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
### Applied Quantitative Finance - Core Courses

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
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<tbody>
<tr>
<td><strong>First Semester</strong></td>
<td>Microeconomics I</td>
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<td>Macroeconomics I</td>
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<td></td>
<td>Statistical Methods</td>
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<td></td>
<td>Mathematical methods</td>
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<td><strong>Second Semester</strong></td>
<td>Microeconomics II</td>
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<td>Econometric Methods</td>
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<td>Financial Economics I</td>
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<td><strong>Third Semester</strong></td>
<td>Applied Macro and Financial Econometrics</td>
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<td>Risk Analysis and Management</td>
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<td>Elective 1</td>
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<td>Elective 2</td>
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<td>Elective 3</td>
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<td><strong>Fourth Semester</strong></td>
<td>Financial Instruments and Markets</td>
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<td>Interest rate Calculation and Option Pricing</td>
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<td></td>
<td>Elective 3</td>
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<td>Elective 4</td>
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*Elective 3 Dissertation instead of electives 3 & 4 worth 8 credits*
### Electives for Semester III

<table>
<thead>
<tr>
<th>Course</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Agricultural Economics</td>
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<tr>
<td>Applied Macro and Financial Econometrics [C] {for GE, AE and EE}</td>
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<tr>
<td>Applied Econometrics [C] {for FE and AQF}</td>
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<tr>
<td>Economics of Insurance I [C]</td>
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<tr>
<td>Energy, Economics and Environment</td>
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<tr>
<td>Environmental Valuation [C]</td>
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<tr>
<td>Environment and Health</td>
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<tr>
<td>Financial Economics II (Pre-requisite Financial Economics I)</td>
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<tr>
<td>Financial Regulation and Banking Supervision</td>
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<tr>
<td>Fixed Income Securities</td>
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<td>Games and Information</td>
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<td>Health Economics</td>
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<td>Industrial Development and Industrial Organization</td>
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<td>Investment Banking</td>
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<tr>
<td>Programming and Computational Languages</td>
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<tr>
<td>Risk Analysis and Management [C]</td>
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<tr>
<td>International Trade &amp; Finance</td>
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<tr>
<td>Stochastic Models</td>
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</tbody>
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**Note:**

1. All Core and elective courses are worth 4 credits each.
2. Total credits = 68 for all programmes
3. ‘C’ Stands for core course for some streams which are allowed as electives for other streams
## Electives for Semester IV

<table>
<thead>
<tr>
<th>Course</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Advanced Technique in Finance</td>
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<tr>
<td>Economics of Global Climate Change</td>
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<tr>
<td>Economics of Insurance II (Pre-requisite Econ of Insurance I) [C]</td>
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<tr>
<td>Empirical Methods in Finance</td>
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<tr>
<td>Environmental Policy [C]</td>
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<tr>
<td>Finance and Financial Reporting [C]</td>
<td></td>
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<tr>
<td>Financial Instruments and Markets [C]</td>
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<tr>
<td>Financial Market Microstructure</td>
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<tr>
<td>Financial Regulation and Banking Supervision</td>
<td></td>
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<tr>
<td>Interest Rate Calculation and Option Pricing [C]</td>
<td></td>
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<tr>
<td>International Finance [C]</td>
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<tr>
<td>Macroeconomics II [for FE and AQF]</td>
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<tr>
<td>Microeconomics II [for AE]</td>
<td></td>
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<tr>
<td>Multinational Enterprises and Industrial Policy</td>
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<tr>
<td>Agricultural Development &amp; Policy</td>
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<tr>
<td>Regional Economics</td>
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<tr>
<td>Risk Management - Theory and Practice [C] [C]</td>
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<tr>
<td>Risk Model</td>
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<tr>
<td>Survival Model</td>
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<tr>
<td>Sustainable Development [C]</td>
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</tbody>
</table>

**Note:**
1. All Core and elective courses are worth 4 credits each.
2. Total credits = 68 for all programmes
3. ‘C’ Stands for core course for some streams which are allowed as electives for other streams
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

Review Books
- Nicholson, W., Microeconomic Theory: Basic Principles and Extensions, eighth edition, South Western Thomson Learning, 2002
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

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
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:**

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, macroeconomic 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**
- Recent research papers in Microeconomics will be discussed
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
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:

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:


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

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
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 tress, 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**

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
(component to be included)

Books
- 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 UNIVARAITE 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

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 $Z=\{\ldots,-2,-1,0,1,2,\ldots\}$ and on $\{0,1,2,\ldots,b\}$; 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
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**

Smother 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**

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

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**

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 Propogation**

   Back Propogation, 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**

- Gurney, K., *An Introduction to Neural Networks*, Routledge, 1997
- McNelis, P.D., Neural Networks in Finance, Academic Press, 2005
1. 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-Schole's theory and applications, Put-call parity, Implied volatility, Exchange options, Currency options, American options, Sensitivity analysis (Greeks)

4. Interest rate models and derivatives

5. Further option theory

Books
- Shreve S.E.: Stochastic calculas for finance volume 2-continuos time models, springer Verlag 2004
- J.C. Hull and SankarShan Basu: Options, futures and other derivatives- Prentice Hall 2010
- David Apple Baum: Levy processes and stochastic calculus- Cambridge university press 2004
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 prospective, Allais and Elsberg’s paradoxes, rationality from an economics and evolutionary prospective, 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


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 externals 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
