Financial Modeling Module

SECTION 1: MODULE OVERVIEW

Introduction

Following the decision to enhance the pathway to CERA, the SOA has restructured the FSA-level examination system and introduced a revised Investment track, now called Quantitative Finance and Investments (QFI). Within this track, many of the topics will be similar to those that have previously made up the Investment track, but they will be explored at a more technical and quantitative level.

The SOA has first introduced the basics of financial mathematics and financial modeling in the Models for Financial Economics (MFE) Exam, which is part of the ASA requirements. For that exam, candidates devote a significant portion of their time to valuation of securities and only a small portion to models and simulation.

This Financial Modeling module, which currently supports the QFI track and is recommended to be taken first within the track, seeks to expand the knowledge first learned in the MFE course in both theoretical and practical aspects. In addition, in a quest to prepare candidates for the real world, this module will introduce a hands-on experience operating with financial models as it explains the modeling aspects of an annuity product and asks you to follow along. The module will then explore the model and interpret the results.

Module Objectives

After you complete this module, you will be able to:

- Identify options embedded in financial products and the risks they pose.
- Describe derivative types and demonstrate the use of derivatives in risk management.
- Describe basic risk mitigation methods.
- Apply the techniques of Monte Carlo simulation as it applies to financial risk models and option pricing.
- Identify and explain modeling products and their inherent risks.
- Analyze the outcomes of various events and situations affecting an insurance product.

Module Sections

This module consists of six sections:

- Section 1: Module Overview (you are here now).
- Section 2: Options Embedded in Financial Products.
- Section 3: Risks Inherent in Financial Products.
- Section 4: Derivatives.
- Section 5: Derivative Pricing—Theories and Models.
- Section 6: Range of Outcomes—Projecting Results with Hedging.

In addition, this module includes an end-of-module test and a series of exercises.

SECTION 2: OPTIONS EMBEDDED IN FINANCIAL PRODUCTS

Introduction and Objectives

You learned a lot about financial products from the Fundamentals of Actuarial Practice (FAP) e-Learning course. FAP encompasses real-world applications and uses examples to demonstrate actuarial principles and practices. Throughout the remainder of the Financial Modeling module, we will use a similar approach.

Guarantees and embedded options are common in financial products. The term "embedded option" comes from the finance literature. The term refers to an option that is part of, and inseparable from, a contract or financial instrument. The fact that the option is "embedded" in the instrument differentiates the option from a "stand-alone" option that can be purchased on an exchange or traded in the over-the-counter market.

For example, many bond issues include a provision in the indenture that gives the issuer and/or the bondholder an option to take some action against the other party, such as granting the issuer the option to call the bond at some point in the future at a pre-determined price, or giving the bondholder the option to convert the bond at some point in the future to equity at a pre-determined conversion ratio.

Upon completion of this section, you will be able to:

- Describe various financial products that offer guarantees and/or embedded options.
- Identify the guarantee(s) and/or embedded option(s) in a financial product.
- Describe cash flow characteristics of an embedded option.

SECTION 3: RISKS INHERENT IN FINANCIAL PRODUCTS

Introduction and Objectives

As insurance companies offer guarantees and/or embedded options to gain certain competitive advantages, for example to lure customers with additional certainty or better tax treatment, it comes with a cost: risk.

Section 3 introduces risks incurred while offering a product with a guarantee and/or an embedded option. Available risk mitigation strategies that are frequently used are introduced afterward, with their effectiveness (pros and cons) also analyzed.

After completing Section 3, you will be able to:

- Identify risks that accompany the guarantees and embedded options of financial products.
- Describe the underlying drivers for the risks.
- Identify different risk mitigation methods.

SECTION 4: DERIVATIVES

Introduction and Objectives

In the Financial Mathematics Exam (Exam FM), you developed an understanding of the fundamental concept of financial derivatives, including the basics of options, forwards and futures, swaps, hedging strategies, and implications for actuaries.

The rapid innovation and use of financial derivatives in the last few decades has transformed the world of finance and capital markets. A more in-depth understanding of derivatives market is becoming increasingly important for actuaries across all disciplines — life, health, pension, property and casualty, and many non-traditional fields.

In this section, we will revisit financial derivatives and their applications in actuarial work.

Upon completion of Section 4, you will be able to:

- Describe the basics of the derivatives market.
- Define the basic types of equity and interest derivatives.
- Calculate the payoff and profile for different derivatives.
- Describe and apply insurance strategies using derivatives.
- Demonstrate the use of derivatives in risk management.
- Identify and apply different derivative strategies for insurance products.

SECTION 5: DERIVATIVES PRICING – THEORIES AND MODELS

Introduction and Objectives

In the previous section, you have learned about basic derivatives and their application to insurance companies and pension funds. In this section, we will cover the theoretical underpinning and modeling for derivatives pricing.

You will first learn the concept of arbitrage-free pricing, which forms the foundation of valuation within modern finance. Next, we will review the pricing functions for forwards and options, both of which have important applications for actuaries.

We will review the effect of various market inputs on option prices and hedging cost, which have an important role for delta hedging and variable annuity risk management. Finally, we will look at a few basic interest rate models.

Upon completion of Section 5, you will be able to:

- Apply the arbitrage-free theorem and lattice models to evaluate basic options.
- Explain the basics of forward and option pricing.
- Describe the option Greeks.
- Apply the concept of delta hedging.
- Distinguish risk-neutral vs. real-world pricing.
- Apply Monte Carlo simulation to calculate option prices.

SECTION 6: RANGE OF OUTCOMES – PROJECTING RESULTS WITH HEDGING

Introduction and Objectives

In the previous sections you examined pricing using Monte Carlo scenarios with risk-neutral assumptions. You also examined different ways to hedge and how to figure out the hedge targets primarily using Monte Carlo scenarios with risk-neutral assumptions.

In this section, you will be given a chance to simulate the way in which a hedging program would work in reality. The key model of this section allows you to look at a set of real-world scenarios in which we simulate both the insurance liability and a dynamic hedging program. You will also explore the financial implications of how the hedging program will be affected if some of the assumptions used to set hedge targets are not borne out in the real-world scenarios.

After completing this section, you will be able to:

- Explain the value of hedging.
- Describe the connection between pricing and hedging.
- Explain the impact of hedging not working perfectly.
- Identify additional model and market-related pitfalls.

END-OF-MODULE TEST

END-OF-MODULE EXERCISE