



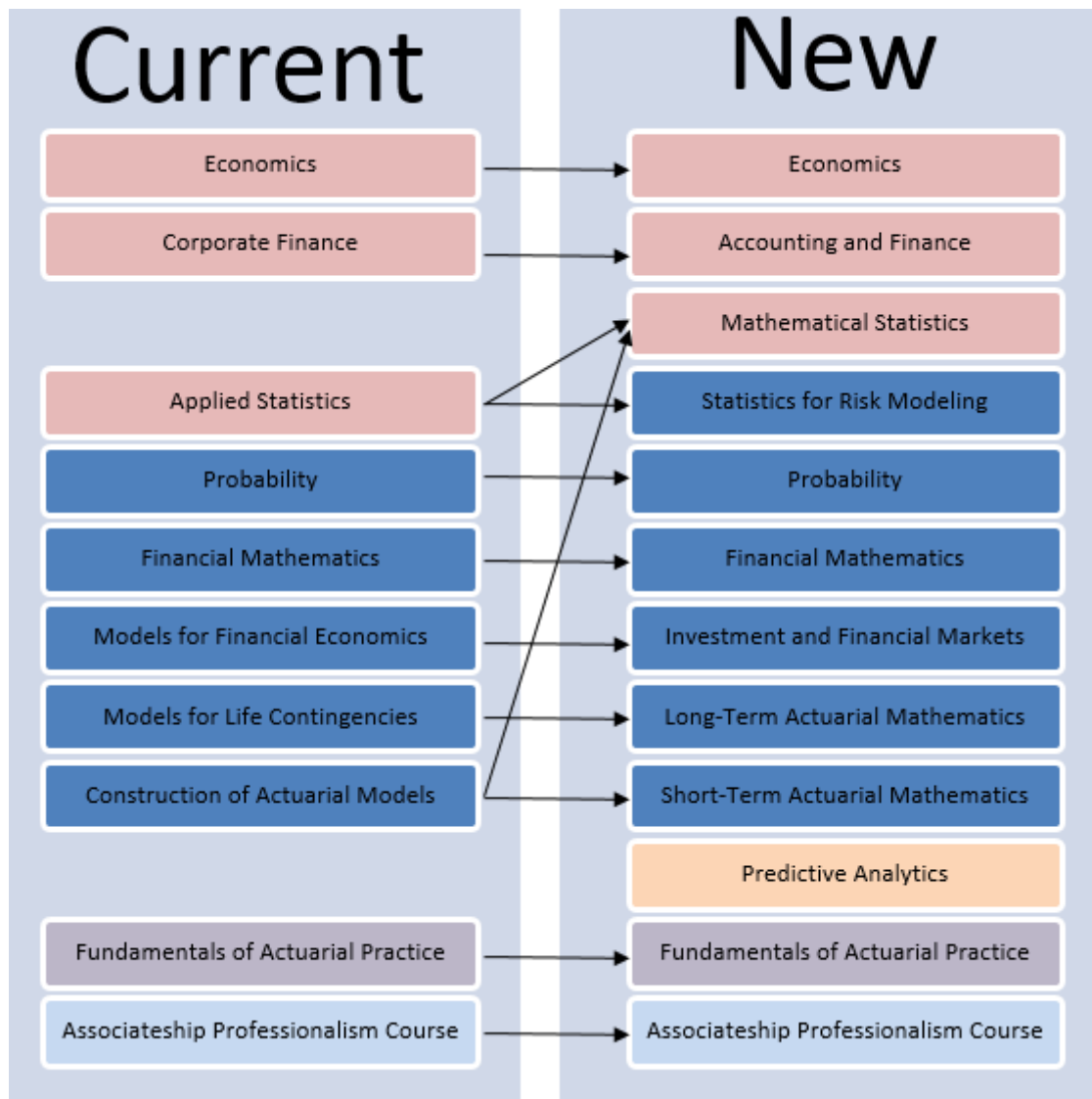
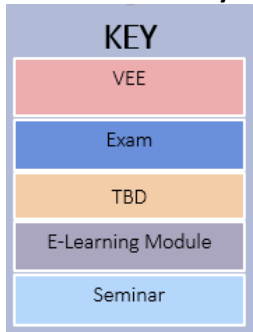
LEARNING OBJECTIVES FOR ASA COMPONENTS EFFECTIVE JULY 1, 2018

Updated January 18, 2017

The following pages contain learning objectives for the ASA components that will be required effective July 1, 2018. The following should be noted about these components.

- The VEE requirements are final. Applications for course approval will be accepted starting February 1, 2017. Information will be provided on the VEE web pages regarding the application process and timing.
- It is possible minor adjustments will be made to these learning objectives. An exam syllabus is not considered official until it is posted on the dedicated web page for that examination.
- Prior to July 1, 2018 the supporting readings for the examinations will be identified along with other important information such as length of exam. These will be made available as each is ready rather than waiting for all components to be finalized.

New ASA Pathway at a glance, with transition rules



VEE–Accounting and Finance

While this material may be entirely covered in a course or courses that cover both topics, it is more likely that separate courses will be used for accounting and for finance. If distinct courses are used, the application should indicate which are for the accounting topic and which are for the finance topic. The typical finance program covers the topics below in one semester with an introductory course. Should the topics be split across two semesters or courses, both will be required. Most of the topics listed below should be covered:

Accounting

- Describe the basic principles of personal and corporate taxation and the taxation of investments held by institutions.
- Explain why companies are required to produce annual reports and accounts.
- Explain fundamental accounting concepts and terms, and describe the main sources of accounting regulation.
- Explain the purpose and interactions between the income statement, balance sheet, and cash flow statements.
- 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.
- Explain the basic structure of company and group accounts.
- Explain the purpose of the main components of company accounts and interpret them.
- Construct simple statements of financial position and profit or loss.
- Calculate and interpret financial and accounting ratios.

Finance

- Explain the characteristics of various forms of equity capital from the point of view of the issuer and the investor.
- Explain the characteristics of various forms of long-term debt capital from the point of view of the issuer and the investor.
- Explain the characteristics of various forms of short- and medium-term financing from the point of view of the issuer and the investor.
- Calculate weighted-average cost of capital.
- Explain the main methods of capital budgeting.
- Calculate a project's investment return.

VEE–Economics

Typically, the VEE requirement for economics will be met if a candidate has completed two economics courses, one course covering microeconomics and the other covering macroeconomics. If distinct courses are used, the application should indicate which are for the microeconomics topic and which are for the macroeconomics topic. Most of the topics listed below should be covered:

Microeconomics

- Explain the concept of utility and how rational utility maximizing agencies make consumption choices.
- Explain the elasticity of supply and demand and the effects on a market of the different levels of elasticity.
- Explain the interaction between supply and demand and the way in which equilibrium market prices are achieved.
- Explain various pricing strategies that can be used by firms.
- Explain the core economic concepts involved in choices made by businesses with respect to short-run and long-run investment and production choices.
- Explain competitive markets and how they operate.
- Explain profitability in markets with imperfect competition.

Macroeconomics

- Explain basic macroeconomic measures (e.g., GDP) used to compare the economies of countries.
- Describe the structure of public finances for an industrialized country.
- Explain the effect of fiscal and monetary policy on the economy, including the effect on financial markets.
- Explain the role of international trade, exchange rates and the balance of payments in the economy.
- Explain the effect of savings and consumption rates on the economy.
- 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.
- Describe the function of money in the economy.
- Explain the relationship between money and interest rates.
- Explain how macroeconomic policies affect businesses.

VEE–Mathematical Statistics

Typically, the VEE requirement for mathematical statistics will be covered by a one semester course that follows the probability course used to cover the learning objectives for Exam P. This course should be calculus-based. All of the topics listed below should be covered:

- Explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions.
- Describe the main methods of estimation and the main properties of estimators, and apply them. Methods include matching moments, percentile matching, and maximum likelihood, and properties include bias, variance, mean squared error, consistency, efficiency, and UMVUE.
- Construct confidence intervals for unknown parameters, including the mean, differences of two means, variances, and proportions.
- 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.

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| 1. Topic: General Probability (10-20%) |
| Learning Objectives |
| The Candidate will understand basic probability concepts. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Define set functions, sample space, and events. Define probability as a set function on a collection of events and state the basic axioms of probability.b) Calculate probabilities of mutually exclusive events.c) Calculate probabilities using the addition and multiplication rules.d) Define independence and calculate probability of independent events.e) Calculate probabilities using combinatorics, such as combinations and permutations.f) Define and calculate conditional probabilities.g) State Bayes Theorem and use it to calculate conditional probabilities. |
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| 2. Topic: Univariate Random Variables (35-45%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning discrete and continuous univariate random variables (including binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, gamma, normal, and mixed) and their applications. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Explain and apply the concepts of random variables, probability and probability density functions, cumulative distribution functions.b) Calculate conditional probabilities.c) Explain and calculate expected value, mode, median, percentile, and higher moments.d) Explain and calculate variance, standard deviation, and coefficient of variation.e) Define probability generating functions and moment generating functions and use them to calculate probabilities and moments.f) Determine the sum of independent random variables (Poisson and normal).g) Apply transformations. |

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| 3. Topic: Multivariate Random Variables (35-45%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning multivariate random variables (including the bivariate normal) and their applications. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Explain and perform calculations concerning joint probability and probability density functions and cumulative distribution functions.b) Determine conditional and marginal probability and probability density functions, cumulative distribution functions.c) Calculate moments for joint, conditional, and marginal random variables.d) Explain and apply joint moment generating functions.e) Calculate variance and standard deviation for conditional and marginal probability distributions.f) Calculate joint moments, such as the covariance and the correlation coefficient.g) Determine the distribution of a transformation of jointly distributed random variables. Determine the distribution of order statistics from a set of independent random variables.h) Calculate probabilities and moments for linear combinations of independent random variables.i) State and apply the Central Limit Theorem. |

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| 1. Time Value of Money (10-20%) |
| Learning Objectives |
| The Candidate will understand and be able to perform calculations relating to present value, current value, and accumulated value. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Recognize and define the following terms: interest rate (rate of interest), simple interest, compound interest, accumulation function, future value, current value, present value, net present value, discount factor, discount rate (rate of discount), convertible m-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value.b) Given any three of interest rate, period of time, present value, current value, and future value, calculate the remaining item using simple or compound interest. 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 any of the other items.d) Write the equation of value given a set of cash flows and an interest rate. |
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| 2. Topic: Annuities/cash flows with non-contingent payments (15-20%) |
| Learning Objectives |
| The Candidate will be able to calculate present value, current value, and accumulated value for sequences of non-contingent payments. |
| Learning Outcomes |
| The Candidate will be able to: a) Recognize and define the following terms: annuity-immediate, annuity due, perpetuity, payable m-thly or payable continuously, level payment annuity, arithmetic increasing/decreasing annuity, geometric increasing/decreasing annuity, term of annuity. b) For each of the following types of annuity/cash flows, given sufficient information of immediate or due, present value, future value, current value, interest rate, payment amount, and term of annuity, calculate any remaining item. <ul style="list-style-type: none">• Level annuity, finite term.• Level perpetuity.• Non-level annuities/cash flows.<ul style="list-style-type: none">○ Arithmetic progression, finite term and perpetuity.○ Geometric progression, finite term and perpetuity.○ Other non-level annuities/cash flows. |

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| 3. Topic: Loans (15-20%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning loans and how to perform related calculations. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <p>a) Recognize and define the following terms: principal, interest, term of loan, outstanding balance, final payment (drop payment, balloon payment), amortization.</p> <p>b) Calculate:</p> <ul style="list-style-type: none"> • The missing item, given any four of: term of loan, interest rate, payment amount, payment period, principal. • The outstanding balance at any point in time. • The amount of interest and principal repayment in a given payment. • Similar calculations to the above when refinancing is involved. |

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| 4. Topic: Bonds (15-20%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning bonds, and how to perform related calculations. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <p>a) Recognize and define the following terms: price, book value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon, coupon rate, term of bond, callable/non-callable.</p> <p>b) Given sufficient partial information about the items listed below, calculate any of the remaining items</p> <ul style="list-style-type: none"> • 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. |

5. Topic: General Cash Flows and Portfolios (10-15%)**Learning Objectives**

The Candidate will understand key concepts concerning yield curves, rates of return, and measures of duration and convexity, and how to perform related calculations.

Learning Outcomes

The Candidate will be able to:

- a) Recognize and define the following terms: yield rate/rate of return, dollar-weighted rate of return, time-weighted rate of return, current value, duration (Macaulay and modified), convexity (Macaulay and modified), portfolio, spot rate, forward rate, yield curve, stock price, stock dividend.
- b) Calculate:
 - The dollar-weighted and time-weighted rate of return.
 - The duration and convexity of a set of cash flows.
 - Either Macaulay or modified duration given the other.
 - The approximate change in present value due to a change in interest rate,
 - Using 1st-order linear approximation based on modified duration.
 - Using 1st-order approximation based on Macaulay duration.
 - The price of a stock using the dividend discount model.
 - The present value of a set of cash flows, using a yield curve developed from forward and spot rates.

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| 6. Topic: Immunization (10-15%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning cash flow matching and immunization, and how to perform related calculations. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Recognize and define the following terms: cash flow matching, immunization (including full immunization), Redington immunization. b) Construct an investment portfolio to: <ul style="list-style-type: none"> • Redington immunize a set of liability cash flows. • Fully immunize a set of liability cash flows. • Exactly match a set of liability cash flows. |

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| 7. Topic: Interest Rate Swaps (0-10%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning interest rate swaps, and how to perform related calculations. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) 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. b) Calculate: <ul style="list-style-type: none"> • The swap rate in an interest rate swap, deferred or otherwise, and with either constant or varying notional amount. • The market value of an interest rate swap, deferred or otherwise, and with either constant or varying notional amount. |

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| 8. Topic: Determinants of Interest Rates (0-10%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning the determinants of interest rates, the components of interest, and how to perform related calculations. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Recognize and define the components of interest rates including: real risk-free rate, inflation rate, default risk premium, liquidity premium, and maturity risk premium.b) Identify the real interest and the nominal interest rate in the context of loans with and without inflation protection and calculate the effect of changes in inflation on loans with inflation protection.c) Explain how the components of interest rates apply in various contexts, such as commercial loans, mortgages, credit cards, bonds, and government securities.d) 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.e) Explain the theories of why interest rates differ by term, including liquidity preference (opportunity cost), expectations, preferred habitat, and market segmentation.f) Explain how interest rates differ from one country to another (e.g., U.S. vs. Canada). |

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| 1. Topic: Mean-Variance Portfolio Theory (10-15%) |
| Learning Objectives |
| The Candidate will understand the assumptions of mean-variance portfolio theory and its principal results. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <p>a) Understand the mathematics and summary statistics of portfolios.</p> <ul style="list-style-type: none"> • Estimate the risk and return of an asset, given appropriate inputs. • 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. <p>b) Perform mean-variance analysis.</p> <ul style="list-style-type: none"> • Explain the assumptions of mean-variance theory and understand the importance of the mean-standard deviation diagram and the resulting efficient market frontier. • Calculate the optimal portfolio, locate the capital market line, and describe the limitations of this approach. • Describe how portfolio risk can be reduced through diversification across multiple securities or across multiple asset classes. |
| 2. Topic: Asset Pricing Models (5-10%) |
| Learning Objectives |
| The Candidate will understand different methods for the valuation of asset portfolios and explain their appropriateness in different situations. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <p>a) Understand the Capital Asset Pricing Model (CAPM).</p> <ul style="list-style-type: none"> • Explain the assumptions and properties of the CAPM. • Calculate the required return on a particular asset, a portfolio or a project using the CAPM. <p>b) Understand factor models.</p> <ul style="list-style-type: none"> • Explain the assumptions of a factor model for security returns. • Identify the expected return, factors, factor betas, and firm-specific components of a security from its factor equation. • Calculate the required return on a particular asset, a portfolio or a project using a single-factor and a multi-factor model. |

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| 3. Topic: Market Efficiency and Behavioral Finance (5-10%) |
| Learning Objectives |
| The Candidate will understand the notion of efficient markets and explain why market participants may make irrational systematic errors, leading to market inefficiencies. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Explain the three forms of the efficient market hypothesis (EMH). <ul style="list-style-type: none"> • Explain the concepts of efficient markets, and distinguish between the strong, semi-strong, and weak versions of the EMH. • Identify empirical evidence for or against each form of the EMH. b) Explain the main findings of behavioral finance. <ul style="list-style-type: none"> • Identify empirical examples of market anomalies that show results contrary to the EMH. • Use behavioral finance to demonstrate why asset prices, especially in times of uncertainty and high volatility, may deviate from their fundamental values. |

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| 4. Topic: Investment Risk and Project Analysis (7.5-12.5%) |
| Learning Objectives |
| The Candidate will understand different ways to measure investment risk and conduct project analysis using advanced techniques used in capital budgeting. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Discuss the advantages and disadvantages of different measures of investment risk. <ul style="list-style-type: none"> • Define the following measures of investment risk: variance, semi-variance, Value-at-Risk (VaR) and Tail Value-at-Risk (TVaR). • Explain the advantages and disadvantages of the risk measures listed above. • Calculate the risk measures listed above in order to compare investment opportunities. b) Conduct risk analysis. <ul style="list-style-type: none"> • Understand the following methods to conduct risk analysis: sensitivity analysis, break-even analysis, scenario analysis, and Monte-Carlo simulation. • Use a decision tree to model future outcomes and analyze real options embedded in a project. |

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| 5. Topic: Capital Structure (10-15%) |
| Learning Objectives |
| The Candidate will understand the factors that a company has to consider when deciding its capital structure. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Understand different methods to raise capital.<ul style="list-style-type: none">• Understand the two main forms of financing: equity issues and debt issues.• Describe the process by which a company raises capital including venture capital, IPOs, additional issues, and private placement.b) Describe the effect of capital structure on a company.<ul style="list-style-type: none">• 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.• Describe the effect of corporate tax and costs of financial distress, including the threat of bankruptcy, on the capital structure of a company.• Explain the role of agency costs and asymmetric information in affecting a company's pecking order of financing choices. |

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| 6. Topic: Introductory Derivatives – Forwards and Futures (5-10%) |
| Learning Objectives |
| The Candidate will understand how forward contracts and futures contracts can be used in conjunction with the underlying asset in a risk management context. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Describe the characteristics and terms of the main derivatives instruments (including forwards and futures).<ul style="list-style-type: none">• Distinguish between long and short positions for both assets (including short selling of stocks) and derivatives on assets.• Recognize the transaction costs affecting profit calculations for both assets and derivatives on assets (including commissions and bid-ask spread).b) Describe the characteristics and terms relating to both forward contracts and prepaid forward contracts.<ul style="list-style-type: none">• Recognize the definitions of the following terms relating to both forward contracts and prepaid forward contracts.• Determine payoffs and profits for both long and short positions on forward contracts.• Calculate prices for both forward contracts and prepaid forward contracts on stocks with no dividends, continuous dividends, and discrete dividends.c) Describe the characteristics and terms relating to both futures contracts and the associated margin accounts.<ul style="list-style-type: none">• Recognize the definitions of the following terms: Marking to market, margin balance, maintenance margin, and margin call.• Evaluate an investor’s margin balance based on changes in asset values. |

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| 7. Topic: General Properties of Options (10-15%) |
| Learning Objectives |
| The Candidate will understand how call options and put options can be used in conjunction with the underlying asset in a risk management context. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Explain the cash flow characteristics and terms relating to various options.<ul style="list-style-type: none">• Define and recognize the following terms: call and put options, expiration date, strike price, moneyness, and option style.• Calculate the payoff and profit on both long and short positions with respect to both call and put options.• Explain the cash flow characteristics of exotic options: Asian (arithmetic and geometric), barrier, compound, gap, exchange, and lookback.b) Apply option strategies in a risk management context.<ul style="list-style-type: none">• 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.• 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.• Evaluate the payoff and profit of the option strategies described above.c) Understand the general properties of options that affect option prices.<ul style="list-style-type: none">• Apply put-call parity to European options on stocks with no dividends, continuous dividends, and discrete dividends.• Compare options with respect to term-to-maturity and strike price.• Identify factors affecting the early exercise of American options and the situations where the values of European and American options are the same. |

8. Topic: Binomial Option Pricing Models (7.5-12.5%)

Learning Objectives

The Candidate will understand how binomial trees can be used to approximate the prices of both European and American call and put options on various underlying assets.

Learning Outcomes

The Candidate will be able to:

- a) Understand the concept of no arbitrage and the risk-neutral approach to valuing derivatives securities.
 - Explain the concept of no arbitrage when comparing actual and synthetic calls, or when comparing actual and synthetic puts.
 - Explain the concepts underlying the risk-neutral approach to valuing derivatives securities in the context of the Binomial Option Pricing Model.
- b) Use the Binomial Option Pricing Model to calculate the value of call and put options.
 - Price options under a one-period binomial model on a stock with no dividends.
 - 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.
 - Extend the binomial model to other underlying assets, including stock indices with continuous dividends, stocks with discrete dividends, currencies, and futures contracts..

9. Topic: Black-Scholes Option Pricing Model (7.5-12.5%)

Learning Objectives

The Candidate will understand how the Black-Scholes Formula can be used to form the prices of European call and put options on various underlying assets.

Learning Outcomes

The Candidate will be able to:

- a) Explain the properties of the lognormal distribution and its applicability to option pricing.
 - Calculate lognormal-based probabilities and percentiles for stock prices.
 - Calculate lognormal-based means and variances of stock prices.
 - Calculate lognormal-based conditional expectations of stock prices given that options expire in-the-money.
- b) Understand the Black-Scholes Formula.
 - Recognize the assumptions underlying the Black-Scholes model.
 - 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.
 - Generalize the Black-Scholes Formula to value exchange options and gap calls/puts.
 - Estimate a stock's historical volatility from past stock price data.

10. Topic: Option Greeks and Risk Management (7.5-12.5%)

Learning Objectives

The Candidate will understand the importance of Option Greeks in forming hedged asset portfolios that include positions in both options and the underlying asset.

Learning Outcomes

The Candidate will be able to:

- a) Explain the calculation and use of option price partial derivatives.
 - Compute and interpret Option Greeks, including Delta, Gamma, Theta, Vega, Rho, and Psi.
 - 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.
 - Approximate option prices using Delta, Gamma, and Theta.
- b) Explain how to control risk by using options in a hedging context.
 - 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.
 - 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.

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| 1. Topic: Long-term insurance coverages (2-8%) |
| Learning Objectives |
| The Candidate will understand the key features of long-term insurance coverages. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Describe the long-term coverages in insurance (life, health, and general), annuities, and retirement benefits (e.g. pensions, retiree health care, etc.)b) Describe the similarities and differences between the long-term coverages identified in Learning Outcome 1a.c) Describe the appropriate models to be used to calculate expected present values, premiums or contributions, and reserves for each long-term coverage. |

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| <p>2. Topic: Survival models and their estimation (15-25%)</p> |
| <p>Learning Objectives</p> |
| <p>The Candidate will understand key concepts concerning parametric and non-parametric (tabular) and multi-state models including single life, or multiple life, and multiple decrements.</p> |
| <p>Learning Outcomes</p> |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Explain and interpret survival models and transitioning between states. b) Calculate and interpret standard functions including survival and mortality probabilities, force of mortality, and complete and curtate expectation of life. c) Calculate nonparametric estimates of survival models using the Kaplan-Meier and Nelson-Aalen formulas for seriatim data and adaptations for grouped data. d) Calculate, using both seriatim and grouped data, maximum likelihood estimates of transition probabilities assuming constant transition intensity during fixed age intervals. e) Calculate the variances of and construct confidence intervals for the estimators in parts c) and d). f) Calculate transition intensities exactly, or estimate transition intensities using large sample approximations. g) Describe and apply simple longevity models. h) 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. i) Construct and interpret select and ultimate survival models. j) 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. k) Apply to calculations involving these models appropriate approximation methods for fractional ages based on uniform distribution of deaths or constant force. |

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| 3. Topic: Present Value Random Variables (10-20%) |
| Learning Objectives |
| 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 2. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Calculate and interpret probabilities, means, variances, and percentiles. b) Calculate and interpret the effect of changes in underlying assumptions such as mortality and interest. c) Apply appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler. |

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| 4. Topic: Premium Calculation (15-30%) |
| Learning Objectives |
| The Candidate will be able to use and explain premium-calculation methodologies. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Calculate and interpret probabilities, means, variances, and percentiles of random variables associated with a premium, including loss-at-issue random variables. b) Calculate premiums based on the equivalence principle, the portfolio percentile premium principle, and profit testing. c) Using the models in Learning Objective 2, calculate and interpret the effect of changes in benefits or underlying assumptions such as decrements, morbidity, expenses, and interest. d) Apply appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler. |

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| 5. Topic: Reserves (20-30%) |
| Learning Objectives |
| The Candidate will understand reserves for insurances and annuities for models in Learning Objectives 2 and 4. |
| Learning Outcomes |
| The Candidate will be able to: a) Calculate and interpret the following reserve types: <ul style="list-style-type: none">• 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. |

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| <p>6. Topic: Pension Plans and Retirement Benefits (10-15%)</p> |
| <p>Learning Objectives</p> |
| <p>The Candidate will understand how the models from previous Learning Objectives apply to pension plans and retirement benefits.</p> |
| <p>Learning Outcomes</p> |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Describe and compare defined contribution and defined benefit 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 learning outcome 6c 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 a defined benefit plan under the projected unit credit (PUC) cost method and the traditional unit credit (TUC) cost method. 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 learning outcomes 6d, 6e, and 6f. h) Apply appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler. |

Sections 1-5 have a combined weight of 20-30%

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| 1. Topic: Severity Models |
| Learning Objectives |
| The Candidate will understand and be able to perform calculations with commonly used severity models. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Calculate moments, percentiles, and generating functions.b) Describe how changes in the parameters affect the distribution.c) Recognize classes of distributions, including extreme value distributions, and their relationships.d) Create new distributions by multiplication by a constant, raising to a power, exponentiation, and mixing.e) Identify the applications to which each distribution may apply and explain why.f) Apply the distribution to an application, given the parameters.g) 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. |

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| 2. Topic: Frequency Models |
| Learning Objectives |
| The Candidate will understand and be able to perform calculations with commonly used frequency models. |
| Learning Outcomes |
| <p>The Candidate will be able to, for the Poisson, mixed Poisson, binomial, negative binomial, and geometric distributions, and mixtures thereof:</p> <ul style="list-style-type: none"> a) Calculate moments and generating functions. b) Describe how changes in the parameters affect the distribution. c) Recognize classes of distributions and their relationships. d) Identify the applications to which each distribution may apply and explain why. e) Apply the distribution to an application, given the parameters. f) Derive and perform calculations with the zero-truncated and zero-modified versions of these distributions. |

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| 3. Topic: Aggregate Models |
| Learning Objectives |
| The Candidate will understand and be able to perform calculations with aggregate models. |
| Learning Outcomes |
| <p>The Candidate will be able to, for aggregate risk models:</p> <ul style="list-style-type: none"> a) Define collective and individual risk models and calculate their expectation and variance. b) Use the normal distribution to approximate the aggregate distribution. c) Use the recursive formula to calculate the values of the collective risk models with discrete distributions of severities. d) Calculate the expected aggregate payments in the presence of an aggregate deductible. e) Evaluate the effect of the coverage modifications on the expected aggregate payments. f) Perform the exact calculation of aggregate loss distribution in case of the normal distribution of severities, exponential and gamma (Erlang) distribution of severities and a compound model with negative binomial frequency and exponential distribution of severities. |

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| 4. Topic: Coverage Modifications |
| Learning Objectives |
| The Candidate will understand and be able to perform calculations with respect to coverage modifications. |
| Learning Outcomes |
| The Candidate will be able to, for frequency, severity, and aggregate models: <ul style="list-style-type: none">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. |

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| 5. Topic: Risk Measures |
| Learning Objectives |
| The Candidate will understand and be able to perform calculations with common risk measures. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Calculate Value at Risk and Tail Value at Risk.b) Explain the desirable properties of a risk measure and determine whether a given risk measure has these properties. |

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| 6. Topic: Construction and Selection of Parametric Models (20-30%) |
| Learning Objectives |
| The Candidate will understand and be able to construct and estimate parameters for parametric models. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ol style="list-style-type: none"> a) Estimate the parameters for severity, frequency, and aggregate distributions using Maximum Likelihood Estimation for: <ul style="list-style-type: none"> • Complete, individual data • Complete, grouped data • Truncated or censored data b) Estimate the variance of the estimators and construct confidence intervals. c) Use the delta method to estimate the variance of the maximum likelihood estimator of a function of the parameter(s). d) Estimate the parameters for severity, frequency, and aggregate distributions using Bayesian Estimation. e) Perform model selection using: <ul style="list-style-type: none"> • Hypothesis tests, including Chi-square goodness-of-fit and Likelihood ratio test (LRT). • Score-based approaches, including Schwarz Bayesian Criterion (SBC) / Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC). |

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| 7. Topic: Credibility (20-30%) |
| Learning Objectives |
| The Candidate will understand and be able to estimate losses using credibility procedures. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Apply and critique limited fluctuation (classical) credibility. b) Explain and apply Bayesian credibility. c) Apply conjugate priors in Bayesian credibility. d) Apply Buhlmann and Buhlmann-Straub models and understand their relationship to Bayesian models. e) Explain and apply empirical Bayesian method in the nonparametric and semiparametric cases. |

Topics 8-9 have a combined weight of 20-30%

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| 8. Topic: Insurance and Reinsurance Coverages |
| Learning Objectives |
| The Candidate will understand the basic insurance and reinsurance coverages for short-term insurances. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ul style="list-style-type: none"> a) Describe different types of short-term insurance coverage including homeowners, liability, health, disability, and dental. b) Describe the types of policy limits and coverage modifications for short-term insurance. c) Describe the operation of basic forms of proportional and excess of loss reinsurance. d) Derive the distribution of claim amounts paid by the insurer and reinsurer under various forms of reinsurance. |

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| 9. Topic: Pricing and Reserving for Short-Term Insurance Coverages |
| Learning Objectives |
| The Candidate will be able to use basic methods to calculate premiums and reserves for short-term insurance coverages. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Explain the role of rating factors and exposure.b) Describe the different forms of experience rating.c) Describe and apply techniques for estimating unpaid losses from a run-off triangle, using the following methods:<ul style="list-style-type: none">• Chain ladder• Average cost per claim• Bornhuetter Fergusond) Describe the underlying statistical models for the methods in (c).e) Calculate premiums using the pure premium and loss ratio methods. |

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| 1. Topic: Basics of Statistical Learning (7.5-12.5%) |
| Learning Objectives |
| The Candidate will understand key concepts of statistical learning and the R programming language. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ol style="list-style-type: none"> Explain the types of modeling problems and methods, including supervised versus unsupervised learning and regression versus classification. Explain the common methods of assessing model accuracy. Explain models in R and access and interpret output, including diagnostics. Employ basic methods of exploratory data analysis, including data checking and validation. |
| 2. Topic: Linear Models (40-50%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning the construction of generalized linear models. |
| Learning Outcomes |
| <p>The Candidate will be able to:</p> <ol style="list-style-type: none"> Describe and explain the components of, in particular, the exponential family of distributions and link functions. Describe and understand the differences between least squares and maximum likelihood parameter estimation. Interpret diagnostic tests of model fit and assumption checking, both graphical and quantitative. Select an appropriate model, including: <ul style="list-style-type: none"> Select distribution and link function. Select variables, considering transformations and interactions. Interpret model results with emphasis on using the model to answer the underlying business question. Interpret predicted values and confidence and prediction intervals. Understand how approaches may differ compared to using an ordinary least squares model. Explain uses of linear models. |

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| 3. Topic: Time Series Models (12.5-17.5%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning regression-based time series models. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">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. |

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| 4. Topic: Principal Components Analysis (2.5-7.5%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning principal components analysis. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Define principal components.b) Interpret the results of a principal components analysis.c) Explain uses of principal components. |

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| 5. Topic: Decision Trees (10-15%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning decision tree models. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Explain the purpose and uses of decision trees.b) Explain and interpret decision trees.c) Explain and interpret bagging, boosting, and random forests.d) Explain and interpret classification trees.e) Compare decision trees to linear models.f) Interpret the results of a decision tree analysis. |

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| 6. Topic: Cluster Analysis (10-15%) |
| Learning Objectives |
| The Candidate will understand key concepts concerning cluster analysis. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Explain the uses of clustering.b) Explain <i>K</i>-means clustering.c) Explain hierarchical clustering.d) Explain methods for deciding the number of clusters.e) Interpret the results of a clustering analysis. |

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| 1. Model Building Process (10-20%) |
| Learning Objectives |
| The Candidate will understand key steps and considerations in building a predictive analytics model. |
| Learning Outcomes |
| The Candidate will be able to: a) Understand issues and remedies with regard to data collection and validation. b) Explain the basic steps in the model building process: <ul style="list-style-type: none">• Problem definition and exploratory data analysis.• Model selection.• Model validation.• Monitoring. c) Understand ethical and professional considerations with regard to data and modeling. |

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| 2. Topic: Problem Definition, Exploratory Data Analysis, and Initial Model Selection (15-25%) |
| Learning Objectives |
| The Candidate will be able to identify the business problem, how the available data relates to possible analyses, and use the information to propose models. |
| Learning Outcomes |
| 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. |

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| 3. Topic: Model Selection (20-30%) |
| Learning Objectives |
| The Candidate will be able to select a model that addresses the business problem. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Explain why a given model is or is not appropriate for addressing the given business problem.b) Use a training data set to select appropriate model components.c) Use a training data set to estimate model parameters.d) Confirm that the assumptions of the selected model hold (or indicate where they are violated). |

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| 4. Topic: Model Validation (15-25%) |
| Learning Objectives |
| The Candidate will be able to provide evidence that the selected model is valid for its intended purposes. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Conduct and interpret sensitivity, stress, and scenario tests.b) Perform diagnostic tests of model fit and assumption checking, both graphical and quantitative.c) Construct and interpret graphical evidence such as gain and lift curves.d) Use holdout data to validate a model. |

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| 5. Topic: Communication of Results and Uncertainties (15-25%) |
| Learning Objectives |
| The Candidate will be able to effectively communicate results of an analysis and any limitations and uncertainties. |
| Learning Outcomes |
| The Candidate will be able to: <ul style="list-style-type: none">a) Tailor communication to the intended audience.b) Communicate model limitations.c) Estimate and understand uncertainties in parameter estimates and predicted values directly and through simulation.d) Effectively communicate data issues and proposed solutions.e) Effectively use graphs and charts.f) Explain the business problem and how the analysis addresses that problem. |