CIA Education Syllabus
Approved by the CIA Board on
November 26, 2015

Revised November 23, 2017

Document 218011

2017 EDUCATION SYLLABUS

Strategic Vision of the CIA on Education

The CIA is viewed as an educational body, not just an accreditation body. It takes full accountability for the educational path to Fellow of the Canadian Institute of Actuaries (FCIA) (which may involve outsourcing) with the FCIA recognized as being a high-quality, stand-alone educational designation (i.e., not having to be aligned to another designation).

This goal moves the Institute towards having a complete and well-defined Canadian education syllabus against which to evaluate and select education providers, and towards having greater accountability and responsibility for the education of actuaries in Canada, including having the appropriate level of control over syllabus content in outsourced situations.

CIA's Vision Statement

Financial security for Canadians.

CIA's Mission Statement

As the trusted bilingual voice of the Canadian actuarial profession, we advance actuarial science and its application for the well-being of society.

"*To define the Canadian education and eligibility criteria to become an ACIA and FCIA, and determine [recommend] how the requisite knowledge will be taught and tested.*"

"*The CIA education system develops actuaries that are recognized internationally for work of the highest professional actuarial standards.*"

From the Task Force on Canadian Eligibility and Education Requirements report, 2014

CIA Education System Principles

In drafting the following education principles, the CIA has taken into consideration the principles of the International Actuarial Association (IAA), Casualty Actuarial Society (CAS), and Society of Actuaries (SOA), and recognizes the earlier work of these organizations.

1. The CIA is responsible for actuarial education in Canada and promotes Canadian interests with respect to education, qualification, and professional development.

2. The CIA education system develops actuaries that are recognized internationally for work of the highest professional actuarial standards.

3. The CIA education system fosters a high degree of professionalism which helps protect the public interest.

4. The CIA attracts the best and brightest candidates to the profession in Canada, and develops actuaries who are qualified and equipped to meet current and emerging needs in traditional and non-traditional areas of practice.

5. The CIA education system emphasizes quality of learning to foster deep understanding through the selection of the most appropriate education and assessment methods, to meet the needs of all stakeholders.

6. The CIA may offer education through the following:

   - Its own education programs;
   - University accreditation programs;
   - Other actuarial organizations; and
   - Other education providers.

7. The CIA will provide a balanced education syllabus which will include theoretical concepts, technical material, practical applications, professionalism, communications, and general business acumen.

8. The CIA education syllabus, at a minimum, will meet the IAA and chartered enterprise risk analyst (CERA) global syllabus requirements and enhance these syllabuses with Canadian-specific content where appropriate.

9. The CIA education system will be inclusive in serving the education needs of the actuarial profession in all areas of practice, official language preference, and geographic location in Canada.

TABLE OF CONTENTS

SYLLABUS DEVELOPMENT

The CIA is responsible for actuarial education in Canada and promotes Canadian interests with respect to education, qualification, and professional development. The CIA syllabus has been developed by defining, in the CIA's own terms, the ideal knowledge and skills that Canadian actuaries should possess.

The syllabus was initially drafted by the Task Force on Canadian Eligibility and Education Requirements in 2013–2014, and is now maintained and continually enhanced by the Education Syllabus Committee. The Education Syllabus Committee recognizes the significant work of the task force to this point.

The Education Syllabus Committee will also monitor coverage of the syllabus in partnership with other committees of the Eligibility and Education Council as appropriate. The syllabus is the basis for the CIA education system and will be the benchmark against which all education partners will be evaluated. A periodic review of exam content and question style of the exams of education partners is required.

The CIA syllabus aims to provide a balanced education including theoretical concepts, technical material, practical applications, professionalism, communications, and general business acumen. The syllabus also strives to produce actuaries who are recognized internationally for work of the highest professional actuarial standards, while meeting the IAA and CERA global syllabus requirements and enhancing these syllabi with Canadian-specific content where appropriate.

The syllabus is divided into numerous topics. Within each of these topics, there are a number of high-level and more detailed subdivisions. The weightings within learning objectives are approximate, but can be useful in providing some indication of the amount of coverage required for teaching and assessment within each subdivision.

The CIA education syllabus sets out the depth of knowledge and application required, using Bloom's *Taxonomy of Education Objectives*. For comparison purposes, the development of the IAA Education Syllabus is based on the revised Bloom's taxonomy. This model reflects two dimensions: the knowledge dimension and the cognitive process dimension. This [framework](#) is widely used and respected by educators worldwide. Classification of the learning objectives according to Bloom's taxonomy will be shown in future versions of the syllabus.

The education syllabus sets out the minimum education requirements for Associate (ACIA) and Fellow (FCIA) enrollment in the Institute, which are defined below.

Associate Definition

An Associate of the CIA possesses the knowledge and fundamental concepts of identifying, evaluating, and analyzing risk. An Associate has broad comprehension of the concepts and techniques of the CIA Associate education syllabus and has completed the requisite professionalism training as defined by the CIA.

Associates of the Canadian Institute of Actuaries are authorized to append to their names the initials ACIA (Associate, Canadian Institute of Actuaries) or AICA (associé, Institut canadien des actuaires). Associates will also gain voting rights five full years after they obtain Associate status in the Institute. ACIAs would not be expected to have signing authority, and cannot fill reserved roles. Associates shall act honestly, with integrity and competence, and in a manner to fulfil the profession's responsibility to the public and to uphold the reputation of the actuarial profession.

Fellow Definition

A Fellow of the CIA possesses the knowledge and ability to apply within the business environment, the Canadian practice-specific concepts and techniques as defined by the CIA in its Fellow education syllabi. A Fellow understands how Canadian professional standards and legislation affect their work and has acquired a minimum of three years practical work experience including 12 months Canadian-specific experience while enrolled as an Associate of the CIA. A Fellow may be capable of fulfilling certain reserved roles in Canada.

Fellows of the Canadian Institute of Actuaries are authorized to append to their names the initials FCIA (Fellow, Canadian Institute of Actuaries) or FICA (fellow, Institut canadien des actuaires). All Fellows of the Institute are eligible to vote immediately upon confirmation of Fellowship. Fellows shall act honestly, with integrity and competence, and in a manner to fulfil the profession's responsibility to the public and to uphold the reputation of the actuarial profession.

ACIA SYLLABUS

1. Applied Statistical Methods

Candidates should be able to use and apply the following concepts:

1.1 Explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions.

1.2 Describe the main methods of estimation and the main properties of estimators, and apply them.

1.3 Methods include matching moments, percentile matching, and maximum likelihood, and properties include bias, variance, mean squared error, consistency, efficiency, and UMVUE.

1.4 Construct confidence intervals for unknown parameters, including the mean, differences of two means, variances, and proportions.

1.5 Test hypotheses. Concepts to be covered include Neyman-Pearson lemma, significance and power, likelihood ratio test, and information criteria. Tests should include for mean, variance, contingency tables, and goodness-of-fit.

Time Series with Constant Variance

1.6 The Candidate will be able to:

  a) Define and explain the concepts and components of stochastic time series processes, including stationarity and autocorrelation.

  b) Describe specific time series models, including random walk, exponential smoothing, autoregressive, and autoregressive conditionally heteroskedastic.

  c) Interpret predicted values and confidence and prediction intervals.

  d) Explain uses of time series models.

1.7 Use time series to model trends:

  a)   Perform Estimation, data analysis, and Forecasting

  b)   Calculate Forecast errors and confidence intervals

1.8 Model relationships of current and past values of a statistic / metric (AR, MA, ARMA, ARIMA):

  a)   Estimation, data analysis, and forecasting

  b)   Forecast errors and confidence intervals

1.9 Calculate and understand forecasts produced by the ARIMA model.

1.10   Perform calculations relevant to Time Series with Regression.

2. General Probability

Candidates should be able to use and apply the following concepts:

2.1   Set functions including set notation and basic elements of probability;

2.2   Mutually exclusive events;

2.3   Addition and multiplication rules;

2.4   Independence of events;

2.5   Combinatorial probability;

2.6   Conditional probability; and

2.7   Bayes theorem and the law of total probability.

3. Corporate Finance and Accounting

Candidates should be able to do the following:

Accounting

3.1   Describe the basic principles of personal and corporate taxation and the taxation of investments held by institutions.

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

3.3   Explain fundamental accounting concepts and terms, and describe the main sources of accounting regulation.

3.4   Explain the purpose and interactions between the income statement, balance sheet, and cash flow statements.

3.5   Explain the value of reporting on environmental, social and economic sustainability and other alternatives to traditional financial reporting, and describe possible contents of such reports.

3.6   Explain the basic structure of company and group accounts.

3.7   Explain the purpose of the main components of company accounts and interpret them.

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

3.9   Calculate and interpret financial and accounting ratios.

Finance

3.10   Explain the characteristics of various forms of equity capital from the point of view of the issuer and the investor.

3.11   Explain the characteristics of various forms of long-term debt capital from the point of view of the issuer and the investor.

3.12   Explain the characteristics of various forms of short- and medium-term financing from the point of view of the issuer and the investor.

3.13   Calculate weighted-average cost of capital.

3.14   Explain the main methods of capital budgeting.

3.15   Calculate a project's investment return

3.16   Describe the role of derivative securities and contracts in corporate finance.

Capital structure

3.17   Understand different methods to raise capital.

3.18   Understand the two main forms of financing: equity issues and debt issues.

3.19 Describe the process by which a company raises capital including venture capital, IPOs, additional issues, and private placement.

3.20 Describe the effect of capital structure on a company.

3.21 Calculate the effect from changes in capital structure on a company's overall value, equity beta, cost of debt, cost of equity, and weighted-average cost of capital, assuming the two Modigliani and Miller propositions hold.

3.22 Describe the effect of corporate tax and costs of financial distress, including the threat of bankruptcy, on the capital structure of a company.

3.23 Explain the role of agency costs and asymmetric information in affecting a company's pecking order of financing choices.

3.24 Describe different possible structures for a business entity and their advantages and disadvantages.

3.25 Explain the principles and objectives of investment management and analyze the investment needs of an institutional or individual investor.

3.26 Describe methods for the valuation of asset portfolios and explain their appropriateness in different situations.

Financial Systems

3.27 Describe the role and main forms of national and international financial markets.

3.28 Explain the relationship between finance and the real resources and objectives of an organization.

3.29 Explain the relationship between finance and the real resources and objectives of a nation.

3.30 Describe the role of private and personal interests in decision making in government and private institutions, and explain agency theory and prohibitions of conflicts of interest and duty

3.31 Describe the main features of the following institutions and analyze their influence on the financial markets: national governments, central banks, investment exchanges, national and international financial bodies, national and international regulators.

3.32 Describe the main participants in financial markets and explain their objectives and roles (examples include investment banks, retail banks, investment management companies, pension funds, insurance and re-insurance companies, non-financial corporations, sovereign funds, micro-finance providers, unregulated organizations).

3.33 Describe typical operating and corporate governance models for the following institutions and explain how they allow the institutions to meet their objectives: insurance company, re-insurance company, pension fund, retail bank, investment management company.

3.34 Describe the main types of social security benefits and financial products and explain how they meet the objectives of issuers and beneficiaries.

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

3.36 Describe major factors affecting the development of financial systems (including demographic changes, economic development, technological changes and climate change).

3.37 Explain the main elements and purpose of prudential and market regulation.

3.38 Explain the main risks to the stability of national and global financial systems.

4. Economics

Candidates should be able to do the following:

Microeconomics

4.1 Explain the concept of utility and how rational utility maximizing agencies make consumption choices.

4.2 Explain the elasticity of supply and demand and the effects on a market of the different levels of elasticity.

4.3 Explain the interaction between supply and demand and the way in which equilibrium market prices are achieved.

4.4 Explain various pricing strategies that can be used by firms.

4.5 Explain the core economic concepts involved in choices made by businesses with respect to short-run and long-run investment and production choices.

4.6 Explain competitive markets and how they operate.

4.7 Explain profitability in markets with imperfect competition.

Macroeconomics

4.8 Explain basic macroeconomic measures (e.g., GDP) used to compare the economies of countries.

4.9 Describe the structure of public finances for an industrialized country.

4.10 Explain the effect of fiscal and monetary policy on the economy, including the effect on financial markets.

4.11 Explain the role of international trade, exchange rates and the balance of payments in the economy.

4.12 Explain the effect of savings and consumption rates on the economy.

4.13 Explain the major factors affecting the level of interest rates, the rate of inflation, the exchange rate, the level of employment and the rate of growth for an industrialized country.

4.14 Describe the function of money in the economy.

4.15 Explain how interest rates are determined.

4.16 Explain the relationship between money and interest rates.

4.17 Explain how macroeconomic policies affect businesses.

5. Univariate Random Variables

The candidate will be able to use and apply the following concepts:

5.1   Random variables with univariate probability distributions including binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, gamma, and normal distributions;

5.2   Probability functions and probability density functions;

5.3   Cumulative distribution functions;

5.4   Mode, median, percentiles, and moments;

5.5   Variance and measures of dispersion;

5.6   Moment generating functions; and

5.7   Transformations.

6. Multivariate Random Variables

The candidate will be able to use and apply the following concepts:

6.1   Random variables with multivariate probability distributions including the bivariate normal distribution;

6.2   Joint probability functions and joint probability density functions;

6.3   Joint cumulative distribution functions;

6.4   Central limit theorem;

6.5   Conditional and marginal probability distributions;

6.6   Moments for joint, conditional, and marginal probability distributions;

6.7   Joint moment generating functions;

6.8   Variance and other measures of dispersion for conditional and marginal probability distributions;

6.9   Covariance and correlation coefficients;

6.10   Transformations and order statistics; and

6.11   Probabilities and moments for linear combinations of independent random variables.

7. Time Value of Money

7.1   The candidate will be able to define and recognize the definitions of the following terms:

    a. Interest rate (rate of interest);
    b. Simple interest;
    c. Compound interest;
    d. Accumulation function;
    e. Future value;
    f. Current value/present value/net present value;
    g. Discount factor;
    h. Discount rate (rate of discount);
    i. Convertible m-thly;
    j. Nominal rate;
    k. Effective rate;
    l. Inflation and real rate of interest;
    m. Force of interest; and
    n. Equation of value.

7.2   The candidate will be able to the following:

    a. Given any three of interest rate, period of time, present value, or future value, calculate the remaining item based on simple or compound interest.
    b. Solve time value of money equations involving variable force of interest.
    c. Given any one of the effective interest rate, the nominal interest rate convertible m-thly, the effective discount rate, the nominal discount rate convertible m-thly, or the force of interest, calculate all of the other items.
    d. Write the equation of value given a set of cash flows and an interest rate.

8. Annuities with Payments that are not Contingent

8.1   The candidate will be able to define and recognize the definitions of the following terms:

a.   Annuity-immediate;
b.   Annuity-due;
c.   Perpetuity;
d.   Payable m-thly or payable continuously;
e.   Level payment annuity;
f.   Arithmetic increasing/decreasing annuity;
g.   Geometric increasing/decreasing annuity; and
h.   Term of annuity.

8.2   For each of the following types of annuity and cash flows, given sufficient information of immediate or due, present value, future value, current value, interest rate, payment amount, and term of annuity, the candidate will be able to calculate any remaining item:

a.   Level annuity, finite term;
b.   Level perpetuity; and
c.   Non-level annuities/cash flows:
  i.   Arithmetic progression, finite term;
  ii.   Arithmetic progression, perpetuity;
  iii.   Geometric progression, finite term;
  iv.   Geometric progression, perpetuity; and
  v.   Other non-level annuities/cash flows.

9. Loans

9.1   The candidate will be able to define and recognize the definitions of the following terms:

a.   Principal;
b.   Interest;
c.   Term of loan;
d.   Outstanding balance;
e.   Final payment (drop payment, balloon payment);
f.   Amortization; and
g.   Sinking fund.

9.2   The candidate will be able to do the following:

a.   Given any four of term of loan, interest rate, payment amount, payment period, or principal, calculate the remaining items.
b.   Calculate the outstanding balance at any point in time.
c.   Calculate the amount of interest and principal repayment in a given payment.
d.   Given the quantities, except one, in a sinking fund arrangement, calculate the missing quantity.
e.   Perform similar calculations to a–d when refinancing is involved.

10. Bonds

10.1   The candidate will be able to develop and recognize the definitions of the following terms:

    a. Price;
    b. Redemption value;
    c. Par value/face value;
    d. Coupon, coupon rate;
    e. Term of bond;
    f. Yield rate;
    g. Callable/non-callable;
    h. Book value; and
    i. Accumulation of discount/amortization of premium.

10.2   The candidate will be able to do the following:

Given sufficient partial information about the following items, calculate the any of the remaining items:

Price, book value, amortization of premium, accumulation of discount, redemption value, face value, yield rate, coupon, coupon rate, term of bond, point in time that a bond has a given book value, amortization of premium, or accumulation of discount.

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

10.4   Describe the properties of various stochastic models of the term structure of interest rates.

10.5   Explain the limitations of the models described above and describe attempts to address them.

11. General Cash Flows and Portfolios

11.1   The candidate will be able to define and recognize the definitions of the following terms:

    a. Yield rate/rate of return;
    b. Dollar-weighted rate of return/time-weighted rate of return;
    c. Current value;
    d. Duration (Macaulay, modified);
    e. Convexity (Macaulay, modified);
    f. Portfolio;
    g. Spot rate;
    h. Forward rate;
    i. Yield curve; and
    j. Stock price, stock dividend.

11.2   The candidate will be able to do the following:

    a. Calculate the portfolio yield rate.
    b. Calculate the dollar-weighted and time-weighted rate of return.
    c. Calculate the duration and convexity of a set of cash flows.
    d. Calculate either Macaulay or modified duration given the other.
    e. Use duration and convexity to approximate the change in present value due to a change in interest rate.
        i. Using 1st-order linear approximation based on modified duration.
        ii. Using 1st-order approximation based on Macaulay duration.
    f. Calculate the price of a stock using the dividend discount model.
    g. Explain how market data can be used to construct a yield curve.
    h. Apply the term structure of interest rates to modelling various cash flows, including calculating the sensitivity of the value to changes in the term structure.

    i.   Describe the characteristics of the main investment assets and of the markets in such assets

    j.   Explain the principal economic influences on investment market price levels and total returns.

    k.   Describe and explain the theoretical and historical relationships between the total returns and the components of total returns on the main asset classes and key economic variables.

12. Mean-Variance Portfolio Theory, Asset Pricing Models, Market efficiency and Behavorial Finance

The candidate will be able to:

Mean-Variance Portfolio Theory

12.1   Understand the mathematics and summary statistics of portfolios.

    a.   Estimate the risk and return of an asset, given appropriate inputs.

    b.   Calculate the risk and expected return of a portfolio of many risky assets, given the expected return, volatility and correlation of returns of the individual assets.

12.2   Perform mean-variance analysis:

    a.   Explain the assumptions of mean-variance theory and understand the importance of the mean-standard deviation diagram and the resulting efficient market frontier.

    b.   Calculate the optimal portfolio, locate the capital market line, and describe the limitations of this approach.

    c.   Describe how portfolio risk can be reduced through diversification across multiple securities or across multiple asset classes.

Asset Pricing Models

12.3   Understand the Capital Asset Pricing Model (CAPM):

    a.   Explain the assumptions and properties of the CAPM.

    b.   Calculate the required return on a particular asset, a portfolio or a project using the CAPM.

12.4   Understand factor models:

    a.   Explain the assumptions of a factor model for security returns.

    b.   Identify the expected return, factors, factor betas, and firm-specific components of a security from its factor equation.

    c.   Calculate the required return on a particular asset, a portfolio or a project using a single factor and a multi-factor model.

Market Efficiency and Behavioral Finance

12.5   Explain the three forms of the efficient market hypothesis (EMH):

    a.   Explain the concepts of efficient markets, and distinguish between the strong, semi-strong, and weak versions of the EMH.

    b.   Identify empirical evidence for or against each form of the EMH.

12.6   Explain the main findings of behavioral finance

    a.   Identify empirical examples of market anomalies that show results contrary to the EMH.

    b.   Use behavioral finance to demonstrate why asset prices, especially in times of uncertainty and high volatility, may deviate from their fundamental values.

13. Immunization

13.1 The candidate will be able to define and recognize the definitions of the following terms:
   a. Cash flow matching;
   b. Immunization (including full immunization); and
   c. Redington's Immunization.

13.2 The candidate will be able to do the following:
   a. Construct an investment portfolio to fully immunize a set of liability cash flows.
   b. Construct an investment portfolio to match present value and duration of a set of liability cash flows.
   c. Construct an investment portfolio to exactly match a set of liability cash flows.
   d. Explain how asset/liability modelling can be used to develop an appropriate investment strategy.
   e. Explain methods of quantifying the risk of investing in different classes and sub-classes of investment.

14. General Derivatives

14.1 The candidate will be able to define and recognize the definitions of the following terms:
   a. Derivative, underlying asset, over-the-counter market;
   b. Short selling, short position, long position;
   c. Spot price;
   d. Net profit/payoff;
   e. Dividends;
   f. Mark-to-market; and
   g. No-arbitrage, risk-averse;

14.2 The candidate will be able to evaluate an investor's margin position based on changes in asset values.

15. Introductory Derivatives – Forwards and Futures

15.1 Describe the characteristics and terms of the main derivatives instruments (including forwards and futures):
   a. Distinguish between long and short positions for both assets (including short selling of stocks) and derivatives on assets.
   b. Recognize the transaction costs affecting profit calculations for both assets and derivatives on assets (including commissions and bid-ask spread).

15.2 Describe the characteristics and terms relating to both forward contracts and prepaid forward contracts:
   a. Recognize the definitions of the following terms relating to both forward contracts and prepaid forward contracts.
   b. Determine payoffs and profits for both long and short positions on forward contracts.
   c. Calculate prices for both forward contracts and prepaid forward contracts on stocks with no dividends, continuous dividends, and discrete dividends.

15.3 Describe the characteristics and terms relating to both futures contracts and the associated margin accounts.
   a. Recognize the definitions of the following terms: Marking to market, margin balance, maintenance margin, and margin call.
   b. Evaluate an investor's margin balance based on changes in asset values

16. General properties of options

16.1   Explain the cash flow characteristics and terms relating to various options:
   a.   Define and recognize the following terms: call and put options, expiration date, strike price, moneyness, and option style.
   b.   Calculate the payoff and profit on both long and short positions with respect to both call and put options.
   c.   Explain the cash flow characteristics of exotic options: Asian (arithmetic and geometric), barrier, compound, gap, exchange, and lookback.

16.2   Apply option strategies in a risk management context.

   a.   Recognize that a long put can be used as an insurance strategy for a long stock position and a short call can be used as an insurance strategy for a short stock position.
   b.   Explain how the following option strategies can be used as tools to manage financial risk or speculate on price or volatility: option spreads (bull, bear, ratio), collar, straddle, strangle, and butterfly spread.
   c.   Evaluate the payoff and profit of the option strategies described above.

16.3   Understand the general properties of options that affect option prices.
   a.   Apply put-call parity to European options on stocks with no dividends, continuous dividends, and discrete dividends.
   b.   Compare options with respect to term-to-maturity and strike price.
   c.   Identify factors affecting the early exercise of American options and the situations where the values of European and American options are the same.

17. Binomial and Black-Scholes Option Pricing Models

17.1   Understand the concept of no arbitrage and the risk-neutral approach to valuing derivatives securities:

   a.   Explain the concept of no arbitrage when comparing actual and synthetic calls, or when comparing actual and synthetic puts.
   b.   Explain the concepts underlying the risk-neutral approach to valuing derivatives securities in the context of the Binomial Option Pricing Model.

17.2   Use the Binomial Option Pricing Model to calculate the value of call and put options:
   a.   Price options under a one-period binomial model on a stock with no dividends.
   b.   Extend the binomial model to multi-period settings for pricing European and American call and put options as well as the following option types: Asian, barrier, and gap.
   c.   Extend the binomial model to other underlying assets, including stock indices with continuous dividends, stocks with discrete dividends, currencies, and futures contracts.

17.3   Explain the properties of the lognormal distribution and its applicability to option pricing.
   a.   Calculate lognormal-based probabilities and percentiles for stock prices.
   b.   Calculate lognormal-based means and variances of stock prices.
   c.   Calculate lognormal-based conditional expectations of stock prices given that options expire in-the-money.

17.4   Understand the Black-Scholes Formula.
   a.   Recognize the assumptions underlying the Black-Scholes model.

b. Use the Black-Scholes Formula to value European calls and puts on stocks with no dividends, stock indices with continuous dividends, stocks with discrete dividends, currencies, and futures contracts.
c. Generalize the Black-Scholes Formula to value exchange options and gap calls/puts.
d. Estimate a stock's historical volatility from past stock price data.

18. Interest Rate Swaps

18.1 Recognize and define the following terms: swap rate, swap term or swap tenor, notional amount, market value of a swap, settlement dates, settlement period, counterparties, deferred swap, amortizing swap, accreting swap, interest rate swap net payments.

18.2 Calculate the swap rate in an interest rate swap, deferred or otherwise, and with either constant or varying notional amount.

18.3 Calculate the market value of an interest rate swap, deferred or otherwise, and with either constant or varying notional amount.

19. Predictive Analytics

Model Building Process
19.1 Understand issues and remedies with regard to data collection and validation.
19.2 Explain the basic steps in the model building process:
   a. Problem definition and exploratory data analysis.
   b. Model selection.
   c. Model validation.
   d. Monitoring.
   e. Understand ethical and professional considerations with regard to data and modeling.

Problem Definition, Exploratory Data Analysis, and Initial Model Selection
19.3 The Candidate will be able to:
   a. Formulate a business problem in terms that are amenable to an analytic solution.
   b. Conduct exploratory data analysis to identify key relationships that inform initial model selection.
   c. Select initial models and methods for analyzing the business problem.
   d. Explain the difference between a stochastic and a deterministic model, and identify the advantages/disadvantages of each.
   e. Describe the characteristics of, and explain the use, of scenario-based and proxy models.
   f. 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.

Model Selection
19.4 Explain why a given model is or is not appropriate for addressing the given business problem.
19.5 Use a training data set to select appropriate model components.
19.6 Use a training data set to estimate model parameters.
19.7 Confirm that the assumptions of the selected model hold (or indicate where they are violated)

Model Validation
19.8 Conduct and interpret sensitivity, stress, and scenario tests.
19.9 Perform diagnostic tests of model fit and assumption checking, both graphical and quantitative.
19.10 Construct and interpret graphical evidence such as gain and lift curves.
19.11 Use holdout data to validate a model

Communication of Results and Uncertainties

19.12 Tailor communication to the intended audience.

19.13 Communicate model limitations.

19.14 Estimate and understand uncertainties in parameter estimates and predicted values directly and through simulation.

19.15 Effectively communicate data issues and proposed solutions.

19.16 Effectively use graphs and charts.

19.17 Explain the business problem and how the analysis addresses that problem.

19.18 Produce an audit trail enabling detailed checking and high-level scrutiny of a model.

Data as a resource for problem solving

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

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

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

19.22 Describe common data structures and data storage systems.

19.23 Describe and explain measures of data quality.

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

20. Determinants of interest rates

20.1 The candidate will be able to define and recognize the components of interest rates including: real risk-free rate, inflation rate, default risk premium, liquidity premium, and maturity risk premium.

20.2   The candidate will be able to explain how the components of interest rates apply in various contexts, such as commercial loans, mortgages, credit cards, bonds, government securities

20.3 The candidate will be able to explain the roles of the Federal Reserve and the FOMC in carrying out fiscal policy and monetary policy and the tools used by the Federal Reserve and the FOMC including targeting the Federal Funds rate, setting reserve requirements, and setting the discount rate.

20.4 The candidate will be able to explain the theories of why interest rates differ by term, including liquidity preference (opportunity cost), expectations, preferred habitat, and market segmentation

20.5   The candidate will be able to explain how interest rates differ from one country to another (e.g., U.S. vs. Canada).

21. Option Greeks and Risk Management

21.1   Explain the calculation and use of option price partial derivatives.
  a. Compute and interpret Option Greeks, including Delta, Gamma, Theta, Vega, Rho, and Psi.
  b. Compute the elasticity, Sharpe ratio, and risk premium for both an individual option (call or put) and a portfolio consisting of both options of multiple types and the underlying stock.
  c.   Approximate option prices using Delta, Gamma, and Theta.

21.2   Explain how to control risk by using options in a hedging context.
  a. Perform delta hedging by calculating the quantities of option units, stock shares, and cash to hold, and whether those positions should be long or short.
  b. Perform gamma hedging by calculating the quantities of option units (of various types) and stock shares to hold, and whether those positions should be long or short.

22. Simulation in Financial Economics

The candidate will be able to do the following:

22.1   Simulate log-normal stock prices.
22.2   Use variance reduction techniques to accelerate convergence.
22.3   Perform stress-testing, back-testing, and scenario analysis.

23. Long-term insurance coverages

23.1   Describe the long-term coverages in insurance (life, health, and general), annuities, and retirement benefits (e.g. pensions, retiree health care, etc.)
23.2   Describe the similarities and differences between the long-term coverages identified in 23.1.
23.3   Describe the appropriate models to be used to calculate expected present values, premiums or contributions, and reserves for each long-term coverage.

24. Survival models and their estimations

24.1   Explain and interpret survival models and transitioning between states.
24.2   Calculate and interpret standard functions including survival and mortality probabilities, force of mortality, and complete and curtate expectation of life.
24.3   Calculate nonparametric estimates of survival models using the Kaplan-Meier, Nelson-Aalen, Cox proportional hazards and Kernel density estimators formulas for seriatim data and adaptations for grouped data.
24.4   Calculate, using both seriatim and grouped data, maximum likelihood estimates of transition probabilities assuming constant transition intensity during fixed age intervals.
24.5   Calculate the variances of and construct confidence intervals for the estimators in parts 3) and 4).
24.6   Calculate transition intensities exactly, or estimate transition intensities using large sample approximations.
24.7   Describe and apply simple longevity models.
24.8   For models dealing with multiple lives and/or multiple states, explain the random variables associated with the model and calculate and interpret marginal and conditional probabilities.
24.9   Construct and interpret select and ultimate survival models, including computer application.
24.10   Describe the behavior of Markov chain models, identify possible transitions between states, and calculate and interpret the probability of being in a particular state and transitioning between states.
24.11   Apply to calculations involving these models appropriate approximation methods for fractional ages based on uniform distribution of deaths or constant force.

25. Present Value Random Variables

25.1   The candidate will be able to perform calculations on the present value random variables associated with benefits and expenses for any of the models in learning objective 24.1. The candidate will be able to do the following:

   a.   Calculate and interpret probabilities, means, percentiles, and higher moments.
   b.   Calculate and interpret the effect of changes in underlying assumptions such as mortality and interest.
   c.   Apply to calculations involving these random variables appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler.

26. Premium Calculation

26.1   The candidate will understand premium-calculation methodologies such as the equivalence principle, the portfolio-premium principle, and return on gross premium. The candidate will be able to do the following:

a.   Calculate and interpret probabilities, means, percentiles, and higher moments of random variables associated with these premiums, including loss-at-issue random variables.

b.   Using any of the models in learning objective 24.1, calculate and interpret the effect of changes in policy design and underlying assumptions such as changes in mortality, benefits, expenses, interest, and dividends.

c.   Perform the calculations in learning outcomes a. and b. for contracts associated with specified contingent cash flows including annuities, universal life and participating insurance.

d.   Apply to calculations involving these premiums appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler.

27. Reserves

27.1   The candidate will understand reserves for insurances and annuities for models in Sections 24 and 26. The candidate will be able to do the following:

a.   Calculate and interpret the following reserve types: Net premium, Modified, Gross premium, Expense.

b.   Calculate and interpret probabilities, means, variances, and percentiles of random variables associated with these reserves, including future-loss random variables.

c.   Calculate and interpret common profit measures such as expected profit, actual profit, gain, gain by source and period, internal rate of return, profit margin, and break-even year

d.   Apply appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler.

28. Pension Plans and Retirement Benefits

28.1   The candidate will understand how the models from previous learning objectives apply to pension plans and retirement benefits.
The candidate will be able to do the following:

a.   Describe and compare defined benefit and defined contribution pension plans including final salary and career average earning plans.

b.   Describe retiree health care plans

c.   Identify and interpret the common states and decrements for pension plans and the parametric and tabular models, including Markov chain models, associated with these decrements.

d.   Given particular participant data, plan provisions, and valuation assumptions, apply the models mentioned in 28.1c) to defined benefit pension plans and calculate and interpret replacement ratios, accrued benefits, gain or loss, and their expected values with adjustments such as the early retirement reduction factor.

e.   Given particular participant data, plan provisions, and valuation assumptions, calculate and interpret the actuarial accrued liability and the normal cost for defined benefit plans under projected unit credit (PUC) and traditional unit credit (TUC) cost methods.

f.   Identify and interpret the assumptions and methods for retiree health care plans. Given particular participant data, plan provisions, and valuation assumptions, calculate and interpret the expected present value of future benefits, accumulated postretirement benefit obligation (APBO), and the normal cost or service cost for retiree health care plans

g. Calculate and interpret the effect of changes in underlying valuation assumptions such as mortality, discrete salary increase changes, other decrements and interest on the quantities mentioned in d, e, and f.

h. Apply to calculations involving these plans and benefits appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler.

29. Severity Models

The candidate will be able to do the following:

29.1   Calculate the basic distributional quantities:

a. Moments;

b. Percentiles; and

c. Generating functions.

29.2   Describe how changes in parameters affect the distribution.

29.3   Recognize classes of distributions, including extreme value distributions, suitable for modelling the distribution of severity of loss and their relationships.

29.4   Apply the following techniques for creating new families of distributions:

a. Multiplication by a constant;

b. Raising to a power;

c. Exponentiation; and

d. Mixing.

29.5   Identify the applications in which each distribution is used and reasons why.

29.6   Apply the distribution to an application, given the parameters.

29.7   Compare two distributions based on various characteristics of their tails, including moments, ratios of moments, limiting tail behavior, hazard rate function, and mean excess function.

30. Frequency Models

For the Poisson, mixed Poisson, binomial, negative binomial, geometric distribution, and mixtures thereof, the candidate will be able to do the following:

30.1   Describe how changes in parameters affect the distribution.

30.2   Calculate moments.

30.3   Identify the applications for which each distribution is used and reasons why.

30.4   Apply the distribution to an application given the parameters.

30.5   Apply the zero-truncated or zero-modified distribution to an application given the parameters.

30.6   Recognize classes of distributions and their relationships.

31. Aggregate Models

The candidate will be able to do the following:

31.1   Compute relevant parameters and statistics for collective risk models.

31.2   Evaluate compound models for aggregate claims.

31.3   Compute aggregate claims distributions.

31.4   For severity, frequency, and aggregate models, evaluate the impacts of coverage modifications:
    a.   Deductibles;
    b.   Limits; and
    c.   Coinsurance.

31.5   Calculate loss elimination ratios.
31.6   Evaluate effects of inflation on losses.

Stochastic Processes

31.7   Understand and apply the properties of Poisson processes:

    a.   For increments in the homogeneous case
    b.   For interval times in the homogeneous case
    c.   Resulting from special types of events in the Poisson process
    d.   Resulting from sums of independent Poisson processes

31.8   For any Poisson process and the inter-arrival and waiting distributions associated with the Poisson process, calculate Expected values, Variances and Probabilities

31.9   For a compound Poisson process, calculate moments associated with the value of the process at a given time.

31.10   Apply the Poisson process concepts to calculate the hazard function and related survival model concepts:
    a.   Relationship between hazard rate, probability density function and cumulative distribution function
    b.   Effect of memoryless nature of Poisson distribution on survival time estimation.

32. Risk Measures, Investment risk and project analysis

Risk Measures

The candidate will be able to do the following:
    32.1   Calculate value at risk (VaR), and tail value at risk (TVaR) and explain their use and limitations.
    32.2   Explain the desirable properties of a risk measure and determine whether a given risk measure has these properties.

Investment risk and project analysis

    32.3   The Candidate will be able to discuss the advantages and disadvantages of different measures of investment risk:
    a. Define the following measures of investment risk: variance, semi-variance, Value-at-Risk (VaR) and Tail Value-at-Risk (TVaR).
    b. Explain the advantages and disadvantages of the risk measures listed above.
    c. Calculate the risk measures listed above in order to compare investment opportunities.

32.4 The Candidate will be able to conduct risk analysis:

a. Understand the following methods to conduct risk analysis: sensitivity analysis, breakeven analysis, scenario analysis, and Monte-Carlo simulation.

b. Use a decision tree to model future outcomes and analyze real options embedded in a project

33. Coverage modifications

33.1 The Candidate will be able to, for frequency, severity, and aggregate models:
   a. Evaluate the effect of coverage modifications, in particular, deductibles, limits, and coinsurance.
   b. Calculate loss elimination ratios and increased limits factors.
   c. Evaluate the effects of inflation on losses.

34. Construction and Selection of Parametric Models

34.1 Estimate the parameters for severity, frequency, and aggregate distributions using Maximum Likelihood Estimation for:
   a) Complete, individual data
   b) Complete, grouped data
   c) Truncated or censored data
34.2 Estimate the variance of the estimators and construct confidence intervals.
34.3 Use the delta method to estimate the variance of the maximum likelihood estimator of a function of the parameter(s).
34.4 Estimate the parameters for severity, frequency, and aggregate distributions using Bayesian Estimation.
34.5 Perform model selection using:
   a) Hypothesis tests, including Chi-square goodness-of-fit and Likelihood ratio test (LRT), and computer applications.
   b) Score-based approaches, including Schwarz Bayesian Criterion (SBC) / Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC).

35. Credibility

The candidate will be able to do the following:

35.1 Apply limited fluctuation (classical) credibility including criteria for both full and partial credibility.

35.2 Perform Bayesian analysis using both discrete and continuous models.

35.3 Apply Bühlmann and Bühlmann-Straub models and understand the relationship of these to the Bayesian model.

35.4 Apply conjugate priors in Bayesian analysis and in particular the Poisson-gamma model.

35.5 Apply empirical Bayesian methods in the non-parametric and semi-parametric cases.

35.6 Calculate Bayes estimate/Bayesian premium.

36. Insurance and Reinsurance Coverages

The Candidate will be able to:

36.1 Describe different types of short-term insurance coverage including homeowners, liability,

36.2 health, disability, and dental.

36.3 Describe the types of policy limits and coverage modifications for short-term insurance.

36.4   Describe the operation of basic forms of proportional and excess of loss reinsurance.

36.5   Derive the distribution of claim amounts paid by the insurer and reinsurer under various

forms of reinsurance.

37. Pricing and Reserving for Short-Term Insurance Coverages

37.1   Explain the role of rating factors and exposure.

37.2   Describe the different forms of experience rating.

37.3   Describe and apply techniques for estimating unpaid losses from a run-off triangle, using the following methods:
   a. Chain ladder
   b. Average cost per claim
   c. Bornhuetter Ferguson

37.4   Describe the underlying statistical models for the methods in (c).

37.5   Calculate premiums using the pure premium and loss ratio methods.

38. Simulation

The candidate will be able to do the following:

38.1   Explain the concepts of Monte Carlo simulation.

38.2   Simulate both discrete and continuous random variables using the inversion method.

38.3   Simulate from discrete mixtures, decrement tables, the (a,b,0) class, and the normal and log-normal distributions using methods designed for those distributions.

38.4   Estimate the number of simulations needed to obtain an estimate with a given error and a given degree of confidence.

38.5   Use simulation to determine the p-value for a hypothesis test.

38.6   Use the bootstrap method to estimate the mean squared error of an estimator.

38.7   Apply simulation methods within the context of actuarial models.

38.8   Use a permutation test to determine the distribution of a test statistic.

39. Statistics for Risk Modelling

Statistical Learning

39.1   Explain the types of modeling problems and methods, including supervised versus unsupervised learning and regression versus classification.

39.2   Explain the common methods of assessing model accuracy.

39.3   Explain models in R and access and interpret output, including diagnostics.

39.4   Employ basic methods of exploratory data analysis, including data checking and validation.

39.5   Use a computer package to fit a statistical distribution to a dataset and calculate appropriate goodness of fit measures.

39.6   Use a computer package to fit a single or multiple linear regression model to a data set and interpret the output.

39.7   Explain when machine learning is an appropriate approach to problem solving and describe examples of the types of problems typically addressed by machine learning, explaining the difference between discrete and continuous approaches.

Linear Models

39.8	Apply simple and multiple regression models to analyze datasets.
39.9	Describe and explain the components of, in particular, the exponential family of distributions and link functions.
39.10	Describe and understand the differences between least squares and maximum likelihood parameter estimation.
39.11	Interpret diagnostic tests of model fit and assumption checking, both graphical and quantitative.
39.12	Select an appropriate model, including:

    a.   Select distribution and link function.

    b.   Select variables, considering transformations and interactions.

39.13	Interpret model results with emphasis on using the model to answer the underlying business question.
39.14	Interpret predicted values and confidence and prediction intervals.
39.15	Understand how approaches may differ compared to using an ordinary least squares model.
39.16	Explain uses of linear models, including computer application.

Principal Components Analysis

39.17	Define principal components.
39.18	Interpret the results of a principal components analysis.
39.19	Explain uses of principal components

Decision Trees

39.20	Explain the purpose and uses of decision trees.
39.21	Explain and interpret decision trees.
39.22	Explain and interpret bagging, boosting, and random forests.
39.23	Explain and interpret classification trees.
39.24	Compare decision trees to linear models.
39.25	Interpret the results of a decision tree analysis.

Cluster Analysis

39.26	Explain the uses of clustering.
39.27	Explain K-means clustering.
39.28	Explain hierarchical clustering.
39.29	Explain methods for deciding the number of clusters.
39.30	Interpret the results of a clustering analysis.

40. Data and Systems

40.1	Data Risk Management Issues

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

b. Explain the main issues to be addressed by a data governance policy and its importance for an organization.
c. Explain the risks associated with use of data (including algorithmic decision making).

Data Visualization and Reporting

40.2   Create appropriate data visualizations to communicate the key conclusions of an analysis.

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

41. Communication Skills

41.1   With respect to general communications, the candidate will be able to develop effective messaging, using clear and relevant language.
41.2   The candidate will be able to convey a key message through written documentation of high quality, enabling an audience to clearly understand an actuarial situation.
41.3   With respect to verbal communication, the candidate will be able to convey a key message by developing presentation skills, which will enable an audience to clearly understand an actuarial situation.

42. Professionalism

The candidate will be able to do the following:

42.1   Describe the requirements of a profession.
42.2   Outline the CIA Rules of Professional Conduct and how they apply in everyday work, and outline the need to prioritize professional responsibility and public interest over personal gain with respect to a work assignment.
42.3   Outline the CIA Standards of Practice and how they apply in everyday work.
42.4   Describe professionalism and how it applies in everyday work.
42.5   Analyze, interpret, and discuss the situations presented in the case studies.
42.6   Describe the CIA disciplinary process and understand the circumstances which could give rise to a charge of professional misconduct and how the CIA's discipline process could apply to such a case.
42.7   Describe the CIA structure, its role, and the services available from the CIA.
42.8   Describe the CIA membership categories and the related qualification requirements.
42.9   Describe the CIA continuing professional development (CPD) requirements.
42.10 Describe the volunteering opportunities with the CIA.

Professionalism in Practice

42.11 Analyze typical situations that could lead to an accusation of professional misconduct and identify actions which could be taken to avoid misconduct.
42.12 Analyze situations where an actuary's integrity could come under pressure and develop a plan for handling the situation successfully.
42.13 Explain the importance of documenting work and the elements of acceptable documentation to achieve a satisfactory audit trail.
42.14 Understand the importance of checking work and the need to consider peer review.
42.15 Apply professional standards and ethics appropriately to a situation outlined in a case study.
42.16 Describe how to monitor changes to standards of practice and how to determine which statements apply to a particular work assignment.

42.17 Understand how to determine which standards apply, and are paramount, when an assignment may be governed by professional standards of more than one actuarial organization.

42.18 Evaluate current level of own professional development and personal limitations to accept a particular actuarial work assignment.

FELLOWSHIP SYLLABUS

The learning objectives of the CIA syllabus related to Fellowship requirements are developed by and for each specialty track. For ease of reference, the following acronyms are used to identify each track:

Finance and investment: FI

Retirement benefits: R

Enterprise risk management: ERM

Group benefits: G

Property and casualty: PC

Individual life insurance and annuities: LI

Actuarial evidence: AE

AE is not the subject of official exams; however, it remains a recognized area of actuarial practice.

FINANCE AND INVESTMENTS

Notions of Fundamentals of Actuarial Practice

The candidate will be able to do the following:

1. Define and describe the role of the professional actuary.
2. Define and describe the control cycle.
3. Describe and explain how core external forces apply across areas of actuarial practice and the control cycle.
4. Describe how risk is defined and managed in an actuarial context.
5. Describe how actuarial solutions are developed to manage risk.
6. Describe how actuarial solutions are designed and priced.
7. Describe how models are selected and used in actuarial practice.
8. Describe the processes used to select assumptions.
9. Describe the elements of the process of monitoring results.

FI 1. Mathematics, Statistics, and Stochastic Calculus

The candidate will be able to do the following:

1.1 Understand and apply concepts of probability and statistics important in mathematical finance.

1.2 Understand the importance of the no-arbitrage condition in asset pricing.

1.3 Apply the concept of martingale in asset pricing.

1.4 Understand Itô integral and stochastic differential equations.

1.5 Understand and apply Itô's lemma.

1.6 Understand and apply Jensen's inequality.

1.7 Demonstrate an understanding of the mathematical considerations for analyzing financial time series.

FI 2. Option Pricing Theory

The candidate will be able to do the following:

2.1 Understand and apply various techniques for analyzing conditional heteroscedastic models including ARCH and GARCH.

2.2 Demonstrate understanding of option pricing techniques and theory for equity and interest rate derivatives.

2.3 Apply the basic concepts of currency markets (purchase price parity, law of one price, etc.).

2.4 Demonstrate understanding of the differences and implications of real-world versus risk-neutral probability measures.

2.5 Define and apply the concepts of martingale, market price of risk and measures in single and multiple state variable contexts.

2.6 Understand and apply Girsanov's theorem in changing measures.

2.7 Understand the Black-Scholes-Merton PDE (partial differential equation).

2.8 Identify limitations of the Black-Scholes pricing formula.

2.9 Describe and explain some approaches for relaxing the assumptions used in the Black-Scholes formula.

2.10 Describe and apply alternatives to the Black-Scholes-Merton model or alternative techniques that can be used to deal with option pricing techniques' limitations.

2.11 Demonstrate understanding of interest rate models.

2.12 Understand the concept of calibration and describe the issues related to calibration.

2.13 Understand the Heath-Jarrow-Morton (HJM) model and the HJM no-arbitrage condition.

2.14 Understand Brace Gatarek Musiela (BGM)/London Interbank Offered Rate (LIBOR) market model.

FI 3. Derivatives and Hedging

The candidate will be able to do the following:

3.1   Compare and contrast the various kinds of volatility, (e.g. actual, realized, implied, forward, etc.).

3.2   Compare and contrast various approaches for setting volatility assumptions in hedging.

3.3   Understand the different approaches to hedging.

3.4   Understand how to delta hedge and the interplay between hedging assumptions and hedging outcomes.

3.5   Appreciate how hedge strategies may go awry.

FI 4. Fixed Income Securities

The candidate will be able to do the following:

4.1   Explain the cash flow characteristics and pricing of treasury securities.

4.2   Demonstrate an understanding of par yield curves, spot curves, and forward curves and their relationship to traded security prices.

4.3   Demonstrate understanding of the different characteristics of securities issued by government agencies.

4.4   Evaluate features of municipal bonds and the role of rating agencies in pricing them.

4.5   Describe the cash flow of various corporate bonds considering underlying risks such as interest rate, credit, and event risks.

4.6   Evaluate different private money market instruments.

4.7   Demonstrate understanding of cash flow patterns and underlying drivers and risks of mortgage-backed securities and collateralized mortgage obligations.

4.8   Construct and manage portfolios of fixed income securities using the following broad categories:

a. Managing funds against a target return; and
b. Managing funds against liabilities.

FI 5. Equities

The candidate will be able to do the following:

5.1   Explain the nature and role of equity investments within portfolios that may include other asset classes.

5.2   Demonstrate an understanding of the basic concepts surrounding passive, active, and semi-active (enhanced index) equity investing, including managing exposures.

5.3   Explain the basic active equity selection strategies including value, growth, and combination approaches.

5.4   Demonstrate an understanding of equity indices and their construction, including distinguishing among the weighting schemes and their biases.

5.5   Identify methods for establishing passive exposure to an equity market.

5.6   Compare techniques for characterizing investment style of an investor.

5.7   Recommend and justify, in a risk-return framework, the optimal portfolio allocations to a group of investment managers.

5.8   Describe the core-satellite approach to portfolio construction with a completeness fund to control overall risk exposures.

5.9   Explain alpha and beta separation as an approach to active management and demonstrate the use of portable alpha.

5.10   Describe the process of identifying, selecting, and contracting with equity managers.

FI 6. Investment Policy

The candidate will be able to do the following:

6.1   Explain how investment policies and strategies can manage risk and create value.

6.2   Identify a fiduciary's obligations and explain how they apply in managing portfolios.

6.3   Determine how a client's objectives, needs and constraints affect investment strategy and portfolio construction. Include capital, funding objectives, risk appetite and risk-return trade-off, tax, accounting considerations, and constraints such as regulators, rating agencies, and liquidity.

6.4   Incorporate financial and non-financial risks into an investment policy, including currency, credit, spread, liquidity, interest rate, equity, insurance product, operational, legal, and political risks.

FI 7. Asset Allocation

The candidate will be able to do the following:

7.1   Explain the impact of asset allocation, relative to various investor goals and constraints.

7.2   Propose and critique asset allocation strategies.

7.3   Evaluate the significance of liabilities in the allocation of assets.

7.4   Incorporate risk management principles in investment policy and strategy, including asset allocation.

FI 8. Advanced Option Pricing

The candidate will be able to do the following:

8.1   Identify and differentiate the features of the classic short-rate models including the Vasicek and the Cox-Ingersoll-Ross (CIR) models.

8.2   Understand and explain the terms time-homogeneous models, affine-term structure models, and affine-coefficient models and explain their significance in the context of short-rate interest models.

8.3   Explain the dynamics of and motivation for the Hull-White extension of the Vasicek model.

8.4   Explain the features of the Black-Karasinski model.

8.5   Understand and explain the relationship between market-quoted caplet volatilities and model volatilities.

8.6   Explain how deterministic shifts can be used to fit any given interest rate term structure and demonstrate an understanding of the CIR++ model.

8.7   Understand and explain the features of the G2++ model, including the following: the motivation for more than one factor; calibration approaches; the pricing of bonds and options; and the model's relationship to the two-factor Hull-White model.

8.8   Explain the set up and motivation of the log-normal forward LIBOR model (LFM).

8.9   Describe the calibration of the LFM to cap and floor prices.

8.10   Explain the LFM drift terms and their dependence on the calibration and choice of numeraire.

8.11   Define and explain the concept of volatility smile and some arguments for its existence.

8.12 Calculate the hedge ratio for a call option given the dependency of the Black-Scholes volatility on the underlying asset.

8.13 Compare and contrast "floating" and "sticky" smiles.

8.14 Calculate the risk-neutral density given call option prices.

8.15 Identify several stylized empirical facts about smiles in a variety of options markets.

8.16 Describe and contrast several approaches for modelling smiles, including the following: stochastic volatility, local volatility, jump diffusions, variance gamma, and mixture models.

8.17 Describe and explain various issues and approaches for fitting a volatility surface.

FI 9. Credit Risk

The candidate will be able to do the following:

9.1 Demonstrate an understanding of events and causes of the recent global credit crisis.

9.2 Demonstrate an understanding of the basic concepts of credit risk modelling such as probability of default, loss given default, exposure at default, and expected loss.

9.3 Demonstrate an understanding of credit valuation models.

9.4 Demonstrate an understanding of Merton asset value models in the context of credit risk.

9.5 Demonstrate an understanding of the term structure of default probability.

9.6 Demonstrate an understanding of modelling approaches for correlated defaults.

9.7 Demonstrate an understanding of, and be able to apply the concept of, duration times spread (DTS.)

9.8 Demonstrate an understanding of credit default swaps (CDS) and the bond-CDS basis, including the use of CDS in portfolio and trading contexts.

9.9 Demonstrate an understanding of mortgage default models in the valuation of mortgage-backed securities (MBS).

9.10 Demonstrate an understanding of measuring and marking-to-market counterparty credit risk in credit derivatives.

9.11 Understand and apply various approaches for managing credit risk in a portfolio setting.

9.12 Understand the rationale, markets, and risks of structured finance.

FI 10. Liquidity Risk

The candidate will be able to do the following:

10.1 Understand the concept of liquidity risk and the threat it represents to financial intermediaries and markets.

10.2 Measure and monitor liquidity risk, using various liquidity measurement tools and ratios.

10.3 Understand the levels of liquidity available with various asset types, and the impact on a company's overall liquidity risk.

10.4 Understand liability termination provisions such as book value surrender and the impact on a company's overall liquidity risk.

10.5 Apply liquidity risk models, including modelling cash flow of various types of assets (e.g., indeterminate maturity assets) and liabilities.

10.6   Apply liquidity scenario analysis with various time horizons.

10.7   Create liquidity risk management plans and procedures, including addressing appropriate product design, investment guidelines, and reporting given a desired liquidity risk level.

10.8   Be familiar with rating agency expectations for liquidity and the implications for company ratings.

FI 11. Quantitative Techniques

The candidate will be able to do the following:

11.1   Demonstrate an understanding of the mathematical considerations for analyzing financial time series.

11.2   Understand and apply various techniques for analyzing conditional heteroscedastic models including ARCH and GARCH.

11.3   Understand and apply various techniques for analyzing multivariate time series.

11.4   Understand the concept of cross correlation in multivariate time series.

11.5   Understand various vector auto regressive models.

11.6   Understand the concept of a factor model in the context of financial time series.

11.7   Apply various techniques for analyzing factor models including principal component analysis and statistical factor analysis.

11.8   Describe and assess performance measurement methodologies for assets, liability, and hedge portfolios.

11.9   Describe and assess techniques that can be used to select or build a benchmark for a given asset portfolio.

11.10   Recommend a benchmark for a given asset portfolio.

11.11   Calculate and interpret performance attribution metrics for a given asset portfolio.

11.12   Explain the limitations of attribution techniques.

11.13   Understand and apply various techniques of adjusting autocorrelated returns for certain asset classes.

FI 12. Behavioural Finance

The candidate will be able to do the following:

12.1   Explain how behavioural characteristics of individuals or firms affect the investment or capital management process.

12.2   Describe how behavioural finance explains the existence of some market anomalies.

12.3   Identify and apply the concepts of behavioural finance with respect to individual investors, institutional investors, portfolio managers, fiduciaries, and corporate managers.

FI 13. Alternative Assets

The candidate will be able to do the following:

13.1   Demonstrate an understanding of the types of investments available in each market, and their most important differences for an investor.

13.2   Demonstrate an understanding of the benchmarks available to evaluate the performance of alternative investment managers and the limitations of the benchmarks.

13.3   Demonstrate an understanding of the investment strategies and portfolio roles that are characteristic of each alternative investment.

13.4   Demonstrate an understanding of the due diligence process for alternative investments.

FI 14. Liability Manufacturing/Management

The candidate will be able to do the following:

14.1   Identify and evaluate the impact of embedded options in liabilities, specifically variable annuities guaranteed riders (guaranteed minimum accumulation benefit (GMAB), guaranteed minimum death benefit (GMDB), guaranteed minimum withdrawal benefit (GMWB), and guaranteed minimum income benefit (GMIB)).

14.2   Demonstrate understanding of risks associated with guarantee riders including the following: market, insurance, policyholder behaviour, basis, credit, regulatory, and accounting.

14.3   Demonstrate understanding of risk management and dynamic hedging for existing GMXB and its embedded options.

14.4   Understand that hedgeable components include equity, interest rate, volatility, and cross Greeks.

14.5   Understand that partially hedgeable or unhedgeable components include policyholder behaviour, mortality and lapse, basis risk, counterparty exposure, foreign bonds and equities, correlation, and operation failures.

14.6   Compare and contrast static vs. dynamic hedging.

FI 15. Governance

The candidate will be able to do the following:

15.1   Compare and contrast the interest of key stakeholders.

15.2   Explain principal versus agent conflict.

15.3   Identify sources of unethical conduct and explain the role of a fiduciary.

15.4   Describe governance mechanisms that attempt to address these conflicts.

15.5   Understand the importance of an organization's culture in effectuating governance.

15.6   Explain how governance may be structured to gain competitive advantages and efficiencies.

15.7   Demonstrate understanding of how ethics relates to business decision-making, and relate ethics in business to personal ethics.

FI 16. Investment Risk Management

The candidate will be able to do the following:

16.1   Explain the importance of risk culture in an investment firm.

16.2   Identify and describe the various kinds of risks, including market, credit, operational, etc.

16.3   Identify and describe various approaches for managing risks, including risk budgeting, position limits, etc.

16.4   Explain the features of a best practices enterprise risk management system.

16.5   Evaluate a company's risk management process.

16.6   Examine examples of risk management failure.

FI 17. Risk Measurement

The candidate will be able to do the following:
  17.1   Evaluate a company's or a portfolio's exposures to various risks.
  17.2   Explain the advantages and limitations of different risk metrics including value at risk.
  17.3   Compare different approaches to stress testing.
  17.4   Analyze and evaluate risk aggregation techniques, including the use and misuse of correlation, integrated risk distributions, and copulas.

FI 18. Financial Modelling

The candidate will be able to do the following:
  18.1   Identify options embedded in financial products and the risks they pose.
  18.2   Describe derivative types and demonstrate the use of derivatives in risk management.
  18.3   Describe basic risk mitigation methods.
  18.4   Apply the techniques of Monte Carlo simulation as it applies to financial risk models and option pricing.
  18.5   Identify and explain modelling products and their inherent risks.
  18.6   Analyze the outcomes of various events and situations affecting an insurance product.

FI 19. Financial Reporting

The candidate will be able to do the following:

  19.1   Describe the basic features of a financial reporting conceptual framework.
  19.2   Explain the key concepts in determining fair value.
  19.3   Describe International Financial Reporting Standards.
  19.4   Explain the general concepts underlying specific U.S. accounting standards for asset reporting, valuing deferred acquisition cost assets, and valuing liabilities.
  19.5   Apply the Canadian Asset Liability Method (CALM) to appropriately value policy liabilities.
  19.6   Explain how liabilities are calculated under U.S. statutory reporting.
  19.7   Describe how insurance companies in the United States and Canada are taxed.
  19.8   Explain the objectives and features of regulatory risk-based capital requirements.
  19.9   Perform risk-based capital (RBC) calculations required by C3 Phase II.

FI 20. Enterprise Risk Management

The candidate will be able to do the following:
  20.1   Explain what enterprise risk management (ERM) means.
  20.2   Describe an ERM framework.
  20.3   Identify regulatory requirements related to ERM.
  20.4   Define, identify, and evaluate operational risks.
  20.5   Understand data issues in general and special considerations with respect to ERM.
  20.6   Describe and apply quantitative and qualitative methods for assessing risk.
  20.7   Describe and apply the components of an effective economic capital model.

RETIREMENT BENEFITS

Notions of Fundamentals of Actuarial Practice

1. Define and describe the role of the professional actuary.

2. Define and describe the control cycle.

3. Describe and explain how core external forces apply across areas of actuarial practice and the control cycle.

4. Describe how risk is defined and managed in an actuarial context.

5. Describe how actuarial solutions are developed to manage risk.

6. Describe how actuarial solutions are designed and priced.

7. Describe how models are selected and used in actuarial practice.

8. Describe the processes used to select assumptions.

9. Describe the elements of the process of monitoring results.

R1. Mathematics of Financial Risks

The candidate will be able to do the following:

1.1   Understand general financial econometrics.

1.2   Understand properties of financial time series.

1.3   Understand and apply various techniques for analyzing conditional heteroscedastic models (autoregressive conditional heteroscedasticity and generalized autoregressive conditional heteroscedasticity).

1.4   Analyze and evaluate stochastic volatility.

R2. Financial Models

The candidate will be able to do the following:

2.1   Describe, explain and evaluate interest rate risk.

2.2   Describe and explain liquidity risk.

2.3   Describe and explain operational risk.

2.4   Describe and explain foreign exchange risk.

2.5   Describe and explain country and sovereign credit risk.

R3. Risk Management

The candidate will be able to do the following:

3.1   Define and explain classification of risk.

3.2   Define and explain pure and speculative risk.

3.3   Define and explain subjective and objective risk.

3.4   Define and explain diversifiable and non-diversifiable risk.

3.5   Identify and evaluate quadrants of risk (hazard, operational, financial, and strategic).

3.6   Understand basic purpose and scope of risk management.

3.7   Identify and evaluate loss exposure.

3.8   Describe and explain the benefits of risk management.

3.9   Identify and describe risk management program goals.

3.10   Evaluate an organization's risk management process.

3.11   Describe various risk control techniques and how to apply them.

3.12   Define risk control goals.

3.13   Apply risk control techniques to achieve risk control goals.

3.14   Manage risks for business continuity management.

3.15   Understand and explain risk financing goals.

3.16   Assess and evaluate risk retention and transfer.

3.17   Select and evaluate appropriate risk financing measures.

3.18   Explain differences between traditional risk management and enterprise risk management (ERM).

3.19   Explain how to improve strategic decision-making with ERM.

3.20   Apply ERM in approaching business uncertainties.

3.21   Define major risk management frameworks and standards.

3.22   Explain risks in asset allocation.

3.23   Develop and construct investment policies.

3.24   Assess and evaluate exposure and position limits.

3.25   Design and implement governance and oversight.

3.26   Describe and explain management of risks through separation of duties.

3.27   Describe and explain compliance risks.

3.28   Describe differences in risk mitigation approaches.

3.29   Define portfolio risk measures.

3.30   Define economic capital.

3.31   Explain and execute portfolio construction.

3.32   Explain and develop portfolio-based performance analysis.

3.33   Apply risk budgeting—decide on setting and allocating active (alpha) risk to enhance the returns available from passive management (beta).

3.34   Design and develop risk monitoring and performance measurement.

3.35   Define hedge funds.

3.36   Demonstrate an understanding of hedge fund strategies.

3.37   Understand how to apply due diligence and fraud detection.

3.38   Describe and discuss risk management of hedge funds.

3.39   Define and understand private equity.

3.40   Define and explain asset liability matching (ALM), understand what liability-driven investing (LDI) is and how it relates to ALM. Evaluate risk-return profile of the strategic asset allocation (SAA) of pension funds.

3.41   Describe and discuss financial risk management.

3.42   Describe and discuss capital management.

3.43   Describe and understand sub-prime mortgages and securitization.

3.44   Describe and understand counterparty risk.

3.45   Identify and outline risk mitigation techniques.

3.46   Calculate credit exposure and credit loss.

3.47   Evaluate collateralization and netting effects.

3.48   Evaluate pricing credit value adjustments (CVA).

3.49   Discuss the types and uses of CVA.

3.50   Explain general mechanics and structures of ERM.

3.51   Appraise and validate valuation of securities.

3.52   Define spread curves.

3.53   Discuss structured finance and securitization.

3.54   Apply the structuring and securitization process.

3.55   Discuss agency problems and moral hazard in the securitization process.

3.56   Discuss and explain tranching, subordination in structured finance.

3.57   Define and explain default risk.

3.58   Estimate defaults and recoveries from market prices and spreads.

3.59   Define and explain expected and unexpected losses.

3.60   Define credit value at risk (VaR).

3.61   Calculate and apply risk-adjusted return on capital (RAROC).

3.62   Understand, manage, and mitigate liquidity risk.

3.63   Understand and manage model risk.

3.64   Evaluate the performance of risk management systems.

3.65   Validate VaR models.

3.66   Apply general enterprise risk management (ERM).

3.67   Define and explain economic capital.

3.68   Estimate operational risks using operational loss data.

3.69   Discuss and explain frequency and severity distributions.

3.70   Formulate and validate modelling and fitting distributions.

3.71   Define data sufficiency.

3.72   Extrapolate beyond the data.

3.73   Describe and explain failure mechanics of dealer banks.

3.74   Define and discuss risk appetite frameworks.

3.75   Describe the Basel Accords.

3.76   Outline minimum capital requirements.

3.77   Discuss and evaluate methods for calculating credit, market, and operational risk.

3.78   Describe and discuss liquidity risk management.

3.79   Describe and discuss stress testing.

3.80   Describe revisions to the Basel II Accord.

3.81   Describe the Basel III framework.

3.82   Compare Basel II/III to Solvency II.

R4. Financial Accounting, Reporting and Regulations

The candidate will be able to do the following:

4.1   Demonstrate an understanding of basic principles of accounting.

4.2   Explain the role of accounting standards.

4.3   Describe and explain differences among different types of business entity.

4.4   Describe basic structure of company accounts.

4.5   Interpret and explain limitation of company accounts.

4.6   Demonstrate an understanding of financial accounting and taxation.

R5. Pension Legislation

The candidate will be able to do the following:

5.1   Describe federal and provincial pension benefits acts and regulations.

5.2   Recognize, define, interpret, and apply minimum standards in respect of the following provisions of registered pension plans:

   5.2.1   Eligibility requirements;

   5.2.2   Retirement benefit formula (uniform accrual and integration with government benefits);

   5.2.3   Employer cost (50 percent cost rule);

   5.2.4   Interest credited on member's contributions;

   5.2.5   Termination benefits;

   5.2.6   Death benefits;

   5.2.7   Spousal protection;

   5.2.8   Vesting and locking-in provisions;

   5.2.9   Portability;

   5.2.10   Pension credit splitting upon marriage breakdown; and

   5.2.11   Retirement age.

   Apply, analyze, evaluate, and produce funding requirements with respect to the following:

   5.2.12   Employer funding (current service, going-concern deficits, solvency deficiency funding requirements);

   5.2.13   Disclosure requirements/privacy/rights to information;

   5.2.14   Plan administrator/pension committee;

   5.2.15   Statement for members (annual or at retirement/termination);

   5.2.16   Pension fund investment standards;

   5.2.17   Remittance of contributions;

   5.2.18   Partial/full plan termination;

   5.2.19   Plan mergers and asset transfers;

   5.2.20   Plan conversion;

   5.2.21   Surplus ownership/contribution holiday;

   5.2.22   Funding relief measures;

5.2.23   Frequency of valuation; and

5.2.24   Use of letters of credit.

Outline and understand the following:

5.2.25   The different filing requirements: Annual Information Return (AIR)/Actuarial Valuation Report and Actuarial Information Summary (AIS)/Pension Benefits Guarantee Fund (PBGF) Assessment/Financial Statement and Form 8 – Investment Information Summary (IIS)/Form 7 – Summary or Revised Summary of Contributions; and

5.2.26   Relevant newsletters and bulletins from pension regulators.

R6. Income Tax Legislation

The candidate will be able to recognize, define, interpret, and apply rules and provisions outlined in the following:

6.1   Income Tax Act and Regulations (pension/retirement savings sections only);

6.2   Information circulars and interpretation bulletins (pension related only);

6.3   Registered Plans Directorate's bulletins, newsletters, and technical manuals;

6.4   Canada Revenue Agency's pension-related forms and guides;

6.5   Types of Registered Retirement Savings Plan (RRSP)/pension plans (defined benefit (DB)/defined contribution (DC)/hybrid/combination), and overall individual/plan-specific limits;

6.6   Permissible funding arrangements;

6.7   Retiring allowance;

6.8   Pension adjustment (PA), past service pension adjustment (PSPA), and pension adjustment reversal (PAR);

6.9   Plan registration rules;

6.10   Limits on registered defined benefit plans benefits;

6.11   Permissible distributions and transfers;

6.12   Deductibility of contributions;

6.13   Allowable surplus;

6.14   Phased retirement;

6.15   Multi-employer pension plans (MEPPs) and specified multi-employer plans (SMEPs);

6.16   Flexible pension plans;

6.17   Group RRSP/deferred profit sharing plan (DPSP)/employee profit-sharing plan (EPSP)/tax-free savings account (TFSA)/supplemental executive retirement plan (SERP)/retirement compensation arrangement (RCA); and

6.18   Reporting and filing requirements.

The candidate will be able to do the following:

6.19   Outline the filing process of T244 (or part of Joint AIR), trust filings (T3D/T3P/T3-RCA).

6.20   Outline the reporting process of PAs, PSPAs (past service pension adjustments), and PARs

6.21   Decide and appraise plan design features and compliance with tax legislation.

6.22   Outline features and rules governing maximum funding valuation/specified individuals/designated plans/individual pension plans.

R7. Reporting of pension, post-employment benefits and post-retirement benefits for financial statement and proxy circular purposes

The candidate will be able to do the following:

7.1   Recognize, define, interpret, and apply the CPA Canada Handbook.

R8. Accounting Standards

The candidate will be able to do the following:

8.1   Recognize, define, and interpret financial statement components: balance sheet/profit and loss statement/changes in other comprehensive income/notes to financial statements.

8.2   Define and describe applicable standards.

8.3   Interpret and apply International Accounting Standard (IAS) 19 and IFRIC 14.

8.4   Apply and evaluate recognition of liability/accounting expense.

8.5   Understand and apply actuarial cost methods.

8.6   Analyze, assess, consider, and decide on actuarial assumptions including healthcare trend rates and utilization.

8.7   Judge and decide benefits to be valued and types of plans to be included.

8.8   Consider and apply allocation/attribution/vesting.

8.9   Recognize and evaluate benefit changes.

8.10   Recognize and evaluate assumption changes.

8.11   Apply and evaluate recognition and amortization of past service costs.

8.12   Apply and evaluate recognition and amortization of actuarial gains and losses.

8.13   Recognize and appraise curtailment and settlement.

8.14   Recognize and evaluate termination benefits, business discontinuance, and a combination of both.

8.15   Differentiate and distinguish multi-employer pension and benefit plans.

8.16   Recognize and apply IAS 19 disclosure requirements.

8.17   Recognize and apply IFRIC 14 adjustments, asset ceiling.

8.18   Recognize and apply IAS 24/37 disclosure requirements.

8.19   Outline, consider, and apply CIA/CICA Joint Policy Statement.

8.20   Analyze and evaluate accounting impacts of transactions such as mergers, acquisitions, and purchase price adjustment.

R9. Actuarial Standards

The candidate will be able to do the following:

9.1   Recognize, define, interpret, and apply the following:

      9.1.1   Standards of Practice General (Part 1000), Pension Plans (Part 3000), and Post-Employment Benefit Plans (Part 6000);

      9.1.2   General standards;

      9.1.3   1100 – Interpretation and Judgment;

      9.1.4   1200 – Application;

      9.1.5   1300 – Permitted Deviations;

      9.1.6   1400 – The Engagement;

      9.1.7   1500 – The Work;

      9.1.8   1600 – Another Person's Work;

      9.1.9   1700 – Assumptions; and

      9.1.10   1800 – Reporting.

9.2   Recognize, define, interpret, and apply pension-specific standards:

      9.2.1   3100 – Scope;

      9.2.2   3200 – Advice on the Funded Status or Funding of a Pension Plan;

      9.2.3   3300 – Full or Partial Wind-up Valuation;

      9.2.4   3400 – Financial Reporting of Pension Costs; and

      9.2.5   3500 – Pension Commuted Values.

9.2.6   Contrast differences between pension commuted values and capitalized value for marriage breakdown purposes.

9.2.7   Consider, assess and decide on PfADs in going-concern valuations.

9.2.8   Evaluate incremental cost on a hypothetical wind-up or solvency basis.

9.2.9   Outline and apply Guidance on Asset Valuation Methods.

9.2.10   Interpret and apply educational notes and guidance on Assumptions for Hypothetical Wind-Up and Solvency Valuations (Committee on Pension Plan Financial Reporting (PPFRC)).

R10. Pension Plan De-Risking

The candidate will be able to do the following:

10.1   Design and construct replication portfolios using available assets or products to defray risk.

10.2   Identify, evaluate, and manage longevity risk.

10.3   Evaluate and execute annuity buy-ins and buyouts.

10.4   Consider, assess, and design target benefit pension plans and shared risk pension plans.

10.5   Interpret, analyze, and apply jurisprudence and legal environment.

R11. Fiduciary Duties

The candidate will be able to do the following:

11.1   Define, describe, and interpret benefit rights.

11.2   Identify, assess, and evaluate funding obligations/responsibility for deficits.

11.3   Interpret, analyze, and assess right to surplus.

11.4   Recognize and apply family law and marriage breakdown requirements.

11.5   Recognize and interpret basic principles of trust law.

11.6   Consider and apply bankruptcy and insolvency legislation.

11.7   Consider and apply employment standards legislation.

11.8   Consider and apply human rights legislation.

11.9   Consider and apply key pension court decisions and jurisprudence such as Monsanto, Indalex, etc.

R12. Social Security Benefit Law and Regulations

The candidate will be able to do the following:

12.1   Describe, apply, and evaluate Canada Pension Plan, Old Age Security, Guaranteed Income Supplement, and provincial programs for disability and death benefits.

12.2   Describe and explain how guarantee funds such as Assuris and Pensions Benefits Guarantee Fund (PBGF) operate.

GROUP BENEFITS

Notions of Fundamentals of Actuarial Practice

The candidate will be able to do the following:

1. Define and describe the role of the professional actuary.

2. Define and describe the control cycle.

3. Describe and explain how core external forces apply across areas of actuarial practice and the control cycle.

4. Describe how risk is defined and managed in an actuarial context.

5. Describe how actuarial solutions are developed to manage risk.

6. Describe how actuarial solutions are designed and priced.

7. Describe how models are selected and used in actuarial practice.

8. Describe the processes used to select assumptions.

9. Describe the elements of the process of monitoring results.

G1. Experience Studies

The candidate will be able to do the following:

1.1   Explain the relevancy and limitations of actuarial experience studies available for group insurance (industry tables and information: life mortality, waiver of premiums, LTD termination, rate comparisons, expense benchmarks, Life Insurance Market Research Association (LIMRA), etc.)

1.2   Explain the relevancy and limitations of non-actuarial experience studies available for group insurance.

1.3   Identify the sources, relevancy, and limitations of trend and forecasts studies available for group insurance (economic forecasts, disability incidence, and health-trend data).

1.4   Outline claims models for various types of coverage.

1.5   Outline expense models for various types of coverage.

G2. Credibility

The candidate will be able to do the following:

2.1   Outline the principles underlying the notion of credibility in group insurance.

2.2   Outline the principles underlying the application of credibility in group insurance.

2.3   Outline the factors affecting the credibility of a particular group (statistical heterogeneity, etc.).

2.4   Analyze the balance between industry statistics and company experience.

2.5   Develop and apply credibility formulae.

G3. Asset Liability Management

The candidate will be able to do the following:

3.1   Compare and contrast asset models.

3.2   Compare and contrast asset allocation among the various lines of business of an insurer.

3.3   Outline the selection process of assets for backing group insurance liabilities.

3.4   Outline the relationship between interest rate guarantees on refund arrangements and selection of assets.

3.5   Outline the relationship between asset liability management (ALM) at the corporate level and ALM at the line-of-business level.

3.6   Outline liability models related to group insurance.

3.7   Interpret and develop appropriate presentation of results.

3.8   Outline the impacts of interest crediting rates on pricing for new business.

3.9   Outline the impact of interest crediting rates on valuation of liabilities.

3.10   Determine risk margins related to the rate of return of assets.

G4. Reserving

The candidate will be able to do the following:

4.1   Outline the various uses of reserving (life insurance company financial reporting, reporting to client on refund accounting, pricing, etc.) and their impact on the selection of methods and assumptions.

4.2   Understand Canadian Asset Liability Method (CALM).

4.3   Identify the applicable Standards of Practice (SOP).

4.4   Identify the applicable educational notes.

4.5   Understand PfADs.

4.6   Compare and contrast aggregate and seriatim.

4.7   Describe current tables/studies used in valuation (CIA experience analyses, Group Long-Term Disability (GLTD), Krieger, SOA tables, etc.).

4.8   Perform calculations for waiver of premiums (WP).

4.9   Perform calculations for long-term disability (LTD) (disabled reserves).

4.10   Perform calculations for non-traditional approaches (WP and LTD reserves based on medical prognosis, etc.).

4.11   Perform calculations – (incurred but not reported (IBNR)).

4.12   Perform analysis on different reserving methods.

4.13   Outline stochastic approaches to calculation of group insurance reserves.

G5. Capital Requirements

The candidate will be able to do the following:

5.1   Outline Minimum Continuing Capital and Surplus Requirements (MCCSR) details.

5.2   Outline the impacts of funding structures (refund accounting with claims fluctuation reserves, stop-loss, large amount pooling, hold harmless agreements, etc.).

5.3   Outline pricing implications from the impact of rate guarantees.

5.4   Outline pricing implications from profit margins resulting from cost of capital.

G6. Product Design and Pricing

The candidate will be able to do the following:

6.1   Outline benefits design features and provisions (life, premium waiver, accidental death and dismemberment (AD&D), disability, medical, dental, critical illness (CI), long-term care (LTC)).

6.2   Identify and understand issues associated with benefit design (drug formularies, new drugs, drug substitution—generic or other, preferred provider networks, evolution of dental fee guides, emerging illnesses, etc.).

6.3   Identify possible anti-selection and its related impacts.

6.4   Outline the underwriting process.

6.5   Identify risk mitigation strategies (pre-existing, etc.).

6.6   Outline the features and provisions of flexible benefits.

6.7   Identify, compare, and contrast pricing variables relevant to group insurance, by product (demographic variables, variables that vary from one group to another, variables that vary from one insurer to another, economic variables, etc.)

G7. Profitability Measures

The candidate will be able to outline and calculate the following:

7.1   Return on capital;

7.2   Return on equity;

7.3   Percent of premium;

7.4   Percent of assets;

7.5   Earnings per share; and

7.6   Types of embedded value ("traditional", "European", "market consistent").

The candidate will be able to do the following:

7.7   Outline and explain the uses of embedded value.

7.8   Outline and explain the sources of earnings.

7.9   Perform benchmarking.

G8. Benefit Law and Regulation

The candidate will have an understanding of the effects of applicable legislation and regulation on the following:

8.1   Allowable benefits;

8.2   Privacy; and

8.3   Human rights and non-discrimination.

The candidate will be able to do the following:

8.4   Outline provisions of the Canadian Life and Health Insurance Association (CLHIA) guidelines (definitions of groups, takeover rules, coordination of benefits, disclosure).

8.5   Outline and describe provincial health plans.

8.6   Outline and describe applicable provisions of the Civil Code of Québec to group insurance.

8.7   Identify and outline relevant case law and its implications.

8.8   Outline and describe provincially mandated benefits (prescription drug coverage in Québec, etc.).

8.9   Compare and contrast the main differences between Québec law and the rest of Canada (designation of beneficiary, change of insurers, civil union, etc.).

8.10   Outline and describe the legal aspects of self-insurance.

G9. Insurance Company Law and Regulation

The candidates will have an understanding of the following pieces of legislation:

9.1   Office of the Superintendent of Financial Institutions (OSFI) Guidelines;

9.2   Insurance Companies Act;

9.3   Uniform Life Insurance Act and major variations;

9.4   Uniform Health Insurance Act and major variations;

9.5   Québec Civil Code;

9.6   Other provincial laws that have an impact on insurance (regulations on insurance and other acts, laws on the sale and distribution of insurance products, etc.).

9.7   Identify special issues (group creditor insurance, change of carrier, designation of beneficiary, etc.).

9.8   Identify and understand relevant case law and its implications.

G10. Insurance Company Tax

The candidate will be able to outline and describe the following insurance company taxation features:

10.1   Tax reserves;

10.2   Investment income tax (IIT);

10.3   Income tax;

10.4   Claims fluctuation reserve (CFR) allowable; and

10.5   Premium taxes.

G11. Benefit Taxation

The candidate will be able to outline and describe the following benefit taxation features:

11.1   Income tax – federal (including relevant folios and interpretation bulletins);

11.2   Income tax – provincial (including differences with federal income tax);

11.3   Premium sales taxes and similar taxes;

11.4   Other premium taxes;

11.5   Claims;

11.6   Administrative services only (ASO);

11.7   Impact of taxation on plan design, including flexible benefits plans;

11.8   Impact of taxation on plan funding (cross-experience rating, cost sharing, etc.); and

11.9   Employee life and health trusts.

G12. Social and Other Benefit Programs

The candidate will be able to outline and describe the following public plans:

12.1   Canada and Québec Pension Plans;

12.2   Canada Health Act;

12.3   Provincial medical plans;

12.4   Workers' Compensation;

12.5   Provincial automobile plans;

12.6   Employment Insurance;

12.7   Québec Parental Insurance Plan; and

12.8   Québec Prescription Drug Insurance Plan.

G13. Risk Management and Reinsurance

The candidate will be able to outline and describe the following concepts:

13.1   Risk mitigation;

13.2   Reinsurance types and uses;

13.3   Management and mitigation of catastrophic claims;

13.4   Non-evidence maximums (NEMs);

13.5   Underwriting guidelines (including unique aspects of group insurance underwriting such as underwriting on the employer and on the broker);

13.6   Large amount pooling; and

13.7   Assuris.

G14. Employee Benefits Accounting

The candidate will be able to outline and apply the following concepts:

14.1   Post-retirement benefits vs. benefits while not actively at work;

14.2   Actuarial aspects of accounting for employee future benefits: Canadian accounting recommendations under IAS 19, CPA section 3462–3463 (private sector and not-for-profit), CPA 3250, and CPA 3255 (public sector) plus non-Canadian accounting recommendations (Accounting Standards Codification (ASC) 715/712 – U.S.) regarding employee future benefits;

14.3   CIA practice-specific standards (advice, reporting, etc.) and

14.4   Issues related to post-employment benefits (cost inflation, selection, and reasonability of assumptions, etc.).

G15. Workers' compensation

The candidate will be able to outline and describe the following concepts:

15.1   Social insurance programs governed by provincial legislation with emphasis on prevention of workplace injuries, diseases and fatalities; Association of Workers' Compensation Boards of Canada (AWCBC);

15.2   Publicly insured programs vs. self-insured programs;

15.3   Integration of workers' compensation programs with private group insurance programs; and

15.4   Unique aspects of disability management when disability arises from a cause covered under workers' compensation.

G16. Financial Reporting

The candidate will be able to outline and describe the following concepts:

16.1   Basic financial statement and its components;

16.2   Canada Annual Statement: statements, key exhibits, and schedules;

16.3   Taxable income;

16.4   Fair value accounting principles;

16.5   International accounting standards; and

16.6   Actuarial reviews of reserves.

G17. Financial and Capital Management

The candidate will be able to outline and describe the following concepts:

17.1   Surplus management and earnings management;

17.2   Creation of value from a financial economics perspective; and

17.3   Concepts, approaches, and method for determining economic capital: i) identification of the significant risk components; ii) selecting calculation methods appropriate to stakeholder's perspectives; and iii) describing how a company would implement an economic cap.

G18. Risk Management and Mitigation

The candidate will be able to use and apply the following concepts:

18.1   General sources of risk in a group insurance line of business (strategic, operational, control, etc.);

18.2   Sources of risk in products including but not limited to mortality, morbidity, and lapse;

18.3   Sources of risk in investments including but not limited to credit risk, liquidity, and asset-liability matching;

18.4   Other risks including operational, marketplace, and expense risks;

18.5   Relation between risks (e.g., product, investments, and operational) and opportunities and influence to firm strategy;

18.6   Roles of rating agencies, analysts, and regulators together with their methods and impact on insurance companies;

18.7   Dynamic Capital Adequacy Testing (DCAT);

18.8   Stress testing; and

18.9   Reinsurance as a risk management tool.

G19. Professional Considerations

The candidate will be able to outline and describe the following concepts:

19.1   Role and responsibilities of the appointed/valuation actuary;

19.2   Professional actuarial qualification standards;

19.3   Actuary's professional responsibilities to stakeholders, including obligations under Sarbanes-Oxley; and

19.4   Requirements of the CIA professional standards that may inadvertently be breached in the group insurance practice (conformity with the law, public interest, etc.).

ENTERPRISE RISK MANAGEMENT (ERM)

Notions of Fundamentals of Actuarial Practice

The candidate will be able to do the following:

1. Define and describe the role of the professional actuary.

2. Define and describe the control cycle.

3. Describe and explain how core external forces apply across areas of actuarial practice and the control cycle.

4. Describe how risk is defined and managed in an actuarial context.

5. Describe how actuarial solutions are developed to manage risk.

6. Describe how actuarial solutions are designed and priced.

7. Describe how models are selected and used in actuarial practice.

8. Describe the processes used to select assumptions.

9. Describe the elements of the process of monitoring results.

E1. Financial Models

The candidate will be able to do the following:

1.1 Establish an introduction to ERM and understand the key elements of ERM framework.

1.2 Develop ERM frameworks for different entities.

E2. Risk Categories and Identification

The candidate will be able to do the following:

2.1 Have an understanding of the types of risk faced by an entity and be able to identify and analyze these risks.

2.2 Explain risk concepts and be able to apply risk definitions to different entities.

2.3 Understand sets of risk taxonomy and apply them to different frameworks.

2.4 Identify and analyze risks faced by an entity, including but not limited to the following: market risk, currency risk, credit risk, spread risk, liquidity risk, interest rate risk, equity risk, hazard/insurance risk, inflationary risk, environmental risk, pricing risk, foreign exchange risk, country and sovereign credit risk.

E3. Risk Modelling and Aggregation of Risks

The candidate will be able to do the following:

3.1 Demonstrate how each of the financial risks faced by an entity can be amenable to quantitative analysis including an explanation of the advantages and disadvantages of various techniques such as value at risk (VaR), stochastic analysis, scenario analysis.

3.2 Evaluate how risks are correlated, and give examples of risks that are positively correlated and risks that are negatively correlated.

3.3 Analyze and evaluate risk aggregation techniques, including use of correlation, integrated risk distributions, and copulas.

3.4 Apply and analyze scenario and stress testing in the risk measurement process.

3.5 Evaluate the theory and applications of extreme value theory in the measuring and modelling of risk.

3.6 Analyze the importance of tails of distributions, tail correlations, and low-frequency/high-severity events.

3.7 Analyze and evaluate model and parameter risk.

3.8 Construct approaches to managing various risks and evaluate how an entity makes decisions about techniques to model, measure, and aggregate risks including but not limited to stochastic processes.

E4. Risk Measures

The candidate will be able to do the following:

4.1 Apply and construct risk metrics to quantify major types of risk exposure such as market risk, credit risk, liquidity risk, regulatory risk, etc. and tolerances in the context of an integrated risk management process.

4.2 Analyze quantitative financial and construct measures from insurance data using modern statistical methods (including asset prices, credit spreads and defaults, interest rates, incidents, causes, and losses). Understand available range of methods with its limitations.

4.3 Describe and evaluate risk management techniques in terms of best practice that can be used to deal with financial and non-financial risks.

4.4 Define and evaluate credit risk. Explain how to incorporate best practices in credit risk measurement, modelling, and management.

E5. Risk Management Tools and Techniques

The candidate will be able to do the following:

5.1 Evaluate the rationale for managing risk and demonstrate the selection of the appropriate risk retention level and hedging of risk.

5.2 Demonstrate and analyze applicability of risk optimization techniques and the impact on an organization's value of an ERM strategy.

5.3 Demonstrate means for transferring risk to a third party, and estimate the costs and benefits of doing so.

5.4 Demonstrate means for reducing risk without transferring it.

5.5 Demonstrate how derivatives, synthetic securities, and financial contracting may be used to reduce risk or to assign it to the party most able to bear it.

5.6 Develop an appropriate choice of hedging strategy for a given situation (e.g., reinsurance, derivatives, financial contracting), which balances benefits with inherent costs, including exposure to credit risk, basis risk, moral hazard, and other risks.

5.7 Analyze the practicalities of market risk hedging, including dynamic hedging.

5.8 Define credit risk as related to derivatives, define credit risk as related to reinsurance ceded, define counterparty risk and demonstrate the use of comprehensive due diligence and aggregate counterparty exposure limits.

5.9 Analyze funding and portfolio management strategies to control equity and interest rate risk, including key rate risks. Explain the concepts of immunization including modern refinements and practical limitations. Contrast various risk measures and be able to apply them to various entities.

5.10 Analyze the application of asset liability management and liability-driven investment principles to investment policy and asset allocation.

5.11 Analyze methods of managing of other risks (operational, strategic, legal, insurance) both pre-event and post-event.

E6. Economic Capital

The candidate will be able to do the following:

6.1   Describe the concept of economic measures of value (e.g., Market Consistent Embedded Value (MCEV)) and demonstrate their uses in the risk management and corporate decision-making processes.

6.2   Define the basic elements and explain the uses of economic capital. Explain the challenges and limits.

6.3   Apply risk measures and demonstrate how to use them in economic capital assessment. Contrast and understand regulatory, accounting, statutory, and economic capital.

6.4   Propose techniques for allocating/appropriating the cost of risks/capital/hedge strategy to business units in order to gauge performance (risk-adjusted performance measures).

6.5   Develop an economic capital model for a representative financial firm.

E7. Own Risk and Solvency Assessment (ORSA)

The candidate will be able to do the following:

7.1   Understand the key elements of ORSA, specifically risk identification and assessment, quantification of risk to capital, board oversight and senior management responsibility, monitoring, reporting, and internal controls.

7.2   Develop internal targets using stress and scenario testing and setting of explicit buffers.

7.3   Develop simple quantitative measures using plausible deterministic scenarios for complex risks.

PROPERTY AND CASUALTY/GENERAL INSURANCE

Notions of Risk Management and Insurance Operations

Candidates will have foundational knowledge in key areas of traditional risk management, as well as enterprise risk management. Additionally, they will have a familiarity with the primary functional areas of an insurer. Lastly, they will have an understanding of actuarial data management and the actuarial data quality standards that apply.

Notions of Insurance Accounting, Coverage Analysis, Insurance Law, and Insurance Regulation

Candidates will have a firm grounding in four major areas that impact actuarial work in insurance accounting, coverage analysis, insurance law, and insurance regulation.

PC 1. Stochastic Processes

The candidate will be able to do the following:

1.1   Describe the properties of Poisson processes:

   a. For increments in the homogeneous case;

   b. For interval times in the homogeneous case;

   c. For increments in the non-homogeneous case;

   d. Resulting from special types of events in the Poisson process; and

   e. Resulting from sums of independent Poisson processes.

1.2   For any Poisson process and the inter-arrival and waiting distributions associated with the Poisson process, calculate the following:

   a. Expected values;

   b. Variances; and

   c. Probabilities.

1.3   For a compound Poisson process, calculate moments associated with the value of the process at a given time.

PC 2. Statistics

The candidate will be able to do the following:

2.1   Maximum-likelihood estimation

   a. Perform point estimation of statistical parameters using maximum likelihood estimation (MLE);

   b. Apply criteria to the estimates such as the following:

      i.   Consistency;

      ii. Unbiasedness;

      iii. Sufficiency;

      iv. Efficiency;

      v.   Minimum variance; and

      vi. Mean square error.

2.2   Test statistical hypotheses including Type I and Type II errors using the following:

   a. Neyman-Pearson lemma;

b. Likelihood ratio tests; and

c. First principles.

2.3   Apply Neyman-Person lemma to construct likelihood ratio equation.

2.4   Use critical values from a sampling distribution to test means and variances.

2.5   Calculate order statistics of a sample and use critical values from a sampling distribution to test means and variances.

2.6   Test parameters from normal models.

2.7   Bayesian Statistics parameter estimation for conjugate prior and posterior distributions:

a. Beta-binomial;

b. Normal-Normal; and

c. Gamma-Poisson.

Extended Linear Models

2.8   Understand the assumptions behind different forms of the Extended Linear Model and be able to select the appropriate model from list below:
  a)   ANOVA
  b)   Generalized Additive Models
  c)   Local Regression
  d)   Lasso
  e)   Ridge Regression
  f)   Partial Least Squares

2.9   Evaluate models developed using Extended Linear Model approach.

2.10   Understand the algorithms behind the numerical solutions for the different forms of the Extended Linear Model family to enable interpretation of output from the statistical software employed in modeling and to make appropriate modeling choices when selecting modeling options

2.11   Understand and be able to select the appropriate model structure for an Extended Linear Model given the behavior of the data set to be modeled.

  a)   Predictor variables
  b)   Response variables
  c)   Regression through the origin
  d)   Transformation of variables
  e)   Categorical vs. continuous explanatory variables
  f)   Interaction terms
  g)   Significance and model comparison statistics
  h)   Residuals and model parameter selection
  i)   Piecewise Linear and Smoothing Splines
  j)   Smoothing parameter for splines
  k)   Basis Functions
  l)   Knot Selection for Splines

m) Weighting function for local regression
n) Selection of functions within functions for Generalized Additive Models
o) Selection of appropriate tuning factor for Lasso or Ridge Regression
p) Select either Lasso or Ridge Regression depending on desired effect from penalized regression
q) Curse of High Dimensionality

Linear Mixed Models

2.12 Understand the algorithms behind the numerical solutions for the Linear Mixed Model to enable interpretation of output from the statistical software employed in modeling to make appropriate choices when evaluating modeling options:

a) EM Algorithm
b) Sandwich Estimator for Variance
c) Credibility adjusted degrees of freedom
d) Linear Mixed Models (Saitherwaite/Kenward Rodgers)
e) Conditional vs. Population Estimate for Mixed Models

2.13 Understand and be able to select the appropriate model structure and variable selection for a Linear Mixed Model given the behavior of the data set to be modeled by interpreting the model diagnostics and or summary statistics on the variables available in the model along with any graphs depicting how the dependent variable behaves as a function of possible explanatory variable:

a) Units of replication for Linear Mixed Models
b) Blocking factors for Linear Mixed Models
c) Estimable vs. Predictable Functions for Linear Mixed Models
d) Interaction terms for Fixed Effects vs. Random Effect variables for Linear Mixed Models
e) Model Selection for Linear Mixed Models when covariance structure changes
f) Covariance structure selection for Linear Mixed Models
g) Selection of fixed vs. random effect class for Mixed Effect explanatory variables
h) Explicitly model variance for Linear Mixed Models
i) Residual graphs evaluating normality and constant variable assumptions
j) Goodness of fit statistics including: t-tests, F tests, Chi-Square tests
k) Know when nested model comparisons are appropriate
l) Application of AIC & BIC relative measures of goodness of fit
m) Application of Scatter Plots and Box Plots as an aide to model design

Bayesian Analysis and Markov Chain Monte Carlo

2.14 Understand how to set up a Bayesian MCMC model and evaluate how a given set of design choices affects the results of a model
a) Recognize benefits and limitations of different kinds of priors (Proper and improper, conjugate and non-conjugate, Hyperpriors)
b) Calculating posterior and posterior predictive distributions for single and multiparameter models.
c) Hierarchical models
d) Linear Regression

2.15   Understand Bayesian computation, how Markov Chain Monte Carlo methods are used, and how to evaluate model performance.

2.16   Evaluate when a given modeling approach should be used given modeling diagnostics on simulation performance.

2.17   Interpret diagnostics on simulation performance:
  a)   Simulation and sampling
  b)   Conditional sampling
  c)   Convergence assessment
  d)   Efficient samplers
  e)   Hamiltonian Monte Carlo

PC 3. Basic Techniques for Ratemaking

The candidate will be able to do the following:

3.1   Calculate a policy premium for a specified risk using the rate pages provided.

3.2   Describe, analyze, or design the information requirements for ratemaking related to exposures and demonstrate the use of exposures in ratemaking.

3.3   Describe, analyze, or design the information requirements for ratemaking related to premiums and demonstrate the use of premiums in ratemaking.

3.4   Describe, analyze, or design the information requirements for ratemaking related to loss and loss adjustment expenses and demonstrate the use of loss and loss adjustment expenses in ratemaking.

3.5   Calculate the underwriting expense provisions underlying the overall rate level indication.

3.6   Calculate the overall rate level indication using the pure premium and loss ratio methods and argue the merits of each.

3.7   Describe, analyze, and validate the considerations beyond the calculated cost-based estimate of the rate when selecting a final rate change to implement.

3.8   Explain the purpose for segregating data into homogeneous groups and summarize the considerations for determining such groups.

3.9   Develop rating differentials for classification and territory and relativities for deductibles and increased limits.

3.10   Assess the considerations for implementing rates to achieve an organization's goals.

3.11   Calculate premium for policies with co-insurance provisions.

3.12   Perform basic individual risk-rating calculations.

PC 4. Estimating Claim Liabilities

The candidate will be able to do the following:

4.1   Describe, analyze, and validate the information requirements for estimating unpaid claims.

4.2   Build and analyze claim development triangles.

4.3   Construct and appraise unpaid claims estimates using each of the following estimation techniques:

    a.   Development technique, including case outstanding technique;

    b.   Expected claim technique;

    c.   Bornhuetter-Ferguson technique;

    d.   Cape Cod technique; and

    e.   Frequency-severity techniques.

4.4   Assess the influence of operating changes on the estimation of unpaid claims.

4.5   Adjust data and/or estimation techniques for changes in the

    a.   Internal environment (e.g., claims processes that result in shift in the adequacy of case outstanding or shift in settlement rates, change in mix of business, change in rate level); and

    b.   External environment (e.g., inflationary or legal environment).

4.6   Estimate recoveries.

4.7   Estimate unpaid claim adjustment expenses.

4.8   Appraise and validate the results of the estimation process for adequacy and reasonableness.

PC 5. Regulation of Insurance and Canadian Insurance Law

The candidate will be able to do the following:

5.1   Describe the historical development of insurance legislation and regulations, including the division of responsibility between federal and provincial/state regulators.

5.2   Discuss the current state of insurance regulation in Canada.

5.3   Discuss the issues, outcome, rationale, and implications of landmark decisions for the insurance industry.

5.4   Describe the litigation environment with respect to insurance.

PC 6. Government and Industry Insurance Programs

The candidate will be able to do the following:

6.1   Describe the origin and purpose of specific government and insurance industry programs.

6.2   Describe the operations and risk transfer process for each of the following government and insurance industry programs and their interactions with the voluntary private insurance sector:

    a.   Agricultural insurance;
    b.   Employment insurance;
    c.   Flood insurance;
    d.   Guaranty funds including the Canadian Property and Casualty Insurance Compensation Corporation ("PACCIC");
    e.   Healthcare insurance;
    f.   Pension plans;
    g.   Residual personal insurance markets (e.g., auto, property);
    h.   Terrorism risk insurance; and
    i.   Workers' compensation insurance.

6.3   Evaluate the effectiveness of a government and insurance industry program (actual or hypothetical).

PC 7. Financial Reporting and Solvency

The candidate will be able to do the following:

7.1   Describe the elements and prepare the schedules of the Canadian Annual Return.

7.2   Evaluate the financial health of an insurance entity based on various solvency frameworks.

PC 8. Professional Responsibilities of the Actuary in Financial Reporting

The candidate will be able to do the following:

8.1   Explain the responsibilities of an actuary as defined by standards of practice, regulators, and insurance laws for financial reporting.

PC 9. Estimation of Policy Liabilities

The candidate will be able to do the following:

9.1   Calculate unpaid claim estimates using credibility models.

9.2   Estimate parameters and unpaid claims using claims development models related to loss reserving methods such as the following:

   a.   Chain ladder;
   b.   Cape Cod;
   c.   Chain ladder plus calendar-year effects; and
   d.   Bornhuetter-Ferguson.

9.3   Calculate the moments and percentiles of unpaid claim distributions implied by the models.

9.4   Estimate unpaid claims for various layers of claims.

9.5   Describe the various sources of risk and uncertainty that are associated with the determination of reserves. Calculate risk margins that consider these sources of risk and uncertainty.

9.6   Calculate the mean and prediction error of a reserve given an underlying statistical model.

9.7   Derive predictive distributions using bootstrapping and simulation techniques.

9.8   Identify data issues and related model adjustments for reserving models.

9.9   Test assumptions underlying reserve models.

9.10   Develop a distribution of reserves using weights and multiple stochastic models.

9.11   Compare and contrast reinsurance and primary reserving procedures.

9.12   Adjust primary methods and data to be used for reinsurance reserving.

9.13   Calculate ceded loss reserves using appropriate methods.

9.14   Forecast premium reserves.

PC 10. Insurance Company Valuation

The candidate will be able to do the following:

10.1   Calculate the effect of loss and expense reserve requirements and regulatory or rating agency capital requirements on the free cash flow to equity for a property and casualty (P&C) insurer.

10.2   Value the equity of a P&C insurer based on its expected future dividends, its free cash flow to equity, or its expected abnormal earnings.

10.3   Value the equity of a firm using comparative or relative valuation methods based on multiples of selected financial variables obtained from either peer companies or from underlying fundamentals.

PC 11. Enterprise Risk Management

The candidate will be able to do the following:

11.1   Demonstrate how insurance and financial risk can be analyzed quantitatively.

11.2   Describe the use of enterprise-wide risk modelling and aggregation techniques.

11.3   Evaluate and select appropriate models to handle diverse risks, including stochastic approaches.

11.4   Demonstrate the properties of various risk measures and their limitations.

11.5   Describe how risk measures and risk modelling, including allocation, can affect strategic management.

11.6   Describe the rationale for, methods for, and effect of managing insurance and financial risks.

11.7   Describe operational risk and demonstrate possible mitigation and quantification methodology.

11.8   Evaluate best practices in risk measurement, modelling, and management of various financial and non-financial risks faced by an entity.

PC 12. Classification Ratemaking

The candidate will be able to do the following:

12.1   Identify and evaluate possible rate classes.

12.2   Measure statistical significance of possible classes and estimate the loss costs of rating classes.

12.3   Formularize and solve generalized linear models (GLMs) for classification ratemaking.

PC 13. Excess, Deductible, and Individual Risk Rating

The candidate will be able to do the following:

13.1   Apply frequency and severity distributions to determine expected losses by layer of insurance.

13.2   Estimate aggregate loss distributions.

13.3   Adjust class rates based on individual risk experience and exposure.

13.4   Assess effectiveness of experience rating plans.

13.5   Construct a retrospectively rated plan.

13.6   Analyze the elements of a loss-sensitive rating plan.

13.7   Calculate the cost of the layer of risk given the loss cost.

PC 14. Catastrophic and Reinsurance Pricing

The candidate will be able to do the following:

14.1   Describe the components and structure of catastrophe models.

14.2   Explain the use of catastrophe models in insurance ratemaking and portfolio management.

14.3   Determine the price of various types of reinsurance contracts.

14.4   Determine the effect of common contract provision on the price of reinsurance contracts.

14.5   Specify, fit, and use loss distribution-based exposure curves.

PC 15. Portfolio Theory and Equilibrium in Capital Markets

The candidate will be able to do the following:

15.1   Explain key concepts of risk:

    a.   Appetite;
    b.   Tolerance;
    c.   Aversion;
    d.   Measurement;
    e.   Portfolio construction; and
    f.   Strategies for monitoring.

15.2   Calculate the expected value, variance, and covariance of returns of asset portfolios in a multi-dimensional setting.

15.3   Describe the Markowitz portfolio selection model.

15.4   Explain and demonstrate the effects of various diversification strategies.

15.5   Explain and use the single factor models and compare/contrast the process of portfolio construction with the full covariance (Markowitz) model.

15.6   Explain the assumptions and construction of capital asset pricing model (CAPM) and use CAPM to calculate expected returns for risky securities.

15.7   Compare/contrast CAPM and single-index model and explain the assumptions that are modified under various extensions of CAPM.

15.8   Use arbitrage pricing theory (APT) to determine the expected return for a security and compare/contrast with CAPM and factor models.

15.9   Explain market efficiency and its implications for portfolio management and describe the various tests and studies of market efficiency.

15.10   Explain the influence of behavioural finance in understanding certain aspects of market efficiency.

15.11   Describe the use of historical data to test the CAPM and APT, the statistical limitations of these tests, and the key findings of various studies.

15.12   Describe the equity premium puzzle and various explanations for the puzzle.

PC 16. Asset-Liability Management

The candidate will be able to do the following:

16.1   Explain the different term structure theories.

16.2   Determine U.S. Treasury zero rates at different maturities.

16.3   Utilize various strategies to manage interest rate risk and cash flow risk in a bond portfolio.

16.4   Calculate the Macaulay duration of loss reserves and the Macaulay duration of the surplus of a P&C insurance company.

16.5   Understand the importance of asset/liability matching (ALM) for P&C insurance companies.

16.6   Quantify franchise value, evaluate the impact of interest rate sensitivity, and demonstrate how interest rate sensitivity of the franchise value can be managed.

PC 17. Financial Risk Management

The candidate will be able to do the following:

17.1   Estimate the credit risk due to default and default correlation associated with fixed-income securities.

17.2   Describe the credit risk in derivatives transactions and various mechanisms to manage the risk.

17.3   Describe the reasons for the development of credit derivatives market, the valuation of credit derivative contracts, and the complexity of trading credit risks.

17.4   Describe liquidity risk and various mechanisms to manage the risk.

17.5   Discuss the development and complexity of financial engineering products such as mortgage-backed securities and other forms of securitization.

17.6   Describe the market for securitizing catastrophe risk in the insurance industry and explain the reasons for its growth.

17.7   Describe various risk measures and the need for practising sound financial risk management.

17.8   Describe the concept of economic capital (or risk capital) in the insurance industry and various methods of allocating the risk capital to business units or lines of business.

17.9   Apply the risk-adjusted return on capital (RAROC) framework to risk management in the insurance industry.

17.10   Assess the performance of business units and set prices for insurance policies on a risk-adjusted basis.

PC 18. Rate of Return, Risk Loads, and Contingency Provision

The candidate will be able to do the following:

18.1   Evaluate the internal rate of return framework.

18.2   Evaluate the components of total return to stockholders and how leverage can be used to maximize shareholder value.

18.3   Assess insurance profitability.

18.4   Describe the underwriting profit provision.

18.5   Calculate and compare the provision for underwriting profit in property and casualty insurance rates.

18.6   Assess the risks of allocating surplus.

18.7   Analyze and calculate income and total rate of return

18.8   Use investment-equivalent reinsurance pricing to determine risk loads.

18.9   Calculate and compare the risk loads for property catastrophe insurance.

INDIVIDUAL LIFE INSURANCE AND ANNUITIES

Notions of Fundamentals of Actuarial Practice

1. Define and describe the role of the professional actuary.

2. Define and describe the control cycle.

3. Describe and explain how core external forces apply across areas of actuarial practice and the control cycle.

4. Describe how risk is defined and managed in an actuarial context.

5. Describe how actuarial solutions are developed to manage risk.

6. Describe how actuarial solutions are designed and priced.

7. Describe how models are selected and used in actuarial practice.

8. Describe the processes used to select assumptions.

9. Describe the elements of the process of monitoring results.

LI 1. Financial Reporting

The candidate will be able to do the following:

1.1   Construct a basic financial statement and its components.

1.2   Describe and explain Canada Annual Statement: statements, key exhibits, and schedules.

1.3   Describe how to compute the taxable income of a life insurance company.

1.4   Describe, use, and recommend methods for performing actuarial reviews of reserves.

1.5   Describe emerging developments impacting Canadian valuation and International Financial Reporting Standards frameworks, and assess their impact on the valuation of reserves and financial statements.

LI 2. Principles of Valuation

The candidate will be able to do the following:

2.1   Describe valuation methods.

2.2   Recommend appropriate valuation assumptions.

2.3   Calculate liabilities for life and annuity products and their associated riders.

2.4   Describe and explain principal factors for variation in mortality and morbidity by region/social and economic environment.

2.5   Describe and discuss risk classification/impact of availability of genetic information.

LI 3. Reinsurance

The candidate will be able to do the following:

3.1   Describe the considerations and evaluate the appropriate reinsurance form from the ceding and assuming company perspectives.

3.2 Explain the consequences and calculate the effect on both ceding and assuming companies with respect to the following:

    a. Risk transfer;

    b. Cash flow;

    c. Financial statements; and

    d. Tax and reserve credit requirements.

LI 4. Financial and Capital Management

The candidate will be able to do the following:

4.1 Describe and calculate performance measures.

4.2 Perform financial analysis by product line and total company.

4.3 Explain and create a "gains-by-source" analysis.

4.4 Apply methods of valuation to business and asset acquisitions and sales including embedded value.

4.5 Explain and apply methods of surplus management and earnings management.

4.6 Describe and apply the principle of creation of value from a financial economics perspective.

4.7 Describe and risk-based capital (RBC) regulatory frameworks and the principles underlying the determination of regulatory capital, in particular the Life Insurance Capital Adequacy Test (LICAT), including the following:

    a. Identification of significant risk components;
    b. Identification of specialized product LICAT requirements; and
    c. Interpreting results from a regulatory perspective.

4.8 Explain and apply the concepts, approaches, and method for determining economic capital:

    a. Identification of the significant risk components;
    b. Selecting calculation methods appropriate to stakeholder's perspectives; and
    c. Describing how a company would implement an economic cap.

LI 5. Model Office and Asset/Liability Modelling

The candidate will be able to do the following:

5.1 For the ALM model:

    a. Select appropriate assumptions and scenarios;
    b. Model dynamic behavior of both assets and liabilities;
    c. Model and explain strategies, including hedging; and
    d. Analyze and evaluate results including actual vs. projected differences.

5.2 Recommend appropriate strategies for model office process.

5.3 Recommend appropriate strategies for limitations of models and possible sources of error.

LI 6.Risk Management and Mitigation

The candidate will be able to do the following:

6.1 Identify, categorize, and evaluate potential sources of risk in products including but not limited to mortality, morbidity, and lapse.

6.2 Identify, categorize, and evaluate potential sources of risk in investments including but not limited to credit risk, liquidity, and asset-liability matching.

6.3 Identify, categorize, and evaluate potential other risks including operational, marketplace, and expense risks.

6.4 Explain the relation between risks (e.g., product, investments, and operational) and opportunities and influence to firm strategy.

6.5 Explain methods of risk mitigation and hedging, and limitations of such methods including variable annuities.

6.6 Explain methods for measuring and controlling equity-based exposure associated with embedded options.

6.7 Explain and discuss roles of rating agencies, analysts, and regulators together with their methods and impact on insurance companies.

6.8 Understand the key elements of ORSA, specifically risk identification and assessment, quantification of risk to capital, board oversight and senior management responsibility, monitoring, reporting, and internal controls.

6.9 Develop internal targets using stress and scenario testing and setting of explicit buffers.

6.10 Develop simple quantitative measures using plausible deterministic scenarios for complex risks.

LI 7. Professional Considerations

The candidate will be able to do the following:

7.1 Explain the role and responsibilities of the Appointed/valuation actuary.

7.2 Identify and apply the professional actuarial qualification standards.

7.3 Identify and apply actuarial standards of practice relevant to financial reporting and valuation.

LI 8. Product Development Process

The candidate will be able to do the following:

8.1 Describe and explain steps in the iterative control cycle process within the context of product development:

    a. Idea generation;
    b. Feasibility;
    c. Planning the design;
    d. Actuarial development:
       i. Assumptions;
      ii. Profitability regulatory issues;
     iii. Choice of model; and
    e. Implementing and monitoring the product.

8.2 Describe and explain interaction of the actuary with other stakeholders within the product development process.

LI 9. Drivers of Product Design (the Idea-Generation Step)

The candidate will be able to do the following:

9.1 Describe and explain customers and their needs—internal and/or external.

9.2 Describe and explain drivers in product design:

a. Company strengths and weaknesses;
b. Economic forces;
c. Marketplace demographics;
d. Consumer behaviour;
e. Distribution channel behaviour; and
f. Competition.

9.3 Describe and explain questions to ask sales and marketing (including agents, brokers, and direct marketing).

LI 10. Feasibility Step of New Product and Impact on Design

The candidate will be able to do the following:

10.1 Explain the considerations for prudent and practical decision-making.

10.2 Describe tax regulation and compliance.

10.3 Describe and explain impact of investment policy and policy loans on design.

10.4 Identify gaps between the product design and the operations of the company and procedures and systems.

10.5 Recommend ways to close the gaps between design and the internal/external constraints.

LI 11. Design and Purpose of Various Product Types, Benefits, and Features

The candidate will be able to do the following:

11.1 Describe in detail product types, benefits, and features.

11.2 Construct and recommend design consistent with the market needs identified in the idea-generation step.

11.3 Evaluate feasibility of the recommended design.

LI 12. Relationship between the Product Features, their Inherent Risks, and the Selection of Appropriate Pricing Assumptions, Profit Measures, and Modelling Approaches

The candidate will be able to do the following:

12.1 Identify and explain the setting of appropriate assumptions for product characteristics such as the following:

a. Riders;
b. Policyholder dividends;
c. Equity linked;
d. Embedded options;
e. Return of premium;
f. Secondary guarantees;
g. Payout annuity benefits;
h. Crediting methodology; and
i. Other non-guaranteed elements.

12.2 Identify and explain the setting of appropriate assumptions for risks and other factors such as:

a. Available experience data;
b. The marketplace;
c. Underwriting;

    d.   Distribution channel characteristics;

    e.   Reinsurance;

    f.   Expenses (fixed, variable, marginal);

    g.   Taxes (income and premium); and

    h.   Investment strategy.

12.3   Analyze results and recommend actions with respect to risk and profit measures such as the following: statutory, generally accepted accounting principles (GAAP), return on equity, market-consistent pricing, embedded value.

12.4   Analyze the capital requirements for a product and solutions such as securitization.

12.5   Describe use of stochastic model, advantages and disadvantages, building of a model, and results.

LI 13. Actuarial Requirements of Product Implementation and Monitoring of Experience Versus Product Assumptions

The candidate will be able to do the following:

13.1   Describe and evaluate compliance with illustration regulation and other policy form regulations.

13.2   Evaluate variation in the actual experience from expected relative, but not limited to, mortality, investment returns, expenses and policyholder behaviour such as policy and premium persistency, through the use of experience studies.

13.3   Describe how to evaluate quality of data.

13.4   Recommend changes to non-guaranteed elements for deviations from expected.

LI 14. Regulation and Taxation

The candidate will be able to do the following:

14.1   Describe and explain purpose of regulation and taxation.

14.2   Describe and explain regulation and tax environment of insurance and annuities in Canada: effect on product development, reserving, pricing, and business practices.

14.3   Describe and explain Canadian contract law.

LI 15. Enterprise Risk Management

The candidate will be able to do the following:

15.1   Describe and explain the effect of strategic planning alternatives on risks taken and results achieved.

15.2   Recommend solutions to exploit risk knowledge.

15.3   Describe and explain effect of company size on effective ERM strategies.

15.4   Discuss future of risk management theory and techniques.

15.5   Describe and explain challenges facing someone setting up a risk unit.

LI 16. CIA Standards of Practice – Life Section

The candidate will be able to describe and understand the following sections of the SOP:

16.1   Part 2100 – Insurance Contract Valuation: All Insurance;

16.2   Part 2300 – Insurance Contract Valuation: Life and Health (accident and sickness) Insurance;

16.3   Part 2400 – The Appointed Actuary;

16.4   Part 2500 – Dynamic Capital Adequacy Testing; and

16.5   Part 2700 – Policyholder Dividend Determination.

COMMUNICATIONS SKILLS AND BUSINESS ACUMEN

CBA1. General Communications

1.1 The candidate will understand features of different audiences:

    a. Peer-to-peer (i.e., within actuarial work groups);
    b. Within the firm (i.e., other departments); and
    c. External (customer, clients).

1.2 The candidate will be able to deliver effective messaging.

1.3 The candidate will be able to use clarifying language.

1.4 The candidate will be able to use self-disclosure.

1.5 The candidate will understand the extent of the use of influence and persuasion.

CBA2. Written Communication

The candidate will be able to do the following:

2.1 Establish differences between technical and non-technical writing.

2.2 Write effective messages (i.e., e-mails).

2.3 Perform effective report writing.

2.4 Write an effective executive summary.

CBA3. Verbal Communication

3.1 The candidate will understand the extent to which interactions will differ considering the needs of different audiences including the following:

    a. One-on-one situations;
    b. Small groups or meetings; and
    c. Larger groups;

3.2 With regards to presentation skills, the candidate will be able to include appropriate key elements of structuring which may include (but not limited to) the following:

    a. Appropriate addressing;
    b. Title/subject;
    c. Introduction/agenda;
    d. Executive summary;
    e. Content;
    f. Conclusion or summary; and
    g. Question and answer session.

3.3 The candidate will deliver an oral communication that is clearly worded and easy for an audience to understand and

    a. Is free from inappropriate technical terms or detail;
    b. Is technically accurate; and
    c. Includes only relevant points.

3.4   The candidate will demonstrate an appropriate use of visual aids where required. Be able to include appropriate visual aids which might include any of the following:

    a.   Charts (bar charts, pie charts, graphs);
    b.   Diagrams;
    c.   Pictures;
    d.   Tables of numbers;
    e.   Slide presentations;
    f.   Bullet points; and
    g.   Flip chart pages

3.5   The candidate will be able to use and apply the following listening skills:

    a.   The four steps to effective listening:
        i.   Attending;
        ii.   Interpreting;
        iii.   Responding; and
        iv.   Remembering.
    b.   The candidate will be able to identify and avoid barriers to effective listening.

CBA4. Business Skills

The candidate will be able to define, use, and apply the following:

4.1   Effective negotiation;

4.2   Decision-making skills;

4.3   Leadership;

4.4   Strategic insights;

4.5   Understanding impact of external factors; and

4.6   Relationship management.

CBA5. Competencies/Business Awareness

5.1   The candidate will develop skills and competencies related to business fundamentals:

    a.   Analyze and comprehends organizational goals and strategies;
    b.   Understand business fundamentals within an organization's environment and incorporate them into decision-making.
    c.   Understand how the work of own division or group fits within the broader organizational context.

5.2   The candidate will apply knowledge of the industry, market and business trends to prioritize activities:

    a.   Evaluate the effect of other industries on the actuarial profession and financial services industry.

5.3   The candidate will apply knowledge of globalization, world politics, and their effect.

5.4   The candidate will be able to identify the issues and challenges faced by each practice area of the actuarial profession.

CBA6. Strategic Thinking

The candidate will be able to do the following:

6.1   Explain strategy and how it relates to competitive advantage and competitive positioning.

6.2   Outline the process for strategic decision-making.

6.3   Evaluate the effect of company structure on decision-making.

6.4   Define the effect of political, legislative, economic, societal, and technological trends on business strategy.

6.5   Understand a company's mission.

6.6   Explain company culture.

6.7   Understand the importance of team building in a business environment.

6.8   Understand effective time management strategies and how to integrate them into the everyday work environment.

6.9   Outline interaction of company functions—finance, human resources (HR), marketing, research and development (R&D), product development, and operations.

6.10   Use effective communications to resolve business issues and inform of decisions.

6.11   Understand business competition and its effect on the market.

6.12   Be able to extract relevant information from large volumes of data.

6.13   Apply a decision-making process to a particular case study.

CBA7. Legal and Regulatory Environment/Framework

The candidate will be able to outline the following concepts of regulation and governance:

7.1   Liability for professional negligence;

7.2   Award for damages;

7.3   Trust and duties of trustees;

7.4   Fiduciary responsibilities;

7.5   Concept of agency and types of authority for an agent;

7.6   Separate legal entity and limit on liability;

7.7   Corporation, partnership, foundation, and society.

ETHICS AND PROFESSIONALISM

EP1. Ethics

The candidate will be able to do the following:

1.1   Understand ethics concepts from the CIA Guiding Principles.

1.2   Use and apply the CIA Rules of Professional Conduct.

1.3   Understand the CIA Discipline Process.

1.4   Apply the ethical decision-making framework as per Diane Girard, revised 2015.

1.5   Explain the distinguishing features of a profession.