

Understanding Actuarial Management:

the actuarial control cycle

SECOND EDITION

Edited by **Clare Bellis, Richard Lyon, Stuart Klugman and John Shepherd**

Foreword

Understanding Actuarial Management: the actuarial control cycle was first published in 2003 by the Institute of Actuaries of Australia, in response to demands from Australian universities for a resource to support Part II of its education syllabus. Since that time, the Actuarial Control Cycle concept has been adopted as part of the education syllabus of many actuarial associations around the world, including the Society of Actuaries.

In planning this second edition, the Institute of Actuaries of Australia and the Society of Actuaries have partnered to produce a completely revised text, ensuring that the requirements of both professional bodies and those of the International Actuarial Association and the UK Actuarial Profession have been met. This collaboration has resulted in what we believe to be a global textbook, for a global profession.

The teams of editors, authors and reviewers who participated in this project were sourced from around the world, reinforcing the project's aims of global application. In particular, the commitment and dedication of the three editors of this edition, Clare Bellis, Richard Lyon and Stuart Klugman, have produced an extremely valuable resource for actuarial students in Australia, the US, Canada and around the world.

On behalf of the Institute of Actuaries of Australia, the Society of Actuaries and the rest of the profession, we offer our congratulations and sincere gratitude to the editors and authors of this second edition of *Understanding Actuarial Management: the actuarial control cycle*, for the exceptional contribution they have made to our future.

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Preface to the Second Edition

The first edition of this book was published by the Institute of Actuaries of Australia (Institute) in 2003. It was written as a textbook for Part II of the Institute's education program but it has since been used around the world – especially by the Society of Actuaries (SOA), as a textbook for its Fundamentals of Actuarial Practice e-learning course.

A lot has happened since 2003 and it is now time for a new edition. This edition sees the following changes to the editorial team:

- Clare Bellis has moved from Australia to the UK;
- Australia-based Richard Lyon, who was a late addition to the editorial team for the first edition, has been involved in the second edition from the outset;
- US-based Stuart Klugman has joined the team for the second edition; and
- John Shepherd has retired and, apart from revising Chapter 5 as author, has not been involved in editing this edition.

The three editors for this edition therefore span the globe; regular editorial telephone calls took place in the afternoon (US Central Time), late evening (UK) and early morning (Australia).

We have taken the opportunity to revise the topics covered in the book. The number of chapters hasn't changed but we have added a chapter about Risk Management Frameworks (Chapter 2) and separated Data and Assumptions (Chapter 10) from Modeling (Chapter 9). At the same time, a single Assets chapter (14) replaces three investment chapters. One of the original investment chapters has been updated and is included as a supporting paper on the CD. In producing this new edition, we continued to take note of the IAAust's Part II (Actuarial Control Cycle) syllabus; and we also covered the equivalents in the International Actuarial Association (IAA), the Institute & Faculty of Actuaries and the SOA.

We have also added an index and a glossary.

Many of our original authors have returned to update their chapters but the addition of several new authors has allowed us to make the panel truly international. This, together with a range of backgrounds, means a diverse selection of examples.

As the chapters were written, they were extensively reviewed by experts around the world, as well as by current and recent students. We gratefully acknowledge the assistance of these reviewers, whose names are listed at the end of the book, and also the guidance provided by the members of the editorial steering committee. Any errors or omissions remain, of course, the responsibility of the editors and the authors of the individual chapters.

Finally, our thanks go to Carol Dolan, Actuarial Education Consultant at the Institute of Actuaries of Australia. Carol has overseen the project from start to finish and her patience, efficiency, creative suggestions and meticulous attention to detail have greatly lightened our load.

Clare Bellis, Richard Lyon and Stuart Klugman

March 2010

Chapter 1: Introduction

by the Editors

1.1 What this book is about

In this book we explain the work of actuaries. We show how actuaries contribute to the design, construction and ongoing management of systems that provide a wide range of financial services. The typical reader of this book will be a student or actuarial trainee who has mastered the economic, financial, mathematical and statistical techniques of actuarial work. For these readers, we explain how actuaries use these techniques to provide advice to enterprises of many types, particularly in financial services. Readers from other backgrounds will also find the book useful for appreciating the work that actuaries perform.

Our emphasis is on the big picture of actuarial work, concentrating on the fundamental concepts that underpin actuarial work across both practice areas and countries. We do not cover the detail of laws, regulations, taxation rules, accounting standards and technical issues. Such detail is important for actuarial practice but not for our current purposes. You will build up your knowledge and understanding of the detail when you start to specialize in a particular practice area, either later in your studies or early in your working career.

Our overview of actuarial work will be structured around a framework called the Actuarial Control Cycle. The Actuarial Control Cycle represents the processes typically required in the ongoing management of a financial enterprise, product or scheme, and the relationships between those processes.

1.2 What is an actuary?

Chances are that you already have your own answer to this question. However, as it provides the foundation for this book, here is what three actuarial society websites say.

The Society of Actuaries (SOA, 2010) says:

An actuary is a business professional who analyzes the financial consequences of risk. Actuaries use mathematics, statistics and financial theory to study uncertain future events, especially those of concern to insurance and pension programs. They evaluate the likelihood of those events and design creative ways to reduce the likelihood and decrease the impact of adverse events that actually do occur.

Actuaries are an important part of the management team of the companies that employ them. Their work requires a combination of strong analytical skills, business knowledge and understanding of human behavior to design and manage programs that control risk.

The Actuarial Profession in the UK (AP, 2010) says:

Most people will know something about the professions of accountants, doctors and lawyers. But tell someone you're an actuary and more than likely they will look at you blankly – never having heard of an actuary.

If, however, they are aware of the work that actuaries do, they are likely to be impressed; being an actuary carries quite a reputation. This is partly due to the

difficult exams, but mostly due to the fact that actuaries are experts in a field that is renowned for its complexity and mathematical prowess.

Actuaries apply financial and statistical theories to solve real business problems. These business problems typically involve analysing future financial events, especially when the amount of a future payment, or the timing of when it is paid, is uncertain. A lot of actuaries' work might be thought of as 'risk management', assessing how likely an event may be and the costs associated with it.

Understanding how businesses operate, how legislation may impact and how financial economics can affect values are all vital skills for an actuary. But what differentiates actuaries is their core mathematical, economic and statistical understanding and their ability to apply this to real financial problems.

The Institute of Actuaries of Australia (IAAust, 2010) says:

Actuaries are among the brightest people in the business world. Actuaries apply their mathematical expertise, statistical knowledge, economic and financial analyses and problem solving skills to a wide range of practical business problems. Actuaries help organisations to understand the long-term financial implications of their decisions, many of which can affect individuals as well as the wider community.

Actuaries apply their skills in a variety of areas including:

- Measuring and managing risk and uncertainty
- Designing financial contracts
- Advising on investments
- Measuring demographic influences on financial arrangements
- Advising on a wide range of financial and statistical problems.

Leaving aside the sales pitch, it is clear that these three professional bodies all agree that actuaries solve business problems involving risk, particularly in a financial context.

Problem solving requires both a good understanding of the problem (and its context) and the tools to get the job done. Most readers of this book will already have the basic actuarial toolkit and will add to this toolkit throughout their actuarial education and beyond.

The actuarial profession has existed for over two centuries and originally concentrated on problems in long-term insurance and pensions (superannuation). For readers with an interest in the historical background, we have included on the CD some articles describing the development of actuarial science. Actuarial skills are, however, more widely applicable than just in the original areas of specialized practice. For example, solving problems involving the economics of distribution channels for any product is not really any different from solving problems connected with the economics of insurance sales.

Actuaries are also creative problem solvers. As the environment changes and new products are needed, actuaries are well-situated to adapt. The book includes examples of applications from a variety of practice areas and we encourage you to think, as you study each chapter, where else could these tools be applied? In the concluding chapter, we describe some applications from areas where actuarial skills would not have been applied even a few decades ago.

1.3 The control cycle framework

The Actuarial Control Cycle is a conceptual framework that is useful in describing the processes needed for the development and ongoing management of a financial enterprise, product or scheme. It is based on a simple problem-solving algorithm:

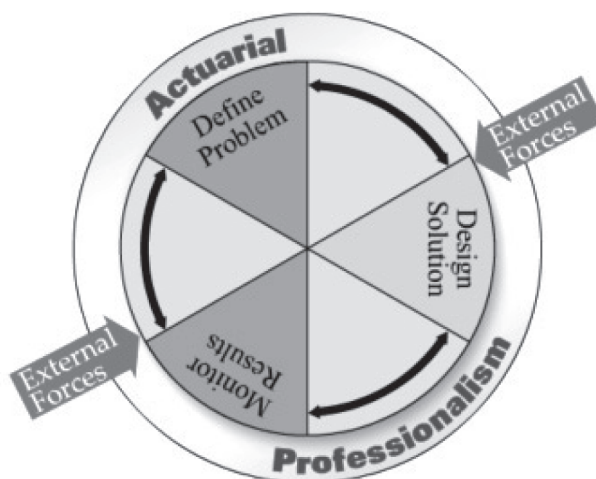
- define the problem;
- design the solution; and
- monitor the results.

The whole process, or control cycle, is conducted within an environment or context that shapes the decisions taken. The cycle is iterative: the three steps may be repeated or at any stage we may return to an earlier step.

This problem-solving process is universal. It applies to any field of activity. For example, a doctor will diagnose a patient's condition and recommend treatment. If the condition does not improve, the doctor will reassess the diagnosis and the treatment. The doctor's decisions will be shaped by the environment: the state of medical science, the availability of tests, drugs and procedures, the circumstances of the patient and so on. At each consultation, the doctor will make judgments about ongoing treatment, weighing up all the available evidence, including test results and the patient's progress since the last visit.

What makes the Actuarial Control Cycle distinctly actuarial is the nature of the work carried out at each stage of the cycle. The problem will usually (though not always) involve uncertain future cash flows. The process of defining the problem includes understanding the background, fully identifying all the issues and specifying them clearly to ensure that the client and the actuary agree on the work to be done. The design of a solution will almost always involve modeling. The actuary may have ongoing responsibility for monitoring the experience as it develops and advising on the response, or may seek to build flexibility into the solution.

Figure 1.1¹ The Actuarial Control Cycle



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Figure 1.1 is a diagram of the Actuarial Control Cycle. In this diagram, we include the two components of the environment in which actuarial work is carried out. The actuary has to take account of external forces, such as economic conditions and the commercial setting. Then the whole process operates within the context of Professionalism, which is an inner guide to attitude and practice that governs the actuary in carrying out the work.

1.4 The structure of the book

The book contains seventeen chapters, each focusing on an aspect of the Actuarial Control Cycle, plus this *Introduction* and a final chapter on *Applying the Actuarial Control Cycle*. The order of the chapters roughly takes us round the cycle shown in Figure 1.1. However, the iterative nature of the cycle means that the topics are inter-related and we could easily have covered them in quite a different order. No topic can really be considered in isolation, so each author draws on concepts elsewhere in the book, both earlier and later. Generally, you should be able to understand each author's message without referring to the other chapters but the messages are likely to be clearer on your second reading of the book.

Chapters 2 to 7 cover the process of identifying and specifying the problem, including understanding the context. Our first topic, *Risk Management Frameworks* (Chapter 2), reflects the fact that actuarial problems typically deal with risk. A systematic framework helps us approach the problem, as well as helping the enterprises that actuaries advise to manage their risks. Next, *Being Professional* (Chapter 3) deals with the implications for an actuary of being a member of a profession. It is important that you understand these implications from the beginning, since they affect virtually everything an actuary does. *The Need for Financial Products* (Chapter 4) explains how products meet the needs of individuals and businesses. *The Context of Actuarial Work* (Chapter 5) describes how external forces must be allowed for by actuaries and the enterprises that they advise.

Next, we consider how businesses and regulators deal with risk. *Applying Risk Management* (Chapter 6) reviews how risk is managed in financial institutions, while *Regulation* (Chapter 7) discusses the impact of actions taken by governments, by courts and by other bodies that establish practices and accepted norms.

The next seven chapters cover the second stage: developing and implementing the solution. *Product Design* (Chapter 8) in some ways offers a solution: the development of a new product to meet some need. However, looked at from another perspective, the introduction of a new product is not an endpoint but the beginning of a whole new set of problems. How do we set a price for the product? How do we ensure that the product does not threaten the solvency of the provider? *Modeling* (Chapter 9), *Data and Assumptions* (Chapter 10), *Valuing Liabilities* (Chapter 12), *Pricing* (Chapter 13) and *Assets* (Chapter 14) provide the tools to help answer these questions. *The Need for Capital* (Chapter 11) comes in the middle of these chapters: you can think of this as representing the fact that capital is central to the Actuarial Control Cycle. Capital is needed to finance the cash outflows when expenses are incurred earlier than revenue is received and, most importantly for a financial institution, to absorb risks.

Four chapters cover the final stage of monitoring and responding to experience: *Solvency* (Chapter 15), *Profit* (Chapter 16), *Monitoring Experience* (Chapter 17) and *Responding to Experience* (Chapter 18). The Actuarial Control Cycle's feedback mechanism is explained, whereby monitoring outcomes leads to better understanding of both the problem and the solution, so that the solution can be improved.

Finally, we examine a number of examples from various types of actuarial work in *Applying the Actuarial Control Cycle* (Chapter 19).

Each chapter, covering a single topic, is written by a different author. As far as possible, we have allowed the author to speak in his/her own voice and to address the topic from his/her own perspective. This means that the writing style varies quite significantly. This presents challenges for the reader but reflects the realities of actuarial practice, where information must be gleaned from a variety of sources.

Throughout the book there are exercises to reinforce the concepts being discussed. Outline solutions can be found on the accompanying CD. The CD also contains articles for further reading. At the end of each chapter there is a list of the relevant items on the CD.

1.5 An illustration of the Actuarial Control Cycle

Let's review how the topics in this book fit together by considering a simple example. Suppose a life insurance company decides to sell lifetime annuities that increase in line with inflation. When the company sells an annuity, it immediately receives a large one-off payment (the single premium). Its commitment in return is to make regular, smaller, increasing payments for the lifetime of the customer. As this could be quite a long time, it is important that the company's risks are properly managed (Chapter 2). In particular, the actuaries advising the company have professional responsibilities (Chapter 3), because people will be entrusting a large part of their retirement savings to the company in exchange for a lifetime income.

What needs will these annuities meet and why will people want to buy them (Chapter 4)? What is the environment in which the company will offer these products (Chapter 5)? How are they taxed? Are competing products available? What is the outlook for interest rates, inflation rates and mortality rates?

The company must understand the sources of risk for these products, such as volatile inflation and increasing longevity (Chapter 6). And the regulators (Chapter 7) will also be concerned about risk.

The product has to be clearly specified (Chapter 8). Decisions are needed on design issues, such as whether or not the annuity has a guaranteed minimum payment period, what that period is and how inflationary increases are to be defined.

Once the product is specified, an actuary can develop a model to forecast the likely future cash flows for the product (Chapter 9). The actuary must analyze available data, both to shape the model and to help in setting assumptions (Chapter 10).

The model will be useful in a number of ways. First, it will help to determine the extent of the risk the company will face. The company needs to know how much capital (Chapter 11) to hold for these annuities, in case inflation is higher, or lifetimes are longer, than anticipated. The company needs to know the value of the long-term liability it will be taking on (Chapter 12).

Secondly, the model, including allowances for liabilities and capital, will help the company decide what prices, or premiums, to charge (Chapter 13) for the product, allowing for the risks involved and the interests of all stakeholders.

After meeting initial expenses, the balance of the single premium is invested in assets (Chapter 14) to generate income from which to make the regular annuity payments. The

selection of assets must take into account the nature of the liabilities, so that the company meets its obligations and achieves its profit objectives without taking excessive risks.

At regular intervals, the company will compare its assets and liabilities to determine whether it has sufficient capital – in particular, whether it meets the capital requirements set by the regulators and is therefore solvent (Chapter 15).

Shareholders, and the taxation authority, will also be interested in how much profit (Chapter 16) is being earned from the lifetime annuities.

In designing, pricing and managing the product, the company will need assumptions about investment earnings, inflation rates, mortality rates and expenses in the future. Over time, the actual rates experienced will be compared with those assumed. Any differences must be analyzed and understood (Chapter 17). An actuary will advise the company how to respond in the light of trends and changes emerging from this monitoring of experience (Chapter 18).

In the control cycle framework, the feedback process closes the loop. In addition, at any point in the cycle, there can be a return to a previous step. For example, if the modeling process shows that the annuity product involves too much risk, the product design stage could be revisited, to seek an alternative product design that could meet the customers' needs at less risk to the company.

1.6 Fred's coffee shop

The example in Section 1.5 is a simplified description of a typical actuarial problem. To help guide you through this book, we have invented another, atypical, example: Fred's coffee shop.

Fred is an actuary in a large financial institution. He enjoys his job but he also wants to try something new. He has recently decided to resign and set up a coffee shop.

We introduce each chapter with a discussion of how it relates to the coffee shop. We have chosen a coffee shop because the situation should be familiar to every reader – and, because it is not a financial services example, it should help you to appreciate how the Actuarial Control Cycle is applicable outside the financial services industry.

1.7 Applying the control cycle framework

The control cycle framework can be applied to the management of an entire financial institution. It can also be applied to subdivisions of the whole, such as subsidiary companies (eg a reinsurance subsidiary or an overseas company), business units (eg funds management), operational functions (eg claims handling), product groups (eg retail banking products) and, of course, individual products (eg disability income insurance). You will recognize cycles within cycles in many situations.

1.8 Communicating the results of actuarial work

It is not the role of this book to discuss the principles and practice of good communication. This does not mean, however, that they are not important for actuaries. An effective actuary needs more than just technical knowledge and skills and experience in applying them.

An actuary might produce technically superb models, projections, estimates and analyses, but whether or not they lead to good decisions, sound strategies, appropriate solutions and effective plans depends on two things. Did the actuary fully understand the client's (or employer's) real needs? Did the client fully understand the actuary's advice? If both answers are "yes," then sound technical work will make a difference.

Both good listening and strong oral and written communication skills are essential for an actuary. An actuary has to communicate effectively with clients and employers – and also with other professionals, such as accountants, lawyers, marketers and IT specialists. Many projects on which actuaries work generate questions that actuaries are not qualified to answer, so advice must be sought from someone who is qualified to give it.

1.9 Conclusion

The Actuarial Control Cycle is a useful framework but it should not be viewed as a template for every piece of work. Some roles that actuaries fulfill deal with only one stage of the cycle, or may not seem to have any direct connection with the cycle. Nonetheless, within this framework you will find principles that will be applicable to all actuarial work.

CD Items

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