Annexure 36

Masters in actuarial science

Actuary" means a person qualified to calculate financial and commercial impact and valuation of uncertainty and risk of future events by using advanced techniques and models based on future scenarios under financial, economic, social, demographic, technology and probabilistic situations.

Actuaries are experts in assessing the financial impact of uncertain events of future times. They use data science and data analytics techniques and build financial models to project future risks and uncertainties based on the assumptions on historical trends and future projections. In short, Actuaries make financial sense of the future.

Traditionally Actuaries work in the area of Insurance where risk and uncertainty is at highest levels. Within the Insurance domain, Actuaries are involved in product design and pricing, valuation of liabilities and reserves, asset liability management, research and analysis. Actuaries also play key role in the valuation of Pensions, Annuities, Employee Benefits, Social Security, Health Benefits, Government Schemes and Investments.

Actuarial skills are becoming relevant for risk management at banks, application of data science and data analytical techniques across the industries, measurement of cyber risks, management and measurement of climate risks and valuation of future assets and liabilities.

Across the Globe, actuaries play statutory roles in insurance industry, employee benefits, social security, health benefits, government schemes and valuation of future liabilities. Actuarial skills are valuable for any business that involves long-term financial projects due to their professional rigor combined with their model-based solution for most complex commercial problems.

Actuaries balance their role in business management with responsibility for safeguarding the financial interests of the public. The duty of Actuaries to consider the public interest is illustrated by their legal responsibility for protecting the benefits promised by

insurance companies, pension schemes and employee benefit schemes. The professions code of conduct demands the highest standards of personal integrity from its members.

By virtue of the role of an Actuary as a multi-skilled professional in core areas of financial risk and uncertainty, a candidate with strong skills in Mathematics, Statistics, Data Analytics and Finance with good analytical skills, logical reasoning coupled with willingness to put hard work continuously to learn and pass all subjects of actuarial examinations can be an ideal candidate.

Institute of Actuaries of India

"Actuarial Common Entrance Test" is applicable to the candidates who plan to enrol as student member of the Institute of Actuaries of India and wish to take actuarial examinations.

Eligibility Criteria: -

Any candidate studying for

- Students who have appeared 10+2 or an equivalent examination and waiting for the result.
- A candidate who has passed 10+2 or any other higher courses/examinations.
- Diploma.
- Finance, or any other stream, but you have love for Mathematics and skills in Numeracy.
- Mathematical Sciences: Maths, Statistics, Econometrics or any other.
- Engineering.
- Management.
- Chartered Accountant, Cost Accountant or a Company Secretary.

Note:-

- ACET Examination is conducted only in India.

- **ACET result is valid for 3 years from the date of declaration of the exam result for taking student membership of IAI.**

Syllabus

Mathematics

- Notation and standard functions
- Numerical Methods
- Algebra
- Differentiation
- Integration
- Vectors
- Matrices

Statistics

- Permutations and combinations.
- Types of data
  - Statistical diagrams, bar chart, histogram, dot plot, stem-and-leaf, boxplot.
- Measures of location
  - mean, median, mode
- Measures of spread
  - range, interquartile range, standard deviation, variance, Skewness
- Probabilities
  - basic rules of probabilities
- Advanced probabilities

- o tree diagrams, conditional probabilities
- Discrete random variables
  - o definitions, probabilities, mean, mode, median, standard deviation, variance, coefficient of skewness
- Continuous random variables
  - o definitions, probabilities, mean, mode, median, standard deviation, variance, coefficient of skewness
- Discrete distributions
  - o discrete uniform, Bernoulli, binomial, Poisson
- Continuous distributions
  - o continuous uniform, exponential, the normal distribution
- Correlation
  - o scatter plots, covariance, correlation coefficient
- Regression

English

- Vocabulary Based (Synonyms Antonyms)
- English Usage or Grammar
- Sentence Correction
- Fill in the blanks
- Cloze Passage
- Analogies or Reverse Analogies
- Jumbled Paragraph
- Meaning-Usage Match
- Summary Questions
- Verbal Reasoning
- Facts / Inferences / Judgements
- Reading Comprehension
- Vocabulary: Vocabulary questions test the candidate's knowledge of the primary meanings of words, secondary shades of meaning, usage, idioms and phrases, antonyms, related words, etc.
- Grammar: Grammar-based questions test the candidate's ability to spot and correct grammatical errors. It should generally tests knowledge of high school level grammar and

includes areas like subject-verb agreement, use of modifiers, parallel construction, redundancy, phrasal verbs, use of articles, prepositions, etc.

- **Verbal Reasoning:** Verbal Reasoning questions are designed to test the candidate's ability to identify relationships or patterns within groups of words or sentences.

Data interpretation

Data is given in form of tables, charts and graphs. In this section it is tested that how can you interpret the given data and answers the questions based on it.

- Tables
- Column Graphs
- Bar Graphs
- Line Charts
- Pie Chart
- Venn Diagrams
- Case lets

Combination of two or more types linked to each other.

Logical reasoning

- Number and Letter Series
- Calendars
- Clocks
- Cubes
- Venn Diagrams
- Binary Logic
- Seating Arrangement
- Logical Sequence
- Logical Matching

- **Logical Connectives**
- **Syllogism**
- **Blood Relations**

Actuarial main exam syllabus

CORE PRINCIPLES

CS1 – Actuarial Statistics Aim The aim of the Actuarial Statistics 1 subject is to provide a grounding in mathematical and statistical techniques that are of particular relevance to actuarial work. Competences On successful completion of this subject, a candidate will be able to:

1 describe the essential features of statistical distributions.

2 summarise data using appropriate statistical analysis, descriptive statistics and graphical presentation.

3 describe and apply the principles of statistical inference.

4 describe, apply and interpret the results of the linear regression model and generalised linear models.

5 explain the fundamental concepts of Bayesian statistics and use them to compute Bayesian estimators. Links to other subjects CS2 builds directly on the material in this subject.

CM1 and CM2 apply the material in this subject to actuarial and financial modelling. This subject assumes that a candidate will be competent in the following elements of foundational mathematics and basic statistics:

1 Summarise the main features of a data set (exploratory data analysis)

1.1 Summarise a set of data using a table or frequency distribution, and display it graphically using a line plot, a box plot, a bar chart,

histogram, stem and leaf plot or another appropriate elementary device.

1.2 Describe the level/location of a set of data using the mean, median, mode, as appropriate.

1.3 Describe the spread/variability of a set of data using the standard deviation, range, interquartile range, as appropriate.

1.4 Explain what is meant by symmetry and skewness for the distribution of a set of data.

2 Probability

2.1 Set functions and sample spaces for an experiment and an event.

 2.2 Probability as a set function on a collection of events and its basic properties.

 2.3 Calculate probabilities of events in simple situations.

 2.4 Derive and use the addition rule for the probability of the union of two events.

2.5 Define and calculate the conditional probability of one event given the occurrence of another event.

2.6 Derive and use Bayes' theorem for events.

 2.7 Define independence for two events, and calculate probabilities in situations involving independence.

3 Random variables

3.1 Explain what is meant by a discrete random variable, define the distribution function and the probability function of such a variable, and use these functions to calculate probabilities.

3.2 Explain what is meant by a continuous random variable, define the distribution function and the probability density function of such a variable, and use these functions to calculate probabilities.

3.3 Define the expected value of a function of a random variable, the mean, the variance, the standard deviation, the coefficient of skewness and the moments of a random variable, and calculate such quantities.

3.4 Evaluate probabilities associated with distributions (by calculation or by referring to tables as appropriate).

3.5 Derive the distribution of a function of a random variable from the distribution of the random variable.

Syllabus topics

1 Random variables and distributions (20%)

2 Data analysis (10%)

3 Statistical inference (25%)

4 Regression theory and applications (30%)

5 Bayesian statistics (15%)

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that

objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations).

 In the CS subjects, the approximate split of assessment across the three skill types is 20% Knowledge, 65% Application and 15% Higher Order skills.

Detailed syllabus

objectives 1 Random variables and distributions (20%)

1.1 Define basic univariate distributions and use them to calculate probabilities, quantiles and moments.

1.1.1 Define and explain the key characteristics of the discrete distributions: geometric, binomial, negative binomial, hypergeometric, Poisson and uniform on a finite set.

 1.1.2 Define and explain the key characteristics of the continuous distributions: normal, lognormal, exponential, gamma, chi-square, t, F, beta and uniform on an interval.

1.1.3 Evaluate probabilities and quantiles associated with distributions (by calculation or using statistical software as appropriate).

1.1.4 Define and explain the key characteristics of the Poisson process and explain the connection between the Poisson process and the Poisson distribution.

1.1.5 Generate basic discrete and continuous random variables using the inverse transform method.

1.1.6 Generate discrete and continuous random variables using statistical software.

1.2 Independence, joint and conditional distributions, linear combinations of random variables.

1.2.1 Explain what is meant by jointly distributed random variables, marginal distributions and conditional distributions.

1.2.2 Define the probability function/density function of a marginal distribution and of a conditional distribution.

1.2.3 Specify the conditions under which random variables are independent.

1.2.4 Define the expected value of a function of two jointly distributed random variables, the covariance and correlation coefficient between two variables, and calculate such quantities.

1.2.5 Define the probability function/density function of the sum of two independent random variables as the convolution of two functions.

1.2.6 Derive the mean and variance of linear combinations of random variables.

1.2.7 Use generating functions to establish the distribution of linear combinations of independent random variables.

1.3 Expectations, conditional expectations.

1.3.1 Define the conditional expectation of one random variable given the value of another random variable, and calculate such a quantity.

1.3.2 Show how the mean and variance of a random variable can be obtained from expected values of conditional expected values, and apply this.

1.4 Generating functions.

 1.4.1 Define and determine the moment generating function of random variables.

 1.4.2 Define and determine the cumulant generating function of random variables.

1.4.3 Use generating functions to determine the moments and cumulants of random variables, by expansion as a series or by differentiation, as appropriate.

1.4.4 Identify the applications for which a moment generating function, a cumulant generating function and cumulants are used and the reasons why they are used.

1.5 Central limit theorem – statement and application.

1.5.1 State the central limit theorem for a sequence of independent, identically distributed random variables.

1.5.2 Generate simulated samples from a given distribution and compare the sampling distribution with the Normal.

2 Data analysis (10%)

2.1 Data analysis.

2.1.1 Describe the possible aims of a data analysis (e.g. descriptive, inferential and predictive).

2.1.2 Describe the stages of conducting a data analysis to solve real-world problems in a scientific manner and describe tools suitable for each stage.

2.1.3 Describe sources of data and explain the characteristics of different data sources, including extremely large data sets.

2.1.4 Explain the meaning and value of reproducible research and describe the elements required to ensure a data analysis is reproducible.

2.2 Exploratory data analysis.

2.2.1 Describe the purpose of exploratory data analysis.

2.2.2 Use appropriate tools to calculate suitable summary statistics and undertake exploratory data visualisations.

2.2.3 Define and calculate Pearson's, Spearman's and Kendall's measures of correlation for bivariate data, explain their interpretation and perform statistical inference as appropriate.

2.2.4 Use principal components analysis to reduce the dimensionality of a complex data set.

2.3 Random sampling and sampling distributions.

2.3.1 Explain what is meant by a sample, a population and statistical inference.

2.3.2 Define a random sample from a distribution of a random variable.

2.3.3 Explain what is meant by a statistic and its sampling distribution.

2.3.4 Determine the mean and variance of a sample mean and the mean of a sample variance in terms of the population mean, variance and sample size.

 2.3.5 State and use the basic sampling distributions for the sample mean and the sample variance for random samples from a normal distribution.

2.3.6 State and use the distribution of the t-statistic for random samples from a normal distribution.

2.3.7 State and use the F distribution for the ratio of two sample variances from independent samples taken from normal distributions.

3 Statistical inference (25%)

 ## 3.1 Estimation and estimators.

3.1.1 Describe and apply the method of moments for constructing estimators of population parameters.

3.1.2 Describe and apply the method of maximum likelihood for constructing estimators of population parameters.

3.1.3 Define the following terms: efficiency, bias, consistency and mean square error.

3.1.4 Define and apply the property of unbiasedness of an estimator.

3.1.5 Define the mean square error of an estimator, and use it to compare estimators.

3.1.6 Describe and apply the asymptotic distribution of maximum likelihood estimators.

3.1.7 Use the bootstrap method to estimate properties of an estimator.

3.2 Confidence intervals and prediction intervals.

3.2.1 Define in general terms a confidence interval for an unknown parameter of a distribution based on a random sample.

3.2.2 Define in general terms a prediction interval for a future observation based on a model fitted to a random sample.

3.2.3 Derive a confidence interval for an unknown parameter using a given sampling distribution.

3.2.4 Calculate confidence intervals for the mean and the variance of a normal distribution.

3.2.5 Calculate confidence intervals for a binomial probability and a Poisson mean, including the use of the normal approximation in both cases.

3.2.6 Calculate confidence intervals for two-sample situations involving the normal distribution and the binomial and Poisson distributions using the normal approximation.

3.2.7 Calculate confidence intervals for a difference between two means from paired data.

3.2.8 Use the bootstrap method to obtain confidence intervals.

3.3 Hypothesis testing and goodness of fit.

3.3.1 Explain what is meant by the following terms: null and alternative hypotheses, simple and composite hypotheses, type I and type II errors, sensitivity, specificity, test statistic, likelihood ratio, critical region, level of significance, probability value and power of a test.

3.3.2 Apply basic tests for the one-sample and two-sample situations involving the normal, binomial and Poisson distributions, and apply basic tests for paired data.

3.3.3 Apply the permutation approach to non-parametric hypothesis tests.

3.3.4 Use a chi-square test to test the hypothesis that a random sample is from a particular distribution, including cases where parameters are unknown.

3.3.5 Explain what is meant by a contingency (or two-way) table, and use a chi-square test to test the independence of two classification criteria.

4 Regression theory and applications (30%)

4.1 Linear regression.

4.1.1 Explain what is meant by response and explanatory variables.

4.1.2 State the simple regression model (with a single explanatory variable).

4.1.3 Derive the least squares estimates of the slope and intercept parameters in a simple linear regression model.

4.1.4 Use appropriate software to fit a simple linear regression model to a data set and interpret the output: • Perform statistical inference on the slope parameter. • Describe the use of measures of goodness of fit of a linear regression model. • Use a fitted linear relationship to predict a mean response or an individual response with confidence limits. • Use residuals to check the suitability and validity of a linear regression model.

4.1.5 State the multiple linear regression model (with several explanatory variables).

4.1.6 Use appropriate software to fit a multiple linear regression model to a data set and interpret the output. 4.1.7 Use measures of model fit to select an appropriate set of explanatory variables.

4.2 Generalised linear models.

4.2.1 Define an exponential family of distributions. Show that the following distributions may be written in this form: binomial, Poisson, exponential, gamma, normal.

4.2.2 State the mean and variance for an exponential family, and define the variance function and the scale parameter. Derive these quantities for the distributions above.

4.2.3 Explain what is meant by the link function and the canonical link function, referring to the distributions above.

4.2.4 Explain what is meant by a variable, a factor taking categorical values and an interaction term. Define the linear predictor, illustrating its form for simple models, including polynomial models and models involving factors.

4.2.5 Define the deviance and scaled deviance and state how the parameters of a generalised linear model may be estimated. Describe how a suitable model may be chosen by using an analysis of deviance and by examining the significance of the parameters.

4.2.6 Define the Pearson and deviance residuals and describe how they may be used.

4.2.7 Apply statistical tests to determine the acceptability of a fitted model: Pearson's chi-square test and the likelihood ratio test.

4.2.8 Fit a generalised linear model to a data set and interpret the output.

5 Bayesian statistics (15%)

5.1 Explain the fundamental concepts of Bayesian statistics and use these concepts to calculate Bayesian estimators.

5.1.1 Use Bayes' theorem to calculate simple conditional probabilities.

5.1.2 Explain what is meant by a prior distribution, a posterior distribution and a conjugate prior distribution.

5.1.3 Derive the posterior distribution for a parameter in simple cases.

5.1.4 Explain what is meant by a loss function.

5.1.5 Use simple loss functions to derive Bayesian estimates of parameters.

5.1.6 Derive credible intervals in simple cases.

5.1.7 Explain what is meant by the credibility premium formula and describe the role played by the credibility factor.

5.1.8 Explain the Bayesian approach to credibility theory and use it to derive credibility premiums in simple cases.

5.1.9 Explain the empirical Bayes approach to credibility theory and use it to derive credibility premiums in simple cases.

5.1.10 Explain the differences between the two approaches and state the assumptions underlying each of them.

Assessment

Assessment consists of a combination of a one-hour and forty-five-minute computer-based data analysis and statistical modelling assignment and a three-hour and fifteen-minute written examination.

END

CS2 – Risk Modelling and Survival Analysis Core Principles

Aim

The aim of the Risk Modelling and Survival Analysis Core Principles subject is to provide a grounding in mathematical and statistical modelling techniques that are of particular relevance to actuarial work, including stochastic processes and survival models and their application. Competences On successful completion of this subject, a candidate will be able to:

 1 describe and use statistical distributions for risk modelling.

2 describe and apply the main concepts underlying the analysis of time series models.

3 describe and apply Markov chains and processes.

4 describe and apply techniques of survival analysis.

5 describe and apply basic principles of machine learning. Links to other subjects This subject assumes that the candidate is competent with the material covered in CS1 and the required knowledge for that subject. CM1 and CM2 apply the material in this subject to actuarial and financial modelling. Topics in this subject are further built upon in SP1, SP7, SP8 and SP9.

Syllabus topics

1 Random variables and distributions for risk modelling (20%)

2 Time series (20%)

3 Stochastic processes (25%)

4 Survival models (25%)

5 Machine learning (10%)

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship examinations'. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the CS subjects, the approximate split of assessment across the three skill types is 20% Knowledge, 65% Application and 15% Higher Order skills. Detailed syllabus objectives

1 Random variables and distributions for risk modelling (20%)

1.1 Loss distributions, with and without risk sharing.

1.1.1 Describe the properties of the statistical distributions that are suitable for modelling individual and aggregate losses.

1.1.2 Explain the concepts of excesses (deductibles) and retention limits.

1.1.3 Describe the operation of simple forms of proportional and excess of loss reinsurance.

1.1.4 Derive the distribution and corresponding moments of the claim amounts paid by the insurer and the reinsurer in the presence of excesses (deductibles) and reinsurance.

1.1.5 Estimate the parameters of a failure time or loss distribution when the data is complete, or when it is incomplete, using maximum likelihood and the method of moments.

1.1.6 Fit a statistical distribution to a data set and calculate appropriate goodness-of-fit measures.

1.2 Compound distributions and their applications in risk modelling.

1.2.1 Construct models appropriate for short-term insurance contracts in terms of the numbers of claims and the amounts of individual claims.

1.2.2 Describe the major simplifying assumptions underlying the models in 1.2.1.

1.2.3 Define a compound Poisson distribution and show that the sum of independent random variables, each having a compound Poisson distribution, also has a compound Poisson distribution.

1.2.4 Derive the mean, variance and coefficient of skewness for compound binomial, compound Poisson and compound negative binomial random variables.

1.2.5 Repeat 1.2.4 for both the insurer and the reinsurer after the operation of simple forms of proportional and excess of loss reinsurance.

1.3 Introduction to copulas.

1.3.1 Describe how a copula can be characterised as a multivariate distribution function that is a function of the marginal distribution functions of its variates, and explain how this allows the marginal distributions to be investigated separately from the dependency between them.

1.3.2 Explain the meaning of the terms 'dependence or concordance', 'upper and lower tail dependence', and state in general terms how tail dependence can be used to help select a copula suitable for modelling particular types of risk.

1.3.3 Describe the form and characteristics of the Gaussian copula and the Archimedean family of copulas.

1.4 Introduction to extreme value theory.

1.4.1 Recognise extreme value distributions, suitable for modelling the distribution of severity of loss and their relationships.

1.4.2 Calculate various measures of tail weight and interpret the results to compare the tail weights.

2 Time series (20%)

2.1 Concepts underlying time series models.

2.1.1 Explain the concept and general properties of stationary, I(0), and integrated, I(1), univariate time series.

2.1.2 Explain the concept of a stationary random series.

2.1.3 Explain the concept of a filter applied to a stationary random series.

2.1.4 Know the notation for backwards shift operator, backwards difference operator and the concept of roots of the characteristic equation of time series.

2.1.5 Explain the concepts and basic properties of Autoregressive (AR), Moving Average (MA), Autoregressive Moving Average (ARMA) and Autoregressive Integrated Moving Average (ARIMA) time series.

2.1.6 Explain the concept and properties of discrete random walks and random walks with normally distributed increments, both with and without drift.

2.1.7 Explain the basic concept of a multivariate autoregressive model.

2.1.8 Explain the concept of cointegrated time series.

2.1.9 Show that certain univariate time series models have the Markov property and describe how to rearrange a univariate time series model as a multivariate Markov model.

2.2 Applications of time series models.

2.2.1 Outline the processes of identification, estimation and diagnosis of a time series, the criteria for choosing between models and the diagnostic tests that may be applied to the residuals of a time series after estimation

. 2.2.2 Describe briefly other non-stationary, non-linear time series models.

2.2.3 Describe simple applications of a time series model, including random walk, autoregressive and cointegrated models, as applied to security prices and other economic variables.

2.2.4 Develop deterministic forecasts from time series data, using simple extrapolation and moving-average models, applying smoothing techniques and seasonal adjustment when appropriate. 3 Stochastic processes (25%)

3.1 Describe and classify stochastic processes.

3.1.1 Define in general terms a stochastic process and in particular a counting process.

3.1.2 Classify a stochastic process according to whether it: • operates in continuous or discrete time. • has a continuous or a discrete state space. • is a mixed type. Give examples of each type of process.

3.1.3 Describe possible applications of mixed processes.

3.1.4 Explain what is meant by the Markov property in the context of a stochastic process and in terms of filtrations.

3.2 Define and apply a Markov chain.

3.2.1 State the essential features of a Markov chain model.

3.2.2 State the Chapman–Kolmogorov equations that represent a Markov chain.

3.2.3 Calculate the stationary distribution for a Markov chain in simple cases.

3.2.4 Describe a system of frequency-based experience rating in terms of a Markov chain and describe other simple applications.

3.2.5 Describe a time-inhomogeneous Markov chain model and describe simple applications.

3.2.6 Demonstrate how Markov chains can be used as a tool for modelling and how they can be simulated.

3.3 Define and apply a Markov process.

3.3.1 State the essential features of a Markov process model.

3.3.2 Define a Poisson process, derive the distribution of the number of events in a given time interval, derive the distribution of inter-event times and apply these results.

3.3.3 Derive the Kolmogorov equations for a Markov process with time-independent and time/age-dependent transition intensities.

3.3.4 Solve the Kolmogorov equations in simple cases.

3.3.5 Describe simple survival models, sickness models and marriage models in terms of Markov processes and describe other simple applications.

3.3.6 State the Kolmogorov equations for a model where the transition intensities depend not only on age/time, but also on the duration of stay in one or more states.

3.3.7 Describe sickness and marriage models in terms of duration-dependent Markov processes and describe other simple applications.

3.3.8 Demonstrate how Markov jump processes can be used as a tool for modelling and how they can be simulated.

4 Survival models (25%) 4.1 Explain concept of survival models.

4.1.1 Describe the model of lifetime or failure time from age x as a random variable.

4.1.2 State the consistency condition between the random variable representing lifetimes from different ages.

4.1.3 Define the distribution and density functions of the random future lifetime, the survival function, the force of mortality or hazard rate, and derive relationships between them.

4.1.4 Define the actuarial symbols tpx and tqx and derive integral formulae for them.

4.1.5 State the Gompertz and Makeham laws of mortality.

4.1.6 Define the curtate future lifetime from age x and state its probability function.

4.1.7 Define the symbols ex and ˚ex and derive an approximate relation between them. Define the expected value and variance of the complete and curtate future lifetimes and derive expressions for them.

4.1.8 Describe the two-state model of a single decrement and compare its assumptions with those of the random lifetime model.

4.2 Describe estimation procedures for lifetime distributions.

4.2.1 Describe the various ways in which lifetime data may be censored.

4.2.2 Describe the estimation of the empirical survival function in the absence of censoring and what problems are introduced by censoring.

4.2.3 Describe the Kaplan–Meier (or product limit) estimator of the survival function in the presence of censoring, compute it from typical data and estimate its variance.

4.2.4 Describe the Nelson–Aalen estimator of the cumulative hazard rate in the presence of censoring, compute it from typical data and estimate its variance.

4.2.5 Describe models for proportional hazards and how these models can be used to estimate the impact of covariates on the hazard.

4.2.6 Describe the Cox model for proportional hazards, derive the partial likelihood estimate in the absence of ties, and state the asymptotic distribution of the partial likelihood estimator.

4.3 Derive maximum likelihood estimators for transition intensities.

4.3.1 Describe an observational plan in respect of a finite number of individuals observed during a finite period of time, and define the resulting statistics, including the waiting times.

4.3.2 Derive the likelihood function for constant transition intensities in a Markov model of transfers between states given the statistics in 4.3.1.

4.3.3 Derive maximum likelihood estimators for the transition intensities in 4.3.2 and state their asymptotic joint distribution.

4.3.4 State the Poisson approximation to the estimator in 4.3.3 in the case of a single decrement.

4.4 Estimate transition intensities dependent on age (exact or census).

4.4.1 Explain the importance of dividing the data into homogeneous classes, including subdivision by age and sex.

4.4.2 Describe the principle of correspondence and explain its fundamental importance in the estimation procedure.

4.4.3 Specify the data needed for the exact calculation of a central exposed to risk (waiting time) depending on age and sex.

4.4.4 Calculate a central exposed to risk given the data in 4.4.3.

4.4.5 Explain how to obtain estimates of transition probabilities.

4.4.6 Explain the assumptions underlying the census approximation of waiting times.

4.4.7 Explain the concept of the rate interval.

4.4.8 Develop census formulae given age at birthday where the age may be classified as next, last or nearest relative to the birthday as appropriate, and the deaths and census data may use different definitions of age.

4.4.9 Specify the age to which estimates of transition intensities or probabilities in 4.4.8 apply.

4.5 Graduation and graduation tests.

4.5.1 Describe and apply statistical tests of the comparison crude estimates with a standard mortality table testing for: • the overall fit. • the presence of consistent bias. • the presence of individual ages where the fit is poor. • the consistency of the 'shape' of the crude estimates and the standard table. For each test, describe: • the formulation of the hypothesis. • the test statistic. • the distribution of the test statistic using approximations where appropriate. • the application of the test statistic.

4.5.2 Describe the reasons for graduating crude estimates of transition intensities or probabilities, and state the desirable properties of a set of graduated estimates.

4.5.3 Describe a test for smoothness of a set of graduated estimates.

4.5.4 Describe the process of graduation by the following methods, and state the advantages and disadvantages of each (the candidate will not be required to carry out a graduation): • Param metric formula • Standard table • Spline functions.

4.5. 5 Describe how the tests in 4.5.1 should be amended to compare crude and graduated sets of estimates.

4.5.6 Describe how the tests in 4.5.1 should be amended to allow for the presence of duplicate policies.

4.5.7 Carry out a comparison of a set of crude estimates and a standard table or of a set of crude estimates and a set of graduated estimates.

4.6 Mortality projection.

4.6.1 Describe the approaches to the forecasting of future mortality rates based on extrapolation, explanation and expectation, as well as their advantages and disadvantages.

4.6.2 Describe the Lee–Carter, age-period-cohort and p-spline regression models for forecasting mortality.

4.6.3 Use an appropriate computer package to apply the models in 4.6.2 to a suitable mortality data set.

4.6.4 List the main sources of error in mortality forecasts.

5 Machine learning (10%)

5.1 Explain and apply elementary principles of machine learning.

5.1.1 Explain the bias/variance trade-off and its relationship with model complexity.

5.1.2 Use cross-validation to evaluate models on unseen data, and to estimate hyper-parameters.

5.1.3 Explain how regularisation can be used to reduce overfitting in highly parameterised models.

5.1.4 Use software to apply supervised learning techniques, to solve regression and classification problems.

5.1.5 Use metrics such as precision, recall, F1 score and diagnostics such as the ROC curve and confusion matrix to evaluate the performance of a binary classifier.

5.1.6 Apply unsupervised learning techniques (principal component analysis, K-means clustering) to reduce data dimensionality, identify latent substructure and detect anomalies.

Assessment Combination of a one-hour and forty-five-minute computer-based data analysis and statistical modelling assignment and a three- hour and fifteen-minute written examination.

CM1 – Actuarial Mathematics Aim The aim of the Actuarial Mathematics subject is to provide a grounding in the principles of modelling as applied to actuarial work – focusing particularly on deterministic models that can be used to model and value known cashflows as well as those that are dependent on death, survival or other uncertain risks. Competences On the successful completion of this subject, the candidate will be able to:

1 describe the basic principles of actuarial modelling.

2 describe, interpret and discuss the theories on interest rates.

3 describe, interpret and discuss mathematical techniques used to model and value cashflows that are contingent on mortality and morbidity risks. Links to other subjects Concepts are introduced in:

CS1 – Actuarial Statistics Topics in this subject are further built upon in: CM2 – Financial Engineering and Loss Reserving CB1 – Business Finance CP1 – Actuarial Practice CP2 – Modelling Practice SP1 – Health and Care Principles SP2 – Life Insurance Principles SP4 – Pensions and other Benefits Principles

Syllabus topics

1 Data and basics of modelling (10%)

2 Theory of interest rates (20%)

3 Equation of value and its applications (15%)

4 Single decrement models (10%)

5 Multiple decrement and multiple life models (10%)

6 Pricing and reserving (35%)

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based

Skill levels the use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting

situations, suggesting possible solutions and actions and making recommendations).

In the CM subjects, the approximate split of assessment across the three skill types is 20% Knowledge, 65% Application and 15% Higher Order skills.

Detailed syllabus objectives

1 Data and basics of modelling (10%)

1.1 Describe the principles of actuarial modelling.

1.1.1 Describe why and how models are used, including, in general terms, the use of models for pricing, reserving and capital modelling.

1.1.2 Explain the benefits and limitations of modelling.

1.1.3 Explain the difference between a stochastic and a deterministic model, and identify the advantages/disadvantages of each.

1.1.4 Describe the characteristics, and explain the use, of scenario-based and proxy models.

1.1.5 Describe, in general terms, how to decide whether a model is suitable for any particular application.

1.1.6 Explain the difference between the short-run and long-run properties of a model and how this may be relevant in deciding whether a model is suitable for any particular application.

1.1.7 Describe, in general terms, how to analyse the potential output from a model, and explain why this is relevant to the choice of model.

1.1.8 Describe the process of sensitivity testing of assumptions, and explain why this forms an important part of the modelling process.

1.1.9 Explain the factors that must be considered when communicating the results following the application of a model.

1.2 Describe how to use a generalised cashflow model to describe financial transactions.

1.2.1 State the inflows and outflows in each future time period, and discuss whether the amount or the timing (or both) is fixed or uncertain for a given cashflow process.

1.2.2 Describe in the form of a cashflow model the operation of financial instruments (like a zero-coupon bond, a fixed interest security, an index-linked security, a current account, cash on deposit, a credit card, an equity, an interest only loan, a repayment loan and an annuity certain) and an insurance contract (like endowment, term assurance, contingent annuity, car insurance and health cash plans).

2 Theory of interest rates (20%)

2.1 Show how interest rates may be expressed in different time periods.

2.1.1 Describe the relationship between the rates of interest and discount over one effective period arithmetically and by general reasoning.

2.1.2 Derive the relationships between the rate of interest payable once per measurement period (effective rate of interest) and the rate of interest payable p (> 1) times per measurement period (nominal rate of interest) and the force of interest.

2.1.3 Calculate the equivalent annual rate of interest implied by the accumulation of a sum of money over a specified period where the force of interest is a function of time.

2.2 Demonstrate a knowledge and understanding of real and money interest rates.

2.3 Describe how to take into account the time value of money using the concepts of compound interest and discounting.

2.3.1 Accumulate a single investment at a constant rate of interest under the operation of simple and compound interest

2.3.2 Define the present value of a future payment.

2.3.3 Discount a single investment under the operation of a simple (commercial) discount at a constant rate of discount.

2.4   Calculate present value and accumulated value for a given stream of cashflows under the following individual or combination of scenarios:

2.4.1 Cashflows are equal at each time period.

2.4.2 Cashflows vary with time, which may or may not be a continuous function of time.

2.4.3 Some of the cashflows are deferred for a period of time.

2.4.4 Rate of interest or discount is constant.

2.4.5 Rate of interest or discount varies with time, which may or may not be a continuous function of time.

2.5 Define and derive the following compound-interest functions (where payments can be in advance or in arrears) in terms i, v, n, d, δ, i(p) and d(p):

2.5.1 a , s , a (p) , s (p) , a , s , a (p) , s (p) , a and s n n n n n n n n n n 2.5.2 m a , a (p) , a , a (p) and a | n m| n m| n m| n m| n 2.5.3 (Ia) n , (Ia) n , (Ia) n and (I a) n and the respective deferred annuities.

2.6 Show an understanding of the term structure of interest rates.

2.6.1 Describe the main factors influencing the term structure of interest rates.

2.6.2 Explain what is meant by, derive the relationships between and evaluate: • discrete spot rates and forward rates. • continuous spot rates and forward rates.

2.6.3 Explain what is meant by the par yield and yield to maturity.

2.7 Show an understanding of duration, convexity and immunisation of cashflows.

2.7.1 Define the duration and convexity of a cashflow sequence, and illustrate how these may be used to estimate the sensitivity of the value of the cashflow sequence to a shift in interest rates.

2.7.2 Evaluate the duration and convexity of a cashflow sequence.

2.7.3 Explain how duration and convexity are used in the (Redington) immunisation of a portfolio of liabilities.

3 Equation of value and its applications (15%) 3.1 Define an equation of value.

3.1.1 Define an equation of value, where payment or receipt is certain.

3.1.2 Describe how an equation of value can be adjusted to allow for uncertain receipts or payments.

3.1.3 Understand the two conditions required for there to be an exact solution to an equation of value.

3.2 Use the concept of equation of value to solve various practical problems.

3.2.1 Apply the equation of value to loans repaid by regular instalments of interest and capital. Obtain repayments, interest and capital components, the effective interest rate (APR) and construct a schedule of repayments.

3.2.2 Calculate the price of, or yield (nominal or real allowing for inflation) from, a bond (fixed-interest or index-linked) where the investor is subject to deduction of income tax on coupon payments and redemption payments are subject to deduction of capital gains tax.

3.2.3 Calculate the running yield and the redemption yield for the financial instrument as described in 3.2.2.

3.2.4 Calculate the upper and lower bounds for the present value of the financial instrument as described in 3.2.2, when the redemption date can be a single date within a given range at the option of the borrower.

3.2.5 Calculate the present value or yield (nominal or real allowing for inflation) from an ordinary share or property, given constant or variable rate of growth of dividends or rents.

3.3 Show how discounted cashflow and equation of value techniques can be used in project appraisals.

3.3.1 Calculate the net present value and accumulated profit of the receipts and payments from an investment project at given rates of interest.

3.3.2 Calculate the internal rate of return,

payback period and discounted payback period and discuss their suitability for assessing the suitability of an investment project.

4. Single decrement models (10%)

4.1 Define various assurance and annuity contracts.

4.1.1 Define the following terms: • **Whole-life assurance** • **Term assurance** • **Pure endowment** • **Endowment assurance** • **Whole-life level annuity** • **Temporary level annuity** • **Guaranteed level annuity** • **Premium** • **Benefit including assurance and annuity contracts where the benefits are deferred.**

4.1.2 Describe the operation of conventional with-profits contracts, in which profits are distributed by the use of regular reversionary bonuses and by terminal bonuses. Describe the benefits payable under the above assurance-type contracts.

4.1.3 Describe the operation of conventional unit-linked contracts, in which death benefits are expressed as combination of absolute amount and relative to a unit fund.

4.1.4 Describe the operation of accumulating with-profits contracts, in which benefits take the form of an accumulating fund of premiums, where either: • **the fund is defined in monetary terms, has no explicit charges and is increased by the addition of regular guaranteed and bonus interest payments plus a terminal bonus; or** • **the fund is defined in terms of the value of a unit fund, is subject to explicit charges and is increased by regular bonus additions plus a terminal bonus (unitised with-profits). In the case of unitised with-profits, the regular additions can take the form of (a) unit price increases (guaranteed and/or discretionary) or (b) allocations of additional units. In either case, a guaranteed minimum monetary death benefit may be applied.**

4.2 Develop formulae for the means and variances of the payments under various assurance and annuity contracts, assuming constant deterministic interest rate.

4.2.1 Describe the life table functions lx and dx and their select equivalents l[x]+r and d[x]+r.

4.2.2 Define the following probabilities: $_n p_x$, $_n q_x$, $_{n|m} q_x$, $_{n|} q_x$ and their select equivalents $_n p_{[x]+r}$, $_n q_{[x]+r}$, $_{n|m} q_{[x]+r}$, $_{n|} q_{[x]+r}$.

4.2.3 Express the probabilities defined in 4.2.2 in terms of life table functions defined in 4.2.1.

4.2.4 Define the assurance and annuity factors and their select and continuous equivalents. Extend the annuity factors to allow for the possibility that payments are more frequent than annual but less frequent than continuous.

4.2.5 Understand and use the relations between annuities payable in advance and in arrear, and between temporary, deferred and whole-life annuities.

4.2.6 Understand and use the relations between assurance and annuity factors using equation of value, and their select and continuous equivalents.

4.2.7 Obtain expressions in the form of sums/integrals for the mean and variance of the present value of benefit payments under each contract defined in 4.1.1, in terms of the (curtate) random future lifetime, assuming: • contingent benefits (constant, increasing or decreasing) are payable at the middle or end of the year of the contingent event or continuously. • annuities are paid in advance, in arrear or continuously, and the amount is constant, increases or decreases by a constant monetary amount or by a fixed or time-dependent variable rate. • premiums are payable in advance, in arrear or continuously and for the full policy term or for a limited period. Where appropriate, simplify the above expressions into a form suitable for evaluation by table look-up or other means.

4.2.8 Define and evaluate the expected accumulations in terms of expected values for the contracts described in 4.1.1 and contract structures described in 4.2.7.

5 Multiple decrement and multiple life models (10%)

5.1 Define and use assurance and annuity functions involving two lives.

5.1.1 Extend the techniques of objectives 4.2 to deal with cashflows dependent upon the death or survival of either or both of two lives.

5.1.2 Extend the technique of 5.1.1 to deal with functions dependent upon a fixed term as well as age.

5.2 Describe and illustrate methods of valuing cashflows that are contingent upon multiple transition events.

5.2.1 Define health insurance, and describe simple health insurance premium and benefit structures.

5.2.2 Explain how a cashflow, contingent upon multiple transition events, may be valued using a multiple-state Markov Model, in terms of the forces and probabilities of transition.

5.2.3 Construct formulae for the expected present values of cashflows that are contingent upon multiple transition events, including simple health insurance premiums and benefits, and calculate these in simple cases. Regular premiums and sickness benefits are payable continuously and assurance benefits are payable immediately on transition.

5.3 Describe and use methods of projecting and valuing expected cashflows that are contingent upon multiple decrement events.

5.3.1 Describe the construction and use of multiple decrement tables.

5.3.2 Define a multiple decrement model as a special case of multiple-state Markov model.

5.3.3 Derive dependent probabilities for a multiple decrement model in terms of given forces of transition, assuming forces of transition are constant over single years of age.

5.3.4 Derive forces of transition from given dependent probabilities, assuming forces of transition are constant over single years of age.

6 Pricing and reserving (35%)

6.1 Define the gross random future loss under an insurance contract, and state the principle of equivalence.

6.2 Describe and calculate gross premiums and reserves of assurance and annuity contracts.

6.2.1 Define and calculate gross premiums for the insurance contract benefits as defined in

objective 4.1 under various scenarios using the equivalence principle or otherwise: • Contracts may accept only single premium. • Regular premiums and annuity benefits may be payable annually more frequently than annually or continuously. • Death benefits (which increase or decrease by a constant compound rate or by a constant monetary amount) may be payable at the end of the year of death or immediately on death. • Survival benefits (other than annuities) may be payable at defined intervals other than at maturity.

6.2.2 State why an insurance company will set up reserves.

6.2.3 Define and calculate gross prospective and retrospective reserves.

6.2.4 State the conditions under which, in general, the prospective reserve is equal to the retrospective reserve allowing for expenses.

6.2.5 Prove that under the appropriate conditions, the prospective reserve is equal to the retrospective reserve, with or without allowance for expenses, for all fixed benefit and increasing/decreasing benefit contracts.

6.2.6 Obtain recursive relationships between successive periodic gross premium reserves, and use this relationship to calculate the profit earned from a contract during the period.

6.2.7 Outline the concepts of net premiums and net premium valuation and how they relate to gross premiums and gross premium valuation respectively.

6.3 Define and calculate, for a single policy or a portfolio of policies (as appropriate): • death strain at risk • expected death strain • actual death strain • mortality profit for policies with death benefits payable immediately on death or at the end of the year of death, policies paying annuity benefits at the start of the year or on survival to the end of the year and policies where single or non-single premiums are payable

6.4 Project expected future cashflows for whole life, endowment and term assurances, annuities, unit-linked contracts and conventional/unitised with-profits contracts, incorporating multiple decrement models as appropriate.

6.4.1 Profit test life insurance contracts of the types listed above and determine the profit vector, the profit signature, the net present value and the profit margin.

6.4.2 Show how a profit test may be used to price a product, and use a profit test to calculate a premium for life insurance contracts of the types listed above.

6.4.3 Show how gross premium reserves can be computed using the above cashflow projection model and included as part of profit testing.

6.5 Show how, for unit-linked contracts, non-unit reserves can be established to eliminate ('zeroise') future negative cashflows, using a profit test model. Assessment Combination of a one-hour and forty-five-minute computer-based modelling assignment and a three-hour and fifteen-minute written examination.

CM2 – Financial Engineering and Loss Reserving Aim The aim of the Financial Engineering and Loss Reserving subject is to provide a grounding in the principles of modelling as applied to actuarial work – focusing particularly on stochastic asset and liability models as well as the valuation of financial derivatives. These skills are also required to communicate with other financial professionals and to critically evaluate modern financial theories. **Competences** On successful completion of this subject,

a student will be able to:

1 describe, interpret and discuss the theories on the behaviour of financial markets.

2 discuss the advantages and disadvantages of different measures of investment risk.

3 describe, construct, interpret and discuss the models underlying asset valuations.

4 describe, construct, interpret and discuss the models underlying liability valuations.

5 describe, construct, interpret and discuss the models underlying option pricing. **Links to other subjects Concepts are introduced in:** CS1 – Actuarial Statistics CS2 – Risk Modelling and Survival Analysis CM1 – Actuarial Mathematics CB2 – Business Economics Topics in this subject are further built upon in: CP1 – Actuarial Practice CP2 – Modelling Practice SP5 – Investment and Finance Principles SP6 – Financial Derivatives Principles SP9 – Enterprise Risk Management Principles

Syllabus topics

1 Theories of financial market behaviour (15%)

2 Measures of investment risk (15%)

3 Stochastic investment return models (10%)

4 Asset valuations (20%)

5 Liability valuations (20%)

6 Option theory (20%) These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions.

CM2 The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations'. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking

into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the CM subjects, the approximate split of

assessment across the three skill types is 20% Knowledge, 65% Application and 15% Higher Order skills.

Detailed syllabus objectives

1 Theories of financial market behaviour (15%)

1.1 Rational expectations theory.

1.1.1 Discuss the three forms of the Efficient Markets Hypothesis and their consequences for investment management.

1.1.2 Describe briefly the evidence for or against each form of the Efficient Markets Hypothesis.

1.2 Rational choice theory.

1.2.1 Explain the meaning of the term 'utility function'.

1.2.2 Explain the axioms underlying utility theory and the expected utility theorem.

1.2.3 Explain how the following economic characteristics of investors can be expressed mathematically in a utility function: • Non-satiation • Risk aversion, risk neutrality and risk seeking • Declining or increasing absolute and relative risk aversion.

1.2.4 Discuss the economic properties of commonly used utility functions.

1.2.5 Discuss how a utility function may depend on current wealth and discuss state-dependent utility functions.

1.2.6 Perform calculations using commonly used utility functions to compare investment opportunities.

1.2.7 State conditions for absolute dominance and for first- and second-order dominance.

1.2.8 Analyse simple insurance problems in terms of utility theory.

1.3 Behavioural economics.

1.3.1 Describe the main features of Kahneman and Tversky's prospect theory critique of expected utility theory.

1.3.2 Explain what is meant by 'framing', 'heuristics' and 'bias' in the context of financial markets and describe the following features of behaviour in such markets: • The herd instinct • Anchoring and adjustment • Self-serving bias • Loss aversion • Confirmation bias• Availability bias • Familiarity bias.

1.3.3 Describe the Bernartzi and Thaler solution to the equity premium puzzle.

2 Measures of investment risk (15%)

2.1 Properties of risk measures.

2.1.1 Define the following measures of investment risk: • Variance of return • Downside semi-variance of return • Shortfall probabilities • Value at Risk (VaR) • Tail VaR (also referred to as Expected Shortfall).

2.1.2 Describe how the risk measures listed in 2.1.1 are related to the form of an investor's utility function.

2.1.3 Perform calculations using the risk measures listed in 2.1.1 to compare investment opportunities.

2.1.4 Explain how the distribution of returns and the thickness of tails will influence the assessment of risk.

2.2 Risk and insurance companies.

2.2.1 Describe how insurance companies help to reduce or remove risk.

2.2.2 Explain what is meant by the terms 'moral hazard' and 'adverse selection'.

3 Stochastic interest rate of return models (10%)

3.1 Show an understanding of simple stochastic models for investment returns.

3.1.1 Describe the concept of a stochastic investment return model and the fundamental distinction between this and a deterministic model.

3.1.2 Derive algebraically, for the model in which the annual rates of return are independently and identically distributed and for other simple models, expressions for the mean value and the variance of the accumulated amount of a single premium.

3.1.3 Derive algebraically, for the model in which the annual rates of return are independently and identically distributed, recursive relationships that permit the evaluation of the mean value and the variance of the accumulated amount of an annual premium.

3.1.4 Derive analytically, for the model in which each year the random variable (1 + r) has an independent log-normal distribution, the distribution functions for the accumulated amount of a single premium and for the present value of a sum due at a given specified future time.

3.1.5 Apply the above results to the calculation of the probability that a simple sequence of payments will accumulate to a given amount at a specific future time.

4 Asset valuations (20%)

4.1 Mean-variance portfolio theory.

4.1.1 Describe and discuss the assumptions of mean-variance portfolio theory.

4.1.2 Discuss the conditions under which application of mean-variance portfolio theory leads to the selection of an optimum portfolio.

4.1.3 Calculate the expected return and risk of a portfolio of many risky assets, given the expected return, variance and covariance of returns of the individual assets, using mean-variance portfolio theory.

4.1.4 Explain the benefits of diversification using mean-variance portfolio theory.

4.2 Asset pricing models.

4.2.1 Describe the assumptions, principal results and uses of the Sharpe-Lintner-Mossin Capital Asset Pricing Model (CAPM).

4.2.2 Discuss the limitations of the basic CAPM and some of the attempts that have been made to develop the theory to overcome these limitations.

4.2.3 Perform calculations using the CAPM.

4.2.4 Discuss the main issues involved in estimating parameters for asset pricing models.

4.3 Single and multifactor models for investment returns.

4.3.1 Describe the three types of multifactor models of asset returns: • Macroeconomic models • Fundamental factor models • Statistical factor models.

4.3.2 Discuss the single-index model of asset returns.

4.3.3 Discuss the concepts of diversifiable and non-diversifiable risk.

4.3.4 Discuss the construction of the different types of multifactor models.

4.3.5 Perform calculations using both single and multifactor models.

4.4 Stochastic models for security prices.

4.4.1 Discuss the continuous time log-normal model of security prices and the empirical evidence for or against the model.

4.4.2 Explain the definition and basic properties of standard Brownian motion or Wiener process.

4.4.3 Demonstrate a basic understanding of stochastic differential equations, the Ito integral, diffusion and mean-reverting processes.

4.4.4 State Ito's Lemma and be able to apply it to simple problems.

4.4.5 Write down the stochastic differential equation for geometric Brownian motion and show how to find its solution.

4.4.6 Write down the stochastic differential equation for the Ornstein-Uhlenbeck process and show how to find its solution.

4.5 Models of the term structures of interest rates.

4.5.1 Explain the principal concepts and terms underlying the theory of a term structure of interest rates.

4.5.2 Describe the desirable characteristics of models for the term structure of interest rates.

4.5.3 Apply the term structure of interest rates to modelling various cashflows, including calculating the sensitivity of the value to changes in the term structure.

4.5.4 Describe, as a computational tool, the risk-neutral approach to the pricing of zero-coupon bonds and interest-rate derivatives for a general one-factor diffusion model for the risk-free rate of interest.

4.5.5 Demonstrate an awareness of the Vasicek, Cox-Ingersoll-Ross and Hull-White models for the term structure of interest rates.

4.5.6 Discuss the limitations of these one-factor models and show an awareness of how these issues can be addressed.

4.6 Simple models for credit risk.

4.6.1 Define the terms 'credit event' and 'recovery rate'.

4.6.2 Describe the different approaches to modelling credit risk: structural models, reduced form models, intensity-based models.

4.6.3 Demonstrate a knowledge and understanding of the Merton model.

4.6.4 Demonstrate a knowledge and understanding of a two-state model for credit ratings with a constant transition intensity.

4.6.5 Describe how the two-state model can be generalised to the Jarrow-Lando-Turnbull model for credit ratings.

4.6.6 Describe how the two-state model can be generalised to incorporate a stochastic transition intensity.

5 Liability valuations (20%)

5.1 Ruin theory.

5.1.1 Explain what is meant by the aggregate claim process and the cashflow process for a risk.

5.1.2 Use the Poisson process and the distribution of inter-event times to calculate probabilities of the number of events in a given time interval and waiting times.

5.1.3 Define a compound Poisson process and calculate probabilities using simulation.

5.1.4 Define the probability of ruin in infinite/finite and continuous/discrete time and state, and explain relationships between the different probabilities of ruin.

5.1.5 Describe the effect on the probability of ruin, in both finite and infinite time, of changing parameter values by reasoning or simulation.

5.1.6 Calculate probabilities of ruin by simulation

5.2 Run-off triangles.

5.2.1 Define a development factor and show how a set of assumed development factors can be used to project the future development of a delay triangle.

5.2.2 Describe and apply a basic chain ladder method for completing the delay triangle using development factors.

5.2.3 Show how the basic chain ladder method can be adjusted to make explicit allowance for inflation.

5.2.4 Describe and apply the average cost per claim method for estimating outstanding claim amounts.

5.2.5 Describe and apply the Born huetter-Ferguson method for estimating outstanding claim amounts.

5.2.6 Describe how a statistical model can be used to underpin a run-off triangles approach.

5.2.7 Discuss the assumptions underlying the application of the methods in 5.2.1 to 5.2.6 above.

5.3 Value basic benefit guarantees using simulation techniques.

6 Option theory (20%)

6.1 Option pricing and valuations.

6.1.1 State what is meant by arbitrage and a complete market.

6.1.2 Outline the factors that affect option prices.

6.1.3 Derive specific results for options that are not model dependent: • Show how to value a forward contract. • Develop upper and lower bounds for European and American call and put options. • Explain what is meant by put–call parity.

6.1.4 Show how to use binomial trees and lattices in valuing options and solve simple examples.

6.1.5 Derive the risk-neutral pricing measure for a binomial lattice and describe the risk-neutral pricing approach to the pricing of equity options.

6.1.6 Explain the difference between the real-world measure and the risk-neutral measure. Explain why the risk-neutral pricing approach is seen as a computational tool (rather than a realistic representation of price dynamics in the real world).

6.1.7 State the alternative names for the risk-neutral and state-price deflator approaches to pricing.

6.1.8 Demonstrate an understanding of the Black-Scholes derivative-pricing model: • Explain what is meant by risk-neutral pricing and the equivalent martingale measure. • Derive the Black-Scholes partial differential equation both in its basic and Garman-Kohlhagen forms. • Demonstrate how to price and hedge a simple derivative contract using the martingale approach.

6.1.9 Show how to use the Black-Scholes model in valuing options and solve simple examples.

6.1.10 Discuss the validity of the assumptions underlying the Black-Scholes model.

6.1.11 Describe and apply in simple models, including the binomial model and the Black-Scholes model, the approach to pricing using deflators and demonstrate its equivalence to the risk-neutral pricing approach.

6.1.12 Demonstrate an awareness of the commonly used terminology for the first and, where appropriate, second partial derivatives (the Greeks) of an option price. Assessment Combination of a one-hour and forty-five-minute computer-based modelling assignment and a three-hour and fifteen-minute written examination.

CB1 – Business Finance Aim The aim of the Business Finance subject is to: • provide a basic understanding of corporate finance, including a knowledge of the instruments used by companies to raise finance and manage financial risk. • provide the ability to interpret the accounts and financial statements of companies and financial institutions. **Competences** On successful completion of this subject,

a candidate will be able to:

1 understand how companies are governed and structured.

2 suggest appropriate ways to finance a company.

3 analyse published accounts.

4 produce management information. **Links to other subjects** CB2 – Business Economics CB3 – Business Management CM1 – Actuarial Mathematics 1 CP1 – Actuarial Practice SP5 – Investment and Finance

Principles Syllabus topics

1 Corporate governance and organisation (20%)

2 How corporates are financed (25%)

3 Evaluating projects (15%)

4 Constructing and interpreting company accounts (40%) These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge-

or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic.

Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the CB1 subject, the approximate split of assessment across these three skill types is 20% Knowledge, 60% Application and 20% Higher Order skills.

Detailed syllabus objectives

1 Corporate governance and organisation (20%)

1.1 Explain the purpose and process of regulating the financial reporting information of incorporated entities.

1.2 Describe the key principles of corporate governance and the regulation of companies.

1.3 Demonstrate an awareness of the key principles of finance.

1.3.1 Outline the relationship between finance and the real resources and objectives of an organisation.

1.3.2 Outline the relationship between the stakeholders in an organisation (including lenders and investors).

1.3.3 Outline the role and effects of the capital markets.

1.3.4 Outline the maximisation of shareholder wealth as the main goal of financial management in a company.

1.3.5 Outline problems relating to the maximisation of shareholder wealth in practice: social responsibility concerns, agency problems and divergent objectives.

1.3.6 Outline the strategies employed by managers to maximise shareholder wealth.

1.3.7 Outline the determinants of value and the actions managers can take to influence value.

1.4 Discuss the ethical responsibilities of the owners and managers of businesses.

2 How corporates are financed (25%)

2.1 Describe the structure of a company and the different methods by which it may be financed.

2.1.1 Outline the distinctive characteristics of sole traders, partnerships, limited companies and social enterprises as business entities.

2.1.2 Describe the different types of loan and share capital.

2.1.3 Contrast authorised and issued share capital.

2.1.4 Discuss the economic advantages and disadvantages of a limited company as a business entity.

2.1.5 Outline the main differences between a private and public company.

2.1.6 Outline the following different types of medium-term company finance: • Credit sale • Leasing • Bank loans.

2.1.7 Describe the following different types of short-term company finance: • Bank overdrafts • Trade credit • Factoring • Bills of exchange • Commercial paper.

2.1.8 Describe alternative methods of raising finance outside the regular banking system, including 'shadow banking', direct project financing, peer-to-peer lending, crowd-funding and micro-finance.

2.2 Describe the basic principles of personal and corporate taxation.

2.2.1 Describe the basic principles of personal taxation of income and capital gains.

2.2.2 Describe the basic principles of company taxation.

2.2.3 Explain the different systems of company taxation from the points of view of an individual shareholder and the company.

2.2.4 Explain why investment funds, including private equity funds, might locate offshore if they obtain their funds from investors in a variety of jurisdictions.

2.2.5 Outline the basic principles of double taxation relief.

2.3 Demonstrate a knowledge and understanding of the characteristics of the principal forms of financial instrument issued or used by companies and the ways in which they may be issued.

2.3.1 Outline for a private company: • the reasons they may have for seeking a quotation on the stock exchange. • how shares are issued and traded. • the advantages and disadvantages for their remaining as a private company compared with becoming a publicly quoted company.

2.3.2 Describe the characteristics of the following: • Debenture stocks • Unsecured loan stocks • Eurobonds • Preference shares • Ordinary shares • Convertible unsecured loan stocks • Convertible preference shares • Contingent convertibles • Floating rate notes • Subordinated debt • Asset-backed securities • Options issued by companies.

2.3.3 Describe the characteristics and possible uses by a non-financial company of: • financial futures. • options. • interest rate and currency swaps.

2.3.4 Outline the following methods of obtaining a quotation for securities: • Offer for sale • Offer for sale by tender • Offer for subscription • Placing • Introduction.

2.3.5 Describe a rights issue to existing shareholders.

2.3.6 Describe the role of underwriting in the issue of securities.

2.4 Discuss the factors to be considered by a company when deciding on its capital structure and dividend policy.

2.4.1 Describe the effect that the capital structure used by a company will have on the market valuation of the company.

2.4.2 Describe the effect of taxation on the capital structure used by a company.

2.4.3 Discuss the principal factors that a company should consider in setting dividend policy.

2.4.4 Discuss alternative ways of distributing profits, such as buybacks.

2.4.5 Discuss the effect that the dividend policy will have on the market valuation of a company

2.5 Discuss how and why companies grow, how and why they may wish to divest and the different ways of company restructuring.

2.5.1 Describe why businesses want to grow larger, how companies achieve internal growth and explain the relationship between growth and profitability.

2.5.2 Describe the constraints on a firm's growth.

2.5.3 Explain why a company may wish to divest subsidiaries or business units.

2.6 Outline the motives for mergers and acquisitions.

2.6.1 Describe the characteristics of a merger.

2.6.2 Discuss methods of evaluating a target company.

2.6.3 Discuss the steps that a buyer will usually take in a leveraged buyout.

3 Evaluating projects (15%)

3.1 Discuss how a company's cost of capital interacts with the nature of the investment projects it undertakes.

3.1.1 Define what is meant by a company's cost of capital.

3.1.2 Describe how to calculate a company's weighted average cost of capital.

3.1.3 Discuss the principal methods that may be used to determine the viability of a capital project.

3.1.4 Carry out cash flow projections and techniques to estimate cashflows.

3.1.5 Describe methods commonly used to evaluate risky investments including simulation and certainty equivalents.

3.1.6 Discuss the issues in establishing the required rate of return for a capital project.

3.1.7 Discuss the factors underlying the choice of discount rate within project assessment, including: • the assumptions and limitations in the use of the weighted average cost of capital. • the allowance for leverage. • the allowance for risk.

3.1.8 Discuss the methods that may be used for identifying the risks that may be present for different types of project.

3.1.9 Discuss suitable techniques for ascertaining the probability of occurrence of different risks over varying timescales and the financial impact of occurrence.

3.1.10 Discuss suitable techniques for ascertaining the distribution of the possible financial outcomes of a capital project.

4 Constructing and interpreting company accounts (40%)

4.1 Describe the basic construction of accounts of different types and the role and principal features of the accounts of a company.

4.1.1 Explain why companies are required to produce annual reports and accounts.

4.1.2 Explain the value of financial reporting on environmental, social and economic sustainability.

4.1.3 Describe alternatives to traditional financial reporting.

4.1.4 Explain the fundamental accounting concepts that should be adopted in the drawing up of company accounts.

4.1.5 Explain the purpose of: • a statement of financial position. • a statement of comprehensive income. • a cash flow statement. • the notes to the accounts.

4.1.6 Construct simple statements of financial position and statements of profit or loss.

4.1.7 Explain cash flow statements.

4.1.8 Describe the structure and content of insurance company accounts.

4.1.9 Describe the structure and content of banking company accounts.

4.1.10 Explain what is meant by the terms subsidiary company and associated company.

4.1.11 Explain the purpose of consolidated accounts.

4.1.12 Explain how goodwill may arise on the consolidation of group accounts.

4.1.13 Explain how depreciation is treated in company accounts.

4.1.14 Explain the function of the following accounts – share capital, other reserves and retained earnings.

4.2 Assess the accounts of a company or a group of companies, including the limitations of such assessment.

4.2.1 Calculate and explain priority percentages and gearing.

4.2.2 Calculate and explain interest cover and asset cover for loan capital.

4.2.3 Describe the possible effects of interest rate movements on a highly geared company.

4.2.4 Calculate and explain price earnings ratio, dividend yield, dividend cover and Earnings Before Interest, Taxation, Depreciation and Amortisation (EBITDA).

4.2.5 Explain net earnings per share.

4.2.6 Calculate and explain accounting ratios that indicate: • profitability. • liquidity. • efficiency.

4.2.7 Discuss the working capital position of a company.

4.2.8 Discuss the shortcomings of historical cost accounting.

4.2.9 Discuss the limitations in the interpretation of company accounts.

4.2.10 Discuss the ways that reported figures can be manipulated to create a false impression of a company's financial position.

4.2.11 Describe the function of forecasts and budgets as sources of management information. Assessment Three-hour and fifteen-minute assessment using objective test questions and 'free form' answer questions.

CB2 – Business Economics Aim The aim of the Business Economics subject is to introduce candidates to the core economic principles and how these can be used in a business environment to help decision-making and behaviour. It provides the fundamental concepts of microeconomics that explain how economic agents make decisions and how these decisions interact. It explores the principles underlying macroeconomics that explain how the economic system works, where it fails and how decisions taken by economic agents affect the economic system. Competences On successful completion of this subject,

a candidate will be able to:

 1 show a systematic knowledge and critical awareness of economic theory in the areas of syllabus covered by the subject.

2 apply a range of techniques to solve problems in the areas of syllabus covered by the subject.

3 appreciate recent developments and methodologies in economics.

4 understand the relevance of economic theory to the business environment and the links between economic theory and its application in business.

5 apply basic microeconomic and macroeconomic theory to business problems. Links to other subjects CB1 – Business Finance CB3 – Business Management CM2 – Financial Engineering and Loss Reserving CP1 – Actuarial Practice SP5 – Investment and Finance Principles Other Specialist Principles subjects and all the Specialist Advanced subjects require the use of economic judgement.

Syllabus topics

1 Economic models and recent historical applications (5%)

2 Microeconomics (40%) • Behaviour of consumers • Behaviour of firms • Behaviour of markets.

3 Macroeconomics (55%) • Relationships between governments, markets and firms • Government policies • International trade. These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. 2 CB2 • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the CB2 subject, the approximate split of assessment across these three skill types is 20% Knowledge, 60% Application and 20% Higher Order skills.

Detailed syllabus objectives

1 Economic models and recent historical applications (5%)

1.1 Discuss the relevance of economics to the world of business.

1.1.1 Describe what is meant by opportunity cost and scarcity and their relevance to economic choice.

1.1.2 Discuss the core economic concepts involved in choices made by businesses relevant to selection of outputs, inputs, technology, location and competition.

1.1.3 Contrast microeconomics and macroeconomics.

1.2 Assess the main strands of economic thinking: • Classical • Marxian socialism • Neo-classical, Keynesian, neo-Keynesian and post-Keynesian • Monetarist • Austrian.

1.3 Analyse the recent macroeconomic history.

1.3.1 Describe the progress of the world economy since the Great Depression, with a particular focus on: • a history of banking crises and irrational behaviour. • consequences of banking crises.

1.3.2 Discuss the banking crisis of 2008, the Great Recession, and recovery.

1.3.3 Describe the effectiveness of monetary policy in the 2008 financial crisis and the governments' actions to combat recession.

1.3.4 Discuss the aftershocks in Europe following the 2008 financial crisis.

1.3.5 Assess the stimulus–austerity debate and regulatory action after the 2008 crisis.

2 Microeconomics – the behaviour of consumers, firms and markets (40%) 2.1 Discuss the workings of competitive markets.

2.1.1 Discuss how the markets operate. • Explain the role of the price mechanism in a free market. • Discuss the behaviour of firms and consumers in such markets.

2.1.2 Describe the factors that influence the market demand and supply.

2.1.3 Describe and discuss how market equilibrium quantity and price are achieved.

2.1.4 Discuss how markets react to changes in demand and supply.

2.1.5 Define and calculate price and income elasticities of demand and price elasticity of supply. • Calculate elasticities of demand using both original and average quantities. CB2 3

2.1.6 Discuss the factors that affect elasticity.

2.1.7 Explain the effect of elasticity on the workings of markets in the short and long run.

2.1.8 Discuss how firms deal with risk and uncertainty about future market movements.

2.1.9 Describe price expectations and speculation and how price bubbles develop.

2.2 Discuss consumer demand and behaviour.

2.2.1 Describe the concept of utility and representation of consumer preferences as indifference curves.

2.2.2 Discuss rational choice and how optimal consumption choice is determined by using indifference curves and budget lines.

2.2.3 Discuss the concepts of rational choice, perfect information and irrational behaviour in behavioural economics.

2.3 Discuss the importance of advertising for a firm.

2.3.1 Explain the effects of advertising on sales and demand.

2.4 Discuss the production function, costs of production, revenue and profit in order to understand a firm's price and output decisions.

2.4.1 Explain how the production function reflects the relationship between inputs and outputs in the short and long run.

2.4.2 Define average and marginal physical product.

2.4.3 Describe the meaning and measurement of costs and explain how these vary with output in the short and long run.

2.4.4 Define total, average and marginal costs.

2.4.5 Describe what is meant by 'economies of scale' and explain the reasons for such economies and how a business can achieve efficiency in selecting the level of its inputs.

2.4.6 Describe revenue and profit and explain how both are influenced by market conditions.

2.4.7 Define and calculate average and marginal revenue.

2.4.8 Describe how profit is measured and explain how the firm arrives at its profit-maximising output.

2.4.9 Explain what is meant by the 'shut-down' point in the short and long run.

2.5 Discuss profit maximisation under perfect competition and monopoly.

2.5.1 Explain what determines the market power of a firm.

2.5.2 Describe the main features of a market characterised by perfect competition.

2.5.3 Explain how output and price are determined in such markets in the short and long run.

2.5.4 Describe how monopolies emerge, how a monopolist selects its profit-maximising price and output and how much profit a monopolist makes.

2.5.5 Describe the barriers to entry in an industry and a contestable market and explain how these affect a monopolist's profit.

2.6 Discuss profit maximisation under imperfect competition.

2.6.1 Describe the behaviour of firms under monopolistic competition and explain why in this type of market only normal profits are made in the long run.

2.6.2 Describe the main features of an oligopoly and explain how firms behave in an oligopoly.

2.6.3 Discuss what determines competition and collusion of firms in an oligopoly and how the strategic decisions of such firms can be explained by game theory.

2.6.4 Discuss whether firms in an oligopoly act in consumers' interest.

2.7 Assess various pricing strategies that firms in the financial services sector can adopt.

2.7.1 Describe how prices are determined in practice and factors that affect the ability of a firm to determine its prices.

2.7.2 Describe average-cost pricing and price discrimination.

2.7.3 Discuss the pricing strategy for multiple products and explain how pricing varies with the stage in the life of a product.

3 Macroeconomics – relationships between governments, markets and firms, government policies and international trade (55%)

3.1 Discuss the reasons for government intervention in the market.

3.1.1 Explain and discuss the extent to which businesses meet the interests of consumers and society in general.

3.1.2 Explain in what sense perfect markets are 'socially efficient' and why most markets fail to achieve social efficiency. CB2 4

3.1.3 Explain why externalities can lead to inefficient markets.

3.1.4 Describe the ways in which governments intervene in markets in order to influence business behaviour, and explain the drawbacks of such intervention.

3.1.5 Explain and discuss whether taxation or regulation could be more useful in correcting markets' shortcomings.

3.1.6 Explain why government intervention might not improve market outcomes in practice even if the existence of 'market failures' suggest they can in theory.

3.1.7 Understand policy instruments that can be used to promote environmental sustainability.

3.2 Discuss the relationship between the government and the individual firm.

3.2.1 Describe the main targets of 'competition policy' and explain the extent to which it is effective.

3.2.2 Explain why a free market fails to achieve the optimal amount of research and development.

3.2.3 Describe the various forms of intervention that the government can undertake in order to encourage technological advance and innovation.

3.3 Discuss globalisation and multinational business.

3.3.1 Describe what is meant by globalisation and its impact on business.

3.3.2 Explain what is driving the process of globalisation and whether the world benefits from globalisation of business.

3.4 Discuss the importance of international trade.

3.4.1 Describe the growth of international trade and its benefits to countries and firms.

3.4.2 Explain the advantages of specialisation.

3.4.3 Discuss the arguments for trade restriction and protection of domestic industries.

3.4.4 Explain the role of the World Trade Organisation (WTO) in international trade.

3.5 Discuss the macroeconomic environment of the business.

3.5.1 Describe the main macroeconomic variables that governments seek to control.

3.5.2 Describe the effect on business output if a stimulus is given to the economy.

3.5.3 Contrast actual and potential growth.

3.5.4 Describe the factors that determine economic growth and explain the reasons for differences in different nations' growth rates.

3.5.5 Describe why economies experience periods of boom followed by periods of recession and explain factors that influence the length and magnitude of the phases of a business cycle.

3.5.6 Describe the causes and costs of unemployment and how unemployment relates to the level of business activity.

3.5.7 Discuss the determination of the price level in the economy by the interaction between aggregate supply (AS) and aggregate demand (AD) in a simple AS–AD model.

3.5.8 Describe the causes and costs of inflation and how inflation relates to the level of business activity.

3.5.9 Explain what is meant by GDP and describe how it is measured. 3.5.10 Discuss the representation of the economy as a simple model of the circular flow of income.

3.6 Discuss what is meant by the balance of payments and how exchange rates are determined.

3.6.1 Describe what is meant by 'the balance of payments' and how trade and financial movements affect it.

3.6.2 Explain how exchange rates are determined and how changes in exchange rates affect business.

3.6.3 Explain the relationship between the balance of payments and the exchange rates. 3.6.4 Discuss the advantages and disadvantages of fixed and floating exchange rates.

3.6.5 Explain how governments and/or central banks seek to influence the exchange rates.

3.6.6 Describe the implications of such actions for other macroeconomic policies and for business.

3.6.7 Describe the purpose and examine the effectiveness of monetary union and single currencies, with reference to the European Economic and Monetary Union, the Exchange Rate Mechanism and the creation of a single currency. CB2 5

3.7 Discuss the role of money and interest rates in the economy.

3.7.1 Describe the function of money.

3.7.2 Describe what determines the amount of money in the economy, what causes it to grow and the role of banks in this process.

3.7.3 Discuss the concept of the money multiplier in the real world.

3.7.4 Describe how interest rates are determined.

3.7.5 Explain the relationship between money and interest rates.

3.7.6 Explain why central banks play a crucial role in the functioning of economies.

3.7.7 Describe how a change in the money supply and/or interest rates affects the level of business activity.

3.8 Discuss the role, structure and stability of the financial system.

3.8.1 Describe the functions of the financial sector. 3.8.2 Distinguish between the functions of investment funds, banks and insurance companies/pension funds.

3.8.3 Describe the different ways banks and insurance companies can be exposed to credit risk and liquidity risks through: • bank loans • corporate bonds • securitisations (which can be owned by the non-bank sector) • syndicated loans • credit derivatives.

3.8.4 Discuss why the banking sector is more likely to be exposed to systemic risk than the non-bank financial sector.

3.8.5 Describe how financial innovation could lead to some functions of the banking sector being performed by non-banks.

3.8.6 Describe the basic principles on which Islamic finance is based.

3.8.7 Describe the features of one Islamic finance product and compare its features to the principles of Islamic finance.

3.9 Discuss what determines the level of business activity and how it affects unemployment and inflation.

3.9.1 Discuss how the equilibrium level of income is determined within a simple aggregate demand–expenditure model.

3.9.2 Describe the concept of the multiplier and calculate its value.

3.9.3 Describe the effect of a rise in money supply on output and prices.

3.9.4 Describe the relationship between unemployment and inflation and whether the relationship is stable.

3.9.5 Discuss how business and consumer expectations affect the relationship between unemployment and inflation and explain how such expectations are formed.

3.9.6 Describe how a policy of targeting inflation affects the relationship between unemployment and inflation.

3.9.7 Describe what determines the course of a business cycle and its turning points.

3.9.8 Discuss whether the business cycle is caused by changes in aggregate demand or changes in aggregate supply (or both).

3.10 Assess how macroeconomic policies impact on businesses.

3.10.1 Describe the types of macroeconomic policy that are likely to impact on business and explain the way in which this impact takes effect.

3.10.2 Describe the impact of fiscal policy on the economy and business and explain the factors that determine its effectiveness in smoothing out economic fluctuations.

3.10.3 Describe the fiscal rules adopted by the government and discuss if following these rules is a good idea.

3.10.4 Explain how monetary policy works in the UK and the Eurozone and describe the roles of the Bank of England and the European Central Bank.

3.10.5 Explain how targeting inflation influences interest rates and hence the economic activity.

3.10.6 Discuss the merits of following a simple inflation target as a rule for determining interest rates, and suggest an alternative rule. CB2 6

3.11 Assess how supply-side policies impact on businesses.

3.11.1 Describe the effect of supply-side policies on business and the economy.

3.11.2 Describe the types of supply-side policies that can be pursued and discuss their effectiveness.

3.11.3 Explain the impact on business of a policy of tax cuts.

3.11.4 Describe the major types of policy open to governments to encourage increased competition. Assessment Three-hour and fifteen-minute assessment using objective test questions and 'free form' answer questions.

CB3 – Business Management Aim The aim of Business Management is to provide candidates with an understanding of: • the business environment in which they will be working. • how to tackle business-related problems. • the basic legal principles that are relevant to actuarial work. • their professional responsibilities. • the need for lifelong learning. Links to other subjects Business Management has links to many other subjects. The knowledge gained should enable candidates to provide more rounded business-related solutions when working on later subjects and help them in the development of their practical work-based skills. Objectives On completion of this subject,

the candidate will be able to:

1 Specify, describe or discuss a range of topics relevant to working as an actuary in the financial services industry.

1.1 Specify the type of skills that must be acquired to become a competent practising actuary in the financial services industry.

1.2 List the aspects of an employing company about which knowledge should be obtained.

1.3 Specify those aspects of the financial services industry about which knowledge should be obtained and maintained.

1.4 Describe why it is important to know how other industries affect the financial services industry.

1.5 State those aspects of the global economy and politics about which some knowledge should be gained and maintained.

1.6 Describe the activities of the Institute and Faculty of Actuaries.

1.7 Discuss the issues and challenges faced currently by each main practice area, namely life, pensions, general, healthcare, finance, investment and enterprise risk management.

2 Develop an approach to strategic thinking.

2.1 Describe what a strategy is and how it relates to competitive advantage and competitive positioning.

2.2 Develop a process for strategic decision making.

2.3 Define a PEST analysis (Political/legislative, Economic, Societal, Technological) and describe how to carry one out.

2.4 Describe how to identify business and consumer needs and how to prioritise them.

2.5 Describe the industry value chain and how to apply it.

2.6 Discuss how to combat competitive forces.

2.7 Learn how to communicate strategic messages to gain buy-in and attention, selecting appropriate structures to present different types of information.

2.8 Discuss how a company's culture affects decision making.

2.9 Discuss how a company's structure affects decision making.

2.10 Analyse case studies and present results of the analyses.

1 CB3

3 Develop an approach to business decision making.

3.1 Discuss the importance of a clear mission statement.

3.2 Describe the importance of a clear business strategy.

3.3 Describe the benefits of teamwork.

3.4 Describe the advantages of time management.

3.5 Discuss the importance of extracting relevant information from a large volume of data.

3.6 Describe the interaction of various company functions.

3.7 Discuss the value of different people skills.

3.8 Assess their ability to influence others.

3.9 Discuss the advantages of communicating clearly.

3.10 Describe how to develop a decision-making process.

3.11 Discuss attitude to risk in decision making.

3.12 Discuss how competition can affect a market. 4 Describe and understand the basic legal principles that are relevant to the work of an actuary and their practical implications. 4.1 Appreciate the sources of English law and how Scottish law may differ (overview only).

4.2 Understand the requirements for a valid contract (overview only).

4.3 Identify when the courts will imply terms into contracts.

4.4 Understand the extent to which liability can be excluded.

4.5 Make simple assessments of likely contractual remedies.

4.6 Calculate a basic award of damages.

4.7 Identify the factors that must be established before liability for professional negligence can arise.

4.8 Understand the concept of a trust and the duties of trustees.

4.9 Understand the concept of agency and list the types of authority an agent may possess.

4.10 Appreciate the concepts of separate legal personality and limited liability.

4.11 Understand and, at a basic level, be able to explain the role of directors and shareholders within a company.

4.12 Appreciate the duties imposed on directors by statute, common law and equity.

4.13 At a basic level, be able to explain the nature of partnership and the duties owed by partners to insiders and third parties.

5 Describe or specify important aspects of professionalism and ethics. 5.1 State important characteristics of a profession and its advantages to interested parties.

5.2 Demonstrate a knowledge of the Actuaries' Code that binds all members of the Institute and Faculty of Actuaries.

5.3 List the measures by which the Financial Reporting Council and the Institute and Faculty of Actuaries regulate the activities of actuaries and candidates in the UK and overseas.

5.4 Describe the corporate governance structure of the Institute and Faculty of Actuaries.

5.5 Analyse appropriate case studies relating to professionalism and ethics, and present results of the analyses.

CORE PRACTICES

CP1 – Actuarial Practice Aim The aim of the Actuarial Practice subject is to use the technical and business skills learnt in the Actuarial Statistics, Actuarial Mathematics, Actuarial Modelling and Business subjects, combining them with new material on how the skills are applied to solve real world problems. The subject provides the essential knowledge of risk management techniques and processes required by all actuaries and is an essential introduction to Enterprise Risk Management, subject SP9 and the Chartered Enterprise Risk Actuary qualification. The subject also underpins the SP and SA subjects, covering essential background material that is common to a number of specialisms. Competences On successful completion of this subject,

a candidate will be able to:

1 understand strategic concepts in the management of financial institutions and products.

2 understand the risks faced both by individuals and groups who may affect financial products and also by the providers of such products.

3 explain the principles and techniques used to manage these risks.

4 understand the key techniques used by the providers of financial products to ensure that promised liabilities can be met.

5 apply this knowledge, together with the skills learned from other subjects, to analyse the issues and formulate, justify and present plausible solutions to business problems. Links to other subjects Each of subjects CS1, CS2, CM1, CM2, CP2, CB1 and CB2 provides principles and tools that are built upon in Actuarial Practice. The Specialist Principles Subjects SP1–SP9 and the Specialist Advanced Subjects SA1–SA7 use the concepts developed in this subject to solve more complex problems, produce coherent advice and make recommendations in specific practice areas.

Syllabus topics

1 Actuarial advice (2.5%)

2 Meeting the needs of stakeholders (2.5%)

3 The Actuarial Control Cycle (2.5%)

4 Risk governance (5%)

5 Risk identification and classification (5%)

6 Risk measurement and monitoring (5%)

7 Responses to risk (7.5%)

8 Capital management and monitoring (5%)

9 The general business environment (20%)

10 Specifying the problem (5%)

11 Producing the solution (30%)

12 Living with the solution (7.5%)

13 Monitoring (2.5%)

14 Principal terms (nil)

2 CP1 These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also correspond with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide a thorough foundation of understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge-based or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the command verbs defined in the document 'Command verbs used in the Associate and Fellowship written examinations'. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the CP1 subject, the approximate split of assessment across these three skill types is 20% Knowledge, 50% Application and 30% Higher Order skills. The focus of skills differs between the two papers. Paper 1 will primarily test Knowledge and Application skills.

 The approximate split of assessment for paper

1 across the three skill types is 30% Knowledge, 55% Application and 15% Higher Order skills. Paper

2 will primarily test the Application and Higher Order skills. The approximate split of assessment for paper 2 across the three skill types is 10% Knowledge, 45% Application and 45% Higher Order skills. Detailed syllabus objectives

1 Actuarial advice (2.5%)

1.1 Identify the clients that actuaries advise in both the public and private sectors and the stakeholders affected by that advice.

1.2 Describe how stakeholders other than the client may be affected by any actuarial advice given.

1.3 Describe the functions of the clients that actuaries advise and the types of advice that actuaries may give to their clients.

1.4 Explain why and how certain factual information about the client should be sought in order to be able to give advice.

1.5 Explain why subjective attitudes of clients and other stakeholders – especially towards risk – are relevant to giving advice.

1.6 Distinguish between the responsibility for giving advice and the responsibility for taking decisions.

1.7 Discuss the professional and technical standards that may apply to actuarial advice.

2 Meeting the needs of stakeholders (2.5%)

2.1 Describe the main providers of benefits on contingent events.

2.2 Describe the main types of social security benefits and financial products and explain how they can provide benefits on contingent events that meet the needs of clients and stakeholders.

2.3 Explain the main principles of insurance and pensions that impact on these benefits and products.

2.4 Describe the ways of analysing the needs of clients and stakeholders to determine appropriate financial products.

3 The Actuarial Control Cycle (2.5%)

3.1 Describe the Actuarial Control Cycle and explain the purpose of each of its components.

3.2 Demonstrate how the Actuarial Control Cycle can be applied in a variety of practical commercial situations, including its use as a risk management control cycle.

4 Risk governance (5%)

4.1 Describe the risk management process for a business that can aid in the design of financial products.

4.2 Discuss the differences between risk and uncertainty and between systematic and diversifiable risk. CP1 3

4.3 Describe how enterprise risk management can add value to the management of a business.

4.4 Discuss the roles and responsibilities of various stakeholders in the management of risk.

4.5 Discuss risk appetite and the attainment of risk efficiency.

5 Risk identification and classification (5%)

5.1 Describe the techniques that can be used to identify the risks associated with financial products or with their providers.

5.2 Discuss how the risks of a project are taken into account in project management.

5.3 Describe the risks and uncertainties affecting: • the level and incidence of benefits payable on contingent events. • the overall security of benefits payable on contingent events.

5.4 Describe how risk classification can aid the design of financial products.

5.5 Show an awareness and understanding of the risk categories that apply to businesses in general, and particularly financial services businesses.

6 Risk measurement and monitoring (5%)

6.1 Describe the various methods used to quantify risk.

6.2 Discuss the uses of scenario analysis, stress-testing and stochastic modelling in the evaluation of risk.

6.3 Describe different methods of risk aggregation and explain their relative advantages and disadvantages.

6.4 Explain the importance of risk reporting to managers and other stakeholders. 6.5 Discuss the methods of measuring and reporting risk that can be used by the main providers of financial products.

7 Responses to risk (7.5%)

7.1 Describe attitudes to and methods of risk acceptance, rejection, transfer and management for stakeholders.

7.2 Distinguish between the risks taken as an opportunity for profit and the risks to be mitigated.

7.3 Describe the principle of pooling risks.

7.4 Describe the methods of transferring risks.

7.5 Analyse the risk management aspects of a particular business issue and recommend an appropriate risk management strategy.

7.6 Describe the tools that can be used to aid the management and control of risk.

7.7 Discuss the issues surrounding the management of risk for financial product providers.

7.8 Describe how risks with low likelihood but high impact may be managed.

8 Capital management and monitoring (5%)

8.1 Discuss the interrelationship between risk and capital management.

8.2 Explain the implication of risk for capital requirement, including economic and regulatory capital requirements.

8.3 Describe how the main providers of benefits on contingent events can meet, manage and match their capital requirements.

8.4 Discuss the implications of the regulatory environment in which the business is written for provisioning and capital requirements.

8.5 Discuss risk-based capital and compare with other measures of capital needs.

8.6 Discuss the merits of looking at an economic balance sheet in order to determine the risk-based capital requirements of a provider of benefits on contingent events.

8.7 Discuss the use of internal models for assessment of economic and regulatory capital requirements.

9 The general business environment (20%)

9.1 Regulatory environment.

9.1.1 Describe the principles and aims of prudential and market conduct regulatory regimes.

9.1.2 Discuss the role that major financial institutions can play in supporting the regulatory and business environment. CP1 4

9.1.3 Explain the concept of information asymmetry.

9.1.4 Explain how certain features of financial contracts may be identified as unfair.

9.1.5 Discuss the implications of a requirement to treat the customer fairly.

9.1.6 Describe the aims of policy developments with respect to climate risks and sustainability.

9.2 External environment.

9.2.1 Describe the implications for the main providers of financial products of: • legislation – regulations. • state benefits. • tax. • accounting standards. • capital adequacy and solvency. • corporate governance. • risk management requirements. • competitive advantage. • commercial requirements. • changing cultural and social trends. • climate change. • demographic changes. • environmental issues. • lifestyle considerations. • international practice. • technological changes.

9.3 Investment environment.

9.3.1 Discuss the cashflows of simple financial arrangements and the need to invest appropriately to provide for contingent financial liabilities.

9.3.2 Demonstrate a knowledge and understanding of the characteristics of the principal investment assets and of the markets in such assets.

9.3.3 Describe how the risk profile of the principal investment assets affects the market in such assets.

9.3.4 Explain the principal economic influences on investment markets.

9.3.5 Describe other factors affecting supply and demand in investment markets.

10 Specifying the problem (5%)

10.1 Contract design.

10.1.1 Discuss the factors to be considered in determining a suitable design for financial products in relation to: • the characteristics of the parties involved. • the risk appetite or risk aversion of the parties involved. • the regulatory environment. • the market for the product. • competitive pressures. • the level and form of benefits to be provided. • any options or guarantees that may be included. • the benefits payable on discontinuance or transfer of rights. • the method of financing the benefits to be provided. • the

choice of assets when benefits are funded. • administrative issues. CP1 5 • the charges that will be levied. • the capital requirements.

10.2 Data.

10.2.1 Explain the ethical and regulatory issues involved in working with personal data and extremely large data sets.

10.2.2 Explain the main issues to be addressed by a data governance policy and its importance for an organisation.

10.2.3 Explain the risks and ethical issues associated with use of data (including algorithmic decision making).

10.2.4 Discuss the data requirements for determining values for assets, future benefits and future funding requirements.

10.2.5 Describe the checks that can and should be made on data.

10.2.6 Describe the circumstances under which the ideal data required may not be available and discuss ways in which this problem may be overcome.

10.2.7 Describe how to determine the appropriate grouping of data to achieve the optimal level of homogeneity. 11 Producing the solution (30%)

11.1 Modelling.

11.1.1 Describe the approaches available to produce the solution to an actuarial or financial problem.

11.1.2 Describe the construction of actuarial models to produce solutions in terms of: • the objectives of the model. • the operational issues that should be considered in designing and running models.

11.1.3 Describe the use of models for: • pricing or setting future financing strategies. • risk management: assessing the capital requirements and the return on capital or the funding levels required. • assessing the provisions needed for existing

commitments to provide benefits on contingent events. • pricing and valuing options and guarantees.

11.1.4 Describe how sensitivity analysis of the results of the models can be used to help decision making.

11.2 Assumption setting.

11.2.1 Describe the principles behind the determination of assumptions as input to a model relevant to producing a specific solution having regard to: • the types of information that may be available to help in determining the assumptions to be used. • the extent to which each type of information may be useful and the other considerations that may be taken into account, in deciding the assumptions. • the level of prudence in the assumptions required to meet the objectives of the client. 11.3 Mortality and morbidity.

11.3.1 Describe the principal forms of heterogeneity within a population, the ways in which selection can occur and how the use of risk classification can address the consequences of selection.

11.3.2 Explain why it is necessary to have different mortality tables for different classes of lives.

11.3.3 State the principal factors that contribute to the variation in mortality and morbidity by region and according to the social and economic environment, specifically: • occupation. • nutrition. • housing. • climate/geography. • education. • genetics.

11.3.4 Explain how various types of selection (e.g. temporary initial selection, class selection) can be expected to occur among individuals or groups effecting financial products. CP1 6

11.3.5 Explain the concept of mortality convergence.

11.3.6 Describe how decrements can have a selective effect on the remaining business.

11.4 Expenses.

11.4.1 Describe the types of expenses that the providers of financial products must meet.

11.4.2 Describe how expenses may be allocated when pricing financial products. 11.5 Developing the cost and the price.

11.5.1 Discuss how to determine the cost of providing benefits on contingent events.

11.5.2 Discuss the factors to take into account when determining the appropriate level and incidence of contributions to provide benefits on contingent events.

11.5.3 Discuss the factors to take into account when determining the price or the contributions to charge for benefits on contingent events.

11.5.4 Discuss the influence of provisioning or regulatory capital requirements on pricing or setting financing strategies.

11.6 Investment management.

11.6.1 Discuss the principles and objectives of investment management and analyse the investment needs of an investor, taking into account liabilities, liquidity requirements and the risk appetite of the investor.

11.6.2 Discuss the different methods for the valuation of individual investments and demonstrate an understanding of their appropriateness in different situations.

11.6.3 Discuss the theoretical relationships between the total returns and the components of total returns, on equities, bonds and cash and price and earnings inflation.

11.6.4 Discuss the different methods for the valuation of portfolios of investments and demonstrate an understanding of their appropriateness in different situations.

11.6.5 Discuss methods of quantifying the risk of investing in different classes and sub-classes of investment.

11.7 Provisioning.

11.7.1 Discuss the different reasons for the valuation of the benefits from financial products and the impact on the choice of methodology and assumptions.

11.7.2 Discuss how to determine values for provisions in terms of: • the need for placing values on provisions and the extent to which values should reflect risk management strategy. • the principles of 'fair valuation' of assets and liabilities and other 'market consistent' methods of valuing the liabilities. • the reasons why the assumptions used may differ in different circumstances. • the reasons why the assumptions and methods used to place a value on guarantees and options may differ from those used for calculating the accounting provisions needed. • how sensitivity analysis can be used to check the appropriateness of the values. • be able to perform calculations to demonstrate an understanding of the valuation methods.

11.7.3 Describe different methods of allowing for risk in cash-flows.

11.7.4 Discuss different methods of allowing for uncertainty in present values of liabilities.

11.7.5 Discuss the purpose of and uses for equalisation reserves.

11.7.6 Describe the influence of comparisons with market values.

11.8 Relationship between assets and liabilities.

11.8.1 Describe the principles of investment and the asset/liability matching requirements of the main providers of benefits on contingent events.

11.8.2 Show how actuarial techniques such as asset/liability modelling may be used to develop an appropriate investment strategy.

11.8.3 Describe the use of a risk budget for controlling risks in a portfolio.

11.8.4 Describe the techniques used to construct and monitor a specific asset portfolio.

11.8.5 Discuss the need to monitor investment performance and to review investment strategy. CP1 7

12 Living with the solution (7.5%) 12.1 Maintaining profitability.

12.1.1 Describe how the main providers of financial products events can control and manage the cost of: • payments arising on contingent events. • expenses associated with the payment of benefits on contingent events.

12.1.2 Discuss how regulatory capital requirements impact on a provider's profitability.

12.1.3 Describe the tools available for capital management.

12.2 Determining the actual results.

12.2.1 Describe how a provider can analyse actual performance against expected performance.

12.2.2 Describe how a provider can analyse performance of an investment portfolio against a benchmark.

12.2.3 Discuss the possible sources of surplus/profit and the management actions that can control the amount of surplus/ profit.

12.2.4 Describe why a provider will carry out an analysis of the changes in its surplus/profit.

12.2.5 Describe how any surplus/profit arising may be distributed.

12.2.6 Discuss the issues surrounding the amount of surplus/profit that may be distributed at any time and the rationale for retention of surplus/profit.

12.3 Reporting actual results.

12.3.1 Describe the reports and systems that may be set up to control the progress of the financial condition of the main providers of financial products.

12.3.2 Describe the reports and systems that may be set up to monitor and manage risk at the enterprise level.

12.4 Insolvency and closure.

12.4.1 Discuss the issues that need to be taken into account on the insolvency or closure of a provider of financial products.

12.5 Options and guarantees.

12.5.1 Discuss the issues surrounding the management of options and guarantees.

13 Monitoring (2.5%)

13.1 Describe how the actual experience can be monitored and assessed, in terms of: • the reasons for monitoring experience. • the data required. • the process of analysis of the various factors affecting the experience. • the use of the results to revise models and assumptions.

13.2 Describe how the results of the monitoring process in the Actuarial Control Cycle or the Risk Management Control Cycle are used to update the financial planning in a subsequent period.

14 Principal terms Have an understanding of the principal terms used in financial services, investments, asset management and risk management. Assessment The assessment will consist of two unseen written papers held in an invigilated environment. Paper 1 will last three hours and fifteen minutes. The questions will normally range from 5 to 15 marks and will broadly cover the assessment of knowledge and straightforward applications. Paper 2 will have forty-five minutes planning time and two hours and thirty minutes writing time. Candidates will be able to make notes and plan their responses during the planning time, but will not be able to write in the answer book during this period. Paper 2 will typically

include one or two case studies. The student will be provided with some background detail for each case study, and will be required to provide written answers to various questions on each scenario. These will test more difficult Application and Higher Order skills. CP1 8 Each paper will be marked out of 100 and the scores for the two papers will be aggregated. There will be no requirement to pass or to reach a minimum standard on either paper on a stand-alone basis. In the examination, questions may be set on any area of work in which actuaries participate, including wider fields such as banking, environmental issues, management of natural resources and other topics. Questions will not require technical knowledge of the subject context beyond the material covered in this and the Actuarial Statistics, Actuarial Modelling and Business subjects, but a general understanding of the business, commercial, social and natural environment will be assumed.

CP2 – Modelling Practice Aim The aim of the Modelling Practice subject is to ensure that the successful candidate can model data, document the work (including maintaining an audit trail for a fellow colleague), analyse the methods used and outputs generated and communicate to colleagues the approach, results and conclusions. Competences On the successful completion of this subject,

 the candidate will be able to:

1 prepare and summarise data, and undertake exploratory data analysis and visualisation.

2 construct an actuarial model to solve a realistic problem.

 3 document the model by constructing an audit trail.

 4 analyse the methods used and outputs generated.

5 communicate the results. Links to other subjects This subject builds upon concepts introduced in CM1 and CM2. It can also use material from CS1 and CS2. This subject also uses the principles in

CP1 and some features of the communications development in CP3. Syllabus topics 1 Preparation and exploratory analysis of data (10%)

2 Development of a model with clear documentation (30%)

3 Analysis of methods and model outputs (15%)

4 Application and interpretation of results (20%)

5 Communication of results and conclusions (25%)

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into 1 CP2 account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the CP2 subject, the approximate split of assessment across the three skill types is 20% Knowledge, 50% Application and 30% Higher Order skills.

Detailed syllabus objectives

1 Preparation and analysis of data (10%)

1.1 Use appropriate tools for cleaning, restructuring and transforming data to make it suitable for analysis.

1.2 Summarise data using appropriate analysis, descriptive statistics and graphical representation.

1.3 Select and carry out appropriate statistical tests of reasonableness.

1.4 Make appropriate assumptions about the data provided.

1.5 Repair corrupt or missing data.

2 Development of a model with clear documentation (30%)

2.1 Plan and produce a spreadsheet model to solve a specified problem.

2.2 Document the results of the model including justification of key assumptions, detailing the methodology adopted, an appropriate level of reasonableness checks, sensitivities and limitations.

2.3 Produce an audit trail enabling detailed checking and high level scrutiny of the model by a fellow student and a senior actuary.

3 Analysis of methods used and model outputs (15%)

3.1 Perform checks on the results of a model, including applying sensitivity and/or scenario tests.

3.2 Comment on the reasonableness of the results under different scenarios.

4 Application and interpretation of results (20%)

4.1 Apply the results to the problem set, suggesting solutions.

4.2 Summarise the results using appropriate charts and tables.

4.3 Consider possible next steps.

5 Communication of results and conclusions (25%)

5.1 Plan and draft a summary document to cover the data, approach, assumptions, results, conclusions and suggested next steps for presentation to a senior actuary.

5.2 Create appropriate data visualisations to communicate the key conclusions of an analysis. Assessment Two three-hour and fifteen-minute computer-based modelling assignments

CP3 - Communications Practice Module summary This module introduces candidates to the skill of providing effective written communication of a technical nature to a non-technical audience. It builds on the idea that actuaries, while working in technical and specialist environments, will often have to provide written communications to non-specialists. These communications need to convey appropriate information, but without unnecessary complexity. The audiences for such communications could include: • pension scheme trustees and insurance company non-executive directors. • CEOs, CFOs and other senior managers. • business managers across business functions such as customer services and marketing. • insurance brokers and financial advisors. Aims The aim of the CP3 subject is for candidates to develop the following skills: • Identify appropriate forms of written communication. • Select appropriate language for a non-specialised audience. • Identify the key issues that need to be addressed and convey these in an effective way. Competences On completion of the module,

a successful candidate will be able to:

1 draft an appropriate piece of communication as directed, to a standard expected of a newly qualified actuary without the need for significant re-drafting.

2 use an effective structure.

3 identify and use appropriate language that the intended recipient(s) will understand easily.

4 provide adequate and appropriate explanation of technical concepts.

5 incorporate appropriate communications tools to help convey meaning (e.g. graphs, tables and charts).

6 reflect appropriately on their approach to a particular piece of communication. Links to other subjects The assessment will draw upon, though not exclusively, material from the core modules and will be set in an actuarial context. Individuals may wish to complete their core modules before sitting CP3, but they are not required to do so.

Syllabus topics

1 Identify relevant information and appropriate content

2 Use an effective structure

3 Adopt appropriate language

4 Include appropriate explanation

5 Incorporate effective communication tools

The balance and weighting given to these syllabus topics will vary depending on the nature of the scenario and questions asked in the assessment. 1 CP3 Skill levels the use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability

to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the CP3 subject, the approximate split of assessment across these skill types is 85% Application and 15% Higher Order. Details of the syllabus objectives are below.

Detailed syllabus objectives

1 Identify relevant information and appropriate content

1.1 Identify key information that must be conveyed in order for a communication to meet the objectives. This may include: • setting out any implications that may affect the intended recipients' decisions. • disclosing the extent of any uncertainty involved and any limitations in the information being communicated, if that uncertainty or those limitations may affect the intended recipients' decisions.

1.2 Assess what information is not necessary and may, if included, detract from communicating effectively.

1.3 Use numbers in a way that is appropriate for the intended recipient(s), given the objectives of the communication: • Prepare numerical examples, where appropriate, by drawing on some or all of the available data or creating representative numeric examples (if suitable data is not provided). • Prepare numerical information so that it is presented in an appropriate format (e.g. appropriate use of percentages, ratios, fractions) and level of detail (e.g. well judged number of significant figures or decimal places). 1.4 Be able to justify the choice of information and content.

2 Use an effective structure

2.1 Prepare an appropriate structure for a specific communication objective.

2.2 Be able to justify the choice of structure.

3 Adopt appropriate language

3.1 Assess what terminology will be easily understood by the intended recipient(s).

3.2 Explain or define necessary technical terms at an appropriate level of detail for the intended recipient(s).

3.3 Be able to justify the choice of language and terminology.

4 Include appropriate explanation

4.1 Set out a draft communication for the intended recipient(s), including: • sufficient explanatory steps. • effective explanation. • appropriate level of detail. • technically correct information that is not misleading.

5 Incorporate effective communication tools

5.1 Set out information using simple and effective communication tools: • Visual presentation of numerical information. • Diagrams or pictures. • Bullet points. 2 CP3 5.2 Be able to justify the choice of communication tool(s) for presenting numerical information (e.g. data tables, bar charts, line charts, pie charts, scatter charts etc.). Assessment Three-hour computer-based exam.

SPECIALIST PRINCIPLES

SP1 – Health and Care Specialist Principles Aim The aim of the Health and Care Principles subject is to instil in successful candidates the ability to apply, in simple situations, the main principles of actuarial planning and control that are relevant to the provision of health and care benefits. Competences On successful completion of this subject,

a candidate will be able to:

1 understand the main principles and techniques of actuarial management and control that are relevant to health and care insurance.

2 apply these principles to simple situations within the context of health and care insurance.

3 analyse hypothetical scenarios, including using judgement to assess the implications of possible actions and to develop appropriate proposals or recommendations relating to the management of health and care insurance business. Links to other subjects CS2 – Actuarial Statistics 2 CM1 – Actuarial Mathematics 1 CP1 – Actuarial Practice SA1 – Health and Care

Advanced Syllabus topics

1 Health and care products and general business environment (15%)

2 Product design and specific features (25%)

3 Risks and risk management (30%)

4 Models and valuation (15%)

5 Monitoring experience and setting assumptions (15%) These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the

document 'Command verbs used in the Associate and Fellowship written examinations. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order 2 SP1 (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the SP subjects, the approximate split of assessment across these three skill types is 25% Knowledge, 50% Application and 25% Higher Order skills. Detailed syllabus objectives 0 Introduction 0.1 Define the principal terms used in health and care.

1 Health and care products and general business environment (15%)

1.1 Describe the main types of health and care contact and their purpose for the customer products: • Critical illness insurance • Income protection insurance • Long-term care insurance • Health cash plans • Major medical expenses • Private medical insurance • Group and individual covers.

1.2 Understand the operating environments in which health and care insurance products and services are traded: • Distribution channels • Regulatory and taxation regimes • Professional guidance • Economic and political influences.

1.3 Explain the role of the State in the provision of alternative or complementary health and care protection: • Objectives of State healthcare provision • Methods of State healthcare provision • Funding approaches.

2 Product design and specific features (25%)

2.1 Demonstrate an understanding of health and care product design, including:

2.1.1 Describe the principles by which health and care insurance contracts are designed and the interest of the various stakeholders in the process.

2.1.2 Determine a suitable design for a product in a given situation.

2.1.3 Discuss the relative merits of different product designs.

3 Risks and risk management (30%)

3.1 Assess how the following can be a source of risk to a health and care insurance company: • Data • Claim rates • Claim amounts • Investment performance • Expenses and inflation • Persistency • Mix of new business • Volume of new business • Guarantees and options 3 SP1 • Competition • Actions of management • Actions of distributors • Counterparties • Legal, regulatory and tax developments • Reputation • Internal audit failures/fraud • Physical risks • Aggregation and concentration of risk • Catastrophes • Non-disclosure and anti-selection • Climate risks.

3.2 Demonstrate the application of reinsurance as a risk management technique.

3.2.1 Describe the purposes of reinsurance.

3.2.2 Describe the different types and structures of reinsurance.

3.2.3 Discuss the factors that should be considered in determining the level of retention.

3.3 Demonstrate the application of underwriting as a risk management technique.

3.3.1 Outline the purposes of underwriting.

3.3.2 Describe the different approaches by which underwriting is applied.

3.3.3 Discuss the factors that should be considered when determining the level of underwriting to use.

3.4 Propose further ways of managing the risks in 3.1, including: • claims management. • data checks. • product design. • managing the distribution process and customer relationship. • managing other counterparties. • other internal processes.

3.5 Demonstrate the application of asset-liability matching as a risk management technique.

3.5.1 State the principles of investment and how they apply to health and care insurance.

3.5.2 Analyse health and care insurance liabilities into different types for asset-liability matching purposes.

3.5.3 Propose an appropriate asset-liability matching strategy for different types of liability.

4 Models and valuation (15%)

4.1 Describe the main features of a health and care insurance model.

4.1.1 Outline the objectives and basic features of a health insurance model.

4.1.2 Compare the stochastic and deterministic approaches.

4.1.3 Compare a formula and cashflow approach.

4.1.4 Outline the basic features of multi-state models.

4.1.5 Explain the use of sensitivity analysis.

4.2 Understand and apply the techniques used in pricing health and care insurance products in terms of: • data availability. • assumptions used. • equation of value/formula approach. • cashflow techniques. 4 SP1 • group risk assessments. • options and guarantees. • external influences.

4.3 Demonstrate the different uses of actuarial models for decision-making purposes in health and care insurance, including: • pricing

products. • developing investment strategy. • projecting solvency. • calculating embedded value.

4.4 Discuss the determination of supervisory reserves and solvency capital requirements for a health and care insurance company.

4.4.1 Describe the purposes of reserves, solvency capital requirements and embedded values and the methodologies by which they are calculated for a health and care insurer, including: • role of statistical and individual case estimates. • setting assumptions, including a comparison with those used in pricing. • market consistent valuation. • Value at Risk (VaR) capital assessment.

4.4.2 Discuss the interplay between the strength of the supervisory reserves and the level of solvency capital required.

4.4.3 Compare passive and active valuation approaches.

5 Monitoring experience and setting assumptions (15%)

5.1 Describe the principles of setting assumptions for health and care insurance business.

5.1.1 Describe the principles of setting assumptions for pricing health and care insurance contracts.

5.1.2 Describe the principles of setting assumptions for determining liabilities.

5.1.3 Explain why the assumptions used for supervisory reserves may be different from those used in pricing.

5.1.4 Outline the principles of setting assumptions for determining embedded value.

5.2 Demonstrate the relevance of experience monitoring to a health insurance company.

5.2.1 Explain why it is important for a health insurance company to monitor its experience.

5.2.2 Describe how the actual mortality, morbidity, claims amounts, persistency, expense, new business and investment experience of a health insurance company should be monitored, including the data required.

5.3 Demonstrate the relevance of analysis of surplus or profit.

5.3.1 Give reasons for undertaking an analysis of surplus and an analysis of embedded value profit.

5.3.2 Suggest ways in which the results of such analyses can be used. 6 Solving problems

6.1 Analyse hypothetical examples and scenarios in relation to the financial management of health and care insurance companies.

6.1.1 Propose solutions and actions that are appropriate to the given context, with justification where required.

6.1.2 Suggest possible reasons why certain actions have been chosen.

6.1.3 Assess the implications of actions within a given scenario.

6.1.4 Discuss the advantages and disadvantages of suggested actions, taking into account different perspectives. Assessment Three-hour and fifteen-minute written examination.

SP2 – Life Insurance Specialist Principles Aim On completion of the Life Insurance Specialist Principles (SP2) subject, candidates should be able to demonstrate an understanding of: • the market and business environment for life insurance products. • the main principles and techniques of actuarial management and control that are relevant to life insurance. • the economic uncertainties and associated risks that underlie life insurance business. The life insurance products covered exclude those covered by the Health and Care Principles subject. Links to other subjects SA2 – Life Insurance Specialist

Advanced Syllabus topics

1 Life insurance products and general business environment (15%)

2 Product design and specific features (25%)

3 Risks and risk management (30%)

4 Models and valuation (15%)

5 Monitoring experience and setting assumptions (15%)

These weightings are indicative of the balance of assessment of this subject between the syllabus topics, averaged over a number of examination sessions. Assessment of skill level Exam questions are designed to test the following: • Knowledge (demonstration of a detailed knowledge and understanding of the topic), • Application (demonstration of an ability to apply the principles underlying the topic within a given context) and • Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations. This includes the ability to develop proposals and recommendations utilising actuarial judgement, i.e. taking into account different points of view, comparing and contrasting situations, clearly communicating any limitations and elements of uncertainty in the approach). In the SP subject exams, the approximate split of assessment across these three skill types is 25% Knowledge, 50% Application and 25% Higher Order skills. The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations'.

Detailed syllabus objectives

0 Introduction

0.1 Define the principal terms used in life insurance.

1 Life insurance products and general business environment (15%)

1.1 Describe the main types of life insurance products.

1.1.1 Describe the main types of life insurance products that provide benefits on death, survival to a specified point in time or continued survival. 3 SP2

1.1.2 Describe the following life insurance product bases: • Conventional without profits • With-profits • Unit-linked • Index-linked.

1.1.3 Outline typical guarantees and options that may be offered on life insurance products.

1.2 Assess the main types of life insurance products in terms of: • the needs of consumers and key risks for the insured. • the purpose and key risks for the insurer.

1.3 Assess the effect of the general business environment on the management of life insurance business, in terms of: • propensity of consumers to purchase products. • local culture. • methods of sale. • remuneration of sales channels. • types of expenses and commissions, including influence of inflation. • economic environment. • legal environment. • regulatory environment. • taxation regime. • professional guidance.

2 Product design and specific features (25%)

2.1 Demonstrate an understanding of life insurance product design, including:

2.1.1 Describe the factors to consider in determining a suitable design, in terms of premiums, benefits and charges, for a life insurance product.

2.1.2 Determine a suitable design for a product in a given situation. 2.1.3 Discuss the relative merits of different product designs.

2.2 Demonstrate an understanding of with-profits business management.

2.2.1 Describe methods of distributing profits to with-profits policyholders.

 2.2.2 Explain the main uses of asset shares and how they may be built up using a recursive formula.

2.3 Describe the principles of unit pricing for internal unit-linked funds.

2.4 Determine discontinuance and alteration terms for without-profits contracts.

2.4.1 State the principles of setting discontinuance and alteration terms.

 2.4.2 Describe different methods of determination of discontinuance and alteration terms.

 2.4.3 Assess the extent to which these methods meet the principles in 2.4.1. 2.4.4 Calculate surrender values and alteration terms for conventional without-profits contracts using reserves or by equating policy values.

3 Risks and risk management (30%)

3.1 Assess how the following can be a source of risk to a life insurance company: • Policy and other data • Mortality rates • Investment performance • Expenses, including the effect of inflation • Persistency 4 SP2 • Mix of new business • Volume of new business • Guarantees and options • Competition • Actions of the board of directors • Actions of distributors • Failure of appropriate management systems and controls • Counterparties • Legal, regulatory and tax developments • Fraud • Aggregation and concentration of risk.

3.2 Demonstrate an understanding of reinsurance as a risk management technique.

 3.2.1 Describe the purposes of reinsurance.

3.2.2 Describe the different types and structures of reinsurance.

3.2.3 Discuss the factors that should be considered before taking out reinsurance.

3.3 Demonstrate an understanding of underwriting as a risk management technique.

3.3.1 Outline the purposes of underwriting.

3.3.2 Describe the different approaches by which underwriting is applied.

3.3.3 Discuss the factors that should be considered when determining the level of underwriting to use.

3.4 Demonstrate an understanding of asset-liability matching as a risk management technique.

3.4.1 State the principles of investment for a life insurance company.

3.4.2 Analyse life insurance liabilities into different types for asset-liability matching purposes.

3.4.3 Propose an appropriate asset-liability matching strategy for different types of liability.

3.5 Propose further ways of managing the risks in 3.1, including: • policy data checks. • choice of with-profits bonus method. • capital management. • expense control. • policy retention activity. • management of new business mix and volumes. • management of options. • systematic risk assessment and management strategies.

4 Models and valuation (15%)

4.1 Describe the main features of a life insurance model.

4.1.1 Outline the objectives and basic features of a life insurance model.

4.1.2 Compare stochastic and deterministic approaches.

4.1.3 Explain the use of sensitivity analysis.

4.2 Demonstrate an understanding of the different uses of actuarial models for decision making purposes in life insurance, including: • pricing products. • developing investment strategy. • projecting solvency. • calculating embedded value. 5 SP2

4.3 Demonstrate an understanding of the methods used for determining the cost of options and guarantees.

4.3.1 Describe the use of stochastic simulation and the use of option prices to determine the cost of an investment guarantee.

4.3.2 Describe the assessment of the cost of simple mortality options.

4.4 Discuss the determination of supervisory reserves and solvency capital requirements for a life insurance company.

4.4.1 Describe how supervisory reserves and solvency capital requirements may be determined, including: • market consistent valuation. • non-unit reserves. • Value at Risk (VaR) capital assessment.

4.4.2 Discuss the interplay between the strength of the supervisory reserves and the level of solvency capital required.

4.4.3 Compare passive and active valuation approaches, including the valuation of assets.

5 Monitoring experience and setting assumptions (15%)

5.1 Describe the principles of setting assumptions for life insurance business.

5.1.1 Describe the principles of setting assumptions for pricing life insurance contracts, including profit requirements.

5.1.2 Describe the principles of setting assumptions for determining liabilities.

5.1.3 Explain why the assumptions used for supervisory reserves may be different from those used in pricing.

5.1.4 Outline the principles of setting assumptions for determining embedded value.

5.2 Demonstrate the relevance of experience monitoring to a life insurance company.

5.2.1 Explain why it is important for a life insurance company to monitor its experience.

5.2.2 Describe how the actual mortality, persistency, expense and investment experience of a life insurance company should be monitored, including the data required.

5.3 Demonstrate the relevance of analysis of surplus or profit.

5.3.1 Give reasons for undertaking an analysis of surplus and an analysis of embedded value profit.

5.3.2 Suggest ways in which the results of such analyses can be used.

6 Solving problems

6.1 Develop proposals and recommendations, with justification where required, in relation to hypothetical scenarios reflecting the management of life insurance business.

6.1.1 Analyse these scenarios, demonstrating an understanding of the syllabus including the following factors (profitability, capital management, risk, regulatory and customer demand).

6.1.2 Suggest possible reasons why certain proposals and recommendations have been made.

6.1.3 Assess the implications of adopting the proposals and/or recommendations within a given scenario.

6.1.4 Discuss the advantages and disadvantages of suggested proposals and recommendations, taking into account different perspectives.

6.1.5 Demonstrate an understanding of any limitations and elements of uncertainty inherent in the proposals or recommendations made. Assessment Three-hour and fifteen-minute written examination

SP4 – Pensions and Other Benefits Specialist Principles Aim The aim of the Pension and Other Benefits Principles subject is for candidates to develop the ability to apply the mathematical and economic techniques and the principles of actuarial planning and control needed for the financial management of pensions and other benefits. Competences On successful completion of this subject,

a candidate will be able to:

1 understand the main principles and techniques of actuarial management and control that are relevant to benefit provision.

2 apply these principles to simple situations within the context of pensions and other benefits.

3 analyse hypothetical scenarios, including using judgement to assess the implications of possible actions and to develop appropriate proposals or recommendations relating to the management of benefit arrangements. Links to other subjects CM1 – Actuarial Mathematics CP1 – Actuarial Practice SA4 – Pensions and Other Benefits Specialist Advanced Syllabus topics 1 Pension provision and general business environment (20%) 2 Scheme design and financing (20%) 3 Managing schemes and risks (20%) 4 Models, valuations and setting assumptions (30%) 5 Monitoring experience and the Control Cycle (10%) These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative

complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into 2 SP4 account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the SP subjects, the approximate split of assessment across these three skill types is 25% Knowledge, 50% Application and 25% Higher Order skills.

 Detailed syllabus objectives

0 Introduction

 0.1 Define the main terms used in the provision of benefits.

1 Pension provision and the general business environment (20%)

1.1 Describe the roles that interested parties may play, and responsibilities they may have, in the provision of benefits, including: • the State and statutory bodies. • employers or groups of employers. • trustees or scheme managers. • financial advisers. • individuals or groups of individuals.

1.2 Compare the provision of benefits from the State, employers in the public and private sector and individuals.

1.3 Discuss the implications, for the parties in 1.1, of the environment in which benefits are provided, including: • different presentation and reporting of benefits and contributions. • regulation and taxation. • any professional guidance for actuaries or other professionals.

1.4 Discuss the issues surrounding sponsor covenants in terms of: • measurement. • integration with funding and investment. 2 Scheme design and financing (20%)

2.1 Describe the different ways in which providers may be able to finance the benefits to be provided, including: • the timing of contributions (relative to when the benefits are due to be paid). • the forms and characteristics of investment that may be available (if benefits are funded). • financial instruments, including contingent assets, that may be used to back benefit promises.

2.2 Discuss the factors to consider in determining a suitable design for a pension scheme, or other benefits such as social security benefits, including: • type of pension scheme (e.g. defined benefit, defined contribution, risk-sharing). • the governance requirements. • the level and form of benefits and/or contributions. • the method of financing the benefits. • how risk is shared between parties. • the choice of assets (when benefits are to be funded).

3 Managing schemes and risks (20%)

3.1 Describe the risks affecting: • the level and incidence of benefits. • the level and incidence of contributions. • the level and incidence of return on assets. • the extent to which assets are exhausted during a member's lifetime. • the overall security of benefits. 3 SP4

3.2 Discuss the issues taken into account in producing information to meet accounting standards, including: • the objectives. • the disclosure requirements. • the calculations of cost of benefit provision.

3.3 Discuss the main factors that should be taken into account in setting appropriate terms and consent requirements for member

options, taking into account the risk and reward for all relevant parties.

3.4 Discuss the factors taken into account in setting the investment strategy of a provider of benefits. Describe how projection models may be used to develop appropriate strategies.

3.5 Discuss the principles underlying the use of insurance as a means of risk mitigation.

4 Models, valuations and setting assumptions (30%)

4.1 Discuss the use of actuarial models for decision-making purposes, including: • the objectives of and requirements for building a model for the financial management of the provision of benefits. • the basic features of a model for projecting income and outgo. • the use of these models for setting contributions, targeting benefit levels and assessing the return on assets. • how sensitivity analysis of the results of the models can be used.

4.2 Discuss the principles underlying the determination of the funding method, valuation method and assumptions for valuing benefits and contributions, including: • the types of information that may be available to help determine the assumptions and methods. • the requirements for prudence. • the objectives of the various parties involved.

4.3 Discuss how to determine values for assets, past and future benefits and future contribution requirements, including: • the data requirements. • the reasons why the assumptions and methods used may differ in different circumstances. • the extent to which values should reflect investment/risk management strategy. • how to place values on guarantees and options. • sensitivity analysis and reasonableness checking. and be able to perform calculations to demonstrate an understanding of the main methods used.

4.4 Discuss the principles underlying the determination of discontinuance terms for benefits, taking into account: • the rights and expectations of beneficiaries. • the availability and selection of

a method of provision of discontinuance benefits. • the level of available assets.

5 Monitoring experience and the Control Cycle (10%)

5.1 Identify the sources of surplus/deficit for a benefit provider and discuss the factors that affect the application of this surplus/deficit.

6 Solving problems

6.1 Analyse hypothetical examples and scenarios in relation to the financial management of pension arrangements. 6.1.1 Propose solutions and actions that are appropriate to the given context, with justification where required.

6.1.2 Suggest possible reasons why certain actions have been chosen.

6.1.3 Assess the implications of actions within a given scenario.

6.1.4 Discuss the advantages and disadvantages of suggested actions, taking into account different perspectives. Assessment Three-hour and fifteen-minute written examination.

SP5 – Investment and Finance Specialist Principles Aim The aim of the Investment and Finance Principles subject is to instil in successful candidates the key principles of evaluating investments, including the appropriate selection and effective risk management of a portfolio of investments that meet the needs of a particular investor. Competences On successful completion of this subject,

a candidate will be able to:

1 understand the main principles and techniques of actuarial management and control that are relevant to the management of investments.

2 apply these principles to given situations within the context of investment management.

3 analyse hypothetical scenarios, including using judgement to assess the implications of possible actions and to develop appropriate proposals or recommendations relating to the management of investments. Links to other subjects CB1 – Business Finance CB2 – Business Economics CM2 – Financial Engineering and Loss Reserving CP1 – Actuarial Practice SA7 – Investment and Finance

Advanced Syllabus topics

1 The economic, regulatory and legislative framework for investment management (10%)

2 Specialist investment products (15%)

3 Valuing investments (10%)

** 4 Monitoring and managing investment risks (10%)**

5 Investor characteristics, including behavioural finance and taxation (10%)

6 Appropriate investment strategies (15%)

7 Portfolio management and risk control (15%)

** 8 Analysing portfolio performance (15%)**

These weightings are indicative of the approximate balance of the assessment of this subject between

the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. 2 SP5 Skill levels the use of a specific command verb within a syllabus objective does not

indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the SP subjects, the approximate split of assessment across these three skill types is 25% Knowledge, 50% Application and 25% Higher Order skills.

Detailed syllabus objectives

1 The economic, regulatory and legislative framework for investment management (10%)

1.1 Explain the influences over the commercial and economic environment from: • central banks. • main investor classes. • government policy.

1.2 Discuss the principles underlying the legislative and regulatory framework for investment management and the securities industry and how these principles can be applied in the areas of: • corporate governance. • role of the listing's authority. • environmental, social and governance factors. • ethical issues. • competition and fair-trading controls. • monopolies regulators. • investment restrictions in investment agreements. • provision of financial services. • institutional investment practices. • development of international accounting standards.

2 Specialist investment products (15%)

2.1 Discuss the characteristics of the following specialist financial instruments: • Financial instruments available for short-term lending

and borrowing • Corporate debt and credit derivatives • Swaps and swaptions • Private debt • Asset-backed securities, securitisation • Venture capital • Hedge funds • Currency • Infrastructure • Commodities • Insurance-linked securities SP5 3 • Structured products • New ways of investing in old asset classes.

2.2 Describe the main types of derivative contract, including: • how they are traded. • their payoffs. • how they can be used by an investment manager.

3 Valuing investments (10%)

3.1 Describe the principles of fundamental analysis of equities and bonds, including: • factors affecting equity prices. • credit analysis of bonds. • role of credit rating agencies.

3.2 Determine the value of individual investments.

3.3 Discuss the appropriateness to valuing investments in different situations of: • fixed income analytics and valuation (including interest rate swaps and futures). • arbitrage pricing and the concept of hedging. • empirical characteristics of asset prices. • fixed income option pricing. • evaluating a securitisation. • evaluating a credit derivative.

4 Monitoring and managing investment risks (10%)

4.1 Describe methods by which an institution can monitor and control its exposure to the following types of risk: • Asset/liability mismatching risk • Market risk • Credit risk (including counterparty risk) • Operational risk • Liquidity risk • Relative performance risk. • Sustainability risk.

4.2 Explain in the context of mean-variance portfolio theory what is meant by: • opportunity set. • efficient frontier. • indifference curves. • the optimum portfolio.

5 Investor characteristics, including behavioural finance and taxation (10%)

5.1 Discuss the application of the key findings in behavioural finance.

5.2 Outline the main steps involved in financial planning.

5.3 Describe the typical ways in which investment returns are taxed and the effect of the taxation basis on investor behaviour.

6 Appropriate investment strategies (15%)

6.1 Propose how actuarial techniques may be used to develop an appropriate investment strategy, including: • asset pricing models. • asset/liability modelling. • liability hedging. • dynamic liability benchmarks. SP5 4

7 Portfolio management and risk control (15%)

7.1 Discuss the principal: • active management 'styles' (value, growth, momentum, rotational). • equity portfolio management techniques. • bond portfolio management techniques.

7.2 Discuss the uses that an institutional investor may make of: • financial futures and options, including over-the-counter contracts. • interest rate and currency and inflation swaps. • forward foreign exchange contracts for currency hedging.

7.3 Discuss the usefulness of multifactor models in practical investment management and risk control.

7.4 Discuss the problems of making significant changes to the investment allocation of a substantial portfolio.

7.5 Discuss transition management and asset allocation techniques (including overlay strategies).

7.6 Describe the role of the custodian.

7.7 Assess portfolio construction with attention to: • value at risk. • tracking error. • risk budgets.

7.8 Discuss measurement, comparison and attribution of risk.

8 Analysing portfolio performance (15%)

8.1 Assess the performance of an investment and discuss the limitations of such measurement techniques, including: • portfolio risk and return analysis. • equity price. • net present value. • net asset value. • return on capital.

8.2 Discuss the construction and uses of investment indices.

8.2.1 Describe the principal indices in the international stock markets.

8.2.2 Explain the problems encountered in constructing indices of unlisted or illiquid assets.

8.2.3 Discuss the uses of investment indices.

8.3 Assess the performance of an investment portfolio and discuss the limitations of such portfolio measurement.

8.3.1 Assess the performance of a portfolio relative to a: • published market index. • predetermined benchmark portfolio.

8.3.2 Assess the performance of a portfolio into components relating to investment sector selection and individual stock selection.

8.3.3 Discuss the relative merits of assessing portfolio performance relative to published indices, other portfolios or a predetermined benchmark portfolio.

8.3.4 Discuss the uses of risk-adjusted performance measures.

8.3.5 Discuss the value of portfolio performance measurement and its limitations.

9 Solving problems

9.1 Analyse hypothetical examples and scenarios in relation to the management of investments.

9.1.1 Propose solutions and actions that are appropriate to the given context, with justification where required.

9.1.2 Suggest possible reasons why certain actions have been chosen. SP5 5

9.1.3 Assess the implications of actions within a given scenario.

9.1.4 Discuss the advantages and disadvantages of suggested actions, taking into account different perspectives. Assessment Three-hour and fifteen-minute written examination.

SP6 – Financial Derivatives Specialist Principles Aim The aim of the Financial Derivatives Specialist Principles subject is to instil in successful candidates the ability (at a more complex application than CM2) to understand different types of financial derivatives and their uses, the markets in which they are traded, methods of valuation of financial derivatives and the assessment and management of risks associated with a portfolio of derivatives. Competences On successful completion of this subject,

a candidate will be able to:

1 understand the main principles and techniques that are relevant to the use and management of financial derivatives

2 apply these principles to given situations within the context of financial derivative management.

3 analyse hypothetical scenarios, including using judgement to assess the implications of possible actions and to develop appropriate proposals or recommendations relating to the management of financial derivatives. Links to other subjects CM2 – Financial Engineering and Loss Reserving CP1 – Actuarial Practice SP5 – Investment and Finance Specialist Principles

Syllabus topics

1 Derivative markets (5%)

2 Derivative types and uses (20%)

3 Derivative pricing and valuation methods, including interest rate models (50%)

4 Management of derivatives (25%)

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Skill levels the use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations. Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgements, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). 2 SP6 In the SP subjects, the approximate split of assessment across these three skill types is 25% Knowledge, 50% Application and 25% Higher Order skills.

Detailed syllabus objectives

1 Derivative markets (5%)

1.1 Demonstrate an awareness of the basic characteristics of the derivatives markets.

1.2 Describe the characteristics of exchange traded contracts and Over-The-Counter (OTC) contracts.

1.3 Describe the uses of forwards, future and options by different types of traders: hedgers, speculators and arbitrageurs.

1.4 Demonstrate an understanding of how futures and options markets work.

1.5 Describe the operation of central counterparty clearing houses (CCPs) and the related regulatory environment.

2 Derivative types and uses (20%)

2.1 Describe the payoffs of forwards and futures, calls and puts (American and European).

2.2 Demonstrate an understanding of forward and futures prices.

2.3 Explain how to use the futures contracts in 2.1 for hedging.

2.4 Describe the following traded derivative contracts: • Stock options • Currency options • Index options • Options on futures • Warrants • Convertibles.

2.5 Describe different types of property derivatives, including their uses, and property indices.

2.6 Describe the following interest rates and interest rate derivatives: • Treasury rates • Reference interest rates • Overnight index swap rates • Repo rates • Zero rates • Forward rates • Forward rate agreements • Interest rate futures • Treasury bond futures • Interest rate swaps • European swap options (swaptions) • Caps and caplets • Floors and floorlets • Bermudan swaptions.

2.7 Describe the following exotic equity and foreign exchange derivatives: • Quanto options • Chooser options • Barrier options • Binary options • Lookback options • Asian options SP6 3 • Exchange options • Basket options.

2.8 Describe the following structured securities and OTC contracts, including how each can be used to hedge certain types of liability: • Separate Trading of Registered Interest and Principal of Securities (STRIPS) • Interest rate swaps • Interest rate swaptions • Index-linked bonds • Inflation swaps • Limited Price Indexation (LPI) swaps • LPI bonds.

2.9 Describe how non-economic risks such as longevity risk can be hedged using suitable structured securities and OTC contracts.

2.10 Demonstrate a knowledge and understanding of credit derivatives and their application.

2.10.1 Describe the following types of credit derivative: • Credit Default Swaps (CDSs) • Collateralised Debt Obligations (CDOs) • Nth to default baskets • Total return swaps.

2.10.2 Explain the relationship between CDSs and corporate bonds, in particular as shown by their relative credit spreads.

2.10.3 Describe the uses of credit derivatives.

3 Derivative pricing and valuation methods, including interest rate models (50%)

3.1 Describe how the following factors affect option prices: • Stock price • Strike price • Term to expiry • Volatility • Risk-free rate • Dividends.

3.2 Demonstrate the theory underpinning the determination of derivative prices and hedging strategies using the binomial model, including: • sample paths. • filtrations. • the Binomial Representation Theorem. • conditional expectations. • previsible process. • self-financing portfolio strategies. • replicating strategies. • pricing under the martingale measure.

3.3 Demonstrate the theory underpinning the determination of derivative prices and hedging strategies using the Black– Scholes model, including: • Brownian motion. • Itô calculus. • Itô's Lemma. • statement of the Cameron–Martin–Girsanov Theorem. SP6 4 • the

concept of the Radon–Nikodym derivative. • change of measure. • statements of the Martingale Representation Theorem. • continuous-time portfolio strategies. • self-financing portfolios in continuous time. • the Black–Scholes model. • construction of replicating strategies using the martingale approach. • the Black–Scholes formula for non-dividend-paying stocks.

3.4 Demonstrate more advanced application of the Black–Scholes model in the determination of derivative prices.

3.4.1 Demonstrate how to adapt the martingale approach to the pricing of foreign exchange options and options on stock indices paying dividends continuously.

3.4.2 Derive the Black–Scholes–Merton partial differential equation.

3.4.3 Explain the role of the market price of risk in the transfer between the real-world and the risk-neutral probability measures.

3.4.4 Demonstrate the role of the volatility parameter in the valuation of options, including: • calculation of implied volatility from option prices. • estimation of volatility from historical time series or other market indices (e.g. the VIX index). • the 'smile' effect and volatility surfaces.

3.4.5 Describe approaches to valuing options on discrete dividend-paying securities.

3.5 Demonstrate alternative numerical methods for the determination of derivative prices and hedging strategies.

3.5.1 Describe the following numerical methods for determining equity and foreign exchange derivative prices and hedging strategies: • Binomial and trinomial trees • Monte Carlo techniques • Finite difference methods.

3.5.2 Discuss possible methods for determining prices of American options, including Monte Carlo simulation using the least squares (Longstaff–Schwartz) approach.

3.6 Demonstrate the pricing of interest rate derivatives, including the Black model.

3.6.1 Determine the following: • The yield curve, zero rates, forward rates and bond prices • The relationship between forward rates and futures rates • The value of interest rate swaps.

3.6.2 Explain the relationship between swap quotes and swap zero rates.

3.6.3 Demonstrate the use of the Black model for pricing and valuing the following contracts: • Bond options • Caps and floors • European swaptions.

3.6.4 Comment on the assumptions underlying Black's model.

3.7 Demonstrate the use of models of the term structure of interest rates.

3.7.1 Explain the difference between equilibrium and no-arbitrage models.

3.7.2 Describe the Hull and White model for the term structure of interest rates.

3.7.3 Contrast the Hull and White model with the Vasicek and Cox–Ingersoll–Ross models.

3.7.4 Describe the numerical techniques that can be used to value an interest rate derivative using the risk-neutral approach to pricing. SP6 5

3.7.5 Outline a valuation method for an interest rate derivative using an appropriate forward measure and zero-coupon bond.

3.7.6 Explain the role of the market price of risk and changes of numeraire in the dynamics of term structure models.

3.7.7 Describe how interest rate models can be developed in a multifactor setting.

3.7.8 Outline the characteristics of the Heath, Jarrow and Morton (HJM) and Brace Gatarek Musiela (BGM) Model.

3.7.9 Demonstrate how the BGM Model can be used to price caps and swaptions.

3.7.10 Discuss the use of Black's model in the calibration of the BGM Model, including the problems with this approach.

3.8 Outline approaches that can be taken to price property swaps.

3.9 Demonstrate an understanding of the pricing of credit derivatives.

3.9.1 Determine the price of a credit default swap.

3.9.2 Explain the role of correlation in pricing credit derivatives.

4 Management of derivatives (25%)

4.1 Demonstrate an understanding of how derivatives are used by investors.

4.1.1 Explain how derivatives help investors meet their objectives.

4.1.2 Assess the change in risk profile of a portfolio following the use of derivatives.

4.1.3 Discuss practical issues and limitations arising from derivative use.

4.1.4 Compare alternative strategies.

4.2 Demonstrate a knowledge and understanding of how to hedge derivatives.

4.2.1 Calculate the partial derivatives (the Greeks).

4.2.2 Describe the use of the Greeks in hedging individual derivatives and portfolios of derivatives.

4.2.3 Explain how option prices and Greeks change in relation to underlying variables.

4.2.4 Describe how to manage portfolios of derivatives using scenario analysis.

4.2.5 Assess the risk management characteristics of a given derivative, including exotic contracts.

4.2.6 Describe the hedging of interest rate derivatives with respect to the underlying parameters (the Greeks).

4.2.7 Describe delta hedging techniques in relation to credit default swaps.

4.3 Describe what is meant by basis risk and its impact on hedging strategies.

4.4 Discuss the risks that arise in the use of derivatives and how to manage them.

4.4.1 Define market risk, credit (or counterparty) risk and liquidity risk.

4.4.2 Identify the market, credit (or counterparty), liquidity and other risks that arise in the use of derivatives.

4.4.3 Outline the way in which these risks affect the use of derivatives and how these risks may be handled.

4.4.4 Describe possible methods for establishing Value-at-Risk (on a portfolio).

4.4.5 Comment on the weaknesses of the Value-at-Risk measure.

4.4.6 Discuss the use and limitations of credit ratings.

4.4.7 Describe simple techniques for measuring and managing credit (or counterparty) risk on derivatives, including: • International Swaps and Derivatives Association (ISDA) agreements. • collateral management.

4.4.8 Describe the risks that arise in the use of specific types of derivatives.

4.5 Describe how special purpose vehicles can be used as part of a mechanism for risk transfer, including the role of a credit enhancement agency.

5 Solving problems

5.1 Analyse hypothetical examples and scenarios in relation to the use and management of financial derivatives.

5.1.1 Propose solutions and actions that are appropriate to the given context, with justification where required. SP6 6

5.1.2 Suggest possible reasons why certain actions have been chosen.

5.1.3 Assess the implications of actions within a given scenario.

5.1.4 Discuss the advantages and disadvantages of suggested actions, taking into account different perspectives.

5.2 Draw charts to illustrate how attributes of portfolios vary with respect to relevant factors, in the context of derivative use. Assessment Three-hour and fifteen-minute written examination.

SP7 – General Insurance Reserving and Capital Modelling Specialist Principles Aim The aim of this General Insurance Reserving and Capital Modelling Specialist Principles subject is for

candidates to develop the following skills:

1 understand the main principles and techniques of reserving and capital modelling that are relevant to general insurance.

2 apply these principles in practice within the context of general insurance.

3 understand the techniques involved in estimating best estimate reserves and setting capital requirements and how reserving and capital modelling link to wider business processes (e.g., business planning and pricing).

4 analyse hypothetical scenarios, including using judgement to assess the implications of possible actions and to develop appropriate proposals or recommendations relating to reserving and capital modelling in general insurance business.

Syllabus topics

1 General insurance products and general business environment (20%) 2 Risk, uncertainty and regulation (15%)

3 Reserving (30%)

4 Capital modelling (17.5%)

5 Data, investigations, reinsurance and accounting (17.5%)

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or application-based. Assessment of skill level Exam questions are designed to test the following: • Knowledge (demonstration of a detailed knowledge and understanding of the topic), • Application (demonstration of an ability to apply the principles underlying the topic within a given context) and • Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations. This includes the ability to develop proposals and recommendations utilising actuarial judgement, i.e. taking into account different points of view, comparing and contrasting situations, clearly

communicating any limitations and elements of uncertainty in the approach). 2 SP7 In the SP subject exams, the approximate split of assessment across these three skill types is 25% Knowledge, 50% Application and 25% Higher Order skills. The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations'.

Detailed syllabus objectives

0 Introduction

0.1 Define the principal terms in use in general insurance.

1 General insurance products and general business environment (20%)

1.1 Describe the main types of general insurance products in terms of: • the needs of customers. • the financial and other risks they pose for the general insurer including their capital requirements and possible effect on solvency.

1.2 Describe the main types of reinsurance products for general insurance operations and the purposes for which they may be used.

1.3 Describe the implications of the general business environment in terms of: • the main features of the general insurance market. • the effect of different marketing strategies. • the effect of fiscal regimes. • the effect of inflation and economic factors. • the effect of legal, political and social factors. • the effect of the climate and environmental factors. • the general effect of professional guidance. • the impact of technological change.

1.4 Outline the key features of the Lloyd's market.

2 Risk, uncertainty and regulation (15%)

2.1 Describe the major areas of risk and uncertainty in general insurance business with respect to reserving and capital modelling, in particular those that may threaten profitability or solvency.

2.2 Discuss the purposes of regulating general insurance business.

2.3 Outline possible methods by which general insurers can be regulated, including advantages and drawbacks of each.

3 Reserving (30%)

3.1 Describe the purpose of calculating general insurance reserves.

3.2 With regard to reserving work using triangulations: • analyse the range of general issues that can affect reserving work using triangulations. • identify how to deal with these general issues in reserving work. • evaluate the main triangulation methods in use – namely the chain ladder method, the Bornhuetter–Ferguson method and the Average Cost per Claim method.

3.3 Suggest appropriate reserving bases for general insurance business, having regard to: • the different reasons for calculating reserves. • the assumptions that may be appropriate in each case. • when to calculate reserves at class level, at individual policy level or at claim event level. • why the assumptions may differ from a rating exercise. • the allowance for future inflation. • whether or not to discount for investment income. 3 SP7 • the approach for additional unexpired risk reserve. • communication of the reserving basis.

3.4 Evaluate stochastic reserving processes.

3.4.1 Describe the uses of stochastic reserving methods.

3.4.2 Describe the likely sources of reserving uncertainty.

3.4.3 Describe the following types of stochastic reserving methods: • Analytic methods • Simulation-based methods.

3.4.4 Describe Mack's model and the ODP model.

3.4.5 Describe how to apply the bootstrapping to these two models.

3.4.6 Describe the issues, advantages and disadvantages of each of the models.

3.4.7 Describe the approach to aggregating the results of stochastic reserving across multiple lines of business, and discuss methods of correlation. 3.5 Evaluate reserving result analyses.

3.5.1 Describe the factors an actuary should consider in assessing the reasonableness of the results of a reserving exercise.

3.5.2 Describe typical diagnostics that are commonly used to assess the reasonableness of the results of a reserving exercise.

3.5.3 Describe the factors an actuary should consider in assessing the reasonableness of changes in results of a reserving exercise over time.

3.5.4 Describe how an analysis of experience may be carried out in the context of a reserving exercise.

3.5.5 Describe how alternative results of reserving exercises can arise and highlight some of the professional issues in resolving them.

3.6 Assess uncertainty and its communication in reserving.

3.6.1 Discuss what is meant by a 'best estimate' reserve.

3.6.2 Describe the following approaches to estimating ranges of reserves: • Stochastic models • Scenario tests • Use of alternative sets of assumptions.

3.6.3 Discuss the uses, advantages and disadvantages of each of these methods.

3.6.4 Discuss the issues to be considered when communicating reserve ranges and uncertainties.

4 Capital modelling (17.5%)

4.1 Evaluate the key considerations in deriving and applying capital modelling techniques.

4.2 Evaluate the following approaches to capital modelling: • Deterministic models • Stochastic models.

4.3 Discuss the following issues with regard to parameterisation of capital models: • Developing assumptions • Validation.

4.4 Describe approaches to the assessment of capital requirements for the following risk types: • Insurance risk • Market risk • Credit risk • Operational risk • Liquidity risk • Group risk. 4 SP7

4.5 Explain some of the areas to consider when approaching a capital modelling exercise.

4.6 Describe the practical considerations that should be borne in mind when undertaking capital modelling.

5 Data, investigations, reinsurance and accounting (17.5%)

5.1 With regard to the use of data in reserving and capital modelling: • describe the types of data that are used. • describe the main uses of data. • describe the requirements for a good information system. • outline the possible causes of data errors. • analyse the effects of inadequate data.

5.2 Outline the major actuarial investigations and analyses of experience undertaken with regard to reserving and capital modelling for general insurers.

5.3 Describe the factors influencing the choice of an appropriate reinsurance programme for a general insurer.

5.4 Describe how to test the appropriateness of alternative reinsurance structures for a general insurer.

5.5 Describe how reinsurance purchasing decisions may be impacted by capital management considerations.

5.6 Describe the following approaches to reserving for outwards reinsurance: • Gross less net • Application of standard techniques to reinsurance data • Use of appropriate factors • Application of detailed contract terms.

5.7 Compare the advantages and disadvantages of each of the above methods and the appropriate circumstances in which to use them.

5.8 Discuss suitable approaches to reserving for inwards reinsurance.

 5.9 Describe, within the context of investment and Asset Liability Management (ALM): • the principles of investment. • the asset-liability matching requirements of a general insurer. • how projection models may be used to develop an appropriate investment strategy.

5.10 Describe the methods and principles of accounting for general insurance business and interpret the accounts of a general insurer.

6 Solving problems

6.1 Analyse hypothetical examples and scenarios in relation to the financial management of general insurance companies.

6.1.1 Propose solutions and actions that are appropriate to the given context, with justification where required.

6.1.2 Suggest possible reasons why certain actions have been chosen.

6.1.3 Assess the implications of actions within a given scenario.

6.1.4 Discuss the advantages and disadvantages of suggested actions, taking into account different perspectives. Assessment Three-hour and fifteen-minute written examination.

SP8 – General Insurance Pricing Specialist Principles Aim The aim of this General Insurance Pricing Specialist Principles subject is for candidates to develop the following skills:

1 understand the main principles and techniques of pricing that are relevant to general insurance, including techniques to estimate the key elements within a technical price.

2 apply these principles in practice within the context of general insurance.

3 understand how pricing links to wider business processes (e.g. business planning, reserving and capital setting).

4 analyse hypothetical scenarios, including using judgement to assess the implications of possible actions and to develop appropriate proposals or recommendations relating to pricing in general insurance business.

Syllabus topics

1 General insurance products and general business environment (20%)

2 Data, risks and risk management (30%)

3 Rating bases and methodology (35%)

4 Credibility, reinsurance and catastrophe modelling (15%)

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic and hence the amount of explanation and support required for it. • the need to provide thorough foundation understanding on which to build the other objectives. • the extent of prior knowledge that is expected. • the degree to which each topic area is more knowledge- or

application-based. Assessment of skill level Exam questions are designed to test the following: • Knowledge (demonstration of a detailed knowledge and understanding of the topic), • Application (demonstration of an ability to apply the principles underlying the topic within a given context) and • Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations. This includes the ability to develop proposals and recommendations utilising actuarial judgement, i.e. taking into account different points of view, comparing and contrasting situations, clearly communicating any limitations and elements of uncertainty in the approach). In the SP subject exams, the approximate split of assessment across these three skill types is 25% Knowledge, 50% Application and 25% Higher Order skills. The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question that can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document 'Command verbs used in the Associate and Fellowship written examinations.

1 SP8

Detailed syllabus

objectives

0 Introduction

0.1 Define the principal terms in use in general insurance.

1 General insurance products and general business environment (20%)

1.1 Describe the main types of general insurance products in terms of: • the needs of customers. • the financial and other risks they pose for the general insurer including their capital requirements and possible effect on solvency.

1.2 Describe the main types of reinsurance products for general insurance operations and the purposes for which they may be used.

1.3 Describe the implications of the general business environment in terms of: • the main features of the general insurance market. • the effect of different marketing strategies. • the effect of fiscal regimes. • the effect of inflation and economic factors. • the effect of legal, political and social factors. • the effect of the climate and environmental factors. • the general effect of professional guidance. • the impact of technological change.

2 Data, risks and risk management (30%)

2.1 Describe the major areas of risk and uncertainty in general insurance business with respect to pricing, in particular those that may threaten profitability or solvency.

2.2 Describe, with regard to the use of data in pricing: • the types of data that are used. • the main uses of data. • the requirements for a good information system. • the possible causes of data errors. • the effects of inadequate data.

2.3 Outline the major actuarial investigations and analyses of experience undertaken with regard to pricing for general insurers.

2.4 Describe the Collective Risk Model and its applications in a general insurance environment. Analyse the derivation of the Aggregate Claim Distribution for the Collective Risk Model and its approximations using stochastic simulation.

3 Rating bases and methodologies (35%)

3.1 Analyse the various components of a general insurance premium.

3.2 Describe the basic methodology used in rating general insurance business.

3.3 Suggest the various factors to consider when setting rates.

3.4 Evaluate appropriate rating bases for general insurance contracts, having regard to: • underwriting considerations. • policy conditions such as self-retention limits. • reinsurance

considerations. • expenses. • investment. • capital allocation, return on capital. 2 SP8

3.5 Discuss the burning cost approach to pricing.

3.5.1 Describe the burning cost approach to rating.

3.5.2 Determine the assumptions required when using this approach.

3.5.3 Outline the practical considerations when using this approach.

3.6 Discuss the frequency/severity approach to pricing.

3.6.1 Describe the frequency/severity approach to rating.

3.6.2 Determine the assumptions required when using this approach.

3.6.3 Outline the practical considerations when using this approach.

3.7 Discuss the use of Original Loss Curves in pricing.

3.7.1 Describe how Original Loss Curves can be used in rating.

3.7.2 Determine the assumptions required when using this approach.

3.7.3 Outline the practical considerations when using this approach.

3.8 Understand generalised linear models, multivariate modelling and machine learning techniques.

3.8.1 Assess the applications of generalised linear models to the rating of personal lines business and small commercial risks.

3.8.2 Outline the different types of multivariate models and machine learning techniques.

3.8.3 Evaluate the uses of multivariate models and machine learning techniques in pricing.

4 Credibility, reinsurance and catastrophe modelling (15%)

4.1 Outline the fundamental concepts of credibility theory.

4.2 Describe and compare the Classical and Bayes credibility models.

4.3 Describe the practical applications of credibility models within a general insurance operation.

4.4 Outline the similarities and differences between pricing direct and reinsurance business.

4.5 Describe how to determine appropriate premiums for each of the following types of reinsurance: • Proportional reinsurance • non-proportional reinsurance • Property catastrophe reinsurance • Stop loss.

4.6 Describe the data required to determine appropriate premiums for each of the above types of reinsurance.

4.7 Outline the basic structure of a catastrophe model.

4.8 Describe the key perils that can be modelled in a catastrophe model.

5 Solving problems

5.1 Analyse hypothetical examples and scenarios in relation to the financial management of general insurance companies.

5.1.1 Propose solutions and actions that are appropriate to the given context, with justification where required.

5.1.2 Suggest possible reasons why certain actions have been chosen.

5.1.3 Assess the implications of actions within a given scenario.

5.1.4 Discuss the advantages and disadvantages of suggested actions, taking into account different perspectives. Assessment Three-hour and fifteen-minute written examination.

SPECIALIST ADVANCED

SA1 – Health and Care Specialist Advanced Aim The aim of the Health and Care Specialist Applications subject is to instill in the successful candidates the ability to apply knowledge of the Indian health and care environment and the principles of actuarial practice to the provision of health and care benefits in India. Links to other subjects Subject SP1 – Health and Care Specialist Principles: provides the underlying principles of health and care upon which this subject is based. It is assumed that candidates have a good understanding of this material. Candidates can expect to be examined in aspects of general principles developed in Subject SP1 – Health and Care Specialist Principles as well as in India specific aspects developed in this subject.

Objectives On completion of this subject the candidate will be able to:

(a) Define the principal terms used in health and care provision in the India.

(b) Analyse the main types of health and care insurance products in terms of: customer needs interaction with State provision higher order insurer risk considerations bundling and unbundling impact of unit-linked wrappers

(c) Describe the general business environment for health and care insurers in India, in terms of: products and distribution, including the roles of the State and employers underwriting approaches, including genetic testing use of counterparties external influences – demographic, medical, economic and social Page 2 of 4 SA1 – Health and Care Specialist Advanced

(d) Understand the legal, taxation and regulatory framework as applicable to Indian health and care insurance: taxation of Indian health and care products: premiums, benefits, profits supervision of valuation of assets, liabilities and capital requirements Solvency II framework in terms of principles, background, scope, structure and its implications for Health Insurance Company. conduct of business rules financial reporting requirements policyholder protection schemes treating customers fairly statutory actuarial roles

(e) Describe the principles underlying the requirements of the professional standards and guidance relevant to actuaries practicing in Indian health and care operations.

(f) Understand how to design and price health and care insurance products to be sold by Indian insurers, including: policy conditions capital requirements and return on capital marketability, competition and distribution management of the risks availability of good quality and relevant data underwriting reinsurance investment policy the renewal process and options regulatory requirements

(g) Understand the principles and practices in specific areas of evaluation: assessment of the market for a new company launch assessment of overseas markets assessment of a company or portfolio for takeover embedded value analysis including understanding of concepts like Market Consistent Embedded Value, Value of In-force Business, Value of New Business, etc. and how these are applicable in case of Health Insurance Company

(h) Evaluate the uses and benefits of reinsurance support in health and care insurance: control of risks financing technical assistance reinsurance impact badging

(i) Analyse the asset-liability matching requirements of Indian health and care insurer and develop appropriate strategies.

(j) Analyse the experience of a health and care insurer. Develop appropriate strategic recommendations for a health and care insurer following an analysis of experience. Page 3 of 4 SA1 – Health and Care Specialist Advanced

(k) Understand the considerations underlying the provision of national health care systems: the importance of healthcare provision different healthcare systems worldwide different approaches to financing healthcare QALYs (quality adjusted life years)

(l) Understand areas of best practice in Indian health and care provision.

(m) Produce coherent advice and recommendations for the overall financial management of a health and care insurance company. Analyse more complex problems in terms of actuarial, economic and financial factors to a level where appropriate analytical techniques may be used. Integrate the results of such an analysis into a coherent whole, and Evaluate critically and interpret the results in a wider context and draw appropriate conclusions.

(n) Understand the working of Mass Health Insurance Schemes that are prevalent in India including their administration, pricing, risks, etc. with specific focus on Pradhan Mantri Jan Arogya Yojana (PMJAY).

(o) Various provisions of IRDAI (Health Insurance) Regulations as amended to date along with other provisions applicable to Health Insurance in India issued by IRDAI through various circulars, notifications, etc. from time to time including but not limited to Guidelines on Standardization in Health Insurance, Guidelines on Product Filing in Health Insurance, Insurance Regulatory and Development Authority of India (Assets, Liabilities, and Solvency Margin of General Insurance Business) Regulations, 2016 etc.

of the Life Insurance Specialist Applications subject is to install in newly-qualified actuaries the ability to demonstrate a detailed understanding of: • the Indian life insurance environment/market. This includes a detailed understanding of the current products sold, the underlying market/customer demand and methods of distribution, as well as the regulatory, professional and

fiscal/taxation regime. • the principles and techniques of actuarial management and control, that are being used in practice within the Indian life insurance market/company. • the financial, commercial and economic issues and associated risk present in the Indian life insurance market. Links to other subjects Subject SP2 Life Insurance Specialist Principles provides the underlying principles upon which this subject is based. It is assumed that students have a good understanding of the principles covered in that. Candidates can expect to be examined in aspects of general principles developed in Subject SP2 as well as in the Indian specific aspects developed in this subject. Objectives of Assessment of skill level Exam questions are designed to test the following: • Knowledge (demonstration of a detailed knowledge and understanding of the topic), • Application (demonstration of an ability to apply the principles underlying the topic within a given context) and • Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations. This includes the ability to develop proposals and recommendations utilising actuarial judgement, i.e. taking into account different points of view, comparing and contrasting situations, clearly communicating any limitations and elements of uncertainty in the approach). In comparison with SP2 'Life Insurance Principles', the assessment of SA2 is looking for candidates to demonstrate a more detailed understanding of the underlying market conditions in India, as well as the ability to apply actuarial techniques and judgement to more detailed and complex problems. In particular to:

1 understand the more complex aspects of actuarial practice within life insurance companies.

2 apply the principles of actuarial practice to the management of life insurance under complex scenarios.

3 recommend coherent solutions and courses of action in relation to the overall financial management of life insurance companies.

 Detailed syllabus objectives:

On completion of this subject the candidate will be able to:

(a) Define the principal terms used in life insurance in India.

(b) Describe the major life insurance products, in addition to the generic products covered in Life Insurance Specialist Principles subject (SP2), of Indian life insurance companies in terms of: • the needs of consumers versus the objectives of the insurer • the benefits, guarantees, and options that may be provided • the main types of products issued • the purpose, benefits and associated risks (including mitigation techniques) of the various products offered The products (Group and Individual) under this syllabus objective are: • term assurance SA2 – Life Insurance Specialist Advanced Page 3 of 9 • income protection insurance • critical illness insurance • conventional with profits • accumulating with profits • unit-linked • index-linked • mortgage endowment • annuities • variable annuities • pension • Group saving • Micro insurance • Health and non-health Riders • Regulatory Standard products In addition to above products, candidates are also expected to have a good understanding of the product lines and applicable rules & regulations as detailed in IRDAI Product Regulations, 2019 (both Linked and Non-Linked).

(c) Describe the effect of the general business environment in India, including the impact on level of risk to the insurer, in terms of: • new business • distribution of products • the wider competitive environment • the principles of treating customers fairly • operational risk • corporate finance • outsourcing • securitisation • mergers and acquisitions • closed funds • other forms of capital • reinsurance

(d) Describe how policyholders' reasonable expectations (PRE) might be measured and managed with regard to the main contract types.

(e) Describe the principles of Indian contract and trust law as they affect life insurance, including reference to IRDAI (Protection of Policyholders' Interests) Regulations 2017, and the Redressal of Public Grievances Rules, 1998.

(f) Describe the Indian regulatory environment as it affects life insurance companies in terms of: • The taxation of the Indian business of life insurance companies and the effect of taxation on the benefits and premiums paid under Indian life insurance contracts. • The supervision of life insurance companies/business under the relevant IRDAI regulations with regard to: o the valuation of the assets and liabilities, o the returns to be submitted including the ARA, Annual Appointed Actuary's confidential report, transfers of surplus, o solvency capital, Economic Capital, individual capital assessments and transfers of liabilities. • Financial/Profit reporting under the IRDAI regulations. SA2 – Life Insurance Specialist Advanced Page 4 of 9 • Value of New Business and Embedded Value reporting and disclosure under the Professional Standards on Indian Embedded Values. • The requirements of the professional and regulatory guidance relevant to actuaries practising in or advising the Indian life insurance companies, including the production of Financial Condition Reports. • Asset -Liability management • The capital management of a life insurance company, including determining and improving available capital, projecting future solvency, the principles of asset-liability management and the use of derivatives. • The role and responsibilities of the Appointed Actuary. • With Profit Committee: requirement and its roles and responsibilities in managing the with profit business.

(g) Demonstrate the understanding of professional standard: APS/GNs

(h) Describe internal controls and procedures necessary to enable the financial reporting listed in Objective (f), having regard to efficient management of the business, including accounting conventions and systems.

 (i) Describe the principles of dynamic solvency/Stress testing in terms of: • the reasons for projecting solvency • the alternative measures of solvency, including risk-based capital approaches - the ongoing need for capital and the role of the estate.

(j) Determine the design of life insurance contracts to be marketed in India and appropriate methods and bases for pricing them.

(k) Describe the management of with profits business, including: • the calculation and use of asset shares • appropriate ways of determining surplus distribution policy • the determination of discontinuance and alteration terms

(l) Describe how unit pricing, in respect of the internal unit-linked funds of an Indian life insurance company, can be a source of risk.

(m) Describe the principles of unit pricing in respect of the internal unit-linked funds of Indian life insurance companies.

(n) Managing investment guarantees: Interest rate Risk and management of the same

(o) Describe the principles behind the determination of discontinuance terms for life insurance contracts and: • Determine appropriate methods and bases for varying the non-linked life insurance contracts of Indian life insurance companies on terms that are not guaranteed. • Determine appropriate methods and bases for varying unit linked or index linked life insurance contracts of Indian life insurance companies.

(p) Describe the impact of credit and counterparty risks and how such risks might be assessed.

(q) Determine, for the purpose of meeting regulatory requirements, appropriate methods and bases for valuing the liabilities of an Indian life insurance company, taking account of the nature of the assets.

(r) Determine methods and appropriate bases for assessing the on-going solvency of an Indian life insurance company, bearing in mind the capital requirements of the company.

(s) Determine appropriate methods and bases for the purpose of assessing the profitability of the existing business of an Indian life insurance company.

(t) Describe the principles behind managing capital, having regard to the (sometimes conflicting) interests of policyholders and shareholders with regard to the estate, in the following contexts: open funds • closed funds inherited estate • transfers of funds (within company, within group of companies, across companies, under mergers/acquisitions, de-mutualisation's)

(u) Describe the principles of asset-liability management, including stochastic approaches, and: analyse the asset-liability matching requirements of an Indian life insurance company develop appropriate strategies.

(v) Analyse the reinsurance and underwriting requirements of an Indian life insurance company for the purpose of the efficient management of the business.

(w) Carry out an analysis of surplus, on either a supervisory or a economic basis, in respect of an Indian life insurance company and use the results to reassess the design of the company's contracts or actuarial base (v) Carry out an analysis of the change in the shareholder value of a Indian life insurance company and use the results to reassess the design of the company's contracts or actuarial bases.

 Study Material for Subject SA2: A - Reading Material by Actuarial Education Co: 2018 Examinations Course Notes Chapters 1, 2, 15-17, 20-21, 23, 24-26 as found in 2018 ActEd course material. Chapter 3 - UK general business environment Except Section 2 and 3 (Material to be supplemented to cover the distribution framework in India covering individual agents, corporate agents, bancassurance, brokers, direct marketing, online distribution) Chapter 4 - UK contract and trust law - Substitute with Indian equivalent including the Indian Redressal of Public Grievances Rules, 1998 and IRDA (Protection of Policyholders' Interests) Regulations, 2002. Chapter 5 - Policyholder tax - substitute with Indian position Chapter 6 & 7 - Life company tax (1) and (2) - substitute with Indian position Chapter 8 – Tax allowance in unit pricing: Omit Chapter 9 & 10 - UK regulatory environment (1) and (2): Omit Chapter 11 - Solvency reporting - substitute with Indian Regulations Chapter 12 - Valuation

of assets / liabilities / solvency margin – supplemented with relevant Indian Regulations Chapter 13 – Professional standards and guidance – substitute with applicable Indian standards and guidance Chapter 14 – Treating customers fairly - substitute with Indian position Chapter 18 - Profit reporting and Chapter 19– Profit reporting – embedded value - substitute UK specific material for profit reporting with that under IRDA regulations Chapter 22 – Management of UK with-profits funds – supplement with the Indian scenario In addition, apart from other natural linkages to SP-2 subject, students are also specifically expected to demonstrate knowledge of areas of unit pricing, reinsurance, underwriting, surrender values and alterations as outlined in SP-2. SA2 – Life Insurance Specialist Advanced Page 6 of 9 B - Core Reading Material for Subject SA2: 1. Insurance Act 1938 (and Insurance Laws (Amendment) Act 2015) – 1(i): Section 13 1(ii): Section 22 1(iii): Sections 27, 27a, 27c 1(iv): Section 35 1(v): Sections 40, 40a, 40b 1(vi): Section 41 1(vii): Section 49 1(viii): Section 52 1(ix): Sections 55, 56 1(x): Sections 64V, 64VA 1(xi): Section 112 1 (xii): Section 113 2. Income Tax Act 1961 2(i): Life office Taxation Section Detail 44 Computation of Profits and gains of insurance business: Profits and gains of insurance business shall be computed as per First Schedule. Annual average surplus arrived by adjusting the surplus or deficit disclosed by the actuarial valuation as per Insurance Act, 1938 (4 of 1938) 115B Tax rate: Tax on profits & gains of life insurance business @ 12.5% 115O Dividend Distribution Tax 10(34) Dividend Income: Any income by way of Dividends referred in section 115O is exempt 10(23AAB)i Pension Income exempt : Any income of fund under pension scheme is exempt 2 (ii): Policyholder Taxation: The candidate is expected to have knowledge of latest provisions at the time of examinations Section Detail 80C Life insurance premium: Deduction in respect of life insurance premium, immediate annuity policy premium 80CCC Pension products: Deduction in respect of contribution to certain pension funds 80CCE Aggregate deduction under section 80C, 80CCC and 80CCD(1) SA2 – Life Insurance Specialist Advanced Page 7 of 9 80D Health insurance premium: Deduction in respect of health insurance premium 17(2)(vii) Employer contribution to superannuation fund 10(10) Gratuity received by an employee on his

retirement under group gratuity product may be exempt 10(10A) Commutation of pension is exempt 10(10D) Sum received under life insurance policy is exempt subject to some conditions 10(13) Any payment from superannuation fund is exempt on death, etc. under Group superannuation product 2(iii): Note on 'Taxation of Life Insurance business – Some Issues' by S P Subhedar 3. IRDA Regulations and Circulars: 3(1): IRDA (Appointed Actuary) Regulations2022 3(2): IRDA (Actuarial Abstract and Report) Regulations 2016 and subsequent amendments 3(3): Circular dated August 2002 from IRDA – Appointed Actuary's Annual Report 3(4): IRDA (Preparation of Financial Statements and Auditors' Report of Insurance Companies) Regulations, 2002 3(5): IRDA (Protection of Policyholders' Interests) Regulations 2017 3(7): IRDA (Assets, Liabilities and Solvency Margin of Insurers) Regulations 2016 and subsequent amendments 3(8): Redressal of Public Grievances Rules, 1998 3(9): Insurance Act, 1938 as amended by Insurance (Amendment) Act, 2002 and Insurance Laws (Amendment) Act 2015 3(10): IRDA (Distribution of Surplus) Regulations 2002 3(11): IRDA (Insurance Advertisements and Disclosure) Regulations, 2000 and amendments thereto in 2010 3(12): IRDA (Registration of Indian Insurance Companies) Regulations 2000 and amendments thereto in 2003, 2008 and 2016 3(13): IRDAI (Insurance Brokers) Regulations, 2018 3(14): IRDAI (Registration of Corporate Agents) Regulations, 2015 and subsequent amendments 3(15): IRDAI (Issuance of Capital by Life Insurance Companies) Regulations, 2015 3(16): IRDAI Circular on ALM and Stress Testing, 2012 3(17): IRDAI (Scheme of Amalgamation and Transfer of life Insurance Business) Regulations, 2013 3(18): IRDAI (Reinsurance) Regulations, 2018 and subsequent amendments 3(19): IRDAI (Health Insurance) Regulations, 2016 SA2 – Life Insurance Specialist Advanced Page 8 of 9 3(20): IRDAI (Linked Insurance products) Regulations, 2013 and 2019 3(21): IRDAI (Non-Linked Insurance products) Regulations, 2013 and 2019 3(22): IRDAI (Investment) Regulations, 2016 and subsequent amendments 3(23): IRDAI (Obligations of Insurers to Rural and Social Sectors) Regulations, 2015 3(24): Circulars on Economic Capital; Ref: IRDA/CIR/LIF/049/3/2010, dated 11 March, 2010 and 27th December, 2010 3(25): IRDAI Circular on Guidelines on Interest Rate Derivatives; Ref: IRDA/F&I/INV/CIR/138/06/2014 3(26): IRDAI

(Micro Insurance) Regulations, 2015 3(27): IRDAI (Expenses of management of insurers transacting life insurance business) Regulations 2016 and subsequent amendments 3(28): IRDAI (Other forms of capital) Regulations 2015 & 2022 3(29): IRDAI(Registration Indian Insurance Companies), Regulations, 2022 4. Guidance notes, APS Published by the Institute of Actuaries of India and reports: 4(i): IAI working group report on MCEV and economic capital for Life insurance industry in India 4(ii): APS 1 - Appointed Actuary and Life Insurance Business 4(iii): APS 2 - Additional Guidance for Appointed Actuaries and other Actuaries involved in Life Insurance 4(iv): APS 3 - Financial Condition Report 4(v): APS 4 - Peer Review and the Appointed Actuary in Life Insurance 4(vi): APS 5 - Appointed Actuary and Principles of Life Insurance Policy Illustrations 4(vii): APS 7 - Appointed Actuary (AA) and Principles for determining Margins for Adverse Deviation (MAD) in Life Insurance liabilities 4(viii): APS 10- Determination of Embedded Value of Life Insurance Companies incorporated in India and regulated by the IRDA for the purpose of Initial Public offering (IPO). APS 34: General Actuarial Practices 4(ix): GN6- Management of Participating Life Insurance Business with Reference to Distribution of Surplus 4(x): GN22- Reserving for Guarantees in Life Assurance Business C - Recommended Additional Reading Material: Note: The following material is suggested as additional reading so as to assist the student to understand the core reading material better. Reading these papers will help the students to understand the subject better and to demonstrate deeper understanding of the subject in their answer. Please note that questions will not be asked directly from the Recommended Additional Reading Material. 1. British Actuarial Journal – Vol. 1, Part 4, No. 4 October 1995: Asset shares and their use in financial management of a with profits funds by P D Needleman, FIA and T A Roff, FIA – Page No. 603 to 670. SA2 – Life Insurance Specialist Advanced Page 9 of 9 2. British Actuarial Journal – Vol. 2, Part 3, No. 8 August 1996: An Alternative to the Net Premium Valuation method for statutory Reporting by P G Scott, FIA, S F Elliott, FIA, L J Grey, FFA, T W Hewitson, FFA, D J Lechmere, FIA, D Lewis, FIA and P D Needleman, FIA – Page No. 527 to 585. 3. Actuarial Investigations of Life Assurance Offices in India – a Retrospective Review By – R M Mehta, FIA, FASI. 4. Fin Re SIAS Paper 5 October,

1993 5. Realistic Reporting of Life Insurance Company Policy Liabilities and Profits: Developments in Anglo American Countries JIS Vol. 121 Part II – 1994 6. Modern Valuation Techniques SIAS paper 6 February 2001 7. Getting to Grips with Fair Value SIAS paper 5 March, 2002 8. Dynamic Solvency Testing SIAS Paper 5 March, 1997 9. Asset Liability Management in the Life Insurance Industry LOMA paper 1993 10. Profit, Capital and Value in a Proprietary Life assurance Company JIA Vol. 121 Part II – 1994. 11. Building a Credible Life Office Model SIAS Paper 1998 12. Demystifying Capital management in the Life Insurance Industry SIAS paper 10 October 2000 13. Summary and Comparison of Approaches Used to Measure Life Office Values SIAS Paper 16 October 2001. 14. Insurance Company Mergers and Acquisitions SIAS paper 15 February, 2000.

Aim The aim of the General Insurance Specialist Applications subject is to instil in successful candidates the ability to apply knowledge of the Indian general insurance environment and the principles of actuarial practice to providers of general insurance in the India and the awareness of regulatory developments in the principal general insurance markets of the world like UK, Europe, and USA. Link to other subjects Subject SP7 — 'General Insurance Reserving and Capital Modelling Specialist Principles' provides the underlying principles of reserving and capital modelling techniques in general insurance upon which this subject is based. It is assumed that candidates have a good understanding of the principles covered in this Subject. Subject SP8 — 'General Insurance Pricing Specialist Principles' provides the underlying principles of premium rating techniques in general insurance upon which this subject is based. It is assumed that candidates have a good understanding of the principles covered in this Subject. Candidates can expect to be examined in aspects of principles developed in Subjects SP7 and

SP8 as well as the further aspects of general principles, and also India specific aspects, developed in this subject. Objectives On completion of this subject,

the successful candidates will be able to:

(a) Define the principal terms in use in general insurance in the India (Glossary)

(b) Describe the principal regulatory and supervisory requirements that affect general insurers established in India and be aware of the current status and expected future development of IFRS-17, Risk Based Capital regimes in India and overseas (e.g. Europe) and the general regulatory environment in the US.

(c) Describe the requirements of the professional guidance and other guidance material issued by IRDAI relevant to actuaries practicing in or advising Indian general insurance companies.

(d) (i) Understand the particular considerations to be borne in mind when pricing large commercial risks. (ii) Describe alternative approaches to rating such risks. (e) Determine appropriate bases for valuing the insurance assets, liabilities and solvency of an Indian general insurer in order to produce: SA3 – General Insurance Specialist Advanced Page 3 of 5 (i) Quarterly solvency margin reports (Forms IRDAI-GI-TA, FORM IRDAI-GI-TR, FORM IRDAI-GI-SM 1A and 1B) (ii) annual accounting and statutory returns, including under IFRS 17 (iii) Annual Actuarial Valuation and related reports submission such as: • Annual Financial Condition Report • Annual Appointed Actuary's IBNR Report • Calculation of Economic Capital

(f) (i) Understand the different reserving techniques and appropriateness of the techniques by line of business. (ii) Knowledge of alternative approaches to reserving commonly used in UK and US markets (iii) Understand the claims experience of the Motor Third Party Liability business in India and methods that may be used for reserving for this business

(g) (i) Analyze the financial planning requirements of a general insurer and develop appropriate strategies (ii) Develop appropriate

models for the purpose of financial planning to enable a general insurer to develop and monitor its strategic objectives at either the corporate or product level (Chapter 10) (iii) Solve complex problems and analyze complex issues associated with: • product design • product pricing • reserving for unexpired risks • reserving for outstanding claims • valuation of assets and liabilities • reinsurance arrangements • investment policy • asset adequacy • long-term financial control • capital modeling and hence draw reasoned conclusions in relation to: o risks undertaken o the requirement for capital o the return on capital • accounting and financial reporting

Study material for subject SA3 A Reading Material by Actuarial Education Co: For the May and November 2023 examinations, ActEd Study Materials: 2022/2023 Examinations Subject SA3 Substitute with Indian market landscape – number of companies, PSU vs Private, market share, performances etc. Source: IRDAI Annual reports, handbooks of statistics. IRDAI quarterly statistical supplements. SA3 – General Insurance Specialist Advanced Page 4 of 5 Topic: Taxation • Substitute with Indian market – Tax on general insurance Topic: Legislation • Substitute with Insurance Act, IRDA Acts and regulations applicable for general insurance available at http://www.irdai.gov.in • Understanding changes in accounting principles on general insurance accounting and financial reporting Topic: Professional Guidance Substitute with: • APS 21 issued by IAI • Professional Conducts Standard (PCS) issued by IAI • APS 33 issued by IAI • APS 34 issued by IAI For all chapters in ActEd Study Materials: 2020/21 Examinations Subject SA3, where ever relevant, candidates should refer SP7 and SP8 ActEd course material to supplement ideas developed / presented. B India specific reading material for Indian Legislations • IRDA (Appointed Actuary) Regulations, 2017 & amendments thereof, if any • IRDA (Assets, Liabilities, and Solvency Margin of General Insurance Business) Regulations, 2016 & amendments thereof, if any • IRDA (Protection of Policyholders' Interests) Regulations 2017 & amendments thereof, if any • Guidelines on estimation of IBNR Claims provision under General Insurance Business as per IRDAI Circular 11/IRDA/ACTL/IBNR/2005-06 dated 08.06.2005 • Information to be submitted as part of the Annual Actuarial Valuation and related

reports submission as per Circular IRDAI/ACT/CIR/GEN/075/03/2017: • IBNR Report, Circular No 11/IRDA/ACTL/IBNR/2005-06 dated 08.06.2005 • Financial Condition Report, Annexure III of Circular No.: IRDAI/ACT/CIR/GEN/075/03/2017 dated 31.03.2017 • Asset Liability Management and Stress Testing, Circular No.: IRDA/ACTL/CIR/ALM/006/01/2012 • Economic Capital Report, Circular No.: IRDA/ACT/CIR/MIS/111/05/2011 dated 25th May 2011 • IRDAI (Health Insurance) Regulations, 2016 & amendments thereof, if any IRDAI (Investment) Regulation 2016 & amendments thereof, if any • IRDAI (Re-insurance) Regulations, 2018 & amendments thereof, if any • Guidelines on Product Filing Procedures for General Insurance Products (IRDAI/NL/GDL/F&U/030/02/2016), and related circulars SA3 – General Insurance Specialist Advanced Page 5 of 5 • Consolidated Guidelines on Product filing in Health Insurance Business (IRDAI/HLT/REG/CIR/194/07/2020) The above list is not exhaustive. The candidate is expected to have knowledge and understanding of all previous and recent extant regulations (and amendments thereof) issued by IRDAI from time to time affecting Indian general insurance business in general and their actuarial implications in particular. Further reading As suggested in the ActEd study material. Candidates are expected to read as much as they can on the general insurance principles and techniques. Some reading materials which are specific to countries other than India may be omitted. Other reading materials are relevant for the IAI SA3 exam in a similar way they are for the IFoA, UK SA3 exams.

SA4 – Pensions and Other Benefits Specialist Advanced

Aim The aim of the Pensions and other Benefits Specialist Advanced subject is to instill in successful candidates the ability to apply knowledge of actuarial and related subjects as these apply to Pension, Social Security and other Employee Benefits in India (in particular and including actuarial and employee benefit work carried out in off-shored functions), UK and across the globe (in general) Links to other subjects Subject SP4: Pension and other Benefits Specialist Principles: provides the underlying principles upon which this subject is based. It is assumed that candidates

have a good understanding of the principles covered in subject SP4.
Objectives

On completion of this subject the candidate actuary will be able to:

(a) Define the principal terms used in India (in particular), UK and across the globe (in general)

(b) Describe the roles of each of the following parties who may be involved in the provision of pensions in India (in particular), UK and across the globe (in general): the State the Pensions Regulator, PFRDA Taxation Authorities, CBDT Employees' Provident Fund Organisation, EPFO employers and groups of employers individuals and groups of individuals trustees actuaries other Employee Benefits advisers Insurers

(c) Describe how the legal framework for pensions & other long term employee benefits applies in India (in particular), UK and across the globe (in general) such as Gratuity, Provident Fund, Public Provident Fund, Pensions (including National Pension System, Atal Pension Yojana, Employees' Pension Fund 1995), Leave Benefits and Medical Benefits, attempt to: encourage appropriate non-State provision, ensure security for non-State provision, ensure adequacy of non-State provision, And with particular reference to scheme entity, funding, solvency and others.

(d) Discuss the implications, for the parties in (b), of the Regulatory, Legislative and Taxation environment in which Pensions and other Employee benefits in India (in particular), UK and across the globe (in general) are provided in terms of the effect of: Page 3 of 7 different presentation and reporting of benefits and contributions accounting standards; Indian and International discuss the issues taken into account in producing information to meet accounting standards, including - the objectives, - the disclosure requirements, including those for directors' remuneration, - the calculations of cost of benefit provision the professional guidance for actuaries contained in Guidance Notes/Actuarial Practice Standards mentioned below, as issued by the Institute of Actuaries of India (updated versions as on 21 July 2018); APS15 – Pension Fund

Terminology (Ver. 1.1/ 01.01.2012) APS20 - Actuarial Practice for Social Security Programmes (Ver. 1.01/ 01.01.2012) APS27 - Employee Benefits - (Ver.1.00 / 01.01.2018) APS34 – General Actuarial Practice - (Ver.1.00 / 29.12.2021) GN29 - Valuation of Interest Rate Guarantees on Exempt Provident Funds (Ver. (2.00/ 31.03.2022)

(e) Describe the ways in which providers in India (in particular), UK and across the globe (in general) may be able to finance the benefits to be provided in terms of: the alternatives that exist relating to the timing of contributions relative to benefit Payments, the forms and characteristics of investment (including those provided by life insurers) that are available if contributions are made before benefits are due for payment. The alternatives to pension available to individuals – these include Regular income products available in Indian Markets including immediate & deferred annuities provided by Insurers, Small savings instruments provided by post office to Senior Citizens

(f) Discuss the factors to consider in determining a suitable design, in terms of benefits and contributions in India (in particular), UK and across the globe (in general), in relation to: types of pension and other employee benefit schemes (e.g. defined benefit, defined contribution, risk sharing) the level and form of benefits and/or contributions to be provided, the method of financing the benefits to be provided, the choice of assets when benefits are to be funded, how the risk is shared between parties.

(g) Discuss the issues surrounding sponsor covenant in India (in particular), UK and across the globe (in general) in terms of what is meant by sponsor covenant how to measure the willingness of the sponsor to contribute Page 4 of 7 how to measure the ability of the sponsor to contribute when the other parties involved should consider the sponsor covenant

(h) Describe the risks and uncertainties affecting: the level and incidence of benefits, the level and incidence of contributions, the level and incidence of return on assets, the extent to which assets

are exhausted during a member's lifetime the overall security of benefits in India.

(i) Analyze the investment strategy of a provider in India (in particular), UK and across the globe (in general) of pensions and related benefits in relation to: any asset-liability matching requirements the trade-off between risk and reward, an awareness of adding value to the shareholders of the business, and describe how projection models may be used to develop appropriate strategies.

(j) Describe the issues that arise from the transfer/amendment of pension and/or other employee benefit rights in the event of a significant corporate activity such as an acquisition or scheme merger, including matters relating to: the interests and responsibilities of the parties involved, the terms that might be set out in the Pensions Clause of a Sale and Purchase agreement, financial aspects, such as the calculation of the bulk transfer value (if relevant) and benefits provided.

(k) Determine an appropriate method and appropriate financial and demographic assumptions for the valuation of defined benefit scheme open or closed to new entrants in India (in particular), UK and across the globe (in general) and placing values on benefits and contributions.

(l) Discuss the principles behind the determination of discontinuance terms in respect of benefits from an occupational pension scheme in India (in particular), UK and across the globe (in general), in relation to how the following may be taken into consideration when determining discontinuance terms: rights of beneficiaries, other benefit expectations, the availability and selection of a method of provision of discontinuance benefits, the level of available assets.

(m) Discuss how to determine values for assets, past and future benefits and future contributions in India (in particular), UK and across the global (in general) environment, including: the data requirements, Page 5 of 7 the need for placing values on assets,

past and future benefits and contributions and the extent to which values should reflect investment/risk management strategy, the reasons why the assumptions used may differ in different circumstances, the reasons why the assumptions and methods used to place a value on guarantees and options may differ from those used for calculating the reserves needed, how sensitivity analysis can be used to check the appropriateness of the values and be able to perform calculations to demonstrate an understanding of the valuation methods.

(n) Discuss the principles underlying the use of insurance, and the choice of insurance contract, as a means of reducing some of the risks and uncertainties associated with the provision of pensions and other employee benefits.

(o) Discuss the benefit options typically available to individuals: Before retirement, At retirement After retirement And discuss how to set appropriate terms and consent requirements for these options (where appropriate), taking into account the risk and reward for all relevant parties.

(p) Identify the sources of surplus/deficit for a benefit provider and discuss the factors that affect the application of this surplus/deficit.

(q) Describe how the financial significance of deviations from expectations should be monitored and assessed, in terms of: the reasons for monitoring, the data required, the process of analysis of the various factors affecting the experience, the use of the results of to help develop solutions to the problems faced in pension provision.

(r) Solve complex problems associated with: pension scheme design, setting funding rates, monitoring asset adequacy, investment policy, protecting members rights. And, through integrating and critically evaluating the results, draw conclusions there from, in particular in relation to: the risks undertaken, the level of funding, ownership of surplus and handling deficiencies, Page 6 of 7 future contributions, mergers and takeovers, winding up a scheme, sponsor covenants. Study Materials Study Material

supplied by Actuarial Education Company - Year 2021 Study material for subject SA4- supplied by Actuarial Education Company for usage of the Institute and Faculty of Actuaries, UK subject to the following; Chapter 1: Introduction – included only Section 1 and 2 Chapter 5: Professional Guidance- Replace professional guidance of IFoA with that of IAI Other Chapters included without any exclusion India Specific Material 1. India Specific Legislation, Environment and Practices – Pension and Other Retirement Benefits by G N Agarwal – Version 1.07 (August 2010). (to be supplied by IAI) 2. Supplementary Note (updated) on India Specific Legislation, Environment And Practices – Pension and Other Retirement Benefits by Anuradha Sriram (to be supplied by IAI) 3. Employee Pension Scheme, 1995 (EPS) and Employees' Deposit Linked Insurance Scheme, 1976 (EDLI) (available in the market) 4. Payment of Gratuity Act 1972 (including amendments till March 2018) (available in the market) 5. Part A, B and C of Fourth Schedule of Income Tax Act, 1961. (available in the market) 6. Part XII, XIII and XIV of Income Tax Rules, 1962 (available in the market) 7. Approaches for Valuing Interest Rate Guarantees under AS 15 (revised, 2005) by Dr. K Sriram – Version 1.00 (April 2008) 8. National Pension System and Atal Pension Bima Yojana – Benefit design, features, investment norms, role of intermediaries & delivery mechanism (available in the market) 9. Code on Social Security, 2020 (available in the market) 10. Funded Products available in Indian Insurance market, Benefits & features (IRDAI Regulations available in the market) 11. Annuity products (both immediate & deferred) available in Indian Market, Small savings products available to Senior citizens 12. Features of the Social pension benefits promoted by Government of India through the Schemes PM Laghu Vyapari Maan Dhan Yojana (PM_LVMY), PM Kissan Maan_Dhan Yojana (PM_KMY), PM Shram Yogi Maan Dhan Yojana (PM_SYM) GNs and APSs issued by IAI 1. Professional Code of Conduct Version 3.0 2. APS9 – Continuing Professional Development (CPD) and the Actuary (Ver. 3.00/ 21.07.2018) 3. APS15 – Pension Fund Terminology (Ver. 1.1/ 01.01.2012) 4. APS20 – Actuarial Practice for Social Security Programmes (Ver. 1.01/01.01.2012) 5. APS27 – Employee Benefits (Ver. 1.00/01.01.2018) 6. APS34 – General Actuarial Practice - (Ver.1.00 / 29.12.2021) 7. GN29 - Valuation of Interest

Rate Guarantees on Exempt Provident Funds (Ver. (2.00/ 31.03.2022) Accounting and Other Standards 1. Accounting Standard AS 15 (revised, 2005) and Ind AS 19 on Employee Benefits issued by ICAI 2. AS 15 (revised, 2005) – Guidance on implementation issued by ICAI 3. AS 15 (revised, 2005) – Opinion on Transitional Liability issued by ICAI 4. AS 15 (revised, 2005) – Opinion on Leave valuation issued by ICAI 5. International Accounting Standard 19 (IAS 19) on Employee Benefits (including Amendments issued up to January, 2016) issued by IASB 6. Section 715 of ASC (FAS 158) https://asc.fasb.org/subtopic&trid=223501

SA7 – Investment and Finance Specialist Advanced Aim The aim of the Investment and Finance Advanced subject is to instill in successful students the ability to apply: • knowledge of the financial environment in the India and other jurisdictions; and • the principles of actuarial practice to the selection and management of investments in complex situations appropriate to the needs of a range of investors, together with relevant aspects of corporate finance.

 Competences On successful completion of this subject, a student will be able to:

1. Understand the more complex aspects of actuarial practice within investment management,in particular being able to show a reasoned and appropriate balance of risk and reward.

2. Apply the principles of actuarial practice to the selection and management of investments under complex scenarios.

3. Compare the approaches by which the principles are applied in practice areas across different jurisdictions.

4. Recommend coherent solutions and courses of action in relation to the overall management of investments. Links to other subjects SP5 – Investment and Finance Principles SP6 – Financial Derivatives Specialist Principles (for information)

Syllabus topics

1. The framework for investment management, including relevant aspects of corporate finance

2. Meeting investor requirements, including investment strategies to meet liabilities

3. Management and risk control for an investment manager, including portfolio management

These weightings are indicative of the approximate balance of the assessment of this subject between the main syllabus topics, averaged over a number of examination sessions. The weightings also have a correspondence with the amount of learning material underlying each syllabus topic. However, this will also reflect aspects such as: • the relative complexity of each topic, and hence the amount of explanation and support required for it; Page 2 of 6 • the need to provide thorough foundation understanding on which to build the other objectives; • the extent of prior knowledge which is expected; and • the degree to which each topic area is more knowledge or application based. Skill levels The use of a specific command verb within a syllabus objective does not indicate that this is the only form of question which can be asked on the topic covered by that objective. The Examiners may ask a question on any syllabus topic using any of the agreed command verbs, as are defined in the document "Command verbs used in the Associate and Fellowship written examinations". Questions may be set at any skill level: Knowledge (demonstration of a detailed knowledge and understanding of the topic), Application (demonstration of an ability to apply the principles underlying the topic within a given context) and Higher Order (demonstration of an ability to perform deeper analysis and assessment of situations, including forming judgments, taking into account different points of view, comparing and contrasting situations, suggesting possible solutions and actions and making recommendations). In the SA subjects, the approximate split of assessment across these three skill types is 20% Knowledge, 50% Application and 30% Higher Order Skills. Detailed

syllabus objectives

1.The framework for investment management, including relevant aspect of corporate finance (upto 30%)

1.1. Describe the financial markets in the developed and emerging economies, including: • public and private market assets. • over the counter and exchange traded derivatives. • the historic behaviour of major asset classes and market indices.

1.2. Describe the key domestic and global influences over the economic and capital markets environment in India and other jurisdictions from: • global economic trends Central Banks. • government policy. • market regulation. • regulatory capital requirements (including the Local , Economic and Risk Based Capital).

1.3. Describe how the principles of a legislative, taxation and regulatory conduct framework apply to investment management in the United Kingdom and other jurisdictions.

1.4. Discuss the key principles of corporate finance including capital structure and financing, and how these relate to different asset classes.

2.Meeting investor requirements, including investment strategies to meet liabilities (upto 35%)

2.1. Discuss the principles and objectives of investment management, along with the main factors influencing investment strategy, and analyse the investment needs of an investor.

2.1.1. Analyse the particular liability characteristics, investment requirements and the influence of the regulatory environment (including capital requirements) on the investment policies of the following institutions: • a life insurance company transacting with-profits, non-profit or unit-linked business • a non-life insurance company • a defined benefit pension fund • a defined contribution pension fund • an endowment, charity or other fund • a bank, hedge

fund or other proprietary investor • other unconstrained investors, including a sovereign wealth fund

2.1.2. Discuss the investment strategies that would be suitable to meet an individual investor's requirements, allowing for their risk appetite, time horizon and other constraints.

3.Management and risk control for an investment manager, including portfolio management (upto 35%)

3.1. Assess the principal approaches and techniques in investment portfolio management.

 3.1.1. Discuss active management and trading approaches, both within and across asset classes, and over different time horizons.

3.1.2. Discuss passive management and quasi-passive management including factor-based approaches.

3.1.3. Discuss investment risk control techniques and risk-based portfolio construction approaches.

3.1.4. Describe how derivative based strategies can be used for risk taking or for risk mitigation.

3.1.5. Describe how a liability benchmark or replicating portfolio can be used as part of an investor's investment strategy.

3.2. Discuss the techniques used for investment management assessment and selection.

 3.2.1. Discuss methods of organising the investment management of a large portfolio.

3.2.2. Describe the structure of a typical institutional investment department.

3.2.3. Describe fund of funds and fiduciary management approaches to investment management.

3.2.4. Describe the function of a performance measurement service.

3.3. Describe the impact of technology on investment management, including: • trading in derivative, equity and bond markets. • product development.

4.Solving problems

4.1. Recommend coherent solutions and courses of action in relation to the overall financial management of investment portfolios, having regard to the liabilities.

4.1.1. Analyse complex problems in terms of actuarial, economic and financial factors to a level where appropriate analytical techniques may be used.

4.1.2. Assess the implications and relevance of such factors, integrating the results into a coherent whole.

4.1.3. Evaluate the results critically in a wider context, drawing appropriate conclusions.

4.1.4. Propose solutions and actions, or a range of possible solutions and actions, based on this evaluation. Assessment 3 hour 15 minutes of written examination. INDIA SPECIFIC LEGISLATION, REGULATIONS,

ENVIRONMENT AND PRACTICES - READING MATERIAL RELEVANT FOR SUBJECT SA7 –INVESTMENT AND FINANCE ADVANCED – 2021 EXAMS • Insurance Regulatory and Development Authority (investment) Regulations, 2000 as amended by the Insurance Regulatory & Development Authority (Investment) (Fourth Amendment) Regulations, 2008 • Guidelines on Corporate Governance for the Insurance Sector - Circular No: IRDA/F&A/CIR/025/2009-10/dated 5th August, 2009 issued by IRDA • Prudential Guidelines on Capital Adequacy and Market Discipline –

New Capital Adequacy Framework- Circular No: RBI/2012-13/95/DBOD.No.BP.BC.16/ 26.06.001/2012-13 dated 2nd July,2012 issued by RBI Note: Only Part A of the above circular (dealing with Minimum Capital Requirement for Banks) is examinable. • Understanding of IFRS and IND AS including the reports of working group and notification issued by IRDAI and Institute of Actuaries of India. Staying abreast with recent developments. • Regulations and circulars issued by Insurance and Regulatory Authority of India from time to time. • The Insolvency and Bankruptcy code, 2016 and subsequent amendments; only application of law w.r.t. management of investments by insurers/pension funds/banks in equities / bonds and other instruments issues by corporates/legal entities is examinable. The impact of bankruptcy code on investment policy and risk management by insurers/pension funds/banks is also examinable. The Insolvency and Bankruptcy code, 2016 - A new era of corporate reform http://www.actuariesindia.org/downloads/souvenir/2016/ActuaryIndia June2016.pdf •IRDA investment regulations The following reading is relevant reading but is not directly examinable: http://www.actuariesindia.org/ core-reading Macro-economic policy decisions taken by major economies due to COVID-19 and their probable impact. The evolving space of Digital Assets and Crypto-currency. "Financial Stability Report, January 2021" issued by RBI

Master of Science [M.Sc.] (Actuarial Science) - Latest Notifications

MSc Actuarial Science is a 2 year post graduate course which deals with the specialisation in mathematics, statistics, and economics. It is a detailed study of mathematical and statistical methods for insurance risk and financial assessment.

Candidates with the minimum qualification of BSc or BCom with Mathematics/ Statistics as the main subjects are eligible to apply for this course.

Admission to the MSc Actuarial Science course can be gained mostly on the basis of entrances, However, there are few colleges offering admission to the course on the basis of merit as well. The average fees per annum to pursue this course are around INR 3-5 lac

A student pursuing this course is likely to bag a job as a financial manager or risk assessor or consultant in Insurance firms, financial services, actuary services or some government department too.

A person with a degree in MSc Actuarial Science has a lot of future options to choose from. Either they can work as an actuary or can pursue PhD with the same specialisation.

MSc Actuarial Science Course Highlights

Some of the major highlights of the course are listed in the table below.

Course Level	Post Graduate Course
Full Form	Masters of Science Actuarial Science
Duration	2 years
Examination Type	Semester Examinations
Eligibility	Candidate holding a B.Sc./ B.Com graduation degree with 50% aggre mathematics/ statistics as the main subjects.
Admission Process	Entrance Examination
Course Fee	INR 3-5 lacs
Average Salary	INR 5-10 lpa

Top Recruiting Companies	Max Bupa Health Insurance, Bharati Shipyard Ltd., WNS, Towers Wa... Services India, Mercer
Job Positions	Actuary Analyst, Actuarial Specialist, Risk Analytics- Actuarial, OA ... Risk Assessor

What is MSc Actuarial Science about?

MSc Actuarial Science is quite popular nowadays and can be described in the following points:-

- MSc in Actuarial Science focuses on mathematics and statistics as the main subject with the specialisation to assess insurance risk and financial assessment.
- With the course design in Mathematics, Statistics, Economics and Commerce as the major area, it lays a strong foundation for students to learn the techniques of the subject for practical applications.
- The course deals with the real life case studies and market analysis using the mathematics and statistical components with the amalgamation of qualitative analysis.
- MSc in Actuarial Science opens the door for a student to work in the insurance sector, be it Life, Health, Property or General Insurance.
- A person holding an actuarial Science degree can also work with any consulting firms, government agencies, banking, accounting firms, financial service firms etc
- The course is mostly opted after completing a B.Sc./B.com degree with mathematics/ statistics to focus on a certain area and to gain specialised knowledge of the subject.

Read More: Top MSc Courses

Why to choose an MSc Actuarial Science course?

MSc Actuarial Science offers various perks for the students including good package, interesting job profile, secured job etc. Below are some points which make it worth choosing:-

- **Popular: -** MSc in Actuarial Science is constantly growing worldwide, and is rated as one of the top jobs globally.
- **High Initial Package: -** The person with Actuarial Science degree earns great initial packages which are doubled within five years of work experience.
- **Diversified Career Options:-** You can work for an insurance sector or as a risk assessor or for a finance firm. Actuaries are also hired in a consultancy firm, government agencies, banks, accounting firms and industrial corporations.
- **Secured Job:-** The demand for actuaries are never diminished. World is in risk or recession, actuaries have a very less chance of losing their job.
- **Interesting career option:-** With the practical applications of mathematics and statistical tools in solving real life problems and risk assessment, career in actuarial science is an interesting one.
- **Balanced Work Life:-** The actuaries job is a low stress one with a high level of knowledge application.

What is the Admission Process followed for MSc Actuarial Science?

The admission process for MSc Actuarial is different in every college. Some of the colleges accept admission on the merit basis and some of the colleges conduct their own entrance exam to test the candidates for admission.

The detailed admission process followed by the universities is as follows:-

1. **Merit Based Admissions**

Some of the universities grant admission to students based on their performance at graduation level. The marks scored at graduation level are taken into consideration and a merit list is formed for admissions.

2. **Admissions based on Entrance Examination and interviews**

The candidates are required to follow the below mentioned steps to register for admissions in MSc Actuarial Science based on the entrance examinations: -

- Candidates should visit the college website or portal to fill the registration form.

- The registration form has columns for details, both personal and academic which need to be filled properly.
- Documents that are required to be attached should be uploaded with the registration form.
- Download the registration form after fee payment.
- Download the Admit Card and appear for the entrance examination conducted by any central body or the university itself.
- The merit list is uploaded by the respective university based on the individual score of the entrance examination.

Read More

What is the Eligibility for taking admission in MSc Actuarial Science?

A candidate who is willing to take admission in MSc Actuarial Science should pass the following eligibility criteria:-

- Candidates should have passed 10+2 examinations with minimum aggregate marks of 60%.
- Any candidate with Bachelor's degree of B.Com or B.Sc. with a minimum aggregate score of 50% and with Mathematics and Statistics as the main subjects are eligible for this course.

What are the MSc Actuarial Science Entrance Examinations?

There are various entrance examinations for admissions in this course. Some of the institutes organise an entrance exam of the college itself and some offer admission based on the common entrance exam.

Common Entrance Exams and university entrance examination which are considered for getting admission in MSc Actuarial Science are:-

- **CUET:-** Christ University Entrance Test is the entrance examination conducted by the <u>Christ University</u> for admissions in their postgraduate courses.
- **Actuarial science entrance exam:-** It is common entrance examination for all the candidates willing to take admission in Institute of Actuaries of India

The pattern of all the entrance examinations is the same as the OMR type. The paper consists of sections covering mathematical questions, aptitude based questions and reasoning questions. There is also a separate section for language evaluation. The entrance exams are pretty simple and need smart work with consistent aptitude practice to pass.

Important details related to some of the popular MSc Actuarial Science Entrance Exams are given in the table below.

Entrance Exams	
CUET PG	
BITSAT	
NEST	
IIT JAM	
DUET	
TISS NET	

MSc Actuarial Science Syllabus

Following table is the semester-wise MSc Actuarial Science syllabus followed by most of the top universities in India.

Semester I	Semester
Holistic Education	Financial Mathematics – II
Financial Mathematics	Probability and Mathematical Statist
Probability and Mathematical Statistics	Financial Economics – I
Managerial Economics	Corporate Finance and Financial Rep
Corporate Finance and Financial Reporting	Life Insurance and Pensions
Financial Markets and Services	-
Semester III	Semester

Actuarial Modelling	Life Contingency – II
Pensions and Other Retirement Benefits	Health Insurance and Enterprise Risk
Life Contingencies	Actuarial Applications Using Excel a
Statistical Methods and Models	Research Methodology
Financial Economics - II	Actuarial Modelling - II

Top MSc Actuarial Science Colleges

Listed below are some of the <u>top MSc Actuarial Science colleges in India:-</u>

College Name	City
<u>Christ University</u>	Bangalore
<u>Amity University</u>	Noida
<u>University of Madras</u>	Chennai
<u>Kerala University</u>	Kerala
<u>Institute of Actuarial and Quantitative Studies</u>	Mumbai
<u>Bishop Heber College</u>	Tamil Nadu
<u>Chandigarh University</u>	Chandigarh
<u>NIMS University</u>	Jaipur
<u>Gurugram University</u>	Gurgaon
DS Actuarial Education Services	Mumbai
University	Average Tuition Fee for Intern
<u>Montana State University</u>	14,720-20,000 USD/ year
<u>Rochester University</u>	26,736 USD/ year
<u>University of Texas-El Paso</u>	31,598 USD (total)
<u>University of Maine</u>	49,552 USD (total)
<u>Dallas Baptist University</u>	19,872 USD/ year
<u>Concordia University</u>	Not available
<u>Arkansas Tech University</u>	12,000-15,000 USD/ semester
<u>University of Wisconsin</u>	59,072 USD/ year
<u>University of Wyoming</u>	18,000-33,000 USD/ year
<u>Kent State University</u>	33,211 USD/ year
<u>University of Kansas</u>	36,714 USD/ year
<u>Indiana University of Pennsylvania</u>	29,809 USD/ year
<u>University of Colorado</u>	58,128 USD/ year
<u>Loyola University</u>	• UG-24,050 USD/ year

	• PG-970 USD/ credit hour
University of Utah	30,252 USD/ year
University of Massachusetts, Boston	• UG-17,569 USD/ year • PG-17,990 USD/ year

MSc Actuarial Science Distance Learning

Distance Education is quite popular nowadays and holds equal importance as the regular course. There are various universities in India offering MSc Actuarial Science Distance Learning programme. The syllabus and curriculum for both distance learning and regular course is the same. The only difference between both of them is that students with regular courses attend lectures and practical classes, however in distance learning, students have to study at home and attend semester examinations.

The eligibility criteria for admission to a correspondence program or distance learning course may depend on the university/institution, the candidates, however, must hold a B.Com/B.Sc. degree with at least 50% aggregate marking. Candidates should have Mathematics and Statistics as the major subjects.

Top distance education universities for MSc Actuarial Science in India are mentioned below -

College/Institute	Location	F
IGNOU	Delhi, Ahmedabad	INR 26.4 K – 3
BRAOU	Hyderabad	INR 5.8 K – 20
Amity University	Noida	INR 80k – 1 la

What after MSc Actuarial Science?

After pursuing MSc in Actuarial Science, one has a lot of career options to choose from. It is new yet gaining popularity in India gradually. MSc Actuarial Science jobs involve solving real life problems with mathematics and statistics tools.

MSc Actuarial Science jobs involve risk assessment or financial assessments. MSc in Actuarial science opens the door for a person to work in the following sectors:-

- Life Insurance
- General Insurance
- Health Insurance
- Reinsurance Companies
- Pension Funds
- Consultants
- Investments
- Government
- Academics
- Risk Management

Some of the companies that hire actuaries in India include Max Bupa Health Insurance, WNS, Towers Watson, PwC Actuarial Services India, Mercer, Directorate of Postal Life Insurance, McKinsey Advanced Healthcare Analytics, E&Y, Milliman, Swiss Re, Future Generali, IDBI etc.

Job Position	Job Description
Actuary	An actuary analyses the risk possibilities of a financial activity and miti involved risks. An actuary is mostly needed in the insurance sector and programs where the task is to use financial theories, statistics and mat to study uncertain future events.
Accountants and Auditors	Accountants and Auditors prepare and examine financial records. They that financial records are accurate and that taxes are paid properly and Accountants and Auditors assess financial operations and work to help that organizations run efficiently.
Budget Analysts	Budget Analysts help public and private institutions organize their finan prepare budget reports and monitor institutional spending.

Cost Estimators	Cost Estimators collect and analyse data in order to estimate the time, materials, and labour required to manufacture a product, construct a bu provide a service. They generally specialize in a particular product or ir
Economists	Economists study the production and distribution of resources, goods, a services by collecting and analyzing data, researching trends, and evalu economic issues.
Financial Analysts	Financial Analysts provide guidance to businesses and individuals maki investment decisions. They assess the performance of stocks, bonds, a types of investments.
Insurance Underwriters	Insurance Underwriters decide whether to provide insurance and under terms. They evaluate insurance applications and determine coverage ar premiums.
Mathematicians	Mathematicians conduct research to develop and understand mathema principles. They also analyze data and apply mathematical techniques t solve real-world problems.
Postsecondary Teachers	Postsecondary Teachers instruct students in a wide variety of academi career and technical subjects beyond the high school level. They also c research and publish scholarly papers and books.

Below are some of the MSc Actuarial Science jobs which are bagged by a person pursuing the degree:-

Learn great tips in our HTML blog about web development. Learn how to implement useful features for your website!

What is the Future MSc Actuarial Science Scope?

MSc Actuarial Science is a new yet trending course, and hence has a lot of market value. The person with MSc in Actuarial Science can choose from a lot of options for future prospects and career options. Some of them are: -

- Students with MSc in Actuarial Science can work in an insurance sector or finance companies as an actuary or risk assessor. They can work in other MNCs too as QA assurer, Analysts, Research Head etc.
- Students who want to pursue further studies can opt for PhD in the same field. A PhD in the same course will brush up the knowledge of a student and will develop a more research thinking.

- After MSc in Actuarial Science, students can also work as a lecturer or assistant professor in any academic institute or educational hubs.
- There are other courses too which can be done after MSc in Actuarial Science. A student can prepare for CA or CS examination.

THANK YOU

BE WISE, BE RICH

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