

# Fundamentals of Actuarial Practice

MODULES 1-8: Module Objectives

# **Fundamentals of Actuarial Practice**

## **Module 1: Introduction/Role of the Professional Actuary**

### ***FAP Introduction: Course Overview***

#### ***Description:***

FAP encompasses real-world applications and uses examples to demonstrate actuarial principles and practices. Practical techniques are presented to assist in your day-to-day work. You will also have opportunities to apply these principles and techniques in traditional and non-traditional actuarial practice areas. With the fundamentals in your toolkit, you will be better prepared to apply your learning to new areas of practice that may emerge during the course of your actuarial career.

FAP design and delivery supports your learning by:

- Introducing you to financial security systems, common actuarial techniques and practical experiences.
- Describing actuarial practices, principles, approaches, methods, commonalities, problems and solutions.
- Explaining actuarial practices across the traditional areas of practice—life insurance, property and casualty insurance, health insurance and retirement benefits.
- Explaining actuarial practices as applied directly on behalf of financial security system providers or as a consultant to those providers.
- Preparing you to apply actuarial skills in nontraditional and emerging areas of practice.
- Providing context for the specific mathematical and technical skills tested in the Preliminary Education examinations, some of which you may have already taken, others of which you might be studying for now (e.g., Probability, Financial Mathematics, Actuarial Models and Construction and Evaluation of Actuarial Models).
- Helping you prepare for your professional role as an Associate of the Society of Actuaries (ASA).

#### ***Objectives:***

- What are financial security systems? How do they operate?
- What issues do actuaries address? What is the actuary's role?
- How does the business environment affect the work of actuaries?
- How is actuarial practice expanding to fill newly developing roles?
- How do actuaries bring professionalism to their work?
- What types of problems do actuaries solve?
- What is risk in an actuarial context?
- How do actuaries identify, assess and manage risk?
- How do actuaries apply the fundamentals in their work?
- What solutions do actuaries bring to their bosses, management, boards of directors or clients?

- **How can you articulate answers to each of these questions to a non-expert audience?**

**Successful completion of the FAP course will enable you to answer these questions.**

# **Fundamentals of Actuarial Practice**

## **Module 1: Introduction/Role of the Professional Actuary**

### ***Section 1: Module Overview***

#### ***Objectives:***

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

- **Explain what actuaries are.**
- **Describe what actuaries do.**
- **Explain how actuaries practice.**
- **Explain how actuaries work in the real world.**
- **Explain how the Control Cycle facilitates actuarial work.**

# **Fundamentals of Actuarial Practice**

## **Module 1: Introduction/Role of the Professional Actuary**

### ***Section 2: The Actuary***

#### ***Description:***

The purpose of Section 2: The Actuary is to provide a brief history of the profession, to consider the future of the actuarial profession, to explore the role of today's actuary, to detail the actuary's skill sets and to review the profession's codes of conduct.

#### ***Objectives:***

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

- Describe important historical events influencing the actuarial profession.
- Describe today's actuarial practice.
- Define "actuary."
- Identify the actuary's knowledge, skills and abilities.
- Describe what an actuary contributes as a professional.
- Describe actuarial codes of conduct.

# **Fundamentals of Actuarial Practice**

## **Module 1: Introduction/Role of the Professional Actuary**

### **Section 3: What Actuaries Do**

#### *Description:*

The purpose of Section 3: What Actuaries Do is to explore the varied definitions of risk and identify how to define it in context, to consider how financial security systems function to manage and reduce risk, to introduce and investigate the areas of practice in which actuaries work, to investigate how actuaries manage risk and to look at the services actuaries provide.

#### *Objectives:*

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

- Define risk.
- Explain how financial security systems interact to combat financial insecurity.
- Describe the actuary's contributions within each area of practice.
- Explain ways in which actuaries manage risk.
- Identify services actuaries provide for financial security systems.

# **Fundamentals of Actuarial Practice**

## **Module 1: Introduction/Role of the Professional Actuary**

### **Section 4: External Forces**

#### ***Description:***

In the previous sections, we reviewed how professionalism surrounds the Control Cycle. Professional codes of conduct and standards govern all actuarial work, emphasizing the fact that an actuary is an expert employing a well-defined body of knowledge. An actuarial designation provides you with instant credibility. To maintain your expert status in your practice area, however, you must stay current. You must always be aware of emerging issues in the profession and in your clients' lines of business. You must be aware of new advances in technology and how these advances may affect your work. You must assume the responsibility for continuing your education through formal offerings as well as informally through personal reading, for example. Your clients will assume that, as a professional, you are always up-to-date on the external factors that affect their business as well as the actuarial profession. External factors not only affect the work you will do as an actuary, they also affect how the actuarial profession conducts its business.

A practicing actuary does not work in a vacuum. External forces influence how the actuary works today and will work in the future. External forces can be thought of as forces that affect the problem or its solution. Further, changes in external forces may affect an existing solution and become apparent as an actuary monitors the results of a solution.

#### ***Objectives:***

The purpose of this section is to introduce you to external forces that are likely to influence the actuary's work and to describe some of the distinguishing features of these forces. External forces and their effects on the work of an actuary are discussed in greater depth in Module 2.

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

- Identify the general categories of external forces which are likely to affect the work of an actuary.
- Discuss the effect of external forces on actuarial work.
- Describe how professionalism underlies all actuarial work.

# **Fundamentals of Actuarial Practice**

## **Module 1: Introduction/Role of the Professional Actuary**

### ***Section 5: The Control Cycle***

#### ***Description:***

You have been introduced to the Control Cycle as a framework for solving actuarial problems. You have learned that professionalism underlies the Control Cycle, while external forces, though generally outside of the actuary's sphere of influence, integrate with and affect the actuary's work.

The purpose of Section 5 is to complete your introduction to the Control Cycle by focusing on its Define the Problem, Design the Solution and Monitor the Results stages. Section 5 also includes a case study that enables you to apply your learning and review a sample actuarial problem in the context of the Control Cycle.

#### ***Objectives:***

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

- Explain the purpose of the Control Cycle.
- Describe the elements of the Control Cycle.
- Explain how the Control Cycles facilitate actuarial work.
- Apply the Control Cycle in the context of an actuarial problem.



## **Fundamentals of Actuarial Practice**

### **Module 1: Introduction/Role of the Professional Actuary**

***End-of-Module Test***

***End-of-Module Exercise***

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

### ***Section 1: Module Overview***

#### ***Description:***

As you learned in Module 1, the actuary works within the framework of a Control Cycle—Define the Problem, Design the Solution and Monitor the Results—and manages this process to arrive at an optimal solution. Central to the actuary’s work is the continuous examination of the core external forces that create new problems, constrain any potential solutions, change the problem being solved or affect existing solutions.

External forces are any factors outside of the actuary’s sphere of influence. The purpose of Module 2 is to provide you with an understanding of how core external forces affect actuarial work.

Identifying these forces and determining their relevance and interrelationships will help you manage actuarial problems, projects and assignments. An understanding of external forces will help you assess risks in a variety of situations in an ever-changing environment.

#### ***Objectives:***

During your Module 2 study, you will learn more about external forces, their interrelationships and their effect on the actuary’s work. Some external forces apply to all areas of actuarial practice while other external forces may be unique to one practice area. Within each of our categories of external forces, you will be introduced to examples of external forces related to the different areas of actuarial practice. Module 2 also covers the importance of anticipating changes in external forces, not simply reacting to the changes as they occur.

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

1. Define external forces.
2. Describe and explain how the following categories of external forces apply within and across areas of actuarial practice and fit into the Control Cycle framework.
  - Cultural/social values.
  - Demographics.
  - Governmental influences.
  - Economic/business environments.
  - Physical environment.
3. Describe the changing nature of external forces.
4. Explain how changes in external forces can lead to risk.

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

### **Section 2: External Forces and the Control Cycle**

#### ***Description:***

External forces affect virtually everything we do as individuals and as actuaries. The purpose of this section is to provide you with an understanding of external forces affecting actuarial work and the role of these forces in the Control Cycle.

A method of categorizing external forces has already been introduced in Module 1 to make it easier to understand how various external forces affect actuarial problems and solutions. This section further describes the categories (cultural/social values, demographics, governmental influences, economic and business environments, and other external forces) and presents examples of core external forces and their effects.

After describing the categories, Section 2 continues with readings that provide background information to help you better understand the actuarial context. Background information is provided on:

- The insurance industry.
- Health care delivery systems.
- Retirement income systems.
- Financial markets and considerations.

#### ***Objectives:***

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

- Describe in simple terms how external forces fit into the control cycle
- Define external forces.
- Describe categories and associated examples of external forces.
- Describe important external forces for actuaries working in the areas of life and health insurance, retirement benefits and specialty areas including investment, finance and enterprise risk management (ERM).

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

### **Section 3: Cultural/Social Values**

#### *Description:*

In this section, you will learn about external forces within the cultural/social values category and how they influence the work of an actuary.

#### *Objectives:*

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

- Describe cultural/social values.
- Describe the application of cultural/social values across and within areas of actuarial practice.
- Explain the effects of cultural/social values on the Define the Problem and Design the Solution stages of the Control Cycle.

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

### ***Section 4: Demographics***

#### ***Description:***

In Section 4 you will learn about external forces within the demographics category and how they influence the work of an actuary.

#### ***Objectives:***

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

- Describe demographics.
- Describe the application of demographics across and within areas of actuarial practice.
- Explain the effects of demographics on the Define the Problem and Design the Solution stages of the Control Cycle.

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

### ***Section 5: Governmental Influences***

#### ***Description:***

In this section, you will learn about external forces within the governmental influences category and how they affect the work of an actuary.

#### ***Objectives:***

- Describe governmental influences.
- Describe the application of governmental influences across and within traditional areas of actuarial practice.
- Explain the effects of governmental influences on the Define the Problem and Design the Solution stages of the Control Cycle.

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

### ***Section 6: Economic and Business Environments***

#### ***Description:***

**In this section, you will learn about external forces within economic and business environments and how they can affect the work of actuaries.**

#### ***Objectives:***

**After you complete this section, you will be able to:**

- **Describe economic and business environments.**
- **Describe economic and business applications across and within areas of actuarial practice.**
- **Explain the effects of economic and business environments on the Define the Problem and Design the Solution stages of the Control Cycle.**



# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

### ***Section 7: Physical Environment***

#### ***Description:***

In this section you will review aspects of the physical environment that can affect an actuary's work.

#### ***Objectives:***

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

- Describe aspects of the physical environment.
- Describe how the physical environment may affect actuarial work.

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

### ***Section 8: External Forces and Change***

#### ***Description:***

In the previous sections of this module you studied external forces and the roles they play in the Define the Problem and Design the Solution stages of the Control Cycle. This section of the module looks at changes in external forces and the influence that these changes have on actuarial work.

As discussed in Module 1, the Control Cycle has a third stage, Monitor the Results. This stage is important because, even if you have properly defined the problem and designed and implemented an ideal solution, external forces can alter the problem and change the circumstances that led to the original solution. Monitoring results also provides an opportunity to create better solutions.

#### ***Objectives:***

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

- Describe the changing nature of external forces.
- Explain how changes in external forces can lead to risk.

# **Fundamentals of Actuarial Practice**

## **Module 2: Core External Forces**

*End-of-Module Test*

*End-of-Module Exercise*

**Fundamentals of Actuarial Practice**  
**Module 3: Risk in Actuarial Problems**

# **Fundamentals of Actuarial Practice**

## **Module 3: Risk in Actuarial Problems**

### ***Section 1: Module Overview***

#### ***Description:***

During your Module 3 study, you will be exposed to typical actuarial problems and the processes used by actuaries to fully define problems. You will learn that problems revolve around risk and that identifying risks to be managed—i.e., looking *below the surface*—will help you to better define the real problem. You will learn how effective identification, analysis, and prioritization of various risks leads to a clearer definition of the problem and, ultimately, better solutions.

#### ***Objectives:***

- Explain “Define the Problem” within the context of the Control Cycle.
- Explain the significance of identifying and defining the real problem and its associated risks.
- Describe risks that actuaries manage within a financial security system.
- Describe risk management for financial security systems.
- Identify commonalities among problems in existing areas of actuarial practice.

# **Fundamentals of Actuarial Practice**

## **Module 3: Risk in Actuarial Problems**

### ***Section 2: Why Define the Problem***

#### ***Description:***

Section 2 focuses on "Define the Problem" as it fits in the Control Cycle and describes examples of scenarios where problems were not correctly defined.

#### ***Objectives:***

##### **Section 2 Objectives:**

- Explain how "Define the Problem" fits within the context of the Control Cycle.
- Given an example of a financial security system failure, describe how better problem definition could have been employed to help avoid the crisis.
- Recognize the significance of successfully defining problems.
- Identify risks related to financial security systems.

# **Fundamentals of Actuarial Practice**

## **Module 3: Risk in Actuarial Problems**

### ***Section 3: Introduction to Risk***

#### ***Description:***

In Module 1 of the FAP course, you were introduced to the concept of risk. In this section, you will review risk and risk analysis as they relate to actuarial problems. You will also have a chance to explore how risk influences the Define the Problem stage of the Control Cycle.

This section also introduces foundations of risk analysis and management. For the purposes of this section, *risk management* is the art and science of balancing risk and reward across the functional areas within a financial security system.

#### ***Objectives:***

##### **Section 3 Objectives:**

- Define risk in an actuarial context.
- Describe risk management.
- Define risk types that need to be managed within a financial security system.
- Explain how risk is transferred from a consumer to a financial security system.
- Explain risk classification.

# **Fundamentals of Actuarial Practice**

## **Module 3: Risk in Actuarial Problems**

### ***Section 4: Define the Problem and Identify Risks***

#### ***Description:***

In this section, you'll look more closely at the relationship between identifying risks and the Define the Problem stage of the Control Cycle. You will be introduced to some of the basic tools often used by actuaries to analyze financial risks.

#### ***Objectives:***

The objectives of section 4 are:

- Determine factors or influences that are important to identify and analyze risks.
- Use techniques commonly used in asset-liability management (ALM) with financial security systems.
- Describe the various risk measures that are used in ALM.
- Describe the capital requirements for a financial security system.
- Describe the role of risk measurement tools when analyzing the risks in financial and non-financial organizations.



# **Fundamentals of Actuarial Practice**

## **Module 3: Risk in Actuarial Problems**

### ***Section 5: Recognize Problem Commonalities***

#### ***Description:***

Understanding the commonalities and similarities that many actuarial problems share provides a foundation or starting point as you define problems. This section examines some of those commonalities.

#### ***Objectives:***

##### **Section 5 Objectives:**

- Describe aspects of actuarial work that are both fundamental and common to all practice areas.
- Categorize commonalities in actuarial problems.

## **Fundamentals of Actuarial Practice**

### **Module 3: Risk in Actuarial Problems**

*End-of-Module Test*

*End-of-Module Exercise*

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

### ***Section 1: Module Overview***

#### ***Description:***

By the end of your module study, you should be able to provide clear and comprehensive responses to the following questions:

- What solutions do actuaries consider?
- What processes, tools and techniques do actuaries use to design solutions?
- How does the Design the Solution stage fit within the Control Cycle?
- How do the Risk Control Cycle, Model Control Cycle, Assumptions Control Cycle and Monitoring Control Cycle relate to the Control Cycle?
- How are Control Cycle principles applied to activities and processes within each stage of the Control Cycle?

Module 4 demonstrates processes that are central to designing effective solutions to typical actuarial problems and exposes you to sample solutions that illustrate the work of an actuary.

#### ***Objectives:***

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

- Explain how solution design fits into the context of the Control Cycle.
- Identify typical actuarial solutions.
- Describe important aspects of designing solutions.
- Describe and use appropriate modeling techniques to design a solution.
- Identify data needed to design a solution.
- Describe the importance of assumptions when designing a solution.
- Describe the importance of validation and reconciliation techniques when designing a solution.
- Describe the process of quantifying risks in ERM.

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

### ***Section 2: Designing the Risk Management Solution***

#### ***Description:***

Actuarial solutions are complex and dynamic. Given a clearly defined problem and the associated risks that must be managed, and given a solid understanding of the needs of those who have a stake in the solution, actuaries are equipped to analyze a range of solutions and then produce an optimal solution.

#### ***Objectives:***

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

- Identify categories and characteristics of actuarial solutions.
- Describe how approaches to managing risk are related to the types of risk.
- Recognize the significance of successful solution design.
- Describe elements of designing actuarial solutions.
- Design a solution for managing reinvestment risk in an insurance company when asset and liability cash flows do not match (asset-liability management).

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

### ***Section 3: Data***

#### ***Description:***

The goal of the Design the Solution stage of the Control Cycle is to determine the optimal risk management solution for the identified problem and associated risks. What resource is needed when designing actuarial solutions?

Data. Data is, after all, our measure of the real world.

Data is the backbone of all of the decision making and modeling that actuaries perform. Data is crucial to modeling both in terms of using data as inputs for the model and using data to make key decisions as to what assumptions are appropriate to use in modeling. Data can also be used as the basis for predictive analytics, which risk managers may use in their decision making. Actuaries have a responsibility to ensure that the data used is appropriate and is as complete and accurate as possible. Decisions about how to identify, collect and use data directly affect the quality of the decision making and modeling results. The conclusions actuaries are able to make are dependent on data.

#### ***Objectives:***

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

- Explain the role of data collection in solution design.
- Describe the considerations in managing data (e.g., sourcing, quality, quantity, relevancy, governance and use).
- Describe data collection techniques.

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

### ***Section 4: Modeling***

#### ***Description:***

If you were to conduct a search on the keyword “model” on the Society of Actuaries’ website, your search would result in over 1,000 matches across the range of publications. Predictive models, stochastic models, behavioral models, simulation models, asset models, contaminated exponential dispersion loss models...the list goes on and on. The Society of Actuaries places modeling in a very prominent role. The vision of the Society of Actuaries is:

“For actuaries to be the leading professionals in measurement and management of risk.”

How does the Society of Actuaries intend to achieve this? The mission of the organization, as stated in the Strategic Plan, is:

“To advance actuarial knowledge and to enhance the ability of actuaries to provide expert advice and relevant solutions for financial, business and societal problems involving uncertain future events.”

How will you help the Society of Actuaries achieve this? By learning how to manage risks through the use of modeling. Modeling is a core actuarial skill.

#### ***Objectives:***

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

- Define models and the modeling process.
- Describe the micro Model Control Cycle.
- Describe modeling considerations.
- Describe modeling techniques used when designing a solution.
- Select and use appropriate modeling techniques to design a solution.

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

### **Section 5: Assumptions**

#### *Description:*

Actuarial solutions are only as good as the data and models on which they are built.

Actuaries use models to generate possible outcomes given the available data, certain economic scenarios, expected behaviors and potential stakeholder actions. Modeling supports the evaluation of the potential outcomes of alternate actions in the decision-making process. This evaluation requires analysis of the effect of key variables on the possible outcomes.

Actuaries are specifically trained to develop assumptions to represent the key variables in the modeling process. The goal is to develop assumptions for the model that are appropriate for the original business problem and that generate adequate outcomes to permit informed decision making.

The quality of a risk management solution is dependent on the quality of the underlying actuarial assumptions used.

There are a variety of assumption-setting techniques. These include parameter selection, probability distribution, parameter estimation and testing, variance and covariance, credibility analysis and expectation and scenario generators. You will learn more about these techniques in FAP Module 7: Selection of Initial Assumptions.

#### *Objectives:*

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

- Describe what an actuarial assumption is.
- Explain the importance of assumptions in actuarial work.
- Describe a methodology for creating assumptions.
- Identify the characteristics of actuarial assumptions.
- Identify some consequences of making inappropriate assumptions.



# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

### **Section 6: Validation and Reconciliation**

#### ***Description:***

It is often necessary to devote a significant amount of resources to the development and implementation of a model. The modeling process often has a demanding deadline and a temptation could arise to accept the results from the model without performing a rigorous validation process. It is imperative that sufficient time be allotted to validating the model and subsequently reconciling the model results to emerging results. These activities help verify that the model used in the solution was appropriate for the original business problem.

Failure to properly validate and reconcile has been likened to a car manufacturer that devoted vast resources to developing an exquisite luxury car model. To meet the tight deadline of having the cars available for the new year, the manufacturer minimized the quality control efforts at the end of the manufacturing process. Imagine the manufacturer's reaction when the first car came off the assembly line for a group of photographers and the front wheel fell off?

In this section you will consider the necessity of validating models and reconciling model results to actual results.

#### ***Objectives:***

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

- Explain the roles of validation and reconciliation in the Control Cycle.
- Distinguish between validation and reconciliation.
- Describe validation and reconciliation methods.
- Apply validation and reconciliation techniques.

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

### ***Section 7: Landfill Case Study***

#### ***Description and Objectives:***

**You were introduced to the Landfill case study in Module 3. At that time you were asked to assist in determining the letter of credit amount for New Site, a landfill site recently purchased by Mountain Landfill. This was an initial problem that had already been set out for you. At that time you were also asked to consider an alternate method to solve the problem related to the pre-funding of New Site's post-closure costs. Should Mountain Landfill establish a system to fund for the closure and post-closure costs associated with New Site in advance? If the post-closure costs were to be funded in advance, then how should advance funding be implemented and managed? The continuation of the Landfill case study in Module 4 addresses a risk management solution for this alternate funding method.**

**In Module 3, you were introduced to some of the underlying elements that will help you design this second solution to meet New Site's post-closure costs problem. These include the external forces surrounding the post-closure administration of New Site Landfill, the regulatory environment governing the post-closure costs of New Site and the stakeholders who have an interest in this problem. The elements that were introduced in Module 3 remain relevant to the new design of a solution in Module 4. In this section you will work on the post-closure costs problem of Mountain Landfill.**

**After you complete this section, you will be able to apply Module 4 concepts to design the solution to this problem.**

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

### **Section 8: Actuarial Communication**

#### ***Description:***

Effective communication with all stakeholders is a key concept that has been discussed in each of the previous FAP modules. The importance of communication has also been reinforced through your work on the End-of-Module Exercises. The U.K. Actuarial Profession's ED9 Actuarial Profession Standard for Communication describes actuarial communication as follows:

“Actuaries communicate information and advice, whether written or oral, in a clear, complete and effective fashion so that the recipient of that advice can be expected to understand it.”<sup>1</sup>

This section further develops the effective communication message within the context of communicating actuarial solutions. You will complete the Landfill case study by reviewing and assessing the sample report to the client, Mountain Landfill. This section also includes some guidelines with respect to preparing written communication.

#### ***Objectives:***

After completing this section, you will be able to:

- Describe the role of effective communication as part of designing solutions.
- Describe elements of effective written reports.
- Apply the principles of Actuarial Standards of Practice 41.

# **Fundamentals of Actuarial Practice**

## **Module 4: Actuarial Solutions**

*End-of-Module Test*

*End-of-Module Exercise*

# **Fundamentals of Actuarial Practice**

## **Module 5: Design and Pricing of an Actuarial Solution**

# **Fundamentals of Actuarial Practice**

## **Module 5: Design and Pricing of an Actuarial Solution**

### ***Section 1: Module Overview***

#### ***Description:***

You have already learned quite a bit about actuarial modeling. In Module 4, you were introduced to the Model Control Cycle, what a model is (“... a construction designed to imitate reality”) and why models are so important to actuarial work (“...actuaries gain insight into how the system operates and can assist their employers or clients in designing strategies to manage the financial risk in the system”). You were introduced to the modeling process, model selection and building, model limitations and modeling techniques. By the end of Module 4, you were able to understand how models are indispensable tools for designing solutions to actuarial problems.

In this module, Designing and Pricing an Actuarial Solution, you will further explore models by tying together what you have already learned into a framework for models that emphasizes pricing, reserving and funding.

***Pricing*** is the function related to the determination of the cost for an individual to participate in a financial security system. ***Reserving*** is the function related to the determination of the amount of assets currently needed to be available to meet the financial security system’s obligations. ***Funding*** is the function related to the determination of the financial security system’s future capital needs and the allocation of current and future assets to meet those needs.

The purposes and details of each of these types of models will be analyzed.

#### ***Objectives:***

Module 5: Designing and Pricing an Actuarial Solution, expands on what you have already learned about modeling by introducing you to a framework for thinking about models. This framework, like the Control Cycle itself, demonstrates how all actuarial work—though performed in many different areas of practice and on many different types of problems—boils down to solving problems for diverse clients in many different situations using very similar approaches.

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

- Explain how the fundamental actuarial formula provides the basis for all modeling.
- Demonstrate how models are applied to develop pricing, reserving and funding solutions.
- Explain how models are applied on an individual and group basis in the different practice areas.

- **Apply primary and secondary models to practice area pricing, reserving and funding problems.**

# **Fundamentals of Actuarial Practice**

## **Module 5: Design and Pricing of an Actuarial Solution**

### ***Section 2: Overview of Actuarial Models***

#### ***Description:***

Actuaries are called upon to identify, understand, quantify and manage a wide range of business risks in the financial services industries. They accomplish this through the use of models.

The Model Control Cycle is a graphic representation of the processes and activities involved in the selection, modification and/or building of a model. The "Risk Management in a Financial Security System" graphic introduced in Module 3 represents the types of risks that a financial security system must manage.

Solutions to actuarial problems are inherently based on one fundamental idea, which is:

*The present value of your current assets less the present value of your current liabilities must be managed so that you can expect to have sufficient resources to meet the needs of the financial security system when due.*

This section introduces you to the concept of a *fundamental actuarial formula* that represents this idea as it pertains to risk management problems. This section also introduces you to a framework that categorizes actuarial models according to this formula. The framework provides a useful way of thinking about models and provides the structure for the remaining sections in this module.

#### ***Objectives:***

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

- Describe how the fundamental actuarial formula provides the basis for all modeling.
- Describe how models are applied to develop pricing, reserving and funding solutions.
- Describe how models are applied on an individual and group basis in the different practice areas.



# **Fundamentals of Actuarial Practice**

## **Module 5: Design and Pricing of an Actuarial Solution**

### **Section 3: Pricing Models**

#### *Description:*

In this section, we'll cover pricing and pricing models, which are based upon the following fundamental formula:

$$0 = V_0 = \sum_0^{\infty} B_t d_t v^t - \pi_t d_t v^t$$

In this section, you will also see how each practice area employs pricing models.

#### *Objectives:*

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

- Explain how pricing models are used to solve pricing problems.
- Explain how to use “secondary” models/methods to define parameters for pricing models.
- Apply primary and secondary models to practice area pricing problems.

## Fundamentals of Actuarial Practice

### Module 5: Design and Pricing of an Actuarial Solution

#### Section 4: Models for Reserving and the Allocation of Capital

##### *Description:*

In the previous section, you learned about pricing problems and pricing models. In this section, you will learn about reserving problems and reserving models. Models for reserving purposes are created using the following simplified formula:

$$V_x = \sum_x^{\infty} B_t d_{x,t} v^{t-x} - \pi_t \Delta_{x,t} v^{t-x}$$

Reserving is a process an actuary uses to determine the current liability associated with future claims. It is a point estimate for future periods.

##### *Objectives:*

In this section, you'll learn more about reserving models. After completing this section, you will be able to:

- Explain how reserving models are used to solve for reserving problems.
- Explain how to use “secondary” models/methods to define parameters for reserving models.
- Apply primary and secondary models to practice area reserving problems.

For reserving purposes, the application of models to solve the fundamental simplified equation as noted above can be completed on a “prescribed basis” or using a “principles-based” approach.

A prescribed basis has been used by insurance regulators for insurance companies in many jurisdictions. Under this approach, regulations are established to mandate both the required methods/models and the required assumptions to be used when determining appropriate reserves for the prescribed purpose; these are called statutory reserves. Prescribed reserves are not limited to insurance regulations. In many instances, pension plan regulations include prescribed methods or assumptions to determine pension plan reserves. For example, solvency valuations for pension plans in Canada are often prescribed.

## Fundamentals of Actuarial Practice

### Module 5: Design and Pricing of an Actuarial Solution

#### Section 5: Models for Funding and the Planning for Capital Needs

##### *Description:*

In the previous two sections, you learned about pricing and reserving and their associated models. In this section, you will cover funding models, which are created to solve for the following simplified formula:

$$V_x = \sum_x^{\infty} B_t d_{x,t} v^{t-x} - \pi_t \Delta_{x,t} v^{t-x}, x \geq 0$$

As mentioned in Section 2, funding involves the question “Will future funds be sufficient to meet the financial security system’s future needs?”

Funding models are used by financial security systems to determine an appropriate build-up of funds to be used for future purposes. Traditionally, funding has been used to secure the long-term benefits promised to the beneficiaries of a financial security system. Funding methods were initially developed for defined benefit pension plans and you will begin your study of funding models with the models typically used for such plans.

Funding problems, however, also apply in the other practice areas. For example, an actuary working in the finance practice area must consider the problems associated with ensuring that the insurance company resources will be sufficient to meet its future obligations. This is a funding problem.

##### *Objectives:*

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

- Explain how funding models are used to solve funding problems.
- Explain how to use “secondary” models/methods to define parameters for funding models.
- Apply models to practice area funding problems.

## **Fundamentals of Actuarial Practice**

### **Module 5: Design and Pricing of an Actuarial Solution**

#### ***Section 6: Tying It All Together***

##### ***Objectives:***

**Are you able to answer the questions below?**

- **How does the fundamental actuarial formula provide the basis for all modeling?**
- **How are models applied to develop pricing, reserving and funding solutions?**
- **How are models applied on individual and group bases?**
- **How are models applied to the various areas of actuarial practice?**

**If you are able to describe and explain the responses to these questions, you are ready to work through the Sample Interim Assessment and then complete the End-of-Module Test**

**Fundamentals of Actuarial Practice**

**Module 5: Design and Pricing of an Actuarial Solution**

***End-of-Module Test***

**Fundamentals of Actuarial Practice**

***Interim Assessment***

# **Fundamentals of Actuarial Practice**

## **Module 6: Model Selection and Solution Design**

# **Fundamentals of Actuarial Practice**

## **Module 6: Model Selection and Solution Design**

### ***Section 1: Module Overview***

#### ***Description:***

Module 5, Designing and Pricing an Actuarial Solution, focused on common actuarial models being used in the practice areas. A framework for thinking about models was introduced and you learned how the fundamental actuarial formula provides a basis for all modeling. You learned how models are applied to develop pricing, reserving and funding solutions as well as how they are applied on an individual and group basis in various practice areas. Finally, the application of primary and secondary models to practice area pricing, reserving and funding problems was presented.

Building on Module 5, Module 6 provides an overview of the model selection and solution design process. This module begins with an explanation of how the model selection and model building process fits within the context of the Control Cycle. A three-stage process for building and selecting models (i.e., define the problem, match the model to the problem and design the solution) provides the basis for the remainder of the content within this module. Specific modeling steps that occur within each stage of the Control Cycle are also covered.

#### ***Objectives:***

By the end of the module, you will be able to:

- Review modeling techniques and models used in actuarial practice
- Define the business problem that needs to be modeled
- Match the model to the problem in context, and
- Design a solution

To achieve these objectives, you will complete case studies from different practice areas that will provide you with practical applications of modeling concepts. To allow you more time for this practice, you will complete fewer readings during this module than you have completed in previous modules.



# **Fundamentals of Actuarial Practice**

## **Module 6: Model Selection and Solution Design**

### ***Section 2: The Model Control Cycle***

#### ***Description:***

This section begins with a review of the relationship between the model selection and building processes and the Control Cycle introduced earlier. You will also review the types of models used in actuarial work.

#### ***Objectives:***

After completing this module, you will be able to:

- Explain how the model selection and model building process fits within the context of the larger Control Cycle.
- Work through the process of selecting and building a model.
- Apply Control Cycle principles to the process of model design and building.
- Describe the rationale for choosing a particular model.

# Fundamentals of Actuarial Practice

## Module 6: Model Selection and Solution Design

### Section 3: Pricing Models

#### *Description:*

In this section, you will begin with an extension of our Ten-Year Term Insurance case study from Module 5. This portion of the case will involve pricing and pricing models that are based upon the following fundamental formula:

$$0 = V_0 = \sum_0^{\infty} B_t d_t v^t - \pi_t d_t v^t$$

#### *Objectives:*

In this section, you will be able to:

- Use the Model Control Cycle to solve a pricing problem.
- Describe how different models can be applied to solve the same problem.
- Determine which model is most appropriate for the presented pricing problem.
- Practice applying a model to solve a pricing problem.

## **Fundamentals of Actuarial Practice**

### **Module 6: Model Selection and Solution Design**

#### ***Section 4: Reserving and the Allocation of Capital***

##### ***Description:***

The Health Reserves case study presented in this section focuses on various reserve models applied to develop reserves for incurred but not reported (IBNR) claims of a small but growing Health Management Organization (HMO) called YourHealth. YourHealth has become a concern for the insurance commissioner. In particular, the commissioner is worried about the adequacy of YourHealth's IBNR reserves.

##### ***Objectives:***

After completing the case study in this section, you will be able to:

- Evaluate YourHealth's reserve methodology.
- Determine if YourHealth's reserves are adequate.
- Determine the size of the reserve deficiency or surplus.

# Fundamentals of Actuarial Practice

## Module 6: Model Selection and Solution Design

### Section 5: Funding and the Planning for Capital Needs

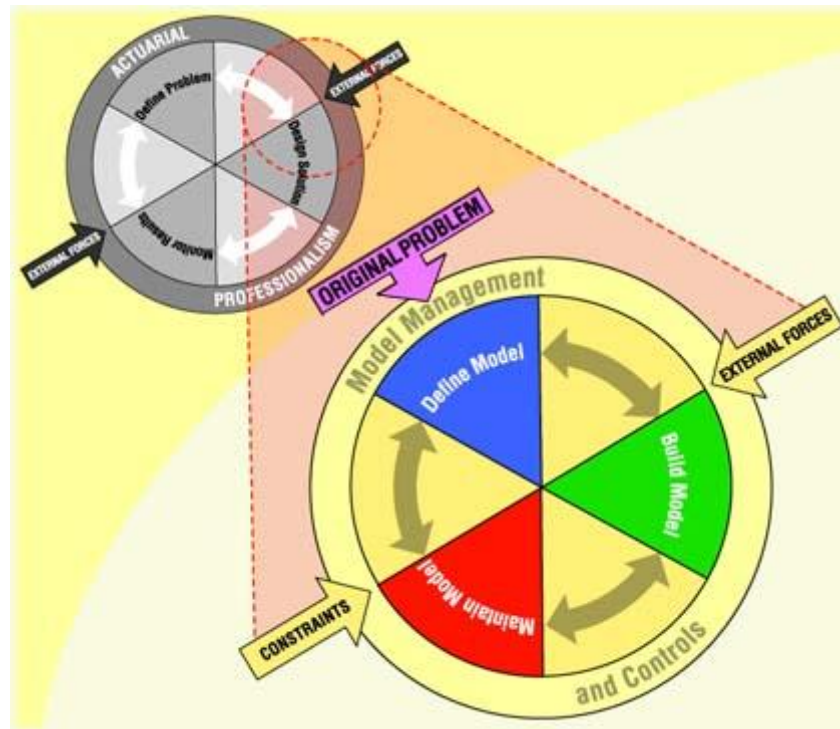
#### *Description:*

Just as you completed case study work [around the selection of models and design of solutions](#) in Sections 3 and 4, this section will provide additional opportunities for you to work with other models and concepts that you have learned in Modules 1-5.

In this section you will complete two new case studies and revisit a prior case start that you started in Module 5.

The first case study, Retirement Benefits, illustrates issues related to the selection of models and design of solutions in private pension related problems. This case study emphasizes the concepts and processes involved. The calculations are very simple.

The second case study, Structured Settlement, focuses on the determination of projected profitability and potential volatility of the financial results of a structured annuity line of business. In addition to working through the Retirement Benefits and Structured Settlement case studies, you will continue to work on the Retiree Medical Funding case study that you started in Module 5.



In this section of the module, you will begin with a case study that is based on a series of retirement benefits business problems. The case will include a traditional funding problem and will also include pension reserving and pricing problems.

First you will review the original business problem that must be managed, in part, by the use of an actuarial model. This will include a review of the following steps related to the original business problem:

- Identify risks
- Identify external forces
- Identify stakeholders and their issues
- Understand the business problem as defined

Before you can define the model, you must have a complete understanding of all the aspects of the original business problem. Once this research is complete, you can proceed to the Define Model stage of the Model Control Cycle. This will involve the following:

- Identify existing models that may be used or adapted for the business problem.
- Identify available data and determine its adequacy, appropriateness and sensitivity.
- Identify required model inputs, assumptions, and constraints.
- Define the model to be used for the business problem.

Once the model has been defined, we will proceed to the Build the Model stage of the process. This will involve the following:

- Build and test the selected model.
- Confirm that model output addresses the original business problem and that the results are reasonable and explainable.
- You should note that we will go back and forth between the Define the Model and Build the Model stages.

Finally, you will return to the original business problem to communicate your findings once you have interpreted the model results. This section will not focus on model maintenance or redefinition.

### *Objectives:*

Are you able to answer the questions below?

- How does the model selection and building process fit within the context of the Control Cycle?
- How could you select an appropriate model for a given pricing, reserving, and funding problem?
- How was the Model Control Cycle used to solve a pricing problem?
- How could you evaluate a reserve methodology and determine if the reserves are adequate?
- How could you identify available model data and determine its adequacy, appropriateness and sensitivity?

- How could you identify required model inputs, assumptions, and constraints?
- How could you build and test a selected model?
- How could you confirm that model output addresses the original business problem and that the results are appropriate and explainable?
- How could you communicate your findings once you have interpreted the model results?

**If you are able to describe and explain the responses to these questions, you are ready to take the Module 6 End-of-Module Test.**

## **Fundamentals of Actuarial Practice**

### **Module 6: Model Selection and Solution Design**

*End-of-Module Test*

*End-of-Module Exercise*

**Fundamentals of Actuarial Practice**  
**Module 7: Selection of Initial Assumptions**



# **Fundamentals of Actuarial Practice**

## **Module 7: Selection of Initial Assumptions**

### ***Section 1: Module Overview***

#### ***Description:***

From your FAP studies, you have already learned quite a bit about assumptions. Module 4: Actuarial Solutions, Section 5 provided you with a thorough overview of assumptions. In that section, you learned that the definition of an assumption is “any non-factual, non-verifiable item the actuary relies on in a model.” You also learned that assumptions may involve filling in a missing piece of data, projecting a future expectation, or hypothesizing the relationship between two variables. You were also introduced to the major types of assumptions: economic, demographic, and experience-based. You learned why assumptions are important to actuaries and their stakeholders.

In addition to what you learned about assumptions in Module 4, you have also had a chance to see the use of assumptions in actuarial work in the FAP course’s case studies and exercises. In those, you were provided with assumptions to complete the various exercises and tasks. While completing those exercises, you were able to see the effect that changes in assumptions had on a model’s results.

How does an actuary go about selecting assumptions? What is the set of assumptions that are material to the actuary’s problem, solution and model? What constraints or other determinants should be considered when selecting them? What methods and tools are available to actuaries when they need to quantify assumptions? These are the questions that will be answered in this module. Click [here](#) to review some additional, important questions.

#### ***Objectives:***

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

- Recall and describe the major categories of assumptions.
- Describe assumption constraints and determinants.
- Describe methods and tools for quantifying assumptions.
- Describe the interdependency of assumptions.

# **Fundamentals of Actuarial Practice**

## **Module 7: Selection of Initial Assumptions**

### ***Section 2: Overview of Selecting Assumptions***

#### ***Description:***

In this section you will learn about the selection of initial assumptions.

#### ***Objectives:***

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

- Recognize the significance of assumptions to the success of ongoing risk management of the financial security system.
- Identify types of actuarial assumptions.
- Describe the processes used to select initial assumptions.

# **Fundamentals of Actuarial Practice**

## **Module 7: Selection of Initial Assumptions**

### ***Section 3: Assumption Constraints & Other Determinants***

#### ***Description:***

You learned in the previous section that there are different types of assumptions and that they are very important in the Control Cycle. Other important factors to consider when selecting assumptions are the constraints and other determinants. This section of Module 7 covers constraints and other determinants as well as the external forces that actuaries face when defining the set of assumptions.

#### ***Objectives:***

As a result of completing this section, you will be able to:

- Identify assumption constraints and other determinants
- Describe assumption constraints
- Describe other determinants for assumptions

# **Fundamentals of Actuarial Practice**

## **Module 7: Selection of Initial Assumptions**

### ***Section 4: Methods and Tools for Quantifying Assumptions***

#### ***Description:***

In the previous section, you learned about some of the criteria, constraints, and other determinants used to select assumptions for actuarial models. This section will provide a high level description of the methods used to quantify and select assumptions. A number of different methods are presented through readings from the various practice areas.

#### ***Objectives:***

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

- Describe types of methods and tools to quantify assumptions
- Describe methods to select initial assumptions
- Describe tools used to select assumptions

## **Fundamentals of Actuarial Practice**

### **Module 7: Selection of Initial Assumptions**

#### ***Section 5: Applying Assumption Concepts***

##### ***Description:***

Thus far in this module, you have studied quite a bit about actuarial assumptions. In addition to learning more about types of assumptions (i.e., economic, demographic and experience-based), you have learned how assumptions relate to the Control Cycle and the process used to select initial assumptions. Further, you looked at how actuaries treat assumption constraints (e.g., those placed by regulatory bodies, the profession or the client/employer) and other determinants (e.g., materiality, the effect of internal or external forces). Finally, you looked at methods and tools actuaries use to quantify assumptions that are used in actuarial models.

In this section, you will have an opportunity to apply your knowledge about assumptions setting to the Retirement Benefits, Structured Settlement, Term Life Insurance, Retiree Medical Funding and Health Assumptions case studies.

##### ***Objectives:***

After completing this section, you will be able to apply assumptions concepts to realistic actuarial scenarios.

# **Fundamentals of Actuarial Practice**

## **Module 7: Selection of Initial Assumptions**

### ***Section 6: Interdependency of Assumptions***

#### ***Description:***

Throughout this module you have read about the constraints and other determinants that an actuary needs to consider when selecting economic, demographic, and experience-based assumptions. This section covers the interdependency of the different assumptions on the design of the solution.

#### ***Objectives:***

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

- Describe interdependency
- Explain how assumptions are dependent on other assumptions
- Explain how assumptions are dependent on the product's design

## **Fundamentals of Actuarial Practice**

### **Module 7: Selection of Initial Assumptions**

*End-of-Module Test*

*End-of-Module Exercise*

# **Fundamentals of Actuarial Practice**

## **Module 8: Monitoring Results**



# **Fundamentals of Actuarial Practice**

## **Module 8: Monitoring Results**

### ***Section 1: Module Overview***

#### ***Description:***

In Module 1 of this course, you learned that the Control Cycle can be stated quite simply as three stages:

1. Define the Problem.
2. Design the Solution.
3. Monitor the Results.

In Modules 1 through 7 you learned to Define the Problem and to Design the Solution. In Module 8, you will explore the Monitor the Results stage of the Control Cycle.

Read Chapter 17, pages 495-526 omitting Section 17.4.4, pages 504-509 in *Understanding Actuarial Management (2010)*. Chapter 17 discusses the Monitoring Results component of the Control Cycle.

#### ***Objectives:***

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

- Describe each element of the Monitoring Results Control Cycle.
- Identify results to be monitored.
- Explain how to validate data gathered for monitoring results.
- Describe possible methods of analyzing experience data.
- Identify the source of experience deviations
- Identify possible solutions to problems resulting from experience deviations.
- Explain the importance of appropriate communication and documentation while monitoring results.

To achieve these objectives, you will complete case studies from different practice areas that will provide you with practical applications of monitoring results.

# **Fundamentals of Actuarial Practice**

## **Module 8: Monitoring Results**

### ***Section 2: Introduction and Gathering Data***

#### ***Description:***

In *Understanding Actuarial Management* (2010), you learned that:

A major component of the Actuarial Control Cycle is the regular comparison of expected outcomes with experience, ie actual outcomes. Analysis of actual experience is an essential element of this comparison.

This section will focus on the process used to monitor results. You will learn about a framework for this process. This framework will provide you with a useful way of thinking about monitoring results.

#### ***Objectives:***

After completing this section, you will be able to:

- Explain how Monitoring Results fits within the context of the larger Control Cycle.
- Describe each element of the Monitoring Results control cycle.
- Describe the process of identifying and gathering data necessary to Monitor Results.
- Describe the process of validating data.
- Apply concepts related to gathering data in an actuarial scenario.

# **Fundamentals of Actuarial Practice**

## **Module 8: Monitoring Results**

### **Section 3: Analyzing Results**

#### *Description:*

The Monitoring Results Control Cycle and the Gather Data element were introduced to you in Section 1. This section will discuss the second element of the Monitoring Results Control Cycle, Analyze Results.

#### *Objectives:*

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

- Identify various methods for analyzing data when monitoring results.
- Explain six data analysis methods including when to apply each.
- Apply concepts related to analyzing results in an actuarial scenario.

# **Fundamentals of Actuarial Practice**

## **Module 8: Monitoring Results**

### ***Section 4: Providing Feedback***

#### ***Description:***

In the previous section, you learned about analyzing results to identify differences between expected and actual experience. In this section you will learn about providing feedback about the discrepancies identified.

#### ***Objectives:***

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

- Identify possible sources of error.
- Identify possible solutions to problems caused by adverse experience.
- Explain the critical importance of appropriate communication and documentation.
- Apply concepts related to providing feedback in actuarial scenarios.

# **Fundamentals of Actuarial Practice**

## **Module 8: Monitoring Results**

### ***Section 5: Recap of the Control Cycle***

#### ***Description:***

This section summarizes the Fundamentals of Actuarial Practice course by using the Control Cycle to highlight key actuarial concepts. The Control Cycle, along with its associated "micro" control cycles and illustrations, provided the structure for this course and provides a framework for recapping key concepts.

#### ***Objectives:***

After you complete this section, you will be able to recall key actuarial concepts and principles related to Control Cycle elements.

**Fundamentals of Actuarial Practice**

**Module 8: Monitoring Results**

***End-of-Module Test***

**Fundamentals of Actuarial Practice**

**Final Assessment**