Quantitative Finance and Investment – Core Exam
Fall 2013

Important Exam Information:

Exam Date and Time	A read-through time will be given prior to the start of the exam–15 minutes in the morning session and 15 minutes in the afternoon session.
Exam Registration	Candidates may register online or with an application.
Order Study Notes	Study notes are part of the required syllabus and are not available electronically but may be purchased through the online store.
Introductory Study Note	The Introductory Study Note has a complete listing of all study notes as well as errata and other important information.
Case Study	There is no case study for this examination.
Formula Package	A Formula Package will be provided with the exam. Please see the Introductory Study Note for more information.
Table	A cumulative normal distribution table will be provided with the exam.
Past Exams	Past Exams from 2000-present are available on SOA website.
Updates	Candidates should be sure to check the Updates page on the exam home page periodically for additional corrections or notices.

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1. **Topic: Mathematics, Statistics and Stochastic Calculus**

Learning Objectives

The candidate will understand the fundamentals of mathematics and economics underlying quantitative methods in finance and investments.

Learning Outcomes

The Candidate will be able to:

a) Understand and apply concepts of probability and statistics important in mathematical finance

b) Understand the importance of the no-arbitrage condition in asset pricing

c) Apply the concept of martingale in asset pricing

d) Understand Ito integral and stochastic differential equations

e) Understand and apply Ito's Lemma

f) Understand and apply Jensen's Inequality

g) Demonstrate an understanding of the mathematical considerations for analyzing financial time series

h) Understand and apply various techniques for analyzing linear time series

Resources

- *An Introduction to the Mathematics of Financial Derivatives,* Neftci, Salih, 2nd Edition
  - Ch. 1-11
- *Solutions Manual for An Introduction to the Mathematics of Financial Derivatives,* Neftci, Salih, 2nd Edition
  - Corresponding material to Ch. 1-11
- *Frequently Asked Questions* in *Quantitative Finance*, Wilmott, Paul, 2nd Edition
  - Ch 2: Q23 (p. 103-105)
  - Ch 6: The Most Popular Probability Distributions and Their Uses in Finance
- QFIC-100-13: Ch. 1 and 2 of *Analysis of Financial Time Series,* Tsay, 3rd Edition

2. **Topic: Option Pricing Theory**

Learning Objectives

- The candidate will understand how to apply the fundamental theory underlying the standard models for pricing financial derivatives
- The candidate will understand the implications for option pricing when markets do not satisfy the common assumptions used in option pricing theory such as market completeness, bounded variation, perfect liquidity, etc.

Learning Outcomes

The Candidate will be able to:

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

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

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

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

e) Understand and apply Girsanov's theorem in changing measures.

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

g) Identify limitations of the Black-Scholes pricing formula.

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

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

j) Demonstrate understanding of interest rate models.

k) Understand the concept of calibration and describe the issues related to calibration.

l) Understand the HJM model and the HJM no-arbitrage condition.

m) Understand BGM/Libor Market model.

Resources

- *An Introduction to the Mathematics of Financial Derivatives,* Neftci, Salih, 2nd Edition.
  - Ch. 6, 10, 12-19
- *Solutions Manual for: An Introduction to the Mathematics of Financial Derivatives,* Neftci, Salih, 2nd Edition
  - Corresponding material to Ch. 6, 10, 12-19
- *Quantitative Finance,* Wilmott, Paul, 2nd Edition
  - Ch. 6, 16-19

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- Wilmott, Paul, *Frequently Asked Questions* in *Quantitative Finance*, 2nd Edition
    - Ch. 2: Q25 (p. 109-112), Q26 (p. 113-115), Q36 (p. 155-159), Q37 (p. 160-161) & Q60 (p. 248-249)
- QFIC-101-13: Chapter 24 of *Quantitative Financial Economics*, 2nd Edition
- QFIC-102-13: Current Issues: Options - What Does An Option Pricing Model Tell Us About Option Prices?
- QFIC-103-13: How to Use the Holes in Black-Scholes
- QFIC-104-13: Chapter 3 of *The Known, the Unknown, and the Unknowable in Financial Risk Management: Measurement and Theory Advancing Practice*

3. **Topic: Derivatives and Hedging**

Learning Objectives

The candidate will understand how to evaluate situations associated with derivatives and hedging activities.

Learning Outcomes

The Candidate will be able to:

a) Compare and contrast the various kinds of volatility, (eg actual, realized, implied, forward, etc)

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

c) Understand the different approaches to hedging.

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

e) Appreciate how hedge strategies may go awry.

Resources

- *Quantitative Finance,* Wilmott, Paul, 2nd Edition
  - Ch. 8-10, 26
- *Frequently Asked Questions* in *Quantitative Finance*, Wilmott, Paul, 2nd Edition
  - Ch 2: Q38 & Q59
- QFIC-105-13: Section IX of Carr, Peter, *FAQ's in Option Pricing Theory* – "Which volatility should one hedge at - historical or implied?" (pp. 26-28)

4. **Topic: Fixed Income**

Learning Objectives

The candidate will understand and identify the variety of fixed instruments available for portfolio management.

This section deals with fixed income securities. As the name implies the cash flow is often predictable, however there are various risks that affect cash flows of these instruments. In general candidates should be able to identify the cash flow pattern and the factors affecting cash flow for commonly available fixed income securities. Candidates should also be comfortable using various interest rate risk quantification measures in the valuation and managing of investment portfolios.

Learning Outcomes

The Candidate will be able to:

a) Explain the cash flow characteristics and pricing of Treasury securities.

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

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

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

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

f) Evaluate different private money market instruments.

g) Demonstrate understanding of cash flow pattern and underlying drivers and risks of mortgage-backed securities and collateralized mortgage obligations.

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

   a. Managing funds against a target return

   b. Managing funds against liabilities

Resources

- *The Handbook of Fixed Income Securities,* Fabozzi, Frank, 8th Edition
  - Ch. 1-2 (background only), 9-12, 16-18, 21, 24-26
- *Managing Investment Portfolios: A Dynamic Process*, Maginn & Tuttle, 3rd Edition
  - Ch. 6, Fixed Income Portfolio Management
- *Quantitative Finance,* Wilmott, Paul, 2nd Edition
  - Ch. 14

5. **Topic: Equities**

Learning Objectives

The candidate will understand the variety of equity investments and strategies available for portfolio management.

Learning Outcomes

The Candidate will be able to:

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

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

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

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

e) Identify methods for establishing passive exposure to an equity market;

f) Compare techniques for characterizing investment style of an investor ;

g) Recommend and justify, in a risk–return framework, the optimal portfolio allocations to a group of investment managers;

h) Describe the core-satellite approach to portfolio construction with a completeness fund to control overall risk exposures;

i) Explain alpha and beta separation as an approach to active management and demonstrate the use of portable alpha;

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

Resources

- *Managing Investment Portfolios: A Dynamic Process*, Maginn & Tuttle, 3rd Edition
    - Ch. 7 Equity Portfolio Management

6. **Topic: Investment Policy**

Learning Objectives

The candidate will understand how to develop an investment policy including governance for institutional investors and financial intermediaries.

Learning Outcomes

The Candidate will be able to:

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

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

c) 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.

d) 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.

Resources

- *Managing Investment Portfolios: A Dynamic Process*, Maginn & Tuttle, 3rd Edition
  - Ch. 1 & 3
- QFIC-106-13: Chapter 10 of *Modern Investment Management: An Equilibrium Approach*
- QFIC-108-13: Managing your Advisor: A Guide to Getting the Most Out of the Portfolio Management Process
- QFIC-107-13: Revisiting the Role of Insurance Company ALM within a Risk Management Framework

7. **Topic: Asset Allocation**

Learning Objectives

The candidate will understand the theory and techniques of portfolio asset allocation.

Learning Outcomes

The Candidate will be able to:

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

b) Propose and critique asset allocation strategies.

c) Evaluate the significance of liabilities in the allocation of assets.

d) Incorporate risk management principles in investment policy and strategy, including asset allocation

Resources

- Maginn & Tuttle, *Managing Investment Portfolios: A Dynamic Process*, 3rd Edition
    - Ch. 5
- QFIC-106-13: Chapter 10 of *Modern Investment Management: An Equilibrium Approach*
- QFIC-107-13: Revisiting the Role of Insurance Company ALM within a Risk Management Framework