk

Statistical concepts for financial risk: probability distribution and its application, decision trees, expected value and correlation, financial risk management, difference between qualitative and quantitative risk-management, financial products and fundamentals of pricing

5. Market and Credit Risk

Definition, managing market risk, current issues in market risk, Value at Risk, advanced techniques for managing market risks, risk and diversification benefits, credit exposure and managing credit risk, financial distress and prediction of bankruptcy, impact of Basel II

Books

- Vaughan, E. J., *Risk Management*, Wiley, 1998
- Doherty, N., *Integrated risk management: techniques and strategies for managing corporate*, McGraw-Hill, 2000
- Jorion, P., *Financial Risk Management Handbook*, Wiley, 2003
- Chapman, R.J., *Simple Tools and Techniques for Enterprise Risk Management*, Wiley, 2006

QF: 11 APPLIED ECONOMETRICS

1. Discrete Response Models

Introduction to binary variables, limitation of LPM, logistic curve, Probit and Logit models, Multinomial models, Ordinal models, Count data models

2. Limited Dependent Variables, Sample Selection and Duration Models

Censored versus truncation, TOBIT model, Truncated regression, Heckman selection model, Duration (hazard) models

3. Panel Data Models

Introduction to panel data, pooled repeated cross-section model, within and between estimators, fixed effects, random effects, Hausman test, one way and two way models, random coefficient model (Hierarchical /multi-level models)

4. Average Treatment Effects

Counterfactuals and self-selection, Methods to control selection: Regression versus Matching and Propensity Score, Difference in Difference Methodology, Regression Discontinuity Research Design, Quantile regression, Randomised Experiments-Use and Abuse

5. Spectral Analysis

(components to be included)

Books

- Angrist, J. D., & Pischke, J. S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
- Baltagi, Badi. *Econometric analysis of panel data*. John Wiley & Sons, 2008
- Cameron, C.A. and Trivedi, P.K. *Microeconometrics: Methods and Applications*. Cambridge U.P., 2005.
- Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
- Johnson, R.A. and D.W. Wichern, *Applied Multivariate Statistical Analysis*, 6th Edition
- Wooldrige, J. M. *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, 2nd edition, 2010.
- Tacq- (1997) *MVT in social science research* Sage International

QF:12 PROGRAMMING AND COMPUTATIONAL LANGUAGES

1. SAS: Master Data Management

Raw data, input statement, external data (libname statement), recoding variables, logical expressions, array processing, reshaping data: subsetting data and variables, combining datasets, grouping, sorting and merging of data sets

2. SAS Analytics: Model Management and Deployment

Describing data: descriptive statistics, creating summary data set using PROC MEANS, PROC UNIVARIATE and PROC TABULATE, plotting data, frequency distribution, t test and non parametric comparisons, PROC ANOVA, model development using PROC REG and PROC LOGIT, model deployment using PROC SCORE

3. SAS: Applications in Banking and Financial Services

Segmentation analysis using PROC FASTCLUS, application of marketing propensity models: prospect pool targeting, proactive retention models, prepayment models, application of credit risk models: risk scorecard development, collection scorecards, and survival model using PROC PHREG

4. MATLAB: Basics and Applications

Basics on MATLAB, functions and script files, MATLAB Graphics, MATLAB programming: fixed-income securities, mean-variance portfolio optimization, numerical integration, unconstrained and constrained optimization

5. Financial Modeling in EXCEL

Excel based financial models, advanced tools, designing VBA macros in excel, excel solver in a VBA macro, looping macros, Monte Carlo simulations

QF: 13 FINANCIAL ECONOMICS II

1. Future Contracts and Markets: Option Pricing Models

Forward and future contracts and markets; European and American options; pricing futures, wasp and synthetic futures; bounds for option prices, put-call parity; derivation of option pricing formula-Binomial approach; Black-Scholes option pricing models, option to expand, valuation of a real option

2. Capital Structure Choice

The value of firm with tax, Modigliani-Miller irrelevance hypothesis, choices in financing-debt and equity, the financing mix: trade-offs and theory; signalling hypothesis; effect of agency cost on capital structure, cost of capital, empirical determinants of capital structure choice

3. Dividend Policy

Irrelevance of dividend policy without tax; valuation, growth and dividend policy, dividend policy with taxes; theory of optimal dividend policy; other issues-stock dividends and share repurchase, empirical determinants of optimal dividend policy

4. Market Microstructure

Defining capital market efficiency, relationship between the value of information and efficient capital markets, rational expectations and market efficiency, market efficiency with costly information, efficient capital market theory and empirical models

5. Special Topics

- a. Value at risk – Theory of VaR and estimation techniques
- b. Acquisitions and takeovers – mergers activities as growth strategies, theories of mergers, implications and empirical evidence
- c. Indian capital market and financial sector reforms

Books

- Copeland, T. E. and J. F. Weston, *Financial Theory and Corporate Policy*, Addison Wesley, 1992
- Hull, J. *Options, Futures and other Derivatives*, fifth edition, Prentice Hall, 2002
- Brealey, R. and S. Myers, *Principles of Corporate Finance*, fifth edition, New York, McGraw Hill, 1997.
- Panjer, H.H. *Financial Economics: with applications to Investments, Insurance and Pensions*, Actuarial Foundation, 1998.
- Houthakker, H.S. and P.J. Williamson, *Economics of Financial Markets*, Oxford University Press, 1996

QF: 14 STOCHASTIC MODELS

1. Stochastic Process and Simple Markov Processes

Principles of actuarial modeling, stochastic vs. deterministic models; short run and long-run properties; stochastic process and counting process; analyzing the output of a model; sensitivity testing; types of stochastic processes: discrete state spaces with discrete and continuous time changes, continuous state space, sample paths, stationary, increments, Markov property, filtrations, white noise, general random walk, Poisson process and compound Poisson process

2. Markov Chains

Chapman-Kolmogorov equations; time homogeneous Markov chains, time-inhomogeneous Markov chains; Models- no claims discount policy model, NCD model, simple random walk on $Z = \{\dots, -2, -1, 0, 1, 2, \dots\}$ and on $\{0, 1, 2, \dots, b\}$; accident proneness model; long-term distribution and behaviours of a Markov chain, stationary probability distribution, modelling using Markov chains; estimating transition probabilities, assessing the fit and simulation

3. Two-State Markov Model

Assumptions, probabilities, joint density function, ML estimator; alternative approach, applications, two state model of a single decrement and comparison with those of a random lifetime model

4. General Properties of Markov Process

Poisson processes, deriving and solving the Kolmogorov equations for Markov process-time and age dependent and time independent transition intensities; birth and death problems; simple survival models, sickness and marriage models in terms of Markov process and duration dependent Markov process; Kolmogorov's backward differential equations, Markov jump process, the jump chain, simple two decrement model, calculation of total waiting time

5. Time-inhomogeneous Markov Jump Process

Chapman-Kolmogorov equations, transition rates, time inhomogeneous HSD model, Kolmogorov' backward and forward differential equations; a two state survival model; integrated form of Kolmogorov equations, applications-marriage, sickness and death; time homogeneous Poisson process models, time homogeneous and inhomogeneous Markov models

Books

- Ross, S.M., *An Introduction to Mathematical Finance*, Cambridge University Press, 2003
- Parzen, E. *Stochastic Processes*, Society for Industrial and Applied Mathematics, 1999.
- Kulkarni, V. *Modeling and Analysis of Stochastic Systems*, G. Thomson Science and Professional, 1995
- Bhat U.N. and G.K. Miller, *Elements of Applied Stochastic Processes*, Wiley, 2002.

QF: 15 ADVANCED TECHNIQUES IN FINANCE

1. Kalman Filters

Introduction to Kalman filters, local level model, local linear trend model, local level model with explanatory variable and intervention variable, confidence interval, filtering and prediction, forecasting

2. Estimation, Testing and Resampling

Smoother and simulation smoother techniques, linear Gaussian state space model, choice of simulation method, Wavelet estimation, goodness of fit tests, tests for cycles, re-sampling in state space models, Bayesian parameter estimation, applications

3. Bootstrap

Introduction, estimation of standard error, parametric bootstraps, number of bootstrap replications, application of bootstrap in regression models, bootstrap pairs, bootstrap residuals, examples, confidence intervals based on bootstrap

4. Hypothesis Testing and Bootstrap Computation

Testing hypothesis with bootstrap, two sample problems, testing multimodality, cross validation, post sampling adjustment, bootstrap bias, bootstrap variance, applications of bootstrap computations

5. Bootstrap Bioequivalence

Confidence intervals, power calculations, Fieller's interval

Books

- Harvey, A., S.J. Koopman, and N. Shephard, *State Space and Unobserved Components Model, Theory and Applications*, Cambridge University Press, 2004
- Efron, B., and R. Tibshirani, *An Introduction to Bootstrap*, Chapman Hall, 1993
- Mooney, C. and R. D. Duval, *Bootstrapping: A Nonparametric Approach to Statistical Inference*, Sage, 1993
- Friedman, J., T. Hastie, and R. Tibshirani, *Additive Logistic Regression- A Statistical View of Boosting*, Annals of Statistics, 2000

QF: 16 ADVANCES IN TIME-SERIES AND PANEL DATA ECONOMETRICS

1. Panel Data Models

Introduction, models with lagged dependent variable, estimation, simultaneous equation panel data models, generalised method of moment estimation, nonstationarity and panel data, panel unit root and cointegration, panel VAR models

2. Generalized Spectral Analysis

Moment generating function, characteristic function, generalized spectrum, inferences on patterns of serial dependence

3. Nonlinear Models

Threshold autoregressive model, smooth transition autoregressive model, exponential smooth transition autoregressive model, regime switching autoregressive model, amplitude-dependent exponential autoregressive model, Markov regime-switching GARCH model

4. Stochastic Volatility Models

Motivation, generalized modeling strategy, SV(1) model, long memory SV model, estimation of stochastic Volatility models, applications

5. Semiparametric and Nonparametric Methods

Univariate density estimation, bandwidth selection: rule of thumb and cross-validation, least-squares cross validation and likelihood cross validation, conditional density and quantile estimation

Books

- Baltagi, B., *Econometric Analysis of Panel Data*, Wiley, 2008
- Tsay, R., *Analysis of Financial Time Series*, Wiley, 2006
- Shephard, N., *Stochastic Volatility: Selected Readings*, Oxford University Press, 2005
- Fornani, F. and A. Mele, *Stochastic Volatility in Financial Markets: Crossing the Bridge to Continuous Time*, Kluwer Academic Publishers, 2000
- Li, Q. and J. S. Racine, *Nonparametric Econometrics: Theory and Practice*, Princeton University Press, 2009

QF: 17 FINANCIAL INSTRUMENTS AND MARKETS

1. World Financial Markets

Introduction, markets by geography, exchange, issuers, liquidity and instruments

2. Liquidity and Security

Difference between exchange and OTC markets, role of intermediaries, short-term debt securities, bond market: classification of bonds according to issuer, comparison of bond markets across different countries

3. Foreign Exchange and Stock Markets

Quotation conventions, types of brokers, central banks' policies, primary and secondary stock markets, market mechanics including types of orders, market participants, margin and short trades

4. Futures Markets

Main exchange traded markets, options on futures, specifications of the most popular contracts, trade orders for futures contracts, mark-to-market procedure, and various expiration conventions

5. Commodities Markets

Specific features, delivery and settlement methods, backwardation, short squeezes and regulations, price risks

Books

- Chacko, G., V. Dessain, P. Hecht, A. Sjöman, Financial Instruments and Markets: A Casebook, Wiley, 2006
- Baz, J. and G. Chacko, Financial Derivatives: Pricing, Applications, and Mathematics, Cambridge University Press, 2008
- Kidwell, D. S., D. W. Blackwell, D. A. Whidbee and R.L. Peterson, Financial Institutions, Markets, and Money, Wiley, 2008

QF: 18 ARTIFICIAL NEURAL NETWORKS

1. Architecture

Introduction to Neural Networks and their History, Biological Neurons and Neural Networks, Artificial neurons, Networks of Artificial Neurons

2. Data Processing

Hebbian Learning, Gradient Descent Learning, Generalized Delta Rule, Practical Considerations

3. Back Propagation

Back Propagation, Learning in Multi-Layer Perceptrons, Learning with Momentum, Conjugate Gradient Learning

4. Performance Management

Bias and Variance, under-Fitting and Over-Fitting, improving generalisation

5. Applications

Practical applications of neural networks in analytics

Books

- Smith, M., *Neural Networks for Statistical Modeling*, Van Nostrand Reinhold, 1993
- Gurney, K., *An Introduction to Neural Networks*, Routledge, 1997
- McNelis, P.D., *Neural Networks in Finance*, Academic Press, 2005
- Rothman, P., *Nonlinear Time Series Analysis of Economic and Financial Data*, Kluwer Academic Publishers, 1999

QF: 19 STOCHASTIC CALCULUS AND QUANTITATIVE FINANCE

1. Stochastic Calculus

Basics of stochastic processes, Poisson process, Brownian motion process and its varied generalisations, Geometric Brownian motion, Analysis of second order processes, Ito integral and Ito lemma with applications, Kolmogorov equations, Jump process, Calculus for jump processes, change of measure, basics of Levy stochastic calculus.

2. Stochastic Tool-kit for finance

Martingales, Martingale representation theorem, stopping time, stopped process, first passage time, Doob's optimal stopping theorem, Girsanov theory, Arc-sine law, pricing kernel as a Martingale, Risk neutral analysis, Sharpe ratio.

3. Valuation of asset prices

Stochastic characterisation of complete and incomplete markets, Forward and future contracts, binomial tree model, Black-Scholes' theory and applications, Put-call parity, Implied volatility, Exchange options, Currency options, American options, Sensitivity analysis (Greeks)

4. Interest rate models and derivatives

Mean-reverting processes, O-U process, Square root process, Factor models - the Merton model, The Vasicek model, The Cox Ingersoll-Ross model, Heath-Jarrow-Merton model, Pricing of Bonds, Stochastic interest rate, Rate of return and yield curve.

5. Further option theory

Swaps, Caps, Floors, Swaptions, Forward LIBOR models, Barrier options, Look back option, Calibration, Levy process as stock price model, Stochastic volatility models, Heston model and Wiggins' model, ARCH and GARCH models and their suitable extensions in diffusion.

Books

- Shreve S.E.: Stochastic calculus for finance volume 2 - continuous time models, Springer Verlag 2004
- J.C. Hull and Sankarshan Basu: Options, futures and other derivatives - Prentice Hall 2010
- Jamil Baz and George Chacko: Financial derivatives - Cambridge University Press 2009
- Paul Wilmott, Sam Howison and Jeff Dewynne: The Mathematics of financial derivatives - Cambridge University Press 2007
- David Applebaum: Levy processes and stochastic calculus - Cambridge University Press 2004
- Yuh-Dauh-Lyu: Financial Engineering and Computation - Cambridge University Press 2002

QF: 20 TOPICS IN BEHAVIORAL FINANCE

1. Information Perception and Intertemporal Choice

Cognitive information perception, peculiarities (biases) of quantitative and numerical information perception, Weber law, subjective probability, representativeness, anchoring, asymmetric perception of gains and losses, framing and other behavioral effects

2. Human Preferences and Market efficiency

Decision-making under risk and uncertainty, decision-making in historical perspective, Allais and Ellsberg's paradoxes, rationality from an economics and evolutionary perspective, different ways to define rationality: dependence on time horizon, individual or group rationality, examples from experimental economics: ultimatum and public goods games, experiments in isolated societies, bounded rationality, investor rationality and market efficiency

3. Behavioral Factors and Financial Markets

Fundamental information and financial markets, market predictability, the concept of limits of arbitrage, asset management and behavioral factors, active portfolio management: return statistics and sources of systematic underperformance, technical analysis and behavioral factors

4. Behavioral Factors and Corporate Finance

Behavioral factors and corporate decisions on capital structure and dividend policy, capital structure dependence on timing of good and bad corporate news announcement, mergers and acquisitions: the Winner's curse and market timing, systematic excessive optimism and overconfidence in managers' decisions, company name and its market value, sunk costs and mental accounting, evolutionary explanations for behavioral effects, evidence from behavioral game theory, systematic approach to using behavioral factors in corporate decision-making

5. External Factors and Investor Behavior

Weather, emotions, and financial markets: sunshine, geomagnetic activity, mechanisms of the external factor connection to human psychophysiology and emotional regulation, misattribution as a mechanism for external factors influence, statistical methodology for capturing the effects of external influence onto stock market returns, emotional content of news articles and their correlation with market dynamics, social trends and market dynamics, active portfolio management: source of the systematic underperformance, fundamental information and technical analysis: case for psychological influence

Books

- Plous, S., *The Psychology of Judgment and Decision Making*, McGraw-Hill, 1993
- Shleifer, A., *Inefficient Markets: An Introduction to Behavioral Finance*, Oxford University Press, 2000
- Shefrin, H., *Beyond Greed and Fear: Understanding Behavioral Finance and the Psychology of Investing*, Oxford University Press, 2006
- Prechter, R. R. (Jr.) and P. M. Kendall, *Pioneering Studies in Socioeconomics*, New Classics Library, 2003

ENVIRONMENTAL ECONOMICS

EE:01 MICROECONOMICS

1. Consumer Behaviour and Demand Consumer preferences

opportunity sets, optimum choices, indirect utility demand functions, income and substitution effects, Slutsky equation, normal versus inferior goods, types of demand functions, elasticity, welfare evaluation, consumer surplus, equivalent variation and compensating variation, revealed preference (weak and strong axioms)

2. Utility Functions and Expected Utility Theorem

Expected utility function, measures of risk aversion, state-preference approach, portfolio theory and pricing of risk, present discounted value approach to investment decisions, adjustments for risk

3. Production and Cost

Production functions, types of production functions (Cobb-Douglas, CES, etc.), marginal products, rate of technical substitution, technical progress, cost functions, average and marginal costs, short run versus long run costs, economies of scale and scope, profit maximization, cost minimization, derivation of input demand

4. Competitive Markets

Assumptions of perfect market, competitive markets – demand and supply, demand and supply curves of individual firms, short-run versus long-run, competitive market equilibrium, tax incidence analysis, price-controls and shortages.

5. Imperfect Competition

Market failure, imperfect markets, sources of monopoly power, monopoly market equilibrium, price discrimination – first, second and third degree, tax incidence, oligopoly, Cournot Model, Stackelberg model, Bertrand Model, Monopolistic Competition.

Books

- Varian, H. R., Microeconomic Analysis, third edition, W.W. Norton and Co., 1992
- Mas-collel, Whinston and Green (1995): Micro-economic Theory, OUP
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Koutsoyiannes. A. “Modern Microeconomics” (Macmillan Press Limited, New York

Review Books

- Varian, H. R., Intermediate Microeconomics: A Modern Approach, third edition, 2010.
- Nicholson, W., Microeconomic Theory: Basic Principles and Extensions, eighth edition, South Western Thomson Learning, 2002

EE: 02 MACROECONOMICS

1. National Income Accounting

Accounting structure, key concepts in accounting for both closed and open economies – gross national product, gross domestic product, net national product, national income, savings and investment, balance of payments, circular flow of income, computational problems – expenditure approach, income approach and value added approach for measurement, input-output tables

2. Keynesian Models

Simple Keynesian Model, assumptions, concepts of involuntary unemployment, liquidity preference, paradox of thrift, investment function, IS-LM model – two sector model, goods and money market equilibrium, multiplier, liquidity trap, complete Keynesian model – three sector model, role of government in terms of monetary and fiscal policy

3. Keynesian Models versus Classical Models

Says Law, quantity theory of money, price flexibility and full employment, Clowers and Pattinking's money demand functions, equilibrium concept in classical model, synthesis between classical models and Keynesian models, interpretation and policy analysis

4. Expectation and Macroeconomic Adjustments

Expectations formations – Adaptive and rational expectations hypothesis, partial adjustment model, Lucas critique, Phillips curve, rules versus discretion, time consistency, inflation targeting, interest rate rules, effects of spending and taxes in models with flexible and sticky prices, perverse effects of fiscal expansion

5. Foreign Exchange

Market for foreign exchange, devaluation and depreciation, real and nominal exchange rate, factors affecting exchange rate, Mundell-Fleming model, fixed versus floating exchange rate, price adjustment, role of fiscal and monetary policies under alternative exchange rate regimes, purchasing power parity concept

Books

- Scarth, W., *Macroeconomics: An Introduction to Advanced Methods*, third edition, Thomson, 2007
- Mankiw, N. G., *Macroeconomics*, fifth edition, Worth Publishers, 2002
- Hall, E. and Taylor, J. B. *Macroeconomics*. W. W. Norton and Company, 1986
- Barro, R.J. *Macroeconomics*, Fifth edition, MIT Press 1997

EE: 03 MATHEMATICAL STATISTICS

1. Probability Theory

Concept of probability, conditional probability and Bayes' theorem; Random variables –discrete and continuous, Density and distribution functions, joint, marginal and conditional distribution, moment generating function, law of large numbers and Central Limit theorem

2. Probability Distributions

Discrete versus continuous distribution, uniform, binomial, negative binomial, Poisson, geometric and hyper-geometric, exponential, normal, log-normal and gamma; joint, marginal and conditional distribution, characteristic function and moment generating function, functions of random variables.

3. Sampling Methods and Sampling distributions

Simple random sampling: with and without replacement, stratified random sampling, probability and non-probability sampling, statistic and sample moments, sampling distributions: Student's-t, Chi-square and F-distribution, determinants of sample size, law of large numbers and Central Limit theorem

4. Estimation

Point estimation of population mean for large sample and small sample, estimation of population proportion and population variance, Maximum likelihood and method of moment estimation, properties of good estimators: unbiasedness, consistency, efficiency, sufficiency, Interval estimation.

5. Hypothesis Testing

Statistical hypothesis, simple versus composite hypothesis, critical region, types and size of error – type-I and type-II error, power of a test, p-value, Hypothesis test about: a population mean, population proportions, difference between two population means, difference between two proportions, a population variance, the ratio of two population variances, Tests of goodness of fit, the analysis of contingency tables (Chi-square test for testing independence of two-classification criteria), test for correlation, Rao-Blackwell Theorem, Cramer-Rao Identity

Books

- DeGroot, M.H. and M.J. Schervish, *Probability and Statistics*,
- Hogg, R. and A. Craig, J., *Introduction to Mathematical Statistics*, McGraw-Hill, 1965.
- Miller, I. and M. Miller, *Mathematical Statistics*, sixth edition, Prentice Hall International, 1999.
- Mood, A. M., R. A. Graybill and R.C. Boes, *Introduction to the Theory of Statistics*, McGraw-Hill, 1974.
- Ramachandran, K. M and C. P. Tsokos, *Mathematical Statistics with Applications*, 2009.

EE: 04 MATHEMATICAL METHODS

1. Differential Calculus

Introduction to Functions and Real Analysis; Derivatives – partial and total, economic applications, marginal and elasticity concepts, functions of several variables, implicit function theorem, higher order derivatives and Young's theorem, Taylor's approximation, convex sets, convex and concave functions, properties of linear homogenous functions, Euler's theorem

2. Linear Algebra

Vectors, matrices, inverse, simultaneous linear equations, Cramer's rule for solving system of linear equations, input-output model, Hawkin - Simon condition, open and closed models quadratic equation, characteristic (eigen) roots and vectors

3. Classical Optimization and Applications

Introduction to quadratic forms, unconstrained optimization, constrained optimization with equality constraints, Lagrangian method, Hessian and Jacobian matrices, applications – utility maximization, cost minimization, profit – output maximization

4. Linear and Non-linear Optimization

Duality theory, constrained optimization with inequality and non-negativity constraints, Kuhn-Tucker formulation, linear programming – formulation, primal and dual, solutions using graphical and Simplex methods, applications from economics and finance

5. Dynamics

Definite and indefinite integrals, applications – measuring consumer and producer surplus, continuous interest – discount calculations, difference and differential equations, phase diagrams, Cobweb model, multiplier accelerator, Harrod-Domar and Solow model

Books:

- Simon, C. and L. Blume, *Mathematics for Economists*, Norton, London, 1994
- Chiang, A. C., *Fundamental Methods of Mathematical Economics*, McGraw-Hill, 1984
- Ok, E.A., *Real Analysis with Economic Applications*, Princeton University Press, 2007
- Knut Sydsaeter and Peter J. Hammond, *Mathematics for Economic Analysis*, Pearson Education Asia, 1995
- M.D. Intriligator, *Mathematical Optimization and Economic Theory*, Prentice-Hall, 1971
- Roberts B. and D.L. Schultze, *Modern Mathematics and Economic Analysis*, W.W. Norton and Company, 1973

EE: 05 MICROECONOMICS II

1. General Equilibrium and Welfare Economics

Absolute versus relative prices, perfectly competitive price and general equilibrium models – with and without production, uniqueness and determinacy, Edgeworth box, Pareto improvement and efficiency, Walrasian equilibrium, money in general equilibrium

2. Welfare Economics

Arrow-Debreu economy, welfare theorems, existence of Walrasian equilibrium, fixed-point theorem, core and core convergence, general equilibrium with time and uncertainty, Jensen's Inequality, social welfare function, transfer efficiency; Kaldor-Hicks-Samuelson criterion, Rawl's theory of social justice

3. Market Failure and Public Goods

Reasons for market failure – market imperfections, public goods, externality, macro-economic factors; types of public goods, theory of public goods – provision and pricing, government intervention, second-best solution, free riding, types of externalities – production and consumption externalities, Pigovian and Coasian solutions

4. Asymmetric Information

Moral hazard problem, adverse selection, principal agent problem, theory of lemon, credit market, implications of asymmetric information, market signaling, hidden information modeling, efficiency wage model, information and insurance

5. Game Theory

Sequential and simultaneous games, extensive forms and normal forms, dominant strategies and elimination of dominated strategies, Nash equilibrium, Dynamic games, backward induction, sub-game perfect equilibrium, applications with oligopoly markets: Cournot, Bertrand, Stackleberg and cartel

Books

- Varian, H.: Microeconomic Analysis, W.W. Norton, 3rd Edition, 1992
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004.
- Mas-Colell, A. , M. Whinston and J Green: Microeconomic Theory, Oxford University Press, 1995
- Gibbons(1992): Game Theory for Applied Economists, Princeton University Press
- Mukherji, A.: Walrasian and Non-Walrasian Equilibria: An Introduction to General Equilibrium Analysis, Claredon Press, Oxford, 1990.
- Recent research papers in Microeconomics will be discussed

EE: 06 ECONOMETRIC METHODS

1. Simple Regression Analysis

Specification of the two variable regression model, Ordinary Least Squares estimation, Assumptions, BLUE property, General and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, ANOVA

2. Multiple Regression Analysis

Motivation, Assumptions and OLS estimation, Interpretation of OLS estimation, Goodness of fit, matrix approach to linear regression models, testing of hypothesis for a single parameter, for linear combination of parameters, for multiple linear restrictions.

3. Transformation of Variables and Dummy Variables

Choice of function forms: linear, log-linear, log-log, quadratic functional forms, Box-Cox test, models with quadratics and interaction terms.

Regression on dummy (qualitative) variables with two categories, with more than two categories- intercept shifters, dummy variable trap, interaction of two categorical variables, interaction of categorical and continuous (quantitative) variables- slope shifters, piecewise linear regression model, Chow test for cross-section data and for time-series data (test structural stability of regression models)

4. Extensions of Linear Models and Non-Linear Estimation

Method of maximum likelihood and its properties (including consistency), trinity of classical tests (Wald test, Lagrange multiplier, likelihood ratio),

Consequences, detection and remedial measures of multicollinearity, heteroskedasticity (WLS, MLE), and autocorrelation (GLS), Specification error (omitted variable, inclusion of irrelevant variables, measurement error in dependent and independent variables), method of moments (IV method)

5. Multi-Equation Models

Seemingly unrelated regression and its application.

Structural equation models-specification, endogenous, exogenous and predetermined variables, structural versus reduced form, simultaneity bias, identification: rank versus order condition, exact and over identifications, methods of estimation: indirect least squares, instrumental variable estimation, two-stage least squares and three-stage least squares.

Books

- Gujarati and Porter, *Basic Econometrics*, Fifth Edition, McGraw Hill/Irwin, 2009.
- Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997. Greene
- Ramanathan, Ramu, *Introductory Econometrics with Applications*, 5th edition, 2002, Thomson Asia Pte Ltd., Singapore.
- Stock, James H., and Mark W. Watson (2006): *Introduction to Econometrics*, Second Edition, (Addison-Wesley Series in Economics).
- Wooldridge, J., *Introductory Econometrics: A Modern Approach*, 2015, Nelson Education.

EE: 07 ENVIRONMENT-ECONOMY INTERLINKAGES

1. Introduction

Environmental dilemmas; human values and environmental problems; environmental justice; Earth's major biomes – functions, changes, and measuring changes in the system; measuring biotic and abiotic components of the system

2. Human Population Change; Environmental Hazards

Population dynamics; population ecology; population and urbanization; resources – natural capital, energy resources, food resources, water resources, soil resources; limits to growth and environmental hazards; environmental demands of human population, precautionary principle

3. Air Pollution and Global Atmospheric Change

Types and sources of air pollution; indoor air pollution and health effects; trans-boundary pollution – ozone depletion, acid deposition, global warming; urban air pollution – policy responses

4. Water Pollution and Solid Waste

Water pollution and health impacts; water as a resource – water footprint; urbanization and solid waste; management of municipal solid waste; industrialization and hazardous waste; managing hazardous waste – national and international policies

5. Energy Sources

Energy consumption patterns; non-renewable energy resources – coal, oil, natural gas; limits to growth; nuclear energy and citing dilemmas; decommissioning nuclear power plants; renewable energy sources – solar and other renewable sources; conservation and efficiency

Books

- Wright, R.T., *Environmental Science: Towards Sustainable Future*, Pearson, Eleventh Edition, 2011
- Kump, L.R., J.F. Kasting, and R.G. Crane, *Earth Systems*, third edition, Prentice Hall, 2009
- Ristinen, R. and J. Kraushaar, *Energy and the Environment*, John Wiley and Sons, 1998

EE: 08 RESOURCE AND ENVIRONMENTAL ECONOMICS

1. Introduction

Economy-environment interaction; Material Balance Principle; entropy law; market failure; property rights; open, closed and common access resources; resource economics – environmental economics – ecological economics: characteristics and synergy

2. Environment vs Development

Relation between development and environmental stress; Environmental Kuznet's curve hypothesis – theory and empirical evidence; concept of sustainable development; indicators of sustainability; various approaches to environmental accounting

3. The Theory of Externality and Public Goods

Market failure; Pigouvian solution; Buchanan's theory; Coase's theorem and its critique; Pigouvian vs Coasian solution; detrimental externality and non-convexities in the production set; Property rights; collective action.

4. Economics of Exhaustible Resources

Hotelling's rule; Solow-Hartwick's Rule; competitive market structures and optimal extraction policy; monopoly, oligopoly, cartel and other market structures – optimal extraction policy; uncertainty and the rate of resource extraction; exploration and extraction; resource scarcity – indicators, evidence and critique.

5. Economics of Renewable Resources

Characteristics of renewable resources – growth functions and growth rate; economic models of fisheries, economics of optimal harvest cycles of forests; extinction of species, economics of Biodiversity.

Books:

- Kolstad, C., *Intermediate Environmental Economics*, Oxford University Press, 2012 (2nd Edition)
- Kolstad, C., *Environmental Economics*, Oxford University Press, 2000.
- Hanley, N., J.F. Shogren, and B. White, *Environmental Economics: In Theory and Practice*, Oxford University Press, 2006.
- Prato, T., *Natural Resource and Environmental Economics*, Wiley-Blackwell, 1999.
- Grafton, Q., Adamowicz, W., Dupont, D., Nelson, H., Hill, R.J., Renzetti, S., *The Economics of Environment and Natural Resources*, Wiley-Blackwell, 2004.
- Perman, R., Ma. Y., Common, M., Maddison, D., Mcgilvray, J., *Natural Resource and Environmental Economics*, Pearson Education Limited, 2011 (4th Edition).
- Gopalakrishnan, C., *Classic Papers in Natural Resource Economics*, Palgrave Macmillan, 2000.
- Conrad, J.M. and C. Clark, *Natural Resource Economics – Notes and Problems*, Cambridge University Press, 1987.
- Dasgupta, P.S. and G.M. Heal, *Economic Theory and Exhaustible Resources*, University Press (Selected chapters), 1979.

EE: 09 ENVIRONMENTAL VALUATION

1. Introduction

Environmental evaluation and public policy; measuring demand for environmental goods – consumer surplus, compensating and equivalent surplus, weak substitutability

2. Concept of Value

Measuring values, benefits and costs – overview; total value – use and non-use values of goods; Willingness-to-Pay versus Willingness-to-Accept; economic valuation of changes in human health – mortality and morbidity concepts; statistical value of life; economic valuation of biodiversity – existential value concept

3. Production Function Approaches to Economic Valuation

Environmental valuation from market information including prices – dose response function, productivity change method, substitution cost method, illness costs, human capital; defensive cost method – defensive costs of decreased drinking water quality; applications

4. Revealed Preference Approaches

Revealed preference models of valuation – basic theory; Hedonic pricing method – property market and labor market; travel cost method – zonal model, individual model, random utility model

5. Stated Preference Approaches and Benefit Transfer

Contingent valuation method – bias, experimental markets; choice modeling – choice experiment, contingent comparison, contingent scoring, pair comparison; applications; benefit transfer approaches – value transfer in theory and practice

Books

- Bateman, Ian J. et al.: *Economic Valuation with Stated Preference Techniques: A Manual*, Edward Elgar, 2002.
- Freeman, A. M.: *The Measurement of Environmental and Resource Values*, 2nd Edition, Resources for the Future, 2003.
- Johansson, P.-O.: *Cost-benefit analysis of environmental change*, Cambridge University Press, 1993.
- Kadekodi, G.K. (ed) (2004), *Environmental Economics in Practice – Case Studies from India*, Oxford University Press, Delhi.
- Chopra, K. and V. Dayal (ed.) (2009), *Handbook of Environmental Economics in India*, Oxford University Press, Delhi.
- Haque, A.K.E., M.N. Murty, and P. Shyamsundar (ed.) (2011), *Environmental Valuation in South Asia*, Cambridge University Press, Delhi.

EE: 10 ENVIRONMENTAL POLICY

1. Design of Environmental Policy Instruments - 1

Uncertainty and choice of policy instrument – price or quantity controls; efficiency without optimality – charges and standards approach; marketable emission permits for environmental protection; taxes *versus* subsidies; regulatory compliance and enforcement

2. Design of Environmental Policy Instruments – 2

Third-wave of environmental policy; information disclosures and environmental management – theory and empirical evidence; small scale sector – collective pollution abatement; comparative analysis of different instruments

3. Geography, Trade and Environment

Geography and Institutions – Environmental Linkages; Impact of trade on environment and environment on trade; Porter's hypothesis; differential environmental standards – race to bottom and pollution havens hypothesis; case studies.

4. International Environmental Issues

Transboundary pollution; economics of global warming; different international Protocols; Causes and consequences of ozone depletion and climate change; Rio conference (Agenda 21); Protocols relating to climate change, Ozone depletion and biodiversity

5. Environmental Regulation in India

Evolution of environmental policy in India; Air and water Acts; fiscal incentives; enforcement and implementation issues; emerging options – eco-taxes and eco-subsidies; case studies on pollution control in India

Books:

- Baumol, W.J. and W.E. Oates, *The theory of Environmental Policy*, Cambridge University Press, 1988.
- Kolstad, C., *Intermediate Environmental Economics*, Oxford University Press, 2012 (2nd Edition)
- Kolstad, C., *Environmental Economics*, Oxford University Press, 2000
- Sandmo, A., *The Public Economics of the Environment*, Oxford University Press, 2000.
- Freemand III, A.M. *The Economic Approach to Environmental Policy*, Edward Elgar, 1998.
- Kraft, M. E. *Environmental Policy and Politics*. 4th ed. Pearson/Longman, 2007
- Sankar, U. (2001), *Environmental Economics*, Oxford University Press, Delhi
- Chopra, K. and V. Dayal (ed.) (2009), *Handbook of Environmental Economics in India*, Oxford University Press, Delhi

EE: 11 APPLIED ECONOMETRICS

1. Discrete Response Models

Introduction to binary variables, limitation of LPM, logistic curve, Probit and Logit models, Multinomial models, Ordinal models, Count data models

2. Limited Dependent Variables, Sample Selection and Duration Models

Censored versus truncation, TOBIT model, Truncated regression, Heckman selection model, Duration (hazard) models

3. Panel Data Models

Introduction to panel data, pooled repeated cross-section model, within and between estimators, fixed effects, random effects, Hausman test, one way and two way models, random coefficient model (Hierarchical /multi-level models)

4. Average Treatment Effects

Counterfactuals and self-selection, Methods to control selection: Regression versus Matching and Propensity Score, Difference in Difference Methodology, Regression Discontinuity Research Design, Quantile regression, Randomised Experiments-Use and Abuse

5. Multivariate Statistical Models

Discriminant Analysis, Principal Component Analysis, Factor Analysis, Cluster Analysis, Structural Equation Models

Books

1. Angrist, J. D., & Pischke, J. S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
2. Baltagi, Badi. *Econometric analysis of panel data*. John Wiley & Sons, 2008
3. Cameron, C.A. and Trivedi, P.K. *Microeconometrics: Methods and Applications*. Cambridge U.P., 2005.
4. Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
5. Johnson, R.A. and D.W. Wichern, *Applied Multivariate Statistical Analysis*, 6th Edition
6. Tacq, Jacques. *Multivariate Analysis Techniques in Social Science Research: From Problem to Analysis* Sage International, 1997.
7. Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, 2nd edition, 2010.

EE:12 SOCIAL COST BENEFIT ANALYSIS

1. Foundations of Cost Benefit Analysis and Investment Criteria

Pareto optimality; market failures due to externalities, public goods, economies of scale, uncertainty and market imperfections; efficiency vs equity; aggregation in cost benefit analysis – across time, across goods, across agents, and across different states of the world; time preference - private and social; net present value; internal rate of return on investment; payback period; choice of discount rate; social discount rate.

2. Shadow Prices:

Shadow prices for goods and factors when (a) goods are traded and non-traded and (b) markets are perfect, imperfect or non-existent; derivation of shadow prices.

3. Weights:

Aggregation across agents; distributional weights – basis and practical issues.

4. Project Valuation and Uncertainty

Identification of relevant costs and benefits; UNIDO guidelines and procedures for project valuation; uncertainty and risk, risk aversion, risk premium.

5. Cost Benefit Analysis and Environment

Ecosystem complexity; uncertainty and irreversibility; discounting and the environment; environmental limits to cost-benefit analysis; applications

Books

- Boardman, A.E., Greenberg, D.H., Vining, A.R. and D.L. Weimer, *Cost-Benefit Analysis: Concepts and Practice, 3rd Edition*, Pearson Education, 2006
- Lyn Squire and van der Tak, *Economic Analysis of Projects*, John Hopkins University Press, 1992.
- Pearce, D.W. and A. Das Gupta, *Cost Benefit Analysis*, Cambridge University Press, 1983.
- Hanley, N. and C.L Spash, *Cost Benefit Analysis and the Environment*, Edward Elgar, 1993

EE: 13 Applied Financial Econometrics

1. Univariate Stationary Time-series Models

Introduction to stochastic process, stationary processes, Wold representation theorem, autocovariance functions, autocorrelation and partial autocorrelation, auto regressive and moving average models, conditions for stationary and invertible process, Box-Jenkins approach, forecasting. Seasonal models, de-seasonalization of time series (classical decompositions).

2. Univariate Nonstationary processes

Nonstationary process, deterministic and stochastic trends, Integrated process and random walk, random walk with drift, Unit root process- Martingale process, test for unit root- Dicky Fuller tests, other unit roots tests –PP, KPSS, ARIMA process. Fractional integrated process

3. Modeling volatility clustering

Volatility-Meaning and measurement, Volatility clustering, Econometric models of volatility, ARCH model, GARCH model and its various extensions, testing for ARCH/GARCH effects, Stochastic volatility models, multivariate GARCH modeling

4. Multivariate Stationary and Non-stationary processes

ARDL Models and its applications, vector autoregressive model, Granger causality, impulse response function, variance decomposition, introduction to cointegration, testing for cointegration: Single-equation approaches: ARDL and Engle Granger method, Johansen test for cointegration, Vector error correction model

5. Dynamic (Stationary and Non-Stationary) Panel Data Models

Arellano and Bond Estimator, Arellano and Bover Estimator and Blundell and Bond System GMM Estimator, Nonstationarity and Panel data, Panel unit root and cointegration tests, Panel VAR models

Books

- Baltagi, Badi. *Econometric Analysis of Panel Data*, 5th Edition, Wiley, 2013.
- Brooks, C., *Introductory Econometrics for Finance*, 3rd Edition, Cambridge University Press, 2014.
- Enders, W., *Applied Econometric Time Series*, second edition, John Wiley and Sons, 2006.
- Hamilton, J. D., *Time Series Analysis*, Princeton University Press, 1994.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997.
- Maddala G.S. and In-Moo Kim, *Unit Roots, Cointegration, and Structural Change*, 1998.
- Pesaran, H.M. *Time Series and Panel Data Econometrics*, Oxford University Press, 2015.

EE:14 GAMES AND INFORMATION

1. Games of Complete Information

Static games; solution concept: Nash equilibrium, mixed and pure strategies, maximin principle; extensive forms, backward induction, subgame perfection, repeated games; applications

2. Games of Incomplete Information

Incomplete and imperfect information; static games of incomplete information, solution concepts, Bayes-Nash equilibrium; dynamic games of incomplete information, equilibrium refinements: weak perfect Bayesian equilibrium, sequential equilibrium and trembling hand perfect equilibrium, forward induction; applications

3. Cooperative Games

Elements of cooperative games, transferable utility games, core, Shapley-Value, coalition structure, credibility and core, matching games, examples

4. Bargaining

Bargaining with complete information, bargaining as an extensive game: Rubinstein model, axiomatic bargaining: Nash bargaining solution, relation between strategic and axiomatic models, outside options, inside options, bargaining with incomplete information, one-sided and two-sided uncertainty, private and correlated values, applications

5. Differential Game

Repeated and differential game, commitment and sub-game perfection, solution concept: open and closed loop solutions, Markov-Perfect equilibrium, hierarchical game and Stackleberg solution, applications

Books

- Osborne, M. J., *An Introduction to Game Theory*, Oxford University Press, 2003
- Gibbons, R., *A Primer in Game Theory*, Harvester-Wheatsheaf, 1992
- Fudenberg, D and J. Tirole, *Game Theory*, MIT Press, 1991
- Osborne, M. J. and A. Rubinstein, *A Course in Game Theory*, MIT Press, 1994
- Muthoo, A., *Bargaining Theory with Applications*, Cambridge University Press, 1999

EE:15 ENERGY ECONOMICS AND ENVIRONMENT

1. Energy and Economy

First and second laws of thermodynamics; forms of energy; understanding energy-economy linkages; Energy Data, Energy Balance and Energy Flows; Understanding and Analyzing Energy Demand; Geo-political issues concerning energy supply

2. Economics of Non-renewable Energy Sources

Economics of coal, petroleum and natural gas; pricing of exhaustible resources; energy prices – theory and empirics; economic regulation of energy markets; electricity regulation and restructuring

3. The Economics of Renewable Energy Supply

Renewable Resources for Electricity Generation; Drivers of Renewable Energy; The Economics of Renewable Energy Supply; Economics of Bio-fuels

4. Energy Demand Analysis Using the Econometric Approach

Energy Demand Analysis at a Disaggregated Level; Sectoral Energy Accounting; Energy Demand Analysis – Industries, Transport, Residential and Commercial Sectors

5. Environmental Implications of Energy

Energy–Environment Interactions; Climate Change and Environmental Kuznets Curve; The Clean Development Mechanism

Books

- Tietenberg, T. *Environmental and Natural Resource Economics*, seventh edition, Addison Wesley, 2006
- Munasinghe, M. and P. Meier, *Energy Policy Analysis and Modelling*. U.K.: Cambridge University Press, 1993.
- Ristinen, R. and J. Kraushaar, *Energy and the Environment*, John Wiley and Sons, 1998.

EE: 16 SUSTAINABLE DEVELOPMENT

1. Introduction

Need for studying the economics of sustainable development; meaning of sustainable development – Comparison with static and dynamic economic efficiency; Weak *versus* strong sustainability

2. Valuing Market and Non-market Ecosystem and Social Services

Uses of monetary valuation; Cost-benefit analysis; Techniques of monetary valuation – recap; Applications

3. Measuring Sustainable Development

Defining conventional gross net product (GNP); modifying GNP for missing (non-market) values – Green GNP; genuine savings; critical capital concerns and strong sustainability

4. Sustainable Development – Ecological Economics

Precautionary Principle; biodiversity and precautionary principle; economic growth and natural carrying capacity

5. Sustainable Development – Visions, Principles, and Operational Rules

Sustainable Development Indicators; Neoclassical economic growth and sustainability; social capital, community sustainability and environmental justice; trans-boundary environmental degradation; global economic integration and environment

Books

- Pearce, D. and E. Barbier, *Blueprint for a Sustainable Economy*, Earthscan, 2000.
- Daly, H.E., *Beyond Growth: The Economics of Sustainable Development*, Beacon Press, 1996.
- Rogers, P. K.F. Jalal and J.A. Boyd, *An Introduction to Sustainable Development*, Earthscan, 2008
- Deb, D. *Beyond Developmentality: Constructing Inclusive Freedom and Sustainability*, Daanish Books, 2009
- Sengupta, R. (2012), *Ecological Limits and Economic Development*, Oxford University Press, Delhi
- Murty, M.N. (2009), *Environment, Sustainable Development, and Well-being: Valuation, Taxes and Incentives*, Oxford University Press, Delhi
- UNU-HIS, UNEP, *Inclusive Wealth Report 2012: Measuring Progress Towards Sustainability*, Cambridge University Press, 2012

EE:17 ECOLOGICAL ECONOMICS

1. Principles of Ecological Economics

Economy *versus* ecology – an inevitable conflict?; green critique of economic orthodoxy; reconstructing economics – the role of ecology and thermodynamics; entropy – a unifying concept for ecological economics; use of entropy in ecological economics

2. Conceptual Foundations of Ecological Economics

Evolution in biology, physics and economics – a conceptual analysis; interdisciplinary research between economists and physical scientists – retrospect and prospect;

3. Integrating Ecology and Economics

Economic agent as a biological species; human economy as a subset of global ecosystem; natural capital as a factor of production; human economy, non-human economy, competitive exclusion; the limits to growth debate – technological progress, economic carrying capacity, biodiversity conservation; ecological integrity and ecosystem health

4. Alternatives to Conventional Economic Growth

Principles of industrial ecology and biomimicry; towards economics of zero and negative growth; Hermand Daly and the steady state economy; Maslow's hierarchy of needs and the steady state revolution

5. Policy Issues

Ecological footprint – global and regional trends; ethics and ecology – intergenerational issues; green economic policy; international case studies – the US, European Union countries, China and India

Books

- Daly, H.E., *Beyond Growth: The Economics of Sustainable Development*, Beacon Press, 1996.
- Daly, H. E., and J. Farley, *Ecological economics: principles and applications*. Island Press, 2003.
- Faber, M., R. Manstetten and J. Proops, *Ecological Economics: Concepts and Methods*, Edward Elgar, 1996.
- Deb, D. *Beyond Developmentality: Constructing Inclusive Freedom and Sustainability*, Daanish Books, 2009
- Sengupta, R. (2012), *Ecological Limits and Economic Development*, Oxford University Press, Delhi

EE:18 TRADE AND ENVIRONMENT

1. Introduction

Impact of trade on environment and environment on trade; globalization and trade-and-environment debate; pollution in a small open economy; scale, composition, and technology effects; endogenous pollution policy

2. Trade and Effects on South

Equilibrium pollution and Environmental Kuznet's curve – income and threshold effects; increasing returns to abatement; pollution havens models of international trade; free trade *versus* environment – empirical assessment; case studies: effects of environmental regulations on oil exporting countries

3. Trade in Endangered Species and Hazardous Waste

Bio-prospecting; CITES – non-compliance; trade in genetic resources; recycling and trade of hazardous material; international treaties governing hazardous waste trade; case studies

4. Trade in Emissions

Tradable permits for emission reduction – theory; sulphur trading and the US experience; carbon markets – the European and the US experience; European ETS – general framework, allocation rules and emission reduction; carbon price signals from the European ETS; clean development mechanism and emerging trading units

5. Trade Laws

Regional agreements; international trade regimes – WTO; leading issues in the WTO negotiations; dispute settlement mechanisms; trade and foreign direct investment

Books

- Copeland, B.R. and M.S. Taylor, *Trade and the Environment: Theory and Evidence*, Princeton University Press, 2005.
- Hunter, D., J. Salzman, and D. Zaelke, *International Environmental Law and Policy*, Foundation Press, 2006
- *Environment and Trade: A Handbook*, Second Edition. International Institute for Sustainable Development, 2005.
- Reeve, R., *Policing International Trade in Endangered Species: The CITES Treaty and Compliance*, Royal Institute of International Affairs, 2004

EE:19 ENVIRONMENT AND HEALTH

1. Introduction

Review of market failures; statistical value of life and health – empirical estimates of statistical value of life; disability adjusted life years

2. Environmental Effects on Health

Health production function; exposure, dose and response; indoor and outdoor air pollution; effects of air pollution on children, adults; effects of climate variability and climate change on mortality and morbidity; environmental toxicology; environmental carcinogenesis; water-borne diseases; municipal, industrial and hazardous waste – health implications

3. Medical Production of Health

Individual as producer of health; characteristics of health services and production; design of health-related insurances; role of the physician as a producer of health; healthcare organisation and funding; effects of health care expenditure on health; market for pharmaceuticals

4. Market Failure in the Provision of Health Care

Adverse selection in insurance markets; moral hazards, externalities, and other market failures in health care; problems of risk and uncertainty; unequal information; imperfect competition; equality in health care

5. Health and Environmental Policy – Inter-linkages

Global policy initiatives: Earth Summit – social, economic and environmental pillars for sustainable development; UN Millennium Development goals – environment and health linkages; national environmental and health action plans – case studies from developing countries in Africa and Asia

Books

- Yassi, A., T. Kiellstrom, T. de Kok, and T.L. Guidotti, *Basic Environmental Health*, Oxford University Press, 2001
- Phelps, C. *Health Economics*, 4th edition, Pearson Education, 2009
- Nadakavukaren, A. *Our Global Environment: A Health Perspective*, Waveland Press, 2005.
- Holgate, S.T., Maynard, R.L. and Koren, H.S., *Air Pollution and Health*, Academic Press, 1999.
- Ramani, K.V., D. Mavalankar, and D. Govil (2008), *Strategic Issues and Challenges in Health Management*, Sage Publications, New Delhi

EE:20 ECONOMICS OF GLOBAL CLIMATE CHANGE

1. Introduction

Science of climate change; global and regional climate predictions; uncertainty in science; physical impacts of climate change – agriculture, sea level rise, health, extreme events; policy debate

2. Climate Change Policy - Mitigation

Efficiency, public goods, externalities; environmental policy instruments – emissions trading, carbon tax, emission trading *versus* tax; stock pollutants and discounting; decisions under risk and uncertainty;

3. Integrated Assessment

Costs and benefits of greenhouse gas mitigation; integrated assessment models; simulation exercises based on DICE model and its variants; sensitivity and uncertainty analysis; Stern review

4. Climate Change Policy - Adaptation

Climate change impact assessment – applications for agriculture, sea level rise and health; vulnerability assessment; economics of adaptation; measurement of adaptation cost; issues in financing adaptation; case studies

5. Climate Change Negotiations and Equity

Criteria for distribution of emission reduction burden; distribution criteria for adaptation fund; inter and intra-generational equity issues; discounting in climate change context

Books

- Perman, R., Ma. Y., Common, M., Maddison, D., Mcgilvray, J., Natural Resource and Environmental Economics, Pearson Education Limited, 2011 (4th Edition).
- Intergovernmental Panel on Climate Change – Fifth Assessment Report, 2011
- Stern, N., *The economics of climate change – The Stern Review*, Cambridge University Press, 2006.
- Nordhaus, W.D., *Managing the Global Commons: The Economics of Climate Change*, MIT Press, 1994.
- Nordhaus, W. and J. Boyer, *Warming the World: Economic Models of Global Warming*, MIT Press, 2003.
- Toman, M.A., U. Chakravorty, and S. Gupta, *India and Global Climate Change: Perspectives on Economics and Policy from a Developing Country*, RFF Press, 2003.
- Nordhaus, W. (2008), *A Question of Balance: Weighing the Options on Global Warming Policies*, Yale University Press, New Haven