

M.Sc. Statistics

Note: Students have to choose elective subjects either STA660E (Quality Control and Reliability) and MTH660E (Optimization) or ECN653C (Economics) and STA660E (Principles of Insurance).

Course Title	: Contingencies	Semester-4th
Course Code	: STA651C	
Credit hrs.	: 4	

Course Objective: Introduces the students the mathematical techniques which can be used to model and value cash flows dependent on death, survival, or other uncertain risks and also help to calculate premium and reserve for the insurance company.

Unit-I: Introduction to life Insurance; traditional and variable insurance, contract design, 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

Unit-II: Joint life status, last survival status, their distribution and density functions, analytical laws of mortality such as Gompertz and Makeham, single and multiple decrement life table, select and ultimate life table.

Unit-III: Assurance and annuity contracts with level and varying benefits, formulae for the means and variances of the present value random variables of the payments under these contracts under the assumption of constant force of interest, in discrete and continuous set up.

Unit-IV: Net premiums for insurance products and annuity schemes defined in (3), gross premiums. Concept of reserve, prospective & retrospective approach.

References:

- Bowers, JR. N.L., Gerber, H.U., Hickman, J.C., Jones, D.A. and Nesbitt, C.J. (1997). Actuarial Mathematics, Second Edition, The Society of Actuaries. Sahaumburg, Illinois.
- Palande, P. S., Shah, R. S. and Lunawat, M. L.(2003). Insurance in India – Changing Policies and Emerging Opportunities, Response Books, New Delhi.
- Harriett, E.J. and Dani, L.L.(1999).Principles of Insurance: Life,Health, and Annuities,Second Edition, Life Office Management Association, Inc. Atlanta, Georgia. 8
- Neill, Alistair (1977). Life Contingencies, The Institute of Actuaries, London.
- Gerber, H.U.(1997) Life Insurance Mathematics,3/e Springer, Swiss Association of Actuaries
- Shailja R Deshmukh (2009) Actuarial Statistics using R, University Press.

M.Sc. Statistics (Actuarial)

Course Title	: Financial Derivatives	Semester-4th
Course Code	: STA652C	
Credit hrs.	: 4	

Course Objective: Introduces the students regarding the fundamentals of financial derivatives. The students' will also get overview of stock markets and trading strategies involving options.

Unit I: - Types of Options, Option positions, Underlying Assets , Specification of stock options, Stock option pricing, Factors affecting option prices , Upper and lower bounds for option prices. Trading strategies involving options, Binomial model: One-step and two-step models, Binomial trees. Risk neutral valuation.

Unit II: Brownian Motion, Arithmetic and Geometric Brownian motion, Markov property of Brownian Motion, Ito Lemma, Ito integral, Applying Ito Lemma.

Unit III: Black-Scholes model: Distribution of rate of returns, volatility, risk neutral pricing, Discrete and Continuous Martingale pricing. Idea underlying the Black-Scholes-Merton differential equation. Estimating volatility, the exponential weighted moving average models

Unit IV: Value at Risk (Var), The GARCH(1,1) models, Maximum likelihood methods , Greek Letters and hedging. Interest rate derivatives, Black model

References:

- Hull John C. and Basu S. (2010) Options, Futures and Other derivatives, 3rd Prentice hall of India Private Ltd., New Delhi.
- Sheldon M Ross (2005): An elementary Introduction to Mathematical Finance, Cambridge University Press.
- Joshi M.S. (2010): The Concept and Practice of Mathematical Finance, Cambridge University Press.
- Shreve Steven E.(2009) Stochastic Calculus for Finance I: The Binomial Asset Pricing models, Springer

M.Sc. Statistics (Actuarial)

Course Title	: Quality Control and Reliability	Semester-4th
Course Code	: STA660E	
Credit hrs.	: 4	

Course objective: The course will give knowledge in statistical quality control with regards to maintain statistical quality in engineering or industrial set up. The students will be able to understand the theory of control charts, sampling plans and process capability indices is the basis for judging whether the process is in statistical control or not.

UNIT-I:

Meaning and scope of SQC, Stewarts control chart, Statistical basis of a control chart, control chart for variables (X, R, & S) charts. Control charts for attributes (np, p & C) charts. Moving average charts. Operating Characteristic function (OC) and Average Run length (ARL) of X-bar chart.

UNIT-II:

Consumer and producer's risk, Operating Characteristic curve/function (OC). Corrective Sampling Plan (CSP), Average Sample Number (ASN), Average out-going Quality (AOQ), Graphical method of drawing AOQ, Average out-going Quality Limit (AOQL), Single Sampling Plan, Methods of finding n and c, Double Sampling Inspection Plan and sequential sampling plan.

UNIT-III:

Capability indices Cp, Cpk and Cpm. estimation, confidence intervals relating to capability indices for normally distributed characteristics. Reliability concepts, hazard rate, distribution of longevity and moments. Some important theorems based on reliability theory.

UNIT-IV:

Common life time distributions: exponential, Weibull, gamma, Gumbel and Rayleigh distributions. Type I and Type II censored samples. Reliability and hazard rate of a system with independent units connected in (a) series and (b) Parallel systems.

TEXT BOOKS:

- Barlow, R.E. and Proschan, F. (1985). Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston
- Biswas, S.(1996). Statistical Quality Control, Sampling Inspection and Reliability; New Age International Publishers.
- Montgomery, D.C. (1985) Introduction to Statistical Quality Control; Wiley
- Ott, E.R. (1975) Process Quality Control; McGraw hill
- Phadke, M.S. (1989) Quality Engineering through Robust Design; Prentice Hall
- Wetherill, G.B. (1977) Sampling Inspection and Quality Control; Halsted Press

M.Sc. Statistics (Actuarial)

Course Title : **Optimization**
Course Code : **MTH660E**
Credit hrs. : **4**

Semester-4th

Course Objective: The aim of the course is to give knowledge to students to use quantitative methods and techniques for effective decisions-making; model formulation and applications that are used in solving business decision problems.

UNIT-I:

Linear programming; concept and uses of linear programming, formulation of linear programming problem. Solution of LP problem- graphical method, simplex method. Duality in linear programming, properties of the primal-dual pair- Dual simplex method. Complementary slackness theorem and complementary slackness conditions.

UNIT II: Transportation and Assignment problems: Formulation of transportation and assignment problems as linear programs. Methods of obtaining the initial basic feasible solution to a transportation problem. Solution of the Transportation problem by MODI Method. Unbalanced transportation problems and their solutions. Degeneracy in Transportation problem and its resolution. Solution of Assignment Problem by Hungarian Method.

UNIT III: Sequencing problems- problems with n jobs and 2 machines, problems with n jobs and k machines. Games and Strategies: Two person zero-sum games, Maximin-Minimax Principle, Mixed Strategies, Solution of 2×2 and $m \times n$ games.

Concept of PERT/CPM networks, estimating the activity time, determination of earliest expected and latest allowable times, determination of critical path Drawing network diagram, probability consideration in PERT networks PERT/CPM- cost analysis, applications of PERT/CPM.

UNIT IV: Queuing models-specifications and effectiveness measures. Steady state solutions and M/M/C models with associated distributions of queue length and waiting time, M/G/1 queue, State solutions of M/E_k/1 and E_k/M/1, Machine inference problems, Transient solution of M/M/C.

Books Recommended:

- Gass, S.I.: Linear Programming-Methods & Applications.
- Hillier & Liberman: Introduction to Operations Research, Mc. Graw Hill Book Co.
- Taha, H.A.: Operations Research-An introduction, Pentice Hall of India Pvt. Ltd. New Delhi. (7th Edition-2003)
- Swaroop K, Gupta, P.K. & Mohan, M.: Operations Research, Sultan Chand & Sons, New Delhi.
- Vohra, N D: 'Quantitative Techniques in Management' Tata McGraw Hill
- Sharma S.D.: 'Operational Research', Kedar Nath Ram Nath and Co., Meerut
- Kothari C R: 'Quantitative Techniques' Vikas Publishing House.
- Bierman, H., C.P. Bonini & W.H. Hausman: 'Quantitative Analysis for Business Decisions, Homewood, Illions: Rechard D, Irwin Inc.
- Gordon, R.L. and I. Pressman: 'Quantitative Decisions making for Business', Prentice Hall Inc.
- Kwas, N.K.: 'Mathematical Programming with Business Applications', McGraw Hill, New York.

M.Sc. Statistics (Actuarial)

Course Title : **Economics**
Course Code : ECN653C
Credit hrs. : **4**

Semester-4th

Course Objective: To understand the concepts of cost, nature of production and its relationship to business operations.

Unit-1: Interaction between supply and demand, elasticity and its calculation. Utility theory, utility function, risk aversion, dominance and its various types, its applications to insurance problems. Cost and revenue, profit maximization.

Unit-II: Different sorts of markets. Microeconomic principles to understand markets, competitive firm, long run costs game theory, surplus economics.

Unit-III: Public Sector finances direct and indirect taxes. Progressive and regressive systems of taxation, revenue and expenditure of the government's Debt Repayment and National Debt. National income: GDP, GNP, NNP, Effects of propensity to save or to consume by public or private sector on national income.

Unit-IV: Fiscal and monetary policies, government interventions, banking system, Exchange rates, international trade and BoP. Factors affecting inflation, interest rates, exchange rates, unemployment and growth.

References:

- Begg, D., Ficher, S. and Dornbusch,R.(2005). Economics, 7th edition McGraw Hill.
- Sloman, J. and Hinde, K. (2007): Economics for Business, 4th edition, Prentice Hall
- A.Nag, (2004) Macroeconomics for Management Students, Macmillan Publishers India Limited
- Institute of Actuaries core reading material for *CT7.Economics (2013)*.

M.Sc. Statistics (Actuarial)

Course Title	:	Principles of Insurance	Semester-4th
Course Code	:	STA660E	
Credit hrs.	:	4	

Course Objective: Introduces the students to understand the insurance mechanism and to identify the relationship between insurers and their customers.

Unit I: The concept of risk, kinds and classification of risk, assessment, transfer risk, appraisal risk selection, underwriting risk appraisal, Mortality tables, physical and moral hazards, representations, warranties, conditions.

Unit II: The business of insurance-risk managed by individuals, risk managed by insurers, premium fixing, reinsurance and its important role of insurance in economic development, the insurance market, role of intermediaries, specialists regulators.

Unit III: Insurance customers, types of customers, customer mindset and customer satisfaction, importance of ethical behaviour

Unit IV: Basic principles of Insurance, utmost good faith, insurable Interest- material facts, economic principles of Insurance Sharing, Subrogation, contribution, Legal principles of Insurance, Actuarial principles.

Unit V: Insurance terminology-terms that are specific to life insurance, traditional product offered by life insurance companies, features of MODULE linked policies, features of annuities and group policies, Insurance terminology specific to general insurance, products offered by non-life insurance companies.

References:

- Neelam C Gulati “Principles of Insurance Management” (2007). Excel Books, New Delhi.
- Harriett E Jones “Principles of Insurance “FLMI Insurance Education Program. Life Management Institute LOMA, (Dec 1995).
- Robert I Mehr “Principles of Insurance” Richard Irwin edition, (8th Edition, 1985).
- Ben G Baldwin (2002).The New Life Insurance Investment Advisor” 2nd Edition. Mc Graw Hill.
- Black and Skipper (2000). “Life and Health Insurance”, Pearson Education

M.Sc. Statistics (Actuarial)

Course Title : **Project/Internship**
Course Code : **STA690C**
Credit hrs. : **5**

Semester-4th