

Post Graduate Diploma in Actuarial Science (PGDAS)

Duration : 1 Year

Eligibility : B.Com.(With Statistics) or B.Sc.(With Maths/Statistics) or B.Com. /B.Sc. in Actuarial Science or BCA or B.Sc. (Computer Science)

List of Papers

Max. Marks

1. Mathematics and Statistics	100
2. Actuarial Science Paper-I (Principles of Life Insurance & Reinsurance)	100
3. Actuarial Science Paper-II (Asset Liability Management & Life Office Management)	100
4. SAS Programming	100
5. Actuarial Science Paper –III (Actuarial Models & Actuarial Modeling)	100
6. Actuarial Science Paper IV (Advance Topics in Actuarial Science)	100
7. & 8. On Job Training & Project Work	200
TOTAL MARKS	800

ACTUARIAL SCIENCE

Paper No : 1. MATHEMATICS AND STATISTICS

Chapter: 1 Differentiations

Derivatives
Basic laws of derivatives
Higher order of derivatives
Application and further topics
Maxima and minima of a function
Applications
Discrete optimization

Chapter: 2 Integration

Integration
Integration by parts
Applications
Advanced integration and its application

Chapter: 3 Progression and annuity

Progression
Geometric series
Annuity
Investment compounded continuously

Chapter: 4 Random variables and probability distributions

Random variables
Probability distribution of a random variable
Binomial distribution
Properties of binomial distribution
Poisson distribution
Properties of Poisson distribution
Standard normal variate
Standard normal distribution
Area under a standard normal curve
Normal distribution
Characteristics of normal distribution
Characteristics of standard distribution

Chapter: 5 Linear correlations

Meaning of linear correlation
Coefficient of correlation
Scatter diagram
Karl Pearson's product moment method

Different formulae of Karl Pearson method
Method of rank correlation
Merits and limitations of rank correlation
Interpretation of correlation coefficient and precautions of it

Chapter: 6 Regression Analysis

Linear regression model
Fitting of a regression line
Scatter diagram and least square method
Regression coefficients
Different formulae of finding regression coefficients
Coefficients of determination
Precaution in using regression
Two regression lines

Chapter: 7 Multiple regression analysis (Applications only)

Multiple and partial correlation.
Multiple correlation analysis.
Partial correlation analysis. Standard errors of estimate of regression coefficients.

Chapter: 8 Small Sample tests and large sample tests

Tests based on t.
F and chi-square distribution.
Fisher's z transformation and its applications.
Testing the significance of single proportion.
Difference between two proportions.
Single mean.
Difference between two means.
Difference between two standard deviations.
Correlation coefficient.

Chapter: 9 Analysis of Variance: One way and two way classified data(Applications only).

Assumption of analysis of variance.
Techniques of analysis of variance.
Confidence intervals for mean and variance for small samples.
Total variation.
Variance between the samples.
Variance within the samples.
Formula of calculation.

Chapter: 10 Linear programming techniques.

Definition of general LPP.

Formulation of LPP.

Graphical solution of LPP for two variables.

The simplex method.

Simplex method for minimization problem.

Problem with multiple optimum solutions.

Unbounded solution.

Degeneracy.

Transportation problem

Initial basic feasible solution of T.P. (by NWCM, LCEM, VAM)

Optimum solution of T.P. by MODI method

Reference books:

An introduction to statistical methods by: C.B. Gupta and Vijay Gupta.

An introduction to statistical methods by: C.B. Gupta

Elementary statistical methods by: S.P. Gupta

Fundamental of statistics by: A.K. Agrawal.

Fndamental of statistics by: D.N.Elhance.

Statistical Techniques by: N.K.Sharma.

Example in statistical analysis by: Des Raj.

Advance mathematics for B.C.A. by: H.R.Vyas.

An introduction to statistical methods by: C.B. Gupta and Vijay Gupta.

An introduction to statistical methods by: C.B. Gupta

Elementary statistical methods by: S.P. Gupta

Fundamental of statistics by: A.K. Agrawal and Sahib singh.

Fundamental of statistics by: D.N.Elhance.

Statistical Techniques by: N.K.Sharma.

Example in statistical analysis by: Des Raj.

Operations research by:S.D.Sharma.

Operations research by:J.KSharma.

Optimization techniques by:P.K.Gupta.

ACTUARIAL SCIENCE

Actuarial Science Paper-I

Paper No : 2. PRINCIPLES OF LIFE INSURANCE & REINSURANCE

UNIT I

Principles of insurance

Life , Health and Annuities

Nature of Insurance – advantages of life insurance – Principles of life insurance – objects of life insurance.

UNIT II

Term Insurance – Kinds of policies and plan available – Annuity contracts and their uses.

UNIT III

Group and Individual Health Insurance Products – Nature of group insurance – types of group insurance.

UNIT IV

Special need plans – Industrial life insurance – Salary saving schemes – Personal accident insurance – Basic principles – Coverage and benefits.

UNIT V

Mediclaime benefits – Deferred mediclaime – Overseas medical benefit conditions.

RE INSURANCE

UNIT I

Introduction – Brief Historical Background – Nature of Reinsurance – Function of Reinsurance – Methods of Reinsurance – Major Forms – Facultative Reinsurance – Treaty Reinsurance.

UNIT II

Reinsurance – Special factors partitioning to Property, Accident / Liability, Marine and Aviation, Basics of Life Reassurance, Reinsurance Programs – Designing and Arranging – Setting Retentions – Program Design – Analysis Reinsurance Needs – Negotiation and Placement of Reinsurance.

UNIT III

Reinsurance Clause, Common Clauses, Operative Clause, Commencement and Termination Clauses – Access to records Clause – Errors and Omissions Clause – Intermediary Clause – Currency Clause – Arbitration Clause – Insolvency Clause – Offset Clause – Claims Settlement Clause – Accounting Clause – Special Clause.

UNIT IV

Reinsurance Markets – Special Characteristics of certain Important Reinsurance Market – Lloyd's – Reinsurance Exchange – Pools. Reinsure Financial Security – Importance – Managing Reinsure Security – Selecting Reinsures -Establishing Criteria for Evaluation of Security – Financial Strength Ratings – Major Rating Agencies.

UNIT V

Alternative of Reinsurance – New forms of Reinsurance – Finite Risk / Financial Reinsurance Futures and Securitization of Reinsurance Contracts - New Markets – Impact of Captives and High Self – Retentions on the Reinsurance Mechanism – Emerging Trends in Global Reinsurance Market.

Reference Books:

1. Asset Liability Management in Insurance - Verennee Briyel
2. Insurance Principles and Practice : M.N. Mishra
3. Principles and Practices of Law : Kothari & Bahl
4. Elements of Business Law : N.D. Kapoor
5. Principles and Practice of Insurance : P. Periyasamy
6. Principles and Practices of Insurance : G.S. Panda
7. Principles of Insurance and Risk Management : Alka Mittal and S.L. Gupta

ACTUARIAL SCIENCE

Actuarial Science Paper-II

Paper No: 3 Asset-Liability Management & Life Office Management

Asset-Liability Management (ALM)

Overview of the asset-liability management and the risks of FI(Financial Institution)
The theory of ALM, The risk-return trade-off in ALM, The goal of ALM, The process of ALM, Developments in ALM, The spread of FI and the ALM, The main theories in ALM, The financial sector, Sources and uses of funds of FI, Introduction to the risks of FI (Interest rate risk, Trading risk, Credit risk, Off-balance sheet risk, Technology/operational risk, FOREX risk, Country/sovereign risk, Liquidity risk), Interaction among risks, Other risks in the financial system, ALM: An introduction to IR(Interest Rate) risk, GAP analysis and management.

GAP analysis and IR risk exposure

Cases in monitoring the balance sheet (sensitivity analysis), Multi-period GAP and profitability analysis, Preparing and interpreting the GAP report, Active GAP management, Asset and liability restructuring, Managing a positive GAP, Empirical issues in GAP Management, Factors affecting the GAP strategy, Managing a negative GAP, GAP analysis, IR changes and the NIM, Review of GAP analysis, The maturity model, Portfolio of A/L, The timing of cash flows, The duration model, Duration and IR elasticity, Duration and the value of equity, The adjusted for convexity model, The repricing model, RSA (Rate Sensitive Assets)– RSL(Rate Sensitive Liabilities), A cumulative alternative, GTA ratio, Problems with the model, New empirical suggestions.

IR risk, balance sheet immunization and hedging strategies

Overview of derivatives instruments, Forward Vs Futures, Hedging IR risk using forward contracts, Hedging IR risk using futures, Macrohedging, Microhedging, Selective hedging, Routine hedging, Adjustments for basis risk, Options and the balance sheet exposure, Hedging the duration GAP with options, Hedging instruments for borrowers, The use of caps, Hedging IR risk for lending FI, The use of floors, Hedging IR risk with synthetics, The use of collars, A numerical application of hedging strategies.

FOREX(Foreign Exchange) risk measurement and hedging strategies in ALM

Fundamentals of FOREX risk, FX trading activities, FX trading and sources of FX risk, FX(foreign Exchange) quotations, FOREX exposure, Measuring FOREX volatility, The BIS proposal, An A/L approach of FX risk, FX risk with A/L positions, FOREX GAP analysis, FOREX simulation analysis, Mismatched currency composition, On-balance-sheet hedging of FX risk, Off-balance-sheet hedging of FX risk, Multi-currency ALM, Currency futures, Spot-Futures perfect correlation, Basis risk, Currency options, Hedging FX sensitive assets, Hedging FX sensitive liabilities.

Credit risk analysis and techniques for loan portfolio management

Different kinds of loans, The fundamentals of credit risk analysis, Default risk models, Qualitative models, Idiosyncratic factors, Market factors, Credit scoring models, Linear probability model, Logit model, Probit model, Linear discriminant models, Term structure derivation of credit risk, Mortality rate derivation of credit risk, RAROC models, An option theory approach to the value of bank debt and equity, Option models of default risk, Merton's model, KMV model, Loan portfolio risk, Simple approaches, MPT approach, Loan volume approach, Loan loss ratio, KMV portfolio manager model, Hedging credit risk, CQS,

Credit forwards, Stock index futures, Put index options, Put option collateral, Credit spread call option, Digital default option, CAT insurance futures, CAT call spread, Credit securitisation, Double credit securitisation: The SBC case.

Market risk and the use of VAR(Value at Risk) - CAR models

Overview of market risk management, JPM's RiskMetrics Model, Fixed income investment, FOREX trading, Equity investment, Portfolio effects, Regulatory models, The 1993-95 BIS proposal, Internal models for large banks, Fundamentals of VAR models, VAR and CAR in ALM, VAR Vs CAR, Loss distributions and VAR, Issues in measuring VAR, Intuition of CAR models, Case study: Barings and VAR, Volatility and period of observation, Summary of VAR and CAR methodology.

Asset - liability swaps, CQS and other hedging strategies in ALM

Fundamentals of swaps, Generic types of swaps, Other types of swaps, Interest rate swap, Optimal notional value for swaps, Hedge ratio, Pricing an IR swap, The no arbitrage conditions, Estimating the discount yield curve, Estimating implied forward rates, Credit risk implications, Credit risk and swaps, Quality swaps, Debt issuance swaps, Asset/liability swaps, Swap boundaries and positive returns, An inverse floater swap, Advantages using swaps.

Capital adequacy and the solvency risk of financial institutions

The role of capital, The cost of equity capital, Capital and insolvency risk, Market values and insolvency risk, Credit and IR risk, Book values and insolvency risk, Credit and IR risk, The discrepancies between market and book values, Arguments against market value accounting, Issues in capital adequacy, Capital to asset ratio, RBC ratios, Calculating RBC ratios, Distinction of capital classes, Risk adjusted assets, Risk adjusted on balance sheet assets, Risk adjusted off balance sheet assets, Risk adjusted value of derivative instruments with netting, Criticism of RBC ratios, Capital requirements for other FI, Securities firms, Life insurance, P/C insurance.

LIFE OFFICE MANAGEMENT

Introduction to insurance company operations:

Life and Health insurance Company (Life Company Operations)

Competition, Regulation, and Ethics in the Life Insurance Industry

Life Insurance Company Formation and Restructuring

The Organizational Structure of Insurance Companies

Marketing Activities and Strategies

Product Development

Pricing Insurance Products

Product Distribution

Home Office Support for Distribution Systems

Life Insurance Underwriting

Customer Service

Claim and Annuity Benefit Administration

Information Management

An Overview of Financial Management

Managing Investments

Accounting

Human Resource Management

Legal and Compliance Operations

Reference Books:

Fabozzi F.J. "Managing institutional assets" Harper & Row.

Fabozzi F.J. – A.Konishi "The handbook of asset-liability management" Rev. Ed. Irwin.

T. Ravi Kumar – Asset Liability Management – Vision Books

by Raymond McLeod, Life Office Management Association. Life Management Institute

by Jane Lightcap Brown, Life Office Management Association. Life Management Institute

ACTUARIAL SCIENCE

Paper No: 4. SAS PROGRAMMING

SAS Programming (BASIC)

Understanding Programming Concepts: explaining the use of computers in data processing - defining programming terms - defining operating environments - defining the programming process

Learning the Concepts of SAS Programming - explaining the basic functionality of SAS - identifying the file types used in SAS - identifying a SAS program file and its components

Reading a Raw Data File - planning to read a raw data file - defining the exercise scenario

Coding to Read Raw Data coding to read a raw data file with column input coding a DATA step

Navigating the SAS Windowing Environment - defining the SAS windowing environment - identifying the three primary SAS programming windows - navigating SAS programming windows - editing and executing SAS code - saving and retrieving SAS code - using the Help facility

Creating a List Report with a PROC Step - planning to create a list report - coding to create a list report

Enhancing the PRINT Procedure Output - sorting the observations in a SAS data set enhancing a report

Creating a Variable with the DATA Step - defining an assignment statement - planning and coding to create a variable

Performing Conditional Logic with the DATA Step - defining conditional logic - planning and coding to perform conditional logic to create a variable - Creating a Summary Report - defining a statistical report - planning and coding to create a summary report.

Introduction : course logistics - an overview of Foundation SAS - Introduction to SAS programs - submitting a SAS program - Working with SAS Syntax - Mastering fundamental concepts - diagnosing and correcting syntax errors –

Getting Familiar with SAS Data Sets - examining descriptor and data portions - accessing SAS data libraries - accessing relational databases (Self-Study)

Reading SAS Data Sets - introduction to reading data - using SAS data as input - subsetting observations and variables - adding permanent attributes

Reading Excel Worksheets - using Excel data as input - doing more with Excel worksheets (Self-Study)

Reading Delimited Raw Data Files - using standard delimited data as input - using nonstandard delimited data as input

Validating and Cleaning Data - introduction to validating and cleaning data - examining data errors when reading raw data files - validating data with the PRINT and FREQ procedures - validating data with the MEANS and UNIVARIATE procedures - cleaning invalid data - Manipulating Data - creating variables - creating variables conditionally - subsetting observations

Combining SAS Data Sets - introduction to combining data sets - appending a data set - concatenating data sets - merging data sets one-to-one - merging data sets one-to-many - merging data sets with non-matches

Enhancing Reports - using global statements - adding labels and formats - creating user-defined formats - subsetting and grouping observations - directing output to external files

Producing Summary Reports - using the FREQ procedure - using the MEANS procedure - using the TABULATE procedure (Self-Study) - Introduction to Graphics Using SAS/GRAPH (Self-Study) - creating bar and pie charts - creating plots - enhancing output

Introduction to the Course Scenario and SAS Intelligence Platform

Orion Star sports and outdoors

SAS Intelligence Platform

Orion Star personas and course data

Using the SAS Add-In for Microsoft Office

- overview of the SAS Add-In for Microsoft Office
- accessing data with the SAS Add-In for Microsoft Office
- analyzing information with the SAS Add-In for Microsoft Office
- using the SAS Add-In for Microsoft Office to access reports

Using SAS Web Report Studio

- overview of SAS Web Report Studio
- using SAS Web Report Studio

SAS Enterprise Guide and SAS Stored Processes

- introduction to SAS Enterprise Guide
- using SAS Enterprise Guide
- introduction to SAS Stored Processes
- creating stored processes with SAS Enterprise Guide

Using SAS Information Map Studio

- overview of SAS Information Map Studio
- using SAS Information Map Studio

Overview of the SAS Management Console

- introduction to the SAS Management Console
- how the SAS Management Console works
- introduction to the SAS Management Console Plug-Ins
- working with the user interface

Reference Books:

Rebecca J. Elliott, ``Learning SAS in the Computer Lab'', Duxbury (1995) ISBN 0-534-23442-9.

Rick Aster, ``Professional SAS Programmer's Pocket Reference'', Windcrest/McGraw-Hill (1993).

Cody and Smith, ``Applied Statistics and the SAS Programming Language'', third edition Prentice Hall (1991) ISBN 0-13-500554-X.

``SAS Language and Procedures: Usage'', SAS Institute (1989) ISBN 1-55544-371-0.

``SAS/ETS User's Guide," version 6 second edition, SAS Institute (1993) ISBN 1-55544-554-3.

``SAS/GRAPH User's Guide," release 6.03 edition, SAS Institute (1988) ISBN 1-55544-087-8.

``SAS Language Reference version 6", SAS Institute (1993) ISBN 1-55544-381-8.

``SAS Procedures Guide," version 6 third edition, SAS Institute (1990) ISBN 1-55544-378-8.

Schlotzhauer and Littell, ``SAS System for Elementary Statistical Analysis", SAS Institute (1987) ISBN 1-55544-076-2.

ACTUARIAL SCIENCE

Paper No: 5 Actuarial Models and Actuarial modeling

A) Survival models

1. Define survival-time random variables
 - a) for one life, both in the single- and multiple-decrement models;
 - b) for two lives, where the lives are independent or dependent (including the common shock model).
2. Calculate the expected values, variances, probabilities, and percentiles for survival-time random variables.
3. Define the continuous survival-time random variable that arises from the discrete survival-time random variable using a:
 - a) uniform distribution;
 - b) constant force of mortality; or
 - c) hyperbolic assumption.

B. Markov Chain Models

1. Define non-homogeneous and homogeneous discrete-time Markov Chain models and calculate the probabilities of
 - a) being in a particular state;
 - b) transitioning between particular states.

C. Life insurances and annuities

1. Define present-value-of-benefit random variables defined on survival-time random variables:
 - a) for one life, both in the single- and multiple-decrement models;
 - b) for two lives, where the lives are independent or dependent (including the common shock model).
2. Define and calculate the expected values, variances and probabilities for:
 - a) present-value-of-benefit random variables;
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 - b) present-value-of-loss-at-issue random variables, as a function of the considerations (premiums);and
 - c) present-value-of-loss random variables, as a function of the considerations (premiums).
3. Calculate considerations (premiums) for life insurances and annuities,
 - a) using the Equivalence Principle; and
 - b) using percentiles.
4. Calculate liabilities, analyzing the present-value-of-future-loss random variables:
 - a) using the prospective method;
 - b) using the retrospective method;
 - c) using special formulas.
5. Calculate
 - a) gross considerations (expense-loaded premiums);
 - b) expense-loaded liabilities (reserves);
 - c) asset shares.
6. Using recursion, calculate expected values (reserves) and variances of present-value-of-future-loss random variables for general fully-discrete life insurances written on a single life.

7. Extend the present-value-of-benefit, present-value-of-loss-at-issue, present-value-of-future-loss random variables and liabilities to discrete-time Markov Chain models, to calculate

- a) actuarial present values of cash flows at transitions between states;
- b) actuarial present values of cash flows while in a state;
- c) considerations (premiums) using the Equivalence Principle;
- d) liabilities (reserves) using the prospective method.

D. Poisson processes

1. Define Poisson process and compound Poisson process.
2. Define and calculate expected values, variances, and probabilities for Poisson processes,
 - a) using increments in the homogeneous case;
 - b) using interevent times in the homogeneous case;
 - c) using increments in the non-homogeneous case.

Reference Books :

- 1) Actuarial Mathematics (Second Edition), 1997, by Bowers, N.L., Gerber, H.U., Hickman, J.C., Jones, D.A. and Nesbitt, C.J. pter 15, Sections 15.1–15.2.1, 15.4, 15.6–15.6.1.
- 2) Models for Quantifying Risk, Second Edition, 2006, by Cunningham, R., Herzog, T. and London

ACTUARIAL SCIENCE

Actuarial Science Paper IV Paper No: 6 Advanced Actuarial Practice

Advanced actuarial consulting topics, including:

- Comprehensive actuarial consulting topics, including selection of cost methods and assumptions, actuarial forecast valuations
- Design of retirement plans
- Actuarial considerations in providing financial accounting information for post employment employee benefit plans
- Effect of changes in demographics and the economic environment on the cost and design of retirement benefits
- Valuation of pension assets and development of funding and investment policies
- Actuarial valuation in civil litigation including divorce and QDROs
- Applicable issues in ethics affecting the actuarial profession

Reference Books:

Advanced Actuarial Practice: A-4 Compendium of readings, 2007 ed.,
Arlington, VA: ASPPA.

Fundamental Concepts of Actuarial Science, revised ed., by Charles L.
Trowbridge.

ACTUARIAL SCIENCE

Paper No : 7 & 8. On Job training & Project work

200 Marks

- **Project duration 8 to 10 Weeks**