DEPARTMENT OF DEMOGRAPHY

School of Physical and Mathematical Sciences

UNIVERSITY OF KERALA

M. Sc. Programme in Actuarial Science
Syllabus

UNDER CREDIT AND SEMESTER SYSTEM

w.e.f. 2017 Admissions

DEPARTMENT OF DEMOGRAPHY
SCHOOL OF PHYSICAL AND MATHEMATICAL SCIENCE
UNIVERSITY OF KERALA

M.Sc Programme in Actuarial Science

Programme Objectives

- To equip students with a high level of knowledge on the Actuarial theory and practice.
- To enable students to become efficient decision makers when they have to occupy positions where an actuarial expertise and risk theory are an essential component
- To enable students to disseminate acquired knowledge by acting as resource persons for imparting such knowledge to others
- To enthuse students to use such acquired knowledge as a foundation for developing professional skills to promote public interest
- The course also aims to give solid grounding for further intensive studies and research which are now highly in demand in the field of insurance, banking, investment, financial services, risk management, regulatory needs etc.

Structure of the Programme

Sem No	Course Code	Name of the Course	Number of Credits
	Core Course		
I	DAS-C-411	Foundations of Financial Mathematics	4
	DAS-C-412	Business Economics (Micro)	4
	DAS-C-413	Probability and Statistics – Part I	4
	DAS-C-414	Techniques of Demographic Analysis – Part I	4
	Core Course		
II	DAS-C-421	Applications of Financial Mathematics	4
	DAS-C-422	Probability and Statistics – Part II	4
	DAS-C-423	Practical (based on DAS-C-413 and DAS-C-422)	2
	DAS-C-424	Techniques of Demographic Analysis – Part II	4
	Elective Course		
	DAS-E-425	Public Health	2
	Core Course		
III	DAS-C-431	Life and Other Contingencies – Part I	4
	DAS-C-432	Multivariate Analysis and Computer Applications	4
	DAS-C-433	Business Economics (Macro)	4
	DAS-C-434	Principles of Insurance – Life, General and Health	4
	Elective Course		
	DAS-E-435	Research Methodology	2
	DAS-E-436	Business Demography	2
	Core Course		
IV	DAS-C-441	Life and Other Contingencies – Part II	4
	DAS-C-442	Practice of insurance in the Indian context	4
	DAS-E-443	Agriculture Insurance	2
	DAS-D-444	Dissertation	6

DETAILED SYLLABUS

Semester : I
Course Code : DAS-C-411
Course Title : Foundations of Financial Mathematics
Credits : 4

AIM: The course aims to develop a mathematical sense of financial transactions through the applications of various mathematical techniques. The ease of calculations involving compound interest rates and annuity functions should be achieved.

COURSE OBJECTIVE: Objective of the course is to understand financial problems arise from various industrial situations and to apply different techniques to solve them. The arithmetic and problem solving ability will be sharpened. It also enables a student a professional way of approaching a financial problem involve different types of annuities.

COURSE CONTENT

Module I: Introduction to Actuarial Science – main subjects involved in actuarial science- actuarial profession- professional standards and examination-origin and development of the profession- institutions involved- actuarial profession around the world- actuarial profession in India

Module II: Cash Flow Models and Investments – Introduction- cash flow process- examples of cash flow scenarios- a zero-coupon bond- a fixed interest security- an index-linked security- cash on deposit- an equity- an annuity certain- an interest-only loan- a repayment loan (or mortgage)- simple interest- compound interest- present values- simple discount- investing over a period- converting between different effective rates.

Module III: Interest rates – introduction- nominal rate of interest-definition- accumulation factors- principle of consistency- the force of interest- formules for accumulation factor- present values- the basic compound interest fuctions- interest payable pthly- Present Values and Accumulated values using interest rates – introduction, present values of cashflows-discrete cashflows- valuing cashflows- constant interest rates- payment streams- sudden changes in interest rates- interest income

Module IV: Level Annuities and determination of their values- introduction, present values payment made in arrear- payments made in advance- accumulations- continuously payable annuities- annuities payable pthly- present values- accumulations- non-integer values of n-

Module V: Decreasing and increasing annuities including deferred annuities – varying annuities- annual payments- continuously payable annuities- decreasing payments- special cases- irregular payments- sudden changes in interest rates- compound increasing annuities- deferred annuities-annual payments- continuously payable annuities- annuties payable pthly

Module VI: Equations of Value and its applications – introduction- the equation of value and the yield on a transaction- solving for an unknown quantity- solving for the amount of a payment- solving for the timing of a payment- solving for the interest rate- uncertain payment or receipt-probability of a cashflow- higher discount rate.

REFERENCES

- Mark S. Joshi" The Concepts and Practice of Mathematical Finance", Cambridge University Press, 2nd Edition (2008)
- Mc Cutcheon and Scott "Introduction to the Mathematics of Finance", Heinemann Professional Publishing, 1989
- Paul Wilmott, Sam Howison and Jeff Dewynne "The Mathematics of Financial Derivatives" Cambridge University Press, 1995
- Ross S.M "An introduction to Mathematical Finance", Cambridge University Press,( )

Semester : I
Code : DAS-C-412
Course Title: Business Economics (Micro)
Credits : 4

AIM: After completion of the student should be able to comprehend a financial situation of a company with economic point of view. The course is designed to equip the student to practice actuarial concepts in a real business environment.

COURSE OBJECTIVE: The micro economic environment a firm is working is an integral part of actuarial theory and practice. This course covers the basic micro economic theory of demand-supply analysis along with an introduction to financial sector. The course is designed as collection of four modules which are very much interconnected. No previous knowledge is assumed.

COURSE CONTENT

Module I: Relevance of economics to the world of business- Opportunity cost and scarcity and their relevance to economic choice- Core economic concepts involved in choices made by businesses relevant to selection of outputs- inputs- technology- location and competition- Microeconomics and macroeconomics- Workings of competitive markets- The role of the price mechanism in a free market- the behavior of firms and consumers in such markets- Factors that influence the market demand and supply and how market equilibrium quantity and price are achieved- Markets reaction to changes in demand and supply

Module II: Price and income elasticity of demand- Price elasticity of supply- Calculation of elasticities of demand using both original and average quantities- Factors that affect elasticity- Effect of elasticity on the workings of markets in the short and long run- Risk and uncertainty about future market movements- Concept of utility and describe effects consumer's purchasing decisions- The way insurance companies help to reduce or remove risk. moral hazard" and"adverse selection- Simple insurance problems in terms of utility theory

Module III: Production function- costs of production- revenue and the production function and the relationship between inputs and outputs in the short and long run- Average and marginal product- Meaning and measurement of costs and explain how these vary with output in the short and long run- Total- average and marginal costs- Economies of scale and explain the reasons for such economies and how a business can achieve efficiency in selecting the level o its inputs. Revenue and profit and explain how both are influenced by market conditions- Calculate average and marginal revenue- Profit-maximizing output- Shut-down point in the short and long run.

Module IV: Profit maximization under perfect competition and monopoly- The market power of a firm- Features of a market characterized by perfect competition and explain how firms in such markets determine output and price in the short and long run- Emergence of monopolies- its profit maximizing price and output and how much profit a monopolist makes- Barriers to entry in an industry and a contestable market and how these affect a monopolist's profit- Profit maximization under

imperfect competition. Behavior of firms under monopolistic competition and explain type of market only normal profits are made in the long run- Main features of an oligopoly and explain how firms behave in an oligopoly- Competition and collusion of firms in an oligopoly and the strategic decisions of such firms can be explained by game theory.

Module V: Importance of a firm's decisions on product selection and marketing and advertising strategies- Product differentiation- Various marketing strategies that firms can adopt and the elements that could be involved in a marketing strategy effects of advertising and features of a successful advertising campaign. Relationship between growth and profitability- The constraints on a firm's growth and alternative growth strategies- The growth strategy of internal expansion and explain how the firm may pursue vertical integration- product differentiation or diversification to achieve internal expansion.

Module VI: The strategy of merging with, or taking over, other firms- Circumstances a firm might want to form a strategic alliance with other firms- Methods of price determination in practice and factors that affect the ability of a firm to determine its prices- Average cost pricing and price discrimination pricing strategy for multiple products and explain how pricing varies with the stage in the life of a product.

REFERENCES

- Economics for Business. by John Sloman, Kevin Hinde and Dean Garrat, Sixth Edition, Pearson

Semester : I
Course Code : DAS-C-413
Course Title : Probability and Statistics – Part I
Credits : 4

AIM: To develop a clear understanding of basic statistical theory on data management. On completion of the course a student will be able to apply basic analytical tools to a set of data.

COURSE OBJECTIVE: Objective of the course is to have thorough knowledge of elementary probability theory and to understand the basic discrete and continuous distributions and sampling distribution.

COURSE CONTENT

Module I: Descriptive Statistics –Variables- Types of variables- Frequency distribution and graphic representation- Measures of central tendency and dispersion-Moments-Skewness and Kurtosis

Module II: Probability Concepts and Random Variables -Basic concepts- Addition theorem- Multiplication theorem- Conditional probability- Baye's Theorem- Probability Density Function- Distribution Function- Expectations- Moment Generating Function-Cumulant Generating Function and Characteristic Function

Module III: Discrete and Continuous Distributions – Uniform distribution-Binomial- Poisson- Geometric- Exponential- Gamma- Beta and Normal distribution

Module IV: Joint Distributions - Concepts of independence- jointly distributed random variables and conditional distributions and application of generating functions to establish the distribution of linear combinations of independent random variables

Module V: Sampling and Sampling Distributions – Probability and Non-Probability Sampling- different sampling methods- Design effect- Chi-Square- Student's t and F distributions

Module VI: Central limit theorem and its applications

REFERENCES

- Chin Long Chiang "Statistical Methods of Analysis" World Scientific Books, 2003
- Dekking, F.M., Kraaikamp, C., Lopuhaa, H.P., Meester, L.E., "A Modern Introduction to Probability and Statistics" Springer Text Series, 2nd Edition
- Patrick Brocket Arnold Levine Saunders "Statistics and Probability and their applications, College publications, USA
- Gupta S.C, V.K Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons,New Delhi

- Gupta S.C, V.K Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons,New Delhi

Semester : I
Code : DAS-C-414
Course Title: Techniques of Demographic Analysis –Part I
Credits : 4

AIM: The aim of the course is to up to date knowledge of available tools for analyzing demographic data obtained from surveys, census and vital registration systems. This course helps to understand all the mathematical procedures that measure population change and its underlying factors and help in visualizing the future prospects of population growth.

COURSE OBJECTIVE: The objective of learning the course is to have knowledge about sources of demographic data, quality of data and adjustments. Basic measures of fertility and reproduction are explained in order to understand the population dynamics and human reproduction process for the effectiveness of population control programmes and their evaluation. Different measures of nuptiality and techniques for analyzing the marital data in understanding the process of marriage and its dissolution. Migration which forms as an important component of population growth.

COURSE CONTENT

Module I : Introduction: Concepts and Definitions of terms- fertility, mortality- Nuptiality- Migration- Structure of Population: Measures of Age and Sex Composition of the PopulationAge **-** pyramid, Quality of Age data- Errors in demographic data – Whipple's Index, Myer's Index- UN Joint Score Index- Sources of data – Census- Vital Statistics- Sample Surveys- Population registers- Quality of Data – Evaluation and Adjustment of Demographic Data Interpolation and Graduation

Module II : Population Growth: Measures of Population growth – Balancing Equation Arithmetic- Geometric- Exponential, Logistic- Doubling Time- Rates and Ratios – Person years lived- Crude and Specific Rates- Standardization – Direct and Indirect Methods: Components of Rates

Module III: Mortality Measures Introduction- Crude and Specific Rates- standardized/Rates Infant Mortality – Infant Mortality Rate- Neo-natal, mortality rate- Post neonatal mortality- Peri natal mortality- Foetal Death- Morbidity: Prevalence and Incidence Rates- Maternal Mortality

Module IV : Fertility Measures :Introduction- Concepts- Types of Analysis- Period and Cohort Measures - Crude and Specific Rates- Standardised Rates Coale's Fertility indices –Total Fertility Rate- Gross Reproduction Rates- Net Reproduction Rate- Replacement Index

Module V : Measures of Nuptiality – Introduction- Crude Marriage rate- General Marriage rate- Age – Specific Marriage rate- Total Marriage rate- Mean Age at Marriage- Singulate Mean Age at Marriage.

Module VI: Migration and Urbanization- Introduction and Concepts- Measures of Migration- Measures of Urbanization- Degree, Tempo and Concentration- Population and Distribution- Centrality and Hierarchy.-Labour Force- Measures of Dependency – Age and Economic – Work Participation Rates

REFERENCES

- Barclay G W Techniques of Population Analysis, New York, John Wiley and Sons, Inc
- Hinde, Andrew Demographic Methods, London,1998
- Jaffe A J, Hand Book of Statistical Methods for Demographers, Washington, US Govt. Printing Office
- MISRA B D An Introduction to the Study of Population, Madras, Publishing
- Athak, K.B. & F.RAM Techniques of Demographic Analysis, Mumbay, Himalaya publishing house.
- Pollard J H Demographic Techniques Australia, Pengamon Press.
- Preston, Samuel H, Patrick Heuveline and Michel Guillot: Demography – Measuring and Modeling Population Processes.
- Ramakumar R T e c h n i c a l Demography, New Delhi, Wiley Eastern Ltd.
- Shryock, Henry S, Jacob S Seigel and Associates, The Methods and Materials of Demography Vol. 1 & 2, Washington DC US Bureau of the Census.
- SPEEGELMAN M Introduction to Demography Cambridge, Harvard University Press
- Srinivasan K, Basic Demographic Techniques and Applications, New Delhi Sage Publications.

Semester **: II**
Course Code **: DAS-C-421**
Course Title **: Applications of Financial Mathematics**
Credits **: 4**

AIM: The course aims to develop fine understanding of the working and application of advanced financial products like loan, stocks, derivatives, options etc..The ability to apply the concept of randomness in various financial variables like interest rates will be achieved.

COURSE OBJECTIVE: The objective of the course is to compare two projects based on their respective cash flows. A broad description of various higher order financial products and elementary practical compound interest problems will be analysed. The stochastic interest rates and performances of portfolios will be done practically.

COURSE CONTENT

Module I: Analysis of Loan Schedules and EMI – introduction and an example- calculating the capital outstanding-the theory-prospective and retrospective loan calculation- calculating the interest and capital elements- the loan schedule- instalments payable more frequently than annually- consumer credit- flat rates and APRs

Module II: Project Appraisals – introduction, estimating cash flows- fixed interest rates- accumulated value- net present values- internal rate of return- the comparison of two investment projects- different interest rates for lending and borrowing payback periods- other considerations- measurement of investment performance-money-weighted rate of return- time-weighted rate of return- linked internal rate of return

Module III: Some important Compound Interest problems – fixed interest securities-calculating the price- allowing for income tax- calculating yields- the effect of the term to redemption on the price- the effect of the term to redemption on the yield- optional redemption dates- deferred income tax- uncertian income securities-equities-property-real rate of interest- inflation adjusted cashflows- index linked bonds- capital gains tax

Module IV: Spot- forward contracts – Arbitrage – some discussions on derivatives – the "no arbitrage" assumption- forward contracts- calculating the forward price for a security with no income- calculating the forward price for a security with fixed cash income- calculating the forward price for a security with known dividend yield-hedging- the value of a forward contract.

Module V: Interest rates variations related to term structure and their importance – discrete time-discrete time spot rates- discrete time forward rates- instantaneous forward rates- theories of the term structure of interest rates- yield to maturity- par yields- duration- convexity and immunisation.

Module VI: Interest rates variations related to term structure and their importance-

continuous time rates- continuous time spot rates- continuous time forward rates- instantaneous forward rates- theories of the term structure of interest rates- yield to maturity- par yields- duration- convexity and immunisation.

REFERENCES

- Mark S. Joshi " The Concepts and Practice of Mathematical Finance", Cambridge University Press, 2nd Edition (2008)
- Mc Cutcheon and Scott "Introduction to the Mathematics of Finance", HeinemannProfessional Publishing, 1989
- Paul Wilmott, Sam Howison and Jeff Dewynne "The Mathematics of Financial Derivatives" Cambridge University Press, 1995
- Ross S.M " An introduction to Mathematical Finance", Cambridge University Press

Semester : II
Code : DAS-C-422
Course Title : Probability and Statistics – Part II
Credits : 4

AIM: To develop a clear understanding of statistical theory on data management as it is the backbone of actuarial analysis. On completion of the course a student will be able to apply basic analytical tools to a set of data.

COURSE OBJECTIVE: The objective of the course to study and practice the statistical inference, ANOVA and time series analysis.

COURSE CONTENT

Module I: Methods of Estimation and properties of estimators and their applications – the methods of moments- the method of maximum likelihood- unbiasedness- consistency- efficiency- Mean square error- Asymptotic distribution of MLEs

Module II: Confidence Intervals – derivation of confidence intervals- confidence intervals for two-sample problems and interpretations on unknown parameter values

Module III: Testing of Hypothesis – Level of significance- Type one and type two errors- critical region- small sample and large sample tests- testing of hypothesis for mean- variance and proportions and differences- Chi square tests for goodness of fit and independence of attributes

Module IV: Correlation and Regression – Relation between variables- Curve fitting and Principle of test squares, two regression lines- Angle between regression Lines- Pearson coefficient of correlation- Rank Correlation Coefficient- testing of Correlation Coefficient

Module V: Analysis of Variance and their applications - One way classification Two way classification

Module VI: Time Series Analysis – Introduction- Meaning- Uses- Components of Time Series- Measurements of trend- various methods

REFERENCES

- Chin Long Chiang "Statistical Methods of Analysis" World Scientific Books, 2003
- Dekking, F.M., Kraaikamp, C., Lopuhaa, H.P., Meester, L.E., "A Modern Introduction to
- Probability and Statistics" Springer Text Series, 2nd Edition
- Patrick Brocket Arnold Levine Saunders "Statistics and Probability and their applications, College publications, USA
- Gupta S.C, V.K Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, NewDelhi

- Gupta S C, V.K Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, NewDelhi

Semester : II
Course Code : DAS-C-423
Course Title : Practical (based on DAS-C-413 and DAS-C-422)
Credits : 2

AIM: Basic analytic tool the students trained through various courses has to be supplemented with some practice in the lab. It will enable their ability to work with data and practical problems of analysis in an elementary level.

COURSE OBJECTIVE: The objective of the course is to enable the student to take up an actuarial career. The different student will be given a list of problems from various parts of the course material already covered with a set of data. They have to reach possible conclusions and validate the same. The interpretation of their results has particular importance in this course.

COURSE CONTENT

Module I: Questionnaire preparation, Data entry – Data view – variable view- insert variable- insert cases- sort cases- merge files- aggregate files- copy data set- split files- select cases- weight cases.

Module II: Compute variable- count values within cases- record – into same variables- into different variables- automatic record- rank cases- time series creation- replace missing values- random number generators.

Module III: Reports – OLAP cubes- case summaries- report summaries in rows and in columns- Descriptive statistics – frequencies- descriptive- explore- cross tabs- ratios- Q -Q plots- P- P plots- Tables – custom tables- multiple response sets.

Module IV: Parametric tests - Compare Means – Means- one sample t test- independent samples t test- paired-samples t test- one way ANOVA

Module V: Non-parametric tests – Chi square- Binomial- one sample K-S test- two samples tests.

Module VI: Data interpretation and inference- report writing.

Semester : II

Code : DAS-C-424
Course Title : Techniques of Demographic Analysis –Part II
Credits : 4

AIM: The aim of the course is to impart up-to-date knowledge of available tools population estimation and projection. This course helps to understand all the demographic and mathematical procedures that are used in estimation and projection of population.

COURSE OBJECTIVE: The objective of learning the course on population projection is to provide students to carry out population projections independently and apply them in other social sector projections, which is required for the development planning process.

COURSE CONTENT

Module I: Life Table- Concepts- Assumptions- Construction of Life tables-Complete and Abridged

Module II: Various types – Single Decrement Associated Life tables, Double Decrement Life Table-Force of Mortality- Uses of Life Tables.

Module III: Multiple Decrement Life table – Multi State Life table- Applications Nuptiality Tables-Contraceptive Effectiveness-Working Life Tables

Module IV: Structure of Population – Stable, Quasi-stable-Stationary Population- Lotka's Stable Population Theory- Applications – Population Momentums- Reproductive value

Module V: Population Estimation and Projections – Methods of Population estimation and Projection – Mathematical and Cohort Component methods- Assumptions, on fertility- Mortality and Migration

Module VI: Sub-National Population Projections – Various Methods- URDG-Projection of Labour Force- Educational Population

REFERENCES

- Coale A J, The Growth and Structure and Human Population – A Mathematical Investigation : Princeton Univ. Press, Princeton
- Coale A J & Demeny P: Regional Model Life Table and Stable Population : Princeton Univ. Press, Princeton
- Frejka James, Future of Population Growth: Alternate Paths to Equilibrium: John Wiley and Sons, Inc. N.York
- Henry, Louis, Population Analysis and Model: London, Edward Arnold
- Hinde Andrew, Demographic Methods: London, Arnold
- Keyfitz N, Introduction to the Mathematics of Population London, Wesley
- Keyfitz N, Applied Mathematical Demography John Wiley and Sons
- Krishsnan Namboodiri & Suchindran C M, Life Table Techniques and their Applications Florida, Academic Press
- Land Ckenneth & Rogers Andri, Multidimensional Mathematical Demography New

York, Academic Press

- Pathak K B & F Ram, Techniques of demographic Analysis, New Delhi, Himalaya Publishing
- Pittenger B Donald , Projecting State and Local Population Cambridge Battenger Publishing Company
- Pollard J H, Mathematical Models for the Growth of Human Population, London Cambridge Univ. Press
- Preston Samuell H Patrick Heuveline & Michel Guillot, Demography Measuring & Modeling Population Processes Oxford, Blackwell
- Ramakumar R, Technical Demography, New Delhi, Wikey Eastern Ltd.
- Shryock H S et al, The Methods and Materials of Demography, New York, Academic Press
- United Nations, Manual III Methods for Population Projection by Sex and Age: New York
- United Nations, Methods of Analysing Census Data on Economic Activities of the Population, New York

Semester : II
Course Code: DAS-E-425
Course Title: PUBLIC HEALTH
Credits : 2

AIM: The aim of the course is to familiarize students with concepts of health, public health, environment, reproductive and child health and their linkages with
COURSE OBJECTIVES: At the end of the course, the students will be able to define various concepts in public health, to summarize demographic and health transition, to explain levels and trends in morbidity, mortality, health care and nutrition, and to illustrate basic health economics concepts and that of nutrition.

COURSE CONTENT

MODULE I: Concepts of health and morbidity- definition of health, physical development- indices of physical development- Measures of Morbidity and Disability- Patterns of morbidity in developing and developed countries- communicable and non-communicable diseases- Trends and patterns in India and Kerala-Morbidity and mortality linkages- Epidemiological and demographic Transition theories

MODULE II: Health and Development- Social determinants of health- inter linkages between health and Development at local and national levels- globalization and poverty- impact of development Policies on health- Health equity.

MODULE III: Basic Health Economics- Demand and Supply of Health- Health Care Cost- Health insurance- Cost benefit analysis.

MODULE IV: Health policy-National and state – Critical appraisal- Health Programmes and Health Care Systems in India – National Health Programmes- health care systems in different states.

MODULE V: Reproductive Health- Definition- General concepts- Maternal and child health- Prenatal and Antenatal care- sanitation- Hygiene- Reproductive Rights- STD,RTI,HIV/AIDS- Male involvement in Reproductive health- Indian Scenario.

MODULE V1: Nutrition- Nutrients- Nutritional deficiency diseases- Nutritional requirement of special groups- Pregnant and lactating women- infants- children and aged- Nutrition Survey- Nutritional Tables-Nutritional situation in India (NFHS-1,2,3,4) Anemia.

REFERENCES

- Charles H Hennekens and Julie E Burning (1987), 'Epidemiology in medicine' edited by Sherry L Meyrent; Little, Brown and Company
- Chatterji K D (1952), Human Parasites and Parasitic Diseases, Calcutta
- ICMR and ICSSR (1981) Health for All : An Alternative Strategy, Indian Institute of Education, Pune.
- J E Park and K Park, Textbook of Preventive and Social Medicine
- Kark S L (1974), Epidemiology and Community Medicine
- Kleinbaum D G; Kupper L L & Morgenstern H (1982) : "Epidemiologic Research – Principles and Quantitative Methods". A Van Nostrand Reinhold Book, New York

- Monica Das Gupta, L C Chen and T N Krishnan (Editors) "Epidemiologic and morbidity transition" in the book Health, Poverty and Development in India

- Shyvin S Mader, 'Human Biology' Win C Brown Publishers

- W W Daniel (1974), Biostatistics: A foundation analysis in the Health Sciences, John Wiley and Sons, Inc. New York

- WHO (1971): International Health Regulations

Semester : III
Course Code : DAS-C-431
Course Title : Life and Other Contingencies –Part I
Credits : 4

AIM: After completion of the course the student will be able to define and apply basic insurance functions and actuarial symbols related to that in practical problems.

COURSE OBJECTIVE: To develop a basic knowledge of survival models, pension related risks and basic insurance contracts, the basic insurance functions and their relationship among each other are discussed in the course.

COURSE CONTENT

Module I: Methods of combining compound interest theory and survival models-special nature of pension related risks and problems

Module II: Commutation Tables - calculation of premiums for basic life contracts

Module III: Definition of Basic Life Insurance Contracts

Module IV: Derivation of formula for Mean and variance of the present value of benefits payable under whole life and endowment contracts

Module V: Various Insurance related Symbols - Definition and explaination

Module VI: Insurance relationships - Proof and applications

REFERENCES

- Alistair Neil "Life Contingencies", Butterworth-Heinemann Ltd., Illustrated Edition (1977)
- Smith B.H "Contingencies of Value", Harward University Press, 1988
- Griffith Davis "Table of Contingencies", Longman & Co, 1825: University of California Library
- Life and Other Contingencies- P F Hooker & L H Longley-Cook – Cambridge – ISBN 0-521-05327-7
- Michael M Parmenter, "Theory of Interest and Life Contingencies with Pension", 3rd Edition.

Semester : III

Course Code : DEM-C-432
Course Title: MULTIVARIATE ANALYSIS AND COMPUTER APPLICATIONS
Credits : 4

AIM: The course is to train the students on a variety of statistical methods used to analyse two or more variables.
COURSE DESCRIPTION: This course intends to give the concept methods and application of various statistical techniques which helps to solve the problems of daily life
COURSE CONTENT
MODULE I: The need for multivariate analysis- data requirements- statistical modelling- need causal relationships- testing of hypothesis- Chi square test- t-test, F-test- ANOVA.
MODULE II: Dummy variables- multicollinearity interaction – with correlation- without correlation- autocorrelation- p value.
MODULE III: Correlation and regression- Bivariate linear Regression- Non-Linear Regression- Ordinary Least Square Method- Regression model as a statistical model- statistical inference- goodness of fit.
MODULE IV: Multiple Correlation and Regression- correlation matrix- Dummy variables- stepwise regression- multi-collinearity- homoscedasticity- interaction- autocorrelation.
MODULE V: Multiple Classification Analysis(MCA)- Basic MCA-unadjusted and adjusted values- MCA with interactions- Path analysis- Factor analysis- Principal component analysis- Discriminant analysis.
MODULE VI: Linear probability model- Logistic function- Logit regression model- Multinomial regression model- Multivariate Logistic model and odds ratio- Statistical inference- Survival Models- Life Tables- Actuarial Life Tables- Product Limit estimate- Proportional Hazard (Cox) Model Basic form- Relative risk- Regression Coefficient as measure of effect- Statistical inference- Goodness of Fit.
REFERENCES

- Alexander M Mood, Frankilin a Graynil, Guane C Boes, Introduction to the Theory of Statistics Third Edition: Mc Graw Hill Book Company, Singapore
- Donald F Morrison, Multivariate Statistical Methods Second Edition: Mc Graw Hill Book Company, Singapore
- Donald F Morrison, Multivariate Statistical Methods, Second Edition: Mc Graw Hill Book Company, Singapore
- George H Dunteman, Introduction to Linear Models: Sage, New Delhi
- James Stevens Lawrence, Applied Multivariate Statistics for the Social Sciences: Erlbaum Associates, Publishers Hillsdale, New Jersey
- Jane Miller' Statistics for Advanced Level – Second Edition: Press Syndicate of the University of Cambridge, New York
- Krishsnan Namboodiri & Suchindran C M, Life Table Techniques and their Applications Florida, Academic Press

- Medhi J, Statistical Methods – An Introductory Text: New Age International (P) Ltd. Publishers, New Delhi

- Ramakumar R. Technical Demography, New Delhi, Wiley Eastern Ltd.

- Richard F Gunst, Regression Analysis and its application – A Data Oriented Approach

- Robert L Mason Library of Congress Cataloging in Publication Data 270 Madison Avenue, New York

- Wassermann and Neter, Regression Analysis.

ADDITIONAL RESOURCES

- https://www.decisionanalyst.com/whitepapers/multivariate/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3071962/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3936971/
- http://www.unesco.org/webworld/portal/idams/html/english/E1mca.htm
- http://www.statisticssolutions.com/factor-analysis-sem-factor-analysis/

Semester : III
Code : DAS-C-433
Course Title : Business Economics (Macro)
Credits : 4

AIM: After completion of the course student should be able to comprehend the structure of the whole economy. The course aims to makes the actuarial student to better locate and define the problem of a particular company in a particular economy. Better and quick response in decision making against a govt policy is must in actuarial practice, which is the aim of this course.

COURSE OBJECTIVE: To understand the role of government in controlling economic and financial variables is massive. The course objective includes deep understanding of supply side policy and its importance. Regulation of unemployment and its importance in determining market demand and other variables should be understood.

COURSE CONTENT

Module I: Extent to which businesses meet the interests of consumers and society in general- Reasons for the social efficiency of perfect markets and the failure markets to achieve social efficiency- The ways in which governments intervene in markets in order to influence business behavior and the drawbacks of such intervention- Whether taxation or regulation could be more useful in correcting markets' shortcomings. competition policy and its effectiveness- Failure of free market to achieve the optimal amount of government can undertake in order to encourage technological advance and innovation.

Module II: Effect of supply- side policies on business and the economy. Types of supply- side policies that can be pursued and their effectiveness- Impact on business of a policy of tax cuts- The major types of policy open to governments to encourage increased competition.

Module III: Globalization and describe its impact on business. Process of globalization- merits and demerits- Importance of international trade- Growth of international trade and its benefits to countries and firms. Advantages of specialization- Trade restriction and protection of domestic industries- Role of the World Trade Organization (WTO) in international trade- Determination of exchange rates and effects of changes in exchange rate on business- Relationship between the balance of payments and the exchange rates- Advantages and disadvantages of fixed and floating exchange rates- Influence of governments and/or central banks to the exchange rates- the implications of such actions for other macroeconomic policies and for business.

Module IV: The main macroeconomic variables that governments seek to control- Factors determine the level of economic activity and hence the overall business climate- Effect on business output if a stimulus is given to the economy- Actual and

potential growth- Periods of boom followed by periods of recession and explain factors which influence the length and magnitude of the phases of a business cycle- Causes and costs of unemployment and how unemployment relates to the level of business activity- Determination of the price level in the economy by the interaction between aggregate supply and aggregate demand in a simple AS-AD model- Causes and costs of inflation and how inflation relates to the level of business activity- GDP and its measurement. Representation of the economy as a simple model of the circular flow of income.

Module V: Function of money- Factors determines the amount of money in the economy- what causes it to grow and what is the role of banks in this process. Determination of interest rates Relationship between money and interest rates- Role of central bank- Role of RBI- The ways through which change in the money supply and/or interest rates affects the level of business activity.

Module VI: Level of business activity and how it affects unemployment and inflation- Effect of a rise in money supply on output and prices- Relationship between unemployment and inflation and whether the relationship is stable- The way how business and consumer expectations affect the relationship between unemployment and inflation and formation such expectations- Policy of targeting inflation and relationship between unemployment and inflation- The course of a business cycle and its turning points- The way through which business cycle is caused by changes in aggregate demand- or changes in aggregate supply- Fiscal rules adopted by the government and discuss if following these rules is a good idea- The way monetary policy works in the India and describes the roles of the Reserve Bank of India- The way targeting inflation influences interest rates and hence economic activity.

REFERENCES

- Economics for Business. by John Sloman, Kevin Hinde and Dean Garrat, Sixth Edition, Pearson

Semester : III
Course Code : DAS-C-434
Course Title : Principles of Insurance- Life, General and Health
Credits : 4

AIM: On completion of this course the student will be able to appreciate various practices and principles in the insurance industry.

COURSE OBJECTIVE: To impart knowledge into the various techiniques and principles that are practiced in the insurance industry

COURSE CONTENT

Module I: Brief Introduction on origin of insurance and its current applications

Module II: Modern Insurance – Principle of Indemnity and Guarantee- Insurable Interest- Principle of Utmost Good faith- Insurance is a Contract - the basics of insurance contract- Principle of Equity

Module III: Life Insurance contracts and group life insurance Schemes.

Module IV: Health Insurance Contracts distinguished.

Module V: General Insurance Contracts distinguished including Miscellaneous Insurance
Contracts

Module VI: Pension and Employee Benefit contracts

REFERENCES

- Ben G Baldwin "The New Life Insurance Investment Advisor" 2nd Edition, Mc Graw Hill
- Harriett E Jones "Principles of Insurance "FLMI Insurance Education Programme, Life Management Institute LOMA, (Dec 1995)
- Neelam C Gulati "Principles of Insurance Management", Excel Books, New Delhi, (2007)
- Robert I Mehr "Principles of Insurance "Richar D Irwin (Ed.), 8th Edition, 1985

Semester : III
Course Code : DAS-E-435
Course Title: RESEARCH METHODOLOGY
Credits : 2

AIM: This course is a general introduction to social research methods and will cover broad topics: the foundations of social science research, research design, data collection, and data analysis and report writing. This module aims to provide students with an understanding of the principles and skills needed in order to design and conduct research. It will encourage students to critically evaluate the methods, strategies and data that used by social scientists and provide training in analysis of a range qualitative and quantitative data.

COURSE OBJECTIVES: By the end of the course, the students should be able to:

- To develop understanding of the basic framework of research process.
- To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- Formulate good research questions and design appropriate research.
- Collect their own data using a variety of methods.
- Analyze both qualitative and quantitative data using computer-based skills.
- Critically evaluate their own research and that of other social scientists.

COURSE CONTENT

MODULE I : Social Research- Scope of Social Research- Development of Research Methodology- Nature and Importance of research, aims of social research- research process- pure research vs- applied research- qualitative research vs quantitative research- exploratory research- descriptive research and experimental research- Stages of research process

MODULE II : Research Design- Meaning of Research Design- Functions and goals of Research Design- characteristics- phases- design for different types of research- pilot study

MODULE III: Sampling design and sampling procedures- Probability Vs- Non-probability sampling techniques- determination of sample size- Questionnaire Construction and Interviewing Case Studies-Content Analysis-Data processing and Analyses- Coding- Tabulation.

MODULE IV: Methods of Data Collection - Discussion on primary data and secondary data- tools and techniques of collecting data- Observational- Survey Research- Qualitative- Secondary data analysis.

MODULE V: Testing of Hypothesis- Small sample test- Student's- t distribution- chi-square test- F-test - test for Mean- Test concerning Proportions- Correlation and Regression

MODULE VI: Analysis Methods- Editing and coding, transform raw data into information- basic data analysis- descriptive statistics- Interpretation and Report Writing- Bibliography- Citation

REFERENCES

- Arlene Finil & Jacqueline kosecoff, How to conduct surveys, - A step by step guide, New Delhi, Sage Publications

- Desai P B, A survey of research in Demography, Mumbai, Popular Prakashan

- Devendra Thakur, Research Methodology in Social Sciences, New Delhi, Deep and Deep Publication

- Goode, William J & Paul K Hatt, Methods in Social Research Mc GRAW HILL, International Book Company

- Julian L Simon, Basic Research Methods in Social Science –The Art of Empirical Investigation, New York, Random House

- Kenneth D Bailey, Methods of Social Research, New York, Macmillon Publishing Company. Inc.

- Kothari C R, Research Methodology Methods and Techniques, New Delhi, Wishwa Prakashan

- Nachmias David & Chava Nachmias, Research Methods in the Social Sciences, New York, St.Martin's Press

- Therese L Baker Doing Social Research, New York, Mc. GRAW HILL

- Wilkinson T S & P L BHANDRKAR Methodology and Techniques of Social research Mumbai, Himalaya Publishing House

Semester : III
Course Code : DAS-E-436
Course Title: BUSINESS DEMOGRAPHY
Credits : 2

AIM: To familiarize students application of demographic concepts, data, and techniques to the practical concerns of business decisions makers and Administration.
COURSE OBJECTIVES: Businesses have based decisions on demographic data and techniques since as far as the nineteenth century. The emergence of business demography as a distinct field, however, is quiet recent. This loosely organized field includes – but is not limited to – site location, sales forecasting, financial planning, market assessment, consumer profiles, target marketing, litigation support and labour force analysis. As the field matured, it became routine for business to base decisions on the advice of consultants and employees skilled in collecting, analyzing and interpreting demographic data.
COURSE CONTENT
MODULE I: Defining Business Demography-Demographics-Applied Demography- The Uses of Business Demography-Demographics- Population as a market for consumer goods and labour market-Population Dynamics and its implications for change in the sizes and composition of market-Relevance of Applied Demography to business organization- importance of the subject in the context of globalization and privatization.
MODULE II: Demographics- Segmenting & targeting population- targeting by Socio-economic characteristics- Demographic data base for market research-Role of Population dynamics on Market- Age- Gender- Education and Income- religion-Household structure -Implications of changes in the key demographic variables on the market for different products-changes in the age structure- House hold- geographic-labour force and in the international population- Social & political Planning-Local Area Estimates and Projections- Education- Health services- Campaign Strategy- Legislative Analysis.
MODULE III: Basic concept in marketing-Definition of market- Evolution of marketing- Roles and Functions of Marketing-Importance of products, prizes and promotion in marketing activities – Marketing strategies-Need to understand life styles and consumer behaviour- Cluster marketing- Investment Demographics-Domestic and International Demographics- Need to understand consumer demographics-Importance in Market Research- Customarized global market- The System Model (holistic approach)- marketing environment- definition of customer.
MODULE IV: Market survey-Market research process, problems formulations-research design sampling data collection methods-analysis and interpretation of data-cases study for some products.
MODULE V: Market forecasts- Population projection-Projection for smaller areas and for market segments family life cycle- household projection future market for products and activities related to children youth ad aged gender specific needs.
MODULE VI: Globalization- global economy, new people management (NPM)-knowledge- marketing planning and strategy

REFERENCES

- Databases: How Long Will GM's Salaried Retires Live?" In Demographics: A Casebook for Business and Government, ed Hallie J.Kintner, Thomas W.Merrick, Peter A. Morrison, and Paul R.Voss. Santa Monica, CA: RAND.

- Mitchell, Susan. 1995. "Birds of a Feather". American Demographics 17(2):40-48.
- Morrison, Peter A. and Allan F.Abrahamse.1996." Applying Demographic Analysis to Store Site Selection". Population Research and Policy Review 15:479-489.

- Morrison, Peter A., Morlie H.Levin, and Paul M.Seever.1996."Tracking Growth of Emerging Consumer Marketers Worldwide: Where Demographic Analysis Fits In." Paper presented at the Sixth International Conference on Applied and Business Demography, Bowling Green, OH.

- Pol. Louis G. and Richard K. Thomas. 1997. Demography for Business Decision Making. Westport, CT: Quorum Books.

- Russell, Cheryl.1984. "The Business of Demographics". Population Bulletin: 39(3). Washington DC: Population Reference Bureau.

- Siegel, Jacob S. 2001. Applied Demography: Applications to Business, Government, Law and Public Policy. San Diego: Academic Press.

Semester : IV
Code : DAS-C-441
Course Title : Life and Other Contingencies- Part-II
Credits : 4

AIM: The course aims to develop a thorough understanding in the application of insurance functions using multi state markov model. The student will be able to execute simple methods of calculating premium and benefits.

COURSE OBJECTIVE: The objective of the course is to have knowledge of some advanced statistical methods to describe basic insurance terms like premium, burning costs and experience rating. It also includes basic principles of estimating IBNR using Chain Ladder method.

COURSE CONTENT

Module I: Explain how a cash flow- contingent upon multiple transition events- may be valued using a multiple-state Markov Model- in terms of the forces and probabilities of transition

Module II: Define health insurance- and describe simple health insurance premium and benefit structures.

Module III: Simple methods of calculating premiums using Commutation Tables

Module IV: Calculation of present values of different types of annuities using integral

Module V: Explain the terms Burning Costs, Experience Rating

Module VI: Explain the term IBNR and INER used in non-Life insurance and the basic principles of estimating IBNR using a chain ladder method

REFERENCE

- Alistair Neil "Life Contingencies", Butterworth-Heinemann Ltd., Illustrated Edition (1977)
- Smith B.H "Contingencies of Value", Harward University Press, 1988
- Griffith Davis "Table of Contingencies", Longman & Co, 1825: University of California Library
- Life and Other Contingencies- P F Hooker & L H Longley-Cook – Cambridge – ISBN 0-521- 05327-7
- Michael M Parmenter, "Theory of Interest and Life Contingencies with Pension", 3rd Edition.
- Students will be expected to read relevant papers currently available in the net PFRDA related papers

Semester : IV
Course Code : DAS-C-442
Course Title : Practice of Insurance in the Indian Context
Credits : 4

AIM: This course aims to develop knowledge in the ways and methods of real insurance practice. All important areas of practicing insurance are focused and demonstrated.

COURSE OBJECTIVE: To impart skills in the different practices, laws and rules so as to enable the student to take up an Actuarial career

COURSE CONTENT

Module I: Role of Actuaries in Insurance practice – Appointed Actuary System- **-** Formation of insurance company and its restrictions, IRDAI

Module II: Proposal Form, Acceptance of Insurance and Policy Documents- Pricing of
Insurance Contracts – principles- Capacity to insurance and Reinsurance requirements in the Indian context

Module III: Taxation of Insurance business- Investment Regulations- System of scientifically valid provisions for unexpired contracts – Reserves

Module IV: Maintenance of separate funds for policyholders and shareholders- Profit sharing Regulations between policyholders and shareholders- Principle of Average Clause and Indisputability clause- Subrogation

Module V: General differences between Life and Non-life insurances- Medical Care Insurance and related matters

Module VI: Solvency of insurers and requirements of Solvency margins- Grievance Redressal system for policyholders- Insurance Ombudsman- Requirements of speedy settlement of Claims and Role of third parties – surveyors and average- Miscellaneous matters - accounting etc

REFERENCE

- Michael G. McMillan, Jerald E. Pinto, Wendy Pirie and Gerhard Van de Venter (Feb 8, 2011) "Investments: Principles of Portfolio and Equity Analysis"
- Goff T.G, "The theory and practice of investment"
- Timothy E. Johnson, "Investment Principles", Prentice Hall College Div; 2 Sub edition (December 1982)

Semester : IV
Course Code : DAS-E-443

Course Title : Agriculture Insurance
Credits : 2

AIM: Aim of the course is to develop basic knowledge of Indian agriculture and an overview of the agriculture insurance in India

COURSE OBJECTIVE: To familiarize the agriculture insurance in India. To know the benefits of crop insurance and the insurability of agricultural risk.

COURSE CONTENT

Module I: Introduction to Indian Agriculture- Agriculture Situation In India- Role of Agriculture in Indian Economy- agriculture Research & Network.

Module II: Agricultural Census-Phase I- Phase II- Phase III- Phase IV- Agricultural Resources- Land Records(Computerisation etc..)

Module III: Evolution of Crop Insurance In India - Individual Based Crop Insurance- Pilot Crop Insurance Scheme (PCIS)- Comprehensive Crop Insurance Scheme (CCIS), Experimental Crop Insurance Scheme (ECIS)- National Agricultural Insurance Scheme (NAIS)- Farm Income Insurance Scheme (FIIS)

Module IV: Agricultural insurance in India- Types of Agricultural Insurance schemes available- Obligations of Insurers in Rural Sector

Module V: Crop Insurance Design Considerations - Insurability of Agricultural Risks- Crop Insurance- Crop Insurance Vs Agricultural Relief- Crop Insurance As Risk Management- Benefits of Crop Insurance.

Module VI: Why Area Approach Based Crop Insurance Suits the Indian Conditions- Key Elements & Generic Considerations In Crop Insurance Design And Operations

REFERENCE

Rao K.N (2010), 'Agricultural Insurance', Insurance Institute of India, Mumbai.

Semester : IV
Code : DAS-D-444
Course Title : Dissertation
Credits : 6

AIM: This six credit course provides the students an opportunity to work on a specific area in Actuarial Science in which they are interested in by taking up a specific problem of interest and submit a detailed report on the same after a scientific investigation of the problem. By the end of the course the students will be able to

- Carry out scientific research on any area in Actuarial Science
- Design and carry out research and analyze data using any software package
- Write a detailed report of the scientific research carried out

COURSE OBJECTIVE: To consolidate and extend the knowledge and skills acquired during the coursework and apply these in a practical way. There will be faculty supervisors helping the students in doing the project work and to write a dissertation on the same.

Assessment Plan

No	**Assessment**	**Marks Assigned**
1	Written report of the research undertaken	75
2	Presentation of findings on the research work	25
	TOTAL	**100**