

**CENTRAL UNIVERSITY OF TAMIL
NADU, TIRUVARUR**

**DETAILED SYLLABI AND CURRICULUM
OF
M.Sc. ACTUARIAL ECONOMICS
Post Graduate Degree (a Two Year Full time)
Programme to be offered at
MADRAS SCHOOL OF ECONOMICS**

Eligibility for Admission

Any graduate of a recognized University with a minimum of 55% marks(50% for OBC-Non Creamy Layer; and 45% for SC/ST candidates) and Mathematics at plus two level. Admission will be based on common entrance test.

**Other Regulations as per M.Sc. Regulations for Post-Graduate
Programmes of Central University of Tamil Nadu**

April 2012

M.Sc. ACTUARIAL ECONOMICS

The post-graduate degree in actuarial economics (M.Sc.-AE) is a two-year intensive course, providing necessary training needed for an expert in actuarial field who analyzes the financial consequences of risk. Such experts can work, apart from education and research, in insurance companies, consulting/investment firms, credit rating agencies, government, and employee benefit department of large corporations, hospitals, and banks. The work profile includes (i) research and training, (ii) designing insurance and pension plans, (iii) determining insurance pricing, and (iv) asset-liability management.

In recent years, there has been a significant change in the global financial industries, which have led to an enormous expansion in the financial sectors of many countries, including India. One of the most significant developments has been the privatization and large-scale expansion of insurance industry, which has led to an increased demand for actuaries. The Insurance Regulatory and Development Authority (IRDA) mandates that life insurance companies must have at least one appointed actuary while the general insurers can meet their actuarial needs with the help of consultants.

This course is designed keeping in view the increasing demand for actuarial economists. Hence, it is designed essentially to deal with the education of economics of insurance, insurance risk, and financial management. In the process, the course draws inputs from mathematical, statistical, and economic analysis involving a wide range of decision-making process in insurance, investment, and financial planning and management.

Being designed to equip the learners with the underlying processes of decision making under uncertainty, this programme seeks to offer in the first year, comprising two semesters, an intensive training in understanding economic and financial theories, which are useful to study the uncertain future events and will sufficiently cover the latest syllabi prescribed for the Core Technical stage by the Actuarial Society of India (ASI). The third and the fourth semesters attempt to provide the opportunity to the students to opt for electives from the number of choices including applied econometrics. In addition, this program provides a valuable opportunity to the students to (i) equip their computation skills by learning econometric applications using soft wares (such as EVIEWS and STATA) and (ii) undertake a dissertation in the final semester to encourage active learning in a real life situation.

M.Sc. (ACTUARIAL ECONOMICS)

SEMESTER 1

Course Code	Course Name	C
<u>AE:01</u>	Microeconomics	4
<u>AE:02</u>	Macroeconomics	4
<u>AE:03</u>	Statistical Methods	4
<u>AE:04</u>	Mathematical Methods	4

SEMESTER 2

Course Code	Course Name	C
<u>AE:05</u>	Financial Mathematics	4
<u>AE:06</u>	Actuarial Mathematics	4
<u>AE:07</u>	Econometric Methods	4
<u>AE:08</u>	Financial Economics I	4

SEMESTER 3

Course Code	Course Name	C
<u>AE:09</u>	Applied Econometrics	4
<u>AE:10</u>	Risk Models	4
<u>AE:11</u>	Stochastic Models	4
<u>AE:12</u>	Financial Economics II	4
<u>AE:13</u>	Economics of Insurance I	4
<u>AE:14</u>	Fixed Income Securities	4
<u>AE:15</u>	Advanced Techniques in Finance	4
<u>AE:P1</u>	Project Work (Phase I)	2

Courses listed under AE11 to AE15 are optional courses. Students need to take any two out of the five offered courses.

SEMESTER 4

Course Code	Course Name	C
<u>AE:16</u>	Finance and Financial Reporting	4
<u>AE:17</u>	Health Economics	4
<u>AE:18</u>	Survival Models	4
<u>AE:19</u>	Environment and Health	4
<u>AE:20</u>	Public Economics	4
<u>AE:21</u>	Economics of Insurance II	4
<u>AE:P2</u>	Project Work (Phase II)	6

Courses listed under AE17 to AE21 are optional courses. Students need to take any two out of the five offered courses.

C-Credit,

Total Credits: 68

CURRICULUM 2010 FOR FULL-TIME MODE FOUR SEMESTERS DETAILED SYLLABUS

SEMESTER 1

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 – monopolistic competition and oligopoly, sources of monopoly power, monopoly market equilibrium, price discrimination – first, second and third degree, tax-incidence

Books

- Varian, H. R., *Microeconomic Analysis*, third edition, W.W. Norton and Co., 1992
- Nicholson, W., *Microeconomic Theory: Basic Principles and Extensions*, eighth edition, South Western Thomson Learning, 2002
- Henderson, M. and R.E. Quandt, *Microeconomic Theory: Mathematical Approach*, McGraw Hill, 1980
- Pindyck, R.S. and D.L. Rubinfeld, *Microeconomics*, fifth edition, Prentice Hall, 2004

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 STATISTICAL METHODS

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. Theory of Probability Distribution

Discrete versus continuous distribution, uniform, binomial, negative binomial, Poisson, geometric and hyper-geometric, normal, log-normal, exponential, gamma and beta distribution, characteristic function and moment generating function

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

4. Theory of Estimation

Point and interval estimation, properties of good estimators: unbiasedness, consistency, efficiency, different methods of estimation, maximum likelihood and method of moment estimation, properties of maximum likelihood and method of moment estimators, confidence interval for unknown parameters

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, Neyman-Pearson lemma, trinity of classical tests (Wald test, Lagrange multiplier, likelihood ratio), application of hypothesis testing with known and unknown variances, Chi-square test for testing independence of two-classification criteria, test for correlation

Books

- Mood, A. M., R. A. Graybill and R.C. Boes, *Introduction to the Theory of Statistics*, McGraw-Hill, 1974
- Hogg, R. and A. Craig, *Introduction to Mathematical Statistics*, McGraw-Hill, 1965
- Miller, I. and M. Miller, *Mathematical Statistics*, sixth edition, Prentice Hall International, 1999
- Goon Gupta and Das Gupta, *Fundamentals of Statistics*, fifth edition, The World Press, 1986

AE:04 MATHEMATICAL METHODS

1. 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

2. Differential Calculus

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

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. Dynamic Models

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, optimal control theory and Hamiltonians; present and current value Hamiltonians, applications from economics and finance

Books:

- Simon, C. and L. Blume, *Mathematics for Economists*, Norton, London, 1994
- Chiang, A. C., *Fundamental Methods of Mathematical Economics*, McGraw-Hill, 1984
- Sydsaeter, K. and P. J. Hammond, *Mathematics for Economic Analysis*, Pearson Education Asia, 1995
- Intriligator, M.D., *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

Second Semester

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. Regression Analysis

Linear regression model, two variables and multi variables, BLUE property, general and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, matrix approach to linear regression models

2. Extension of Linear Regression Models

Consequences and detection of multicollinearity, heteroskedasticity, and autocorrelation; and remedial measures

3. Dummy Variables

Regression on qualitative and quantitative variables, dummy variable trap, structural stability of regression models, Chow test, piecewise linear regression model

4. Simultaneous Equation Models

Simultaneity bias, structural versus reduced form, identification: rank versus order condition, exact and over identifications, triangular model, methods of estimation including indirect least squares, two-stage least squares and three-stage least squares, LIML and FIML

5. Distributed Lag Models

Formation of expectations, naïve expectation versus adaptive expectations models, partial adjustment models, distributed lag models; Koyck's model, Almon lag, polynomial distributed lag models, end point restriction, rational expectations models

Books

- Wooldridge, J., *Introductory Econometrics: A Modern Approach*, South-Western
- Ramanathan, R., *Introductory Econometrics with applications*, fifth edition, Thomson Asia Private Limited, 2002
- Gujarati, N.D., *Basic Econometrics*, fourth edition, McGraw Hill, 2003
- Johnston, J., *Econometric Methods*, third edition, McGraw Hill
- Brooks, C., *Introductory Econometrics for Finance*, first edition, Cambridge University Press, 2003

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. 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, semi-variance of return, shortfall probabilities

3. 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, portfolio weights

4. Index Models, CAPM & APT

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

5. Fixed Income Securities

Bond prices, spot prices, discount factors, and arbitrage, forward rates and yield-to-maturity, Price sensitivity, Hedging

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

Third Semester

AE:09 APPLIED ECONOMETRICS

1. Stationary Time Series

Autocorrelation and partial autocorrelation, auto regressive and moving average models, conditions for stationary and invertible process, Box-Jenkins approach, forecasting, permanent versus temporary abruption, simple exponential smoothing and choice of parameter, seasonal models with trend, seasonal decomposition

2. Nonstationary Time Series and Volatility

Integrated process and random walk, unit root, testing for unit root, introduction to cointegration, Engle Granger method and Johansen test, error correction model, vector auto regressive model, impulse response function, variance decomposition, forecasting; volatility clustering, leverage effect, ARCH model, GARCH model and its various extension, multivariate GARCH modelling, forecasting

3. Limited Dependent Variable Models

Introduction to binary variables, limitation of LPM, logistic curve, Probit and Logit models, predicted probabilities, censored versus truncation, TOBIT model, ordinal models, multinomial models, and nested models

4. Panel data Models

Introduction to panel data, pooled model, within and between estimators, fixed effects, random effects, Hausman test, one way and two way model, random coefficients, dynamic panel data models, difference in difference methodology and dynamic panel data, generalised method of moments estimator

5. Production Function and Demand Estimation

Relationship among production, cost and profit functions, specification, estimation and applications; frontier production functions: DEA and SFA, measurement of multifactor productivity, Engel curves, complete demand models; general and particular restrictions on demand functions, estimation and applications of complete demand systems

Books

- Hamilton, J. D., *Time Series Analysis*, Princeton University Press, 1994
- Enders, W., *Applied Econometric Time Series*, second edition, John Wiley and Sons, 2006
- Wooldridge, J. M., *Econometric Analysis of Cross Section and Panel Data*, MIT Press, 2001
- Greene, W.H. *Econometric Analysis*, fifth edition, Pearson Education Inc., 2003
- Coelli, T., D.S. Prasada Rao, and G. E. Battese, *An Introduction to Efficiency and Productivity Analysis*, Kluwer Academic Publishers, 1997

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 Zehnwirth, *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 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:13 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

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

AE:14 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: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

AE:16 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 rate 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:17 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:18 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: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, doses 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:20 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

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

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

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

Books

- Atkinson, A. and Stiglitz, J., *Lectures in Public Economics*, McGraw Hill, 1980
- Auerbach, 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:21 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

AE: P Project Work (2+6= 8 Credits)

Students need a project work in the third semester (2 credits) and in the fourth semester (6 credits).