CHAPTER 1 – OVERVIEW

Importance of Accurately Estimating Unpaid Claims

Accuracy in estimating unpaid claims is critical to insurers. Unlike manufacturers, insurers may not know the true cost of goods sold during a financial reporting period until several years later. An insurer sells its promise to pay the policyholder or an injured party on behalf of the policyholder in the event of an occurrence covered by the insurance policy. For some insured events, the insurer is able to quantify the exact costs of settlement quickly and with great precision. For other insured events, the insurer may not know the ultimate cost for years, and possibly decades. Nevertheless, the insurer must report its financial results on a regular basis. Claim reserves (also known as technical provisions in some parts of the world) represent the insurer's estimate of its current liabilities for claims that occurred on or prior to the financial statement reporting date but that have not yet been paid. Actuaries around the world work with insurers and self-insurers to quantify, evaluate, and monitor estimates of unpaid claims.

We can look at the importance of accurately estimating unpaid claims from three viewpoints:

— Internal management
— Investors
— Regulators

Internal Management

From an internal management perspective, accuracy in the estimation of unpaid claims is essential for proper decision-making in virtually every area of an insurance company's operations including, but not limited to, pricing, underwriting, strategic, and financial decisions. An accurate estimate of unpaid claims is particularly important in pricing insurance products as inaccurate estimates could threaten the financial condition of an insurer. For example, an inadequate estimate of unpaid claims could drive an insurer to reduce its rates not realizing that the estimated unpaid claims were insufficient to cover historical claims. In this situation, the new lower rates would likely be insufficient to pay the claims that will arise from the new policies. The problem could be exacerbated if the insurer gains market share as a result of the lower rates, which ultimately would prove to be inadequate to cover future claims. This chain of events could eventually lead to a situation where the future solvency of the insurer is at risk.

We can also envision the reverse situation where an excessive estimate of unpaid claims could be a factor in inappropriate pricing decisions that could put the future financial condition of the insurer at risk. A redundant estimate of unpaid claims may drive an insurer to increase rates unnecessarily. The increased rates could lead to loss of market share, resulting in a loss of premium revenue to the insurer. A significant loss of revenue could negatively impact the financial strength of the insurer.

An inaccurate estimate of unpaid claims can also lead to poor underwriting, strategic, and financial decisions. Financial results often influence an insurer's decision-making process regarding where to increase business and whether to exit a market that is underperforming. If the financial results are misstated due to an excessive estimate of unpaid claims, an insurer may inappropriately choose to exit a particular line of business or region; such a decision could

ultimately have a negative impact on the organization's future financial strength. In addition, an inaccurate estimate of unpaid claims can have a negative impact on the insurer's decisions regarding its reinsurance needs as well as its claims management procedures and policies. Finally, the accuracy of the unpaid claims estimate is also important for financial decision-making such as capital management, i.e., which lines of business get a larger proportion of allocated capital.

Investors

From the investors' perspective, accuracy in reserves is also essential to the decision-making process. Inaccurate reserves may lead to misstated balance sheets and income statements for the insurer. If reserves are incorrect, key financial metrics used by investors could be misleading. An insurer with insufficient reserves may present itself in a stronger position than it truly is. Conversely, an insurer with excessive reserves may show a weaker position than its true state. This could affect investors' decisions related to the insurer.

Regulators

Finally, insurance regulators rely on the financial statements of an insurer to carry out their supervisory role. Inaccurate reserves could result in a misstatement of the true financial position of an insurer. If a financially struggling insurer is masking its true state with inadequate reserves, a regulator may not become involved until too late in the process to help the insurer regain its strength.

Further Requirements for Accurate Reserves

State Law

Proper estimating of unpaid claims is more than just a necessity for managing, investing in, and regulating insurers – it is required by law. As early as the 1960s, the New York insurance law specified:

> … every insurer shall maintain reserves in an amount estimated in the aggregate to provide for the payment of all losses or claims incurred on or prior to the date of settlement whether reported or unreported which are unpaid as of such date and for which such insurer may be liable, and also reserves in an amount estimated to provide for the expenses of adjustments or settlement of such claims.

Today, many jurisdictions directly tie the legal requirements for accurate estimation of unpaid claims to the responsibilities of the actuary. The role of the Appointed Actuary has been created through insurance legislation in countries around the world.

National Association of Insurance Commissioners (NAIC)[1]

In the mid-1970s, due to the increasingly litigious environment in the U.S. and in reaction to the insolvencies of a number of property and casualty[2] (P&C) insurance companies, many of which involved inadequate claim reserves, the NAIC recommended that companies include claim reserve opinions (originally called certification of loss reserves) with their annual statements. The first opinion requirements emanated in 1980 from a limited number of state regulations.

In 1990, the NAIC began requiring that most P&C insurers in the U.S. obtain a Statement of Actuarial Opinion signed by a qualified actuary. The statement contains the qualified actuary's opinion regarding the reasonableness of the carried statutory loss and loss adjustment expense (LAE) reserves as shown in the statutory annual statement. In 1993, qualified actuaries signing statements of opinion started using the title of Appointed Actuary because the NAIC required that they must be appointed by the Board of Directors or its equivalent.

Other U.S.-Regulated Entities

Other U.S. non-NAIC regulated entities also require actuarial opinions. For example, many state insurance departments require opinions for captive insurers, self-insurers, and self-insurance pools as well as some underwriting pools and associations.[3]

Canada

In Canada, the Insurance Companies Act requires all federally regulated insurers to have an Appointed Actuary. The first responsibility of the Appointed Actuary, as set out in the Insurance Companies Act, is to value the actuarial and other policy liabilities of the company at the end of a financial year. The Appointed Actuary's valuation must be in accordance with generally accepted actuarial practice, which means complying with the rules and the standards set by the Canadian Institute of Actuaries (CIA). Further responsibilities, including the specific requirements of the Appointed Actuary's report on policy liabilities, are set forth by the Office of the Superintendent of Financial Institutions Canada (OSFI). Most provinces have adopted legislation similar to the federal insurance act, which defines the major responsibilities of the Appointed Actuary; thus, most provincial insurers also have an Appointed Actuary.

[1] As the organization of insurance regulators from the 50 states, the District of Columbia, and the five territories, the NAIC promotes the development of uniform policy when uniformity is appropriate. State insurance regulators created the NAIC in 1871 to address the need to coordinate the regulation of multi-state insurers.

[2] Property and casualty insurance is a term used most frequently in the U.S. and Canada; the terms non-life and general insurance are often used in other countries.

[3] There are many different types of captive insurers operating around the world. Generally, a captive is a limited purpose, licensed insurance company, the main business purpose of which is to insure or reinsure the risks of the captive's owners. Self-insurance describes a wide range of risk financing arrangements through which organizations pay all or a significant portion of their own losses. Underwriting pools and associations are created in some jurisdictions to provide coverage for specific exposures, such as residual market automobile or aviation, across the insurance industry.

Other Examples – Australia and Slovenia

We offer two additional examples of countries that have enacted insurance legislation that requires an actuary to be involved in the process of developing unpaid claim estimates. Insurance legislation in Australia requires insurance companies to have an Appointed Actuary. According to the Amendment of the Insurance Act (1973), the signed actuary's report must contain a statement of the actuary's opinion about each of the following:

- The adequacy of all or part of the amount specified in the general insurer's accounts in respect of its liabilities, and the amount that the actuary considers would be adequate in the circumstances
- The accuracy of any relevant valuations made by the actuary
- The assumptions used by the actuary in making those valuations
- The relevance, appropriateness, and accuracy of the information on which those valuations were based
- Any other matter in respect of which the prudential standards require a statement of the actuary's opinion to be included in the report

The Insurance Act of Slovenia specifies that every company that is authorized to perform insurance operations is obliged to appoint a certified actuary. The insurance legislation defines the tasks of the certified actuary as follows:

> A certified actuary shall be obliged to examine whether premiums are calculated and technical provisions set aside in accordance with the regulations, and whether they are calculated or set aside so as to ensure the long-term meeting of all the insurance underwriting's obligations arising from the insurance contracts. … A certified actuary shall be obliged to submit to the supervisory boards and boards of directors, together with the opinion on the annual report, a report on the findings of the certified actuary with regard to the supervision carried out in the preceding year pursuant to the first paragraph hereunder. The said report must, in particular, include the reasons for issuing a favorable opinion, an opinion with a reservation or an unfavorable opinion of a certified actuary on the annual statements.

These examples demonstrate the important role of actuaries in determining and opining on claim reserves for insurers around the world.

Organization of This Book

This book focuses solely on the estimation of unpaid claims for P&C insurers, reinsurers, and self-insured entities. It is an introduction to the topic for actuarial candidates who should only consider this text as the beginning of their learning. There is a vast array of literature on the estimation of unpaid claims available throughout the international actuarial community. We direct actuaries who want to expand their knowledge of the topic beyond the scope of this text to:

— Casualty Actuarial Society (CAS) seminars such as the Reserve Variability Limited Attendance Seminar and the Casualty Loss Reserve Seminar

— CAS publications including the *Proceedings of the Casualty Actuarial Society* (PCAS), *Forum*, *Discussion Paper Program*, and *Variance*

— International actuarial organizations such as The Institute of Actuaries of Australia and The Institute of Actuaries / The Faculty of Actuaries (UK)

We organize this book in the following four parts:

— Part 1 – Introduction
— Part 2 – Information Gathering
— Part 3 – Basic Techniques for Estimating Unpaid Claims
— Part 4 – Estimating Unpaid Claim Adjustment Expenses

We also include three appendices following Part 4 that contain the CAS Statement of Principles and specific actuarial Standards of Practice promulgated by the American Academy of Actuaries (Academy), which are related to unpaid claim estimate analysis.

In Part 1, we take a detailed look at the process for estimating unpaid claims from the perspective of the claims department. We follow a claim from its first report to the insurer, through the establishment of an initial case outstanding, to partial payments and changes in the case outstanding, and finally to ultimate claim settlement.

We dedicate Part 2 to the topic of information gathering. Before actuaries can delve into quantitative analysis of unpaid claims, they must gather information. This information includes detailed statistics summarizing the historical claims and exposure experience of the insurer as well as a thorough knowledge of the insurer's environment. We describe the types of data actuaries use and methods for organizing the data. We discuss the importance of meetings with those involved in the claims and underwriting processes and provide extensive details of the types of information the actuary should seek from such meetings. The development triangle is one of the most common tools used by actuaries to evaluate the performance of an insurer and to determine estimates of unpaid claims. In Part 2, Chapter 5, we describe how to create and use development triangles.

In Part 3, we explore basic techniques for estimating unpaid claims. We generally rely on examples based on the actual experience of insurers in the U.S. and Canada. (See further description regarding examples later in this chapter.) We use similar portfolios of insurance in successive chapters to allow a comparison of the results from different techniques. A changing environment, such as an increase in claim ratios, a shift in the strength of case outstanding, and a change in product mix, can have a pronounced effect on the accuracy of the estimation technique. In this part, we demonstrate through detailed examples the impact of various changes on each of the methodologies for estimating unpaid claims. We conclude Part 3 with an evaluation of all the methods presented in the previous chapters. In the final chapter for this part, we also discuss on-going monitoring of unpaid claim estimates.

The purpose of Part 4 is to present techniques for estimating unpaid claim adjustment expenses. Claim adjustment expenses are the costs of administering, determining coverage for, settling, or defending claims even if it is ultimately determined that the claim is invalid. Some claims

produce very little adjustment expenses; an example of such a claim is a house fire that is settled with only a few phone calls. Other claims, such as an asbestos claim, may revolve around complex legal and medical issues and may involve many interested parties. Claim adjustment expenses for an asbestos claim often involve litigation which can lead to high defense costs and expert fees and thus, very high expenses. In some cases, the claim adjustment expenses for asbestos claims may be significantly greater than the indemnity payment itself.

Historically, insurers categorized claim adjustment expenses as allocated loss adjustment expenses (ALAE) and unallocated loss adjustment expenses (ULAE).[4] ALAE correspond to those costs the insurer is able to assign to a particular claim, such as legal and expert witness expenses – thus, the name allocated loss adjustment expense. ULAE, on the other hand, is not easily allocated to a specific claim. Examples of ULAE include the payroll, rent, and computer expenses for the claims department of an insurer.

While actuaries in Canada still separate claim adjustment expenses into ALAE and ULAE, the NAIC promulgated two new categorizations of adjustment expenses (effective January 1, 1998) for U.S. insurers reporting on Schedule P[5] of the P&C statutory Annual Statement: defense and cost containment (DCC) and adjusting and other (A&O). Generally, DCC expenses include all defense litigation and medical cost containment expenses regardless of whether internal or external to the insurer; A&O expenses include all claims adjusting expenses, whether internal or external to the insurer.

The material in the appendices addresses some of the key professional obligations of U.S. and Canadian actuaries that are related to the estimation of unpaid claims as promulgated by the CAS and the Academy. The CAS Code of Professional Conduct states:

> It is the professional responsibility of an Actuary to observe applicable standards of practice that have been promulgated by a Recognized Actuarial Organization for the jurisdictions in which the Actuary renders Actuarial Services and to keep current regarding changes in these standards.

The Actuarial Standards Board (ASB) is a U.S. actuarial organization associated with the Academy that promulgates the standards of practice for the U.S. actuarial profession. Because the Academy is a "Recognized Actuarial Organization" and it issues standards of practice with respect to actuarial practice in the U.S., CAS members are required to observe the Academy's standard if they practice in the U.S. The controlling jurisdiction is the one in which the actuary renders the actuarial services. Therefore, CAS members who do not practice in the U.S. are not required to observe the Academy's standards but would instead be required to observe the standards set by any other recognized actuarial organization for the jurisdiction in which they practice (e.g., the CIA in Canada or the Institute/Faculty of Actuaries in the United Kingdom). The requirements for most of these organizations come in the form of standards of practice, educational notes, statements of principles, and other professional guidelines. In the

[4] In Canada, ULAE is also referred to as internal loss adjustment expense (ILAE).

[5] Schedule P is an important section of the U.S. P&C statutory Annual Statement. In his paper "Completing and Using Schedule P," (*CAS Forum*, 2002) Sholom Feldblum states: "Schedule P is the actuarial portion of the Annual Statement and is critical to monitoring the solvency of insurers." Schedule P includes a ten-year summary, by line of insurance, of earned premiums, claim and claim expense payments, and unpaid claims and expenses; it also contains claim development schedules (also by line of insurance) for incurred net claims, paid net claims, and net bulk and incurred but not reported (IBNR) reserves.

appendices to this book, we provide, in their entirety, selected CAS and Academy documents related to the estimation of unpaid claims.

Ranges of Unpaid Claim Estimates

Throughout the book, we focus on obtaining point estimates for unpaid claims and claim-related expenses. We demonstrate the potential difficulty in obtaining one single estimate of the claims liability through numerous examples applied to the same line of business for the same experience period. Each of the methods presented results in a different value of the unpaid claim estimate. Furthermore, we recognize that, to the extent that we are dealing with the estimation of the mean of a stochastic process, the actual unpaid claims will almost always differ from the estimate.

Clearly, a range of estimates of the unpaid and a statement of our confidence that the actual unpaid claims (as proven at final development) will be within the stated range are valuable to management, regulators, policyholders, investors, and even the general public. However, the insurer's balance sheet requires the insurer to record a point estimate of the unpaid claims.[6]

Actuarial Standard of Practice No. 43 (ASOP 43) adopted in June 2007 by the ASB defines the *actuarial central estimate* as an estimate that represents an expected value over the range of reasonably possible outcomes. It is beyond the scope of this book to address ranges of unpaid claim estimates. We refer the reader to the wealth of material published by the CAS and various other international actuarial organizations on the subject of ranges for unpaid claim estimates.

Background Regarding the Examples

Differences in Coverages and Lines of Business Around the World

There are significant differences in the types of P&C insurance offered around the world. There are also differences in the names that are used for similar coverages throughout the world. For example, in the U.S. and Canada, insurers use the name "automobile insurance" to refer to the P&C coverage for automobiles and trucks; insurers from the U.K. call this coverage "motor insurance"; insurers conducting business in India refer to this coverage as "car insurance"; and in South Africa, insurers use both "car insurance" and "motor insurance." Similarly, the name of the coverage protecting personal homes and possessions is "homeowners insurance" in the U.S. and Canada, "home insurance" in India, and "home insurance" or "homeowners insurance" in Australia. In South Africa, some insurers differentiate between "household content" and "household building" insurance.

Some of the major coverages for U.S. P&C insurers, such as workers compensation or medical malpractice, may not exist at all in other countries, or if they exist, they may operate in a very different way. For example, in Canada, workers compensation insurance is not categorized as a P&C insurance coverage and is not sold by insurers. Instead, Canadian workers compensation coverage is provided by monopolistic provincial funds; pension and life (not P&C) actuaries typically provide actuarial services to the provincial workers compensation funds.

[6] In a number of countries (e.g., Australia, Singapore, the United Kingdom, and South Africa), insurers are required to hold provisions (i.e., the estimate of unpaid claims) at the 75% confidence level.

Since this text was written with the hope that it would be used by actuaries throughout the world, the differences in both the names of the coverages and the coverages themselves presented a challenge in creating meaningful examples. There was an even greater challenge in finding sources of data representative of the wide range of claims behavior that often exists in different P&C coverages. Due to limitations in readily available global data sources, we rely on claim development data contained in *Best's Aggregates & Averages Property/Casualty United States & Canada – 2008 Edition* (*Best's Aggregates & Averages*)[7] for many of our examples. We also rely on actuarial colleagues at Canadian insurers who volunteered data from their organizations. This data has been disguised through the use of multipliers and adjustments to protect the privacy of the organizations.

While the names of the particular coverages and the patterns inherent in the data used in our examples may be unique to the U.S. or Canadian insurance environments, we believe that actuaries can apply the approaches, issues, and methodologies within the P&C (i.e., general or non-life) insurance market of any country around the world.

Description of Coverages Referred to in This Book

As noted above, we refer to and use examples for U.S. and Canadian lines of insurance. To assist the reader in understanding these types of coverage, we briefly describe each P&C coverage referred to in the text. The insurance *coverages* (also referred to as *lines of business*) listed below are in alphabetical order.

— *Accident benefits* is a Canadian no-fault automobile coverage that provides numerous benefits following a covered accident including: medical and rehabilitation expenses, funeral benefits, death benefits, and loss of income benefits. Because this is a no-fault coverage, it is payable by the insured's insurer regardless of fault for the accident.

— *Automobile property damage* is a subcoverage of automobile liability insurance and provides protection to the insured against a claim or suit for damage to the property of a third-party arising from the operation of an automobile.

— *Collision* is a subcoverage of automobile physical damage coverage providing protection against claims resulting from any damages to the insured's vehicle caused by collision with another vehicle or object. Collision is a first-party coverage and responds to the claims of the insured when he or she is at fault.

— *Commercial automobile liability* is a coverage that provides protection from the liability that can arise from the business use of owned, hired, or borrowed automobiles or from the operation of an employee's automobiles on behalf of the business.

— *Crime insurance* protects individuals and organizations from loss of money, securities, or inventory resulting from crime, including but not limited to: employee dishonesty, embezzlement, forgery, robbery, safe burglary, computer fraud, wire transfer fraud, and counterfeiting.

[7] *Best's Aggregates & Averages* is a comprehensive reference with current and historical statistics on the U.S. and Canadian P&C insurance industries. It provides industry-wide aggregates and long-term statistical studies. It also provides a complete financial overview of the P&C industry based on consolidated industry performance.

— *Direct compensation* is a Canadian automobile coverage that provides for damage to, or loss of use of, an automobile or its contents, to the extent that the driver of another vehicle was at fault for the accident. It is called direct compensation because, even though someone else caused the damage, the insured person collects directly from his or her insurer instead of from the person who caused the accident.

— *General liability* in the U.S. and Canada covers a wide array of insurance products. The principal exposures covered by general liability insurance are: premises liability, operations liability, products liability, completed operations liability, and professional (i.e., errors and omissions) liability.

— *Medical malpractice* is also known as medical professional liability insurance. This coverage is often further separated into hospital professional and physician/surgeon professional liability insurance. Medical malpractice coverage responds to the unique general liability exposures present for insureds (both individuals and organizations) offering medical care and related professional services. We use an example from a pivotal paper, "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach" by James R. Berquist and Richard E. Sherman.[8] While the data for the medical malpractice example is obviously very dated, the methodology, approach, and conclusions remain applicable today.

— *Personal automobile insurance* is also known as private passenger automobile insurance. Automobile insurance (either personal or commercial) can provide a variety of coverages, including first-party and third-party coverages; the available coverages are dependent upon the jurisdiction in which the insurance is written.

— *Primary insurance* refers to the first layer of insurance coverage. Primary insurance pays compensation in the event of claims arising out of an insured event ahead (first) of any other insurance coverages that the policyholder may have.

— *Private passenger automobile liability* provides third-party liability protection to the insured against a claim or suit for bodily injury or property damage arising out of the operation of a private passenger automobile.

— *Private passenger automobile physical damage* is a personal lines coverage providing protection against damage to or theft of a covered private passenger automobile.

— *Property insurance* provides protection against most risks to property, such as fire, theft, and some weather damages. There are many specialized forms of property insurance including fire insurance, flood insurance, earthquake insurance, home insurance, and boiler and machinery insurance.

— *Umbrella and excess insurance* typically refers to liability types of coverage available to individuals and companies protecting them against claims above and beyond the amounts covered by primary insurance policies or in some circumstances for claims not covered by the primary policies.

[8] *PCAS*, 1977.

— *U.S. workers compensation* provides coverage for the benefits the insured (i.e., the employer) becomes legally responsible for due to workplace injury, illness, and/or disease. The complete name for this U.S. coverage is workers compensation and employers liability insurance. U.S. workers compensation also covers the cost to defend against, and possibly pay, liability claims made against the employer (i.e., the insured) on account of bodily injury to an employee.

Key Terminology

We generally use *italics* for the first reference and definition of a new term. Throughout this text, we strive to use definitions contained within Standards of Practice and Statements of Principles of the CAS and the Academy. We indicate where definitions of the CAS or Academy differ from the Standards of Practice of the CIA. We also strive to clearly identify wherever we deviate from definitions of the U.S. and Canadian professional actuarial organizations.

At the end of each chapter, we present exhibits, some of which include multiple sheets, in Roman numeric order. On all these exhibits, we include detailed footnotes supporting the calculations.

Insurer

Throughout this book, we use the term *insurer* to represent any risk bearer for P&C exposures, whether an insurance company, self-insured entity, or other. There are certain situations where a different approach or different factors within a technique may be more appropriate for insurance companies (including reinsurance companies) than self-insurers (including organizations with funded self-insured programs, captive insurers, pooling associations, etc.). When this happens, we clearly identify the appropriate course of action for the specific type of risk bearer.

Reserves

The term *reserves* itself is tricky. The financial statements of insurers in the U.S. and Canada contain many different types of reserves including: case reserves, loss reserves, bulk and IBNR reserves, case LAE reserves, unearned premium reserves, reserves for bad debts, reserves for rate credits and retrospective adjustments, general and contingency reserves, and earthquake reserves. The primary focus of this text, however, is estimating unpaid claims and claim adjustment expenses.

ASOP 43 limits the term reserve to its strict definition as an amount booked in a financial statement. ASOP 43 defines the term *unpaid claim estimate* to be the actuary's estimate of the obligation for future payment resulting from claims due to past events. ASOP 43 further defines *unpaid claim estimate analysis* to be the process of developing an unpaid claim estimate.

In this text, we strive to use terminology consistent with ASOP 43. We acknowledge that many actuaries and the professionals they work with are more familiar with the term reserves than unpaid claim estimate; similarly, the term reserving is more frequently used today than estimating unpaid claims. Nevertheless, we predominantly use the terminology of ASOP 43, in an attempt to be consistent with more recent CAS developments aimed at improving communication and an

effort to use terminology that is consistent with actuarial standards of practice throughout the world.

We differentiate between *unpaid claim estimate* and *carried reserve*. The unpaid claim estimate is the result of the application of a particular estimation technique. For the same line of business and the same experience period, different estimation techniques will likely generate different unpaid claim estimates. In addition, the unpaid claim estimate will likely change from one valuation date to another for the same portfolio. The carried reserve for unpaid claims is the amount reported in a published statement or in an internal statement of financial condition.

The unpaid claims estimate includes five components: case outstanding on known claims, provision for future development on known claims, estimate for reopened claims, provision for claims incurred but not reported, and provision for claims in transit (i.e., claims reported but not recorded). We use the terms *case outstanding* or *unpaid case* to refer to the estimates of unpaid claims established by the claims department, third-party adjusters, or independent adjusters for known and reported claims only; case outstanding do not include future development on reported claims. Actuaries refer to the sum of the remaining four components (i.e., provision for future development on known claims, estimate for reopened claims, provision for claims incurred but not reported, and provision for claims in transit) as the broad definition of *incurred but not reported* (*IBNR*).

IBNR claims are often further separated into two components:

— Incurred but not yet reported claims (pure IBNR or narrow definition of IBNR)
— Incurred but not enough reported (IBNER, commonly referred to as development on known claims)

One of the most important reasons for separating IBNR into its components is to test the adequacy of case outstanding over time. This can be an important management tool and a useful tool for the actuary when determining which methods are most appropriate for estimating unpaid claims.

Throughout this book, unless specifically noted otherwise, we use the broad definition of IBNR. We also use the terms *IBNR* and *estimated IBNR* interchangeably.

In Part 2, Chapter 3, we discuss the importance of the actuary completely understanding the different types of data provided for the purpose of estimating unpaid claims. The actuary must understand whether or not the data include or exclude: IBNR, estimates of unpaid claim adjustment expenses, recoverables from salvage and/or subrogation, reinsurance recoveries, and policyholder deductibles.

Claims, Losses, and Claim Counts

The terms *claims* and *losses* are used interchangeably in this text. We purposefully use the term claims rather than losses since claims is used more frequently in standards of practice of the U.S. and Canadian actuarial organizations as well as other international actuarial organizations. The term claims is also more frequently used for financial reporting purposes of insurers. We recognize that the current practice within many U.S. and Canadian insurance organizations is still to use the term losses – particularly when referring to ultimate losses, expected losses, loss ratios,

and loss adjustment expenses. Nevertheless, we have specifically selected to use the term claims. Thus, in this text, we refer to ultimate claims, expected claims, claim ratios, and claim adjustment expenses.

We differentiate between claims (dollar values) and *claim counts (*or *number of claims*).

Reported Claims

In this text, we use the term *reported claims* instead of incurred claims (or incurred losses). While the term incurred losses is used by many throughout the P&C insurance industry, it can be misunderstood as to whether or not it includes IBNR. Many actuaries use the labels *case incurred* or *incurred on reported claims* to specifically note that the losses do not include IBNR. For consistency and simplicity throughout this book, we choose the term *reported claims*. Reported claims (both in the text and exhibits of this book) generally refer to the sum of cumulative paid claims and case outstanding estimates at a particular point in time. In certain methods or discussions, which are clearly defined in the text, we will refer to incremental instead of cumulative reported claims.

Ultimate Claims

Ultimate claims represent the total dollar value after all claims are settled and closed without any chance of reopened claims.[9] For some *short-tail* lines of insurance, such as some lines of property insurance and automobile physical damage, insurers generally know the value of ultimate claims within a relatively short period of time, often within one or two years after the end of the accident period. However, for *long-tail* lines of insurance, such as U.S. general liability and workers compensation, it may take many years, and in some situations even decades, before the insurer knows the value of ultimate claims.

A key step in the actuarial process of estimating unpaid claims is the projection of ultimate claims. In this book we present numerous techniques for estimating unpaid claims. While you can mathematically manipulate many of the methods to simply derive the unpaid claim estimate, wherever possible we first present the projection of ultimate claims. Using the projected ultimate claims, we then calculate the estimate of unpaid claims for IBNR and the total unpaid claim estimate (i.e., the sum of IBNR and case outstanding). We believe that the projected ultimate claims are valuable for the purpose of evaluating and selecting the final unpaid claim estimate and for determining the accuracy of the prior estimate of unpaid claims. We address the evaluation of numerous estimation techniques in detail in the last chapter of Part 3.

Claim-Related Expenses

In this text, we use the terms *claim adjustment expenses* and *claim-related expenses* to refer to total claim adjustment expenses (i.e., the sum of ALAE and ULAE, or the sum of DCC and

[9] Some accounting approaches estimate ultimate claims on a policy year basis in a manner that includes losses yet to be incurred. In this book, we address only losses incurred through a specified point in time.

A&O). We continue to use the terms ALAE and ULAE because of their wide-spread use and acceptance. In our examples, unless specifically noted, claims include ALAE and exclude ULAE.

Experience Period

We use the term *experience period* to refer to the years included in a specific technique for estimating unpaid claims.

Emergence

In this book, the term *emergence* is used to refer to the reporting or development of claims and claim counts over time. In Canada, many actuaries use the term emergence to refer to the rate of payment of ultimate claims, particularly in the context of calculating estimates of discounted claim liabilities.

CHAPTER 2 – THE CLAIMS PROCESS

Overview

The financial condition of a P&C insurer cannot be assessed accurately without sound estimates of unpaid claims. But what are unpaid claim estimates and where do they come from? Claim and claim adjustment expense reserves (as reported on an insurer's financial statements) represent an insurer's liability for unpaid claims as of a particular point in time. Both claims professionals and actuaries have responsibilities related to the unpaid claim estimate of an insurer. As previously noted, there are five elements comprising the total unpaid claim estimate:

- Case outstanding
- Provision for future development on known claims
- Estimate for reopened claims
- Provision for claims incurred but not reported
- Provision for claims in transit (incurred and reported but not recorded)

Claims professionals are responsible for estimating case outstanding on claims that are reported to the insurer; these estimates are also known as "unpaid case" and "case estimates." According to consolidated claim development data for the U.S. insurance industry as a whole, unpaid case, net of reinsurance, represent less than 50% of total unpaid claims and claim expenses.[10] (The proportion of unpaid case to total unpaid claims varies tremendously by line of business and from insurer to insurer.) While claims professionals typically estimate case outstanding, actuaries are responsible for estimating the remaining components of total unpaid claims.

In this chapter, we focus on the unpaid claim estimate from the perspective of the claims professional. As we will see in later chapters, actuaries rely on the historical variations in the case outstanding generated by claims professionals as a base for determining the remaining components of total unpaid claims. Therefore, it is important for the actuary to understand the entire claims process. The actuary must understand why the estimated value of a reported claim could vary over time and how changes in case outstanding are processed by an insurer.

Claims Professionals

The claims professional, who is often referred to as a claims examiner or claims adjuster, can be an employee of the insurer or an employee of an organization external to the insurer. Large commercial insurers generally maintain internal claims departments with many claims adjusters managing the claims. Small to mid-sized commercial insurers and self-insurers often hire third-party claims administrators (TPAs) to handle a specific book of claims. TPAs frequently handle the claims from beginning to end (i.e., from the initial report to the final payment). Insurers usually require the TPA to report details of the claims on a predetermined basis (e.g., monthly or quarterly). In certain circumstances, a TPA manages all the claims of an insurer, and the insurer only has a minimal number of claims personnel reviewing the activities of the TPA. The compensation for services of a TPA is generally based on a contract for the entire book of business and not by individual claim, though compensation varies among TPAs.

[10] The source of data is *Best's Aggregates & Averages* (2008 Edition), consolidated annual statement data for the U.S. insurance industry.

An insurer may hire an independent adjuster (IA) to handle an individual claim or a group of claims. The insurer, who may have an active claims department, may need an IA to handle a specific type of claim or a claim in a particular region where the insurer does not have the necessary expertise. Also when a disaster occurs, such as a hurricane or earthquake, the insurer may hire a number of IAs (or a firm of IAs) to handle the large volume of claims. The compensation for the services of IAs is generally based on a fee per claim.

A Claim is Reported

The estimation process for unpaid claims begins when an insured first reports a claim, or notice of an event, to the insurer. Insureds may report claims in several ways, including but not limited to: telephone (often to a call center), Internet (the insurer's Web site), e-mail, in person at an insurer's branch office, notice to an insurance intermediary (such as an insurance agent or broker), or a lawyer's letter with a formal statement of claim. A claims professional of the insurer then reviews the initial claim report.

The first decision a claims adjuster, either internal or external to the insurer, encounters is whether or not the reported claim is covered under the terms of a valid policy. To determine whether the reported incident represents a covered claim and to assist in the establishment of an initial case outstanding estimate, claims professionals generally review the following:

— Effective dates of the policy
— Date of occurrence
— Terms and conditions of the policy
— Policy exclusions
— Policy endorsements
— Policy limits
— Deductibles
— Reinsurance or excess coverage
— Reporting requirements
— Mitigation of loss requirements
— Extent of injury and damages
— Extent of fault
— Potential other parties at fault
— Potential other sources of recovery

Once the claims professional recognizes that a liability exists, or may exist, for a covered incident, he or she will establish an initial case outstanding. For some types of claims, insurers may rely on a formula or tabular value[11] as the basis of the initial case outstanding. For example, an insurer may initially set all automobile physical damage glass claims at $500. For U.S. workers compensation claims, the insurer may use a tabular system where the type of injury dictates the initial case outstanding value. For other types of claims, a claims professional may

[11] Tabular estimates of unpaid claims are used for some lines of insurance whereby initial case outstanding values are set based on specific predetermined formula, which take into account characteristics of the injured party and the insurance benefits. The use of tabular values would be most common for accident benefits and U.S. workers compensation insurance. Not all insurers, however, writing these coverages use tabular systems.

analyze the specific details of the insured event to generate an independent estimate of the initial case outstanding.

It is important to recognize that claims professionals generally estimate case outstanding based on the information known at that time. As additional information about a claim becomes available, the estimated value of the claim will likely change. (We demonstrate this point later in the chapter with a detailed example.)

There are several different approaches commonly used by insurers to set case outstanding. These different approaches may best be understood with an example. Assume a claim is reported under a medical malpractice policy with a policy limit of $1 million. One of the most common approaches is to establish the case outstanding based on the best estimate of the ultimate settlement value of such a claim including consideration of future inflationary forces. Other insurers may set the case outstanding based on the maximum value, which would be the policy limit of $1 million. Another approach is for the claims adjuster to seek the advice of legal counsel. Assume that the legal counsel estimates that there is an 80% chance that the claim will settle without any payment and a 20% chance of a full policy limit claim. Some insurers may then set the case outstanding based on the mode, which would be $0; and others may set the case outstanding based on the expected value calculation or $200,000 [(80% x $0) + (20% x $1 million)].

Insurers differ in their practices with respect to the establishment of case outstanding for claim adjustment expenses. While some insurers establish case outstanding for the estimated claim amount only; others establish case outstanding for the estimated claim amount and all claim-related expenses. Even for those insurers who do establish total estimated claim amount and claim adjustment expense case outstanding, there are differences in whether or not the case outstanding for estimated claim amount and claim-related expenses are recorded and tracked separately. Some insurers may establish case outstanding for ALAE (or DCC) only and other insurers for ULAE (or A&O) only.

There are also different practices for the establishment of case outstanding for salvage and subrogation recoveries. Some insurers set up specific case outstanding based on an estimate of the salvage or subrogation recovery that the insurer expects to receive (i.e., the case outstanding is net of expected salvage and subrogation recoveries). Many insurers, however, simply track the actual salvage and subrogation recoveries but do not establish case outstanding for these types of recoveries.

For many insurers, determining the case outstanding for reinsurance recoveries is a fairly straight-forward exercise. When the reinsurance is proportional (i.e., quota share), insurers determine the ceded case outstanding based on the reinsurer's share of the total case outstanding. If the reinsurance is excess of loss, the reinsurance ceded case outstanding for a claim that exceeds the insurer's retention is simply the total case outstanding estimate (provided that the claims adjuster estimates the case outstanding on a total limits basis) less the insurer's retention.

The Life of a Claim

One single insurance claim may have a life that extends over a number of years. We will use the example of an automobile insurer who issued a policy effective for a one-year term beginning on December 1, 2007 and ending on November 30, 2008. Assume an accident occurred on November 15, 2008, and the insurer did not receive notice of the claim until February 20, 2009,

more than two months after the end of the policy year. Starting on February 20, 2009 (the report date of the claim), a claims professional will record a number of transactions related to this claim.

The different types of claim transactions over the life of the claim could include:

- Establishment of the initial case outstanding estimate
- Notification to the reinsurer if the claim is expected to exceed the insurer's retention
- A partial claim payment to injured party
- Expense payment for independent adjuster
- Change in case outstanding estimate
- Claim payment (assumed to be final payment)
- Takedown of case outstanding and closure of claim
- Reopening of the claim and establishment of a new case outstanding estimate
- Partial payment for defense litigation
- Final claim payment
- Final payment for defense litigation
- Closure of claim

We summarize the details for our sample claim in the following table. (We use the abbreviation case O/S for case outstanding in the following table.)

Table 1 – Claim Fact Summary

Policy Period	December 1, 2007 to November 30, 2008
Date of Accident	November 15, 2008
Date of Claim Report	February 20, 2009

Claim Transactions

Date	Transaction	Reported Value of Claim to Date	Cumulative Paid to Date
February 20, 2009	Case O/S of $15,000 established for claim only	$15,000	$0
April 1, 2009	Claim payment of $1,500 – case O/S reduced to $13,500 (case O/S change of -$1,500)	$15,000	$1,500
May 1, 2009	Expense payment to IA of $500 – no change in case O/S	$15,500	$2,000
September 1, 2009	Case O/S for claim increased to $30,000 (case O/S change of +$16,500)	$32,000	$2,000
March 1, 2010	Claim thought to be settled with additional payment of $24,000 – case O/S reduced to $0 and claim closed (case O/S change of -$30,000)	$26,000	$26,000
January 25, 2011	Claim reopened with case O/S of $10,000 for claim and $10,000 for defense costs	$46,000	$26,000
April 15, 2011	Partial payment of $5,000 for defense litigation and case O/S for defense costs reduced to $5,000 – no change in case O/S for claim	$46,000	$31,000
September 1, 2011	Final claim payment for an additional $12,000 – case O/S for claim reduced to $0 (case O/S change of -$10,000)	$48,000	$43,000
March 1, 2012	Final defense cost payment for an additional $6,000 – case O/S for defense costs reduced to $0 and claim closed (case O/S change of -$5,000)	$49,000	$49,000

As explained in Chapter 1, case outstanding represent the sum of the values assigned to specific known claims whether determined by claims adjusters or set by formula. In our example, case outstanding refers to the estimates, for claim and claim-related expenses (e.g., IA and defense costs), for the one claim that occurred on November 15, 2008. The initial case outstanding is the adjuster's estimate of the total amount the insurer will pay on this individual claim at the time of first notice to the insurer (i.e., February 20, 2009).

The example in Table 1 illustrates a number of important characteristics of insured claims. First, claim activity typically extends over a period of time – more than three years for this particular claim. Second, the estimated value of a claim can change over the life of the claim and is not ultimately established until the claim is finally closed. In our example, the insurer initially closes

the claim on March 1, 2010, but then reopens it almost one year later on January 25, 2011, with an increase to the case outstanding. The estimated case outstanding value can turn out to be too high or too low, although it is reasonable in light of the information available at the time when the claims professional sets the estimate.

A third characteristic is that an insured claim can have many different types of payments associated with it. In our example, the insurer makes an initial claim payment to the injured party on April 1, 2009. This claim payment provides for out-of-pocket medical expenses reported by the claimant. Since the insurer questioned the validity of the claim, they hired an IA; as a result, there was a payment of $500 for the IA's services on May 1, 2009. (Insurers in the U.S. would classify this type of expense as A&O; in Canada, they would categorize this expense as ALAE.) On March 1, 2010, the insurer makes another payment of $24,000 to the claimant for lost wages and additional medical expenses. At this time, the insurer assumes this to be the final payment. Roughly one year later, a claims professional reopens the claim. Over the course of the following year, the insurer makes further payments for defense litigation, additional lost wages, and medical expenses.

A fourth characteristic of insured claims is that there are many dates associated with each claim:

— *Policy effective date* is the date the insurer issues the insurance policy (December 1, 2007)

— *Accident date*, or date of loss, is the date the covered injury occurs (November 15, 2008)

— *Report date* is the date the insurer receives notice of the claim (February 20, 2009)

— *Transaction date* is the date on which either a case outstanding transaction takes place or a payment is made (see all the dates in the preceding table)

— *Closing dates* are the dates on which the claim is initially closed (March 1, 2010) and finally closed (March 1, 2012)

— *Reopening date* is the date the insurer reopens the claim (January 25, 2011)

This example clearly does not cover every combination of transactions possible. Some claims open and close on the same day with a single payment. Such claims would have only one transaction and would likely never show a case outstanding value. In our example, when the partial payment occurs on April 1, 2009, the insurer reduces the case outstanding estimate by exactly the same amount as the claim payment. However, this chain of events may not happen for all claims. As an insurer makes a specific payment, it may choose to reduce the case outstanding more than the payment, less than the payment, not reduce it at all, or even increase it, depending on the exact circumstances of the particular claim.

The payments on a specific claim are the amounts paid through a given date or over some specified time period. Therefore, when referring to paid claims, it is important to clearly state whether the claims are cumulative or incremental. Cumulative paid claims refer to the sum of all claim payments through the valuation date. Incremental paid claims refer to the sum of all claim payments made during a specified time interval.

In the above example, the cumulative paid claims including claim-related expenses are:

— $1,500 at April 1, 2009
— $2,000 at May 1, 2009
— $26,000 at March 1, 2010
— $31,000 at April 15, 2011
— $43,000 at September 1, 2011
— $49,000 at March 1, 2012

The incremental paid claims during calendar year 2009 (January 1, 2009 to December 31, 2009) are $2,000; the incremental paid claims during calendar years 2010, 2011, and 2012 are $24,000, $17,000, and $6,000, respectively.

The case outstanding is the estimated amount of future payments on a specific claim at any given point in time. In our example, the initial case outstanding recorded on the report date of the claim is $15,000. This amount varies over the life of the claim; just before the claim initially closes in March 2010, the case outstanding is $30,000. When the claim is reopened in January 2011, a new case outstanding is established for both claim amount and defense costs. Ultimately, the claim settles for a greater amount than the case outstanding for both claim amount and defense costs.

Similar to paid claims, it is important to define the time period when referring to reported claims. Generally, when looking at a specific claim, we use the term "reported claims" (or case incurred) to mean the sum of cumulative claim payments through a specific date and the case outstanding at the same point in time. Using the example above, the reported claims are:

— $15,000 at the time of first report (i.e., February 20, 2009)

— $15,500 at May 1, 2009 after a payment of $500 to an IA

— $32,000 at September 1, 2009, when the insurer increases the case outstanding to $30,000 ($2,000 cumulative paid claims + $30,000 case outstanding)

— $26,000 upon initial closing on March 1, 2010 ($26,000 cumulative paid claims + $0 case outstanding)

— $46,000 upon reopening on January 25, 2011 ($26,000 cumulative paid claims + $10,000 claims and $10,000 defense costs case outstanding)

— $48,000 at September 1, 2011 after final claim payment ($43,000 cumulative paid claims and LAE + $5,000 case outstanding for defense costs)

— $49,000 at March 1, 2012 after final defense costs payment ($49,000 cumulative paid claims and LAE + $0 case outstanding)

For a particular claim, we calculate the reported claims over a period of time as the reported claims at the end of the period minus the reported claims at the beginning of the period. Mathematically, this is equivalent to adding the incremental paid claims over the period to the change in case outstanding (ending case outstanding minus beginning case outstanding). In our example, the reported claims for the period beginning on January 1, 2009 and ending on December 31, 2009 are $32,000. As of January 1, 2009, the claim was not yet reported and thus

there are $0 reported claims for the claim. The incremental claim payments during 2009 are $2,000 and the change in case outstanding is $30,000 ($30,000 ending case outstanding minus $0 beginning case outstanding). The reported claims over the period January 1, 2010 to December 31, 2010 are -$6,000. The incremental claim payments in 2010 are $24,000 and the change in case outstanding is -$30,000 (ending case outstanding of $0 minus beginning case outstanding of $30,000). You can use similar calculations to derive the reported claims during 2011 and 2012.

As indicated above, we use the term "reported claims" under two contexts, incremental and cumulative, and it is important to look at the time period involved to differentiate between these two contexts. For a particular claim or the aggregate of a group of claims, we can summarize reported claims at a specific point in time. In such a context, reported claims are equal to the sum of cumulative paid claims through a specific date and case outstanding as of that same date. Many actuarial projection techniques rely on this definition of reported claims.

Reported claims can also refer to the claim activity over an interval of time. An example of reported claims used in this context is the insurer's income statement. As previously mentioned, we define the reported claims over a period of time using the following formulae:

Reported claims = reported claims at end of period – reported claims at beginning of period

Reported claims = paid claims during period + case outstanding at end of period
– case outstanding at beginning of period

Further Claim Examples

In Table 2 (on the following page), we present additional illustrations of how claim transactions can affect reported claims. (We use the abbreviation case O/S to refer to case outstanding in Table 2.)

Table 2 – Examples of Changes in Reported Values

	At December 31, 2007			Transactions During 2008			At December 31, 2008		
Example Number	Cumulative Paid Claims	Case O/S	Reported Claims	Paid Claims	Change in Case O/S	Reported Claims	Cumulative Paid Claims	Case O/S	Reported Claims
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	-	-	-	100	-	100	100	-	100
2	200	-	200	50	-	50	250	-	250
(Making payments where there had been no previous case outstanding increases reported claim.)									
3	-	-	-	-	1,000	1,000	-	1,000	1,000
(Establishing a case outstanding increases reported claim by the amount of the case outstanding.)									
4	-	1,000	1,000	100	(100)	-	100	900	1,000
(Payment with offsetting case outstanding reduction has no effect on reported claim.)									
5	500	5,000	5,500	200	(1,000)	(800)	700	4,000	4,700
(If case outstanding is reduced by a larger amount than the claim payment, the impact is a reduction to reported claim.)									
6	5,000	10,000	15,000	12,000	(10,000)	2,000	17,000	-	17,000
(If payment on closing exceeds case outstanding, reported claim transaction is positive.)									
7	5,000	10,000	15,000	6,000	(10,000)	(4,000)	11,000	-	11,000
(If payment on closing is less than case outstanding estimate, reported claim transaction is negative.)									
8	5,000	15,000	20,000	4,500	-	4,500	9,500	15,000	24,500
(Claim payment with no change in case outstanding increases the reported claim.)									
9	3,000	10,000	13,000	-	(4,000)	(4,000)	3,000	6,000	9,000
(No payment and decrease in case outstanding decreases the reported claim.)									
10	2,000	10,000	12,000	1,000	5,000	6,000	3,000	15,000	18,000
(Payment and increase in case outstanding result in increase in reported claim.)									

Columns (4) and (10) of the above table show reported claims as of year-end 2007 and 2008, respectively. Reported claims at a point in time (i.e., year-end 2007 and 2008) are equal to the cumulative claim payments plus the case outstanding at that point in time. However, reported claims shown in Column (7) represent the incremental reported value during the period of time running from January 1, 2008 to December 31, 2008. Reported claims over the year are equal to sum of the payments during the year (Column (5)) and the changes in case outstanding (Column (6)).

The transactions presented in Table 2 vary with respect to the impact on total reported claims. In the first two examples, there are payments made in 2008 on claims where there was no prior existing case outstanding at December 31, 2007; thus total reported claims for both of these claims increase. Such payments could occur when the insurer reopens a claim. In a situation where the payment made during the year is offset by an equal reduction in the case outstanding, there is no change to reported claim (Example Number 4). If the payment is larger than the reduction in case outstanding, then the reported claim will increase (Example Number 6). If the payment is smaller than the reduction in case outstanding, then the reported claim will decrease (Examples Number 5 and 7). A change in case outstanding without any associated payment will also impact the reported claim (Examples Number 3 and 9).

While the reported claims in the interval can be positive or negative, the reported claims at a point in time are rarely negative. Remember that we define the reported claims at a point in time to equal cumulative payments plus case outstanding at that point in time.

PART 2 – INFORMATION GATHERING

INTRODUCTION TO PART 2 – INFORMATION GATHERING

In the chapter "Loss Reserving" in the *Foundations of Casualty Actuarial Science* (2001), Ronald Wiser describes a four-phase approach to the process of estimating unpaid claims:

— Exploring the data to identify its key characteristics and possible anomalies. Balancing data to other verified sources should be undertaken at this point.

— Applying appropriate techniques for estimating unpaid claims.

— Evaluating the conflicting results of the various methods used, with an attempt to reconcile or explain the different outcomes. At this point, the projected ultimate amounts are evaluated in contexts outside their original frame of analysis.

— Monitoring projections of claim development over subsequent calendar periods. Deviations of actual development from projected development of counts or amounts are one of the most useful diagnostic tools in evaluating the accuracy of unpaid claim estimates.

In Chapters 3 through 6 of this book, we focus on Mr. Wiser's first phase, the exploratory analysis of the data. The process for collecting and understanding the data and other relevant information is so critical that we devote four chapters to the topic. We begin Chapter 3 with a description of the types of data that actuaries use for estimating unpaid claims and present various options for organizing the data.

Equally important to collecting quantitative data is developing an understanding of the environment in which the insurer operates. In Chapter 4, we discuss the importance of meeting with the management of both the claims and underwriting departments to gain a more complete understanding of the environment in which the insurer operates. We provide a list of possible questions for actuaries to use in their meetings with management. Changes in the insurer's internal operations as well as changes in the external setting can affect the results of the various techniques for estimating unpaid claims in different ways. (In Part 3, Chapters 7 through 15, we review numerous examples of changing environments and examine the result of such changes on alternative techniques for estimating unpaid claims.)

The development triangle is one of the actuary's most important tools for displaying and analyzing data; it is an important component of many claims projection techniques. In Chapter 5, we describe in depth how to create a development triangle. The development triangle is also a critical tool in the evaluation of the influence of operational and environmental changes on claims. In Chapter 6, we present a detailed example of how actuaries can use development triangles as a diagnostic tool, allowing examination of the consequences of operational and environmental changes on historical claims.

CHAPTER 3 – UNDERSTANDING THE TYPES OF DATA USED IN THE ESTIMATION OF UNPAID CLAIMS

The availability of appropriate data and information is essential for accurately estimating unpaid claims. We can classify data as originating from either internal or external sources.

Sources of Data

Large insurers are usually able to generate the detailed claims and exposure data required by actuaries for the estimation of unpaid claims from their own management information systems. Thus, actuaries working for large insurers often rely solely on data produced internally.

Smaller insurers, however, may be more limited in the internal data that they can generate. The data may be limited in its volume and thus its credibility to the actuary, or the data may be unavailable due to systems limitations of the organization. Such situations may force actuaries to turn to external sources of data. Large insurers who recently entered a new line of insurance or a new geographical region (e.g., a new territory, state, or province) may also need to turn to external sources of information when developing estimates of unpaid claims.

The sources of readily available external data vary by jurisdiction and by product line. The following are examples of external sources of information available in certain jurisdictions:

United States
- Insurance Services Office, Inc. (ISO)
- National Council on Compensation Insurance (NCCI)
- Reinsurance Association of America (RAA)
- The Surety & Fidelity Association of America (SFAA)
- A.M. Best Company (Best)
- NAIC Annual Statement data

Canada
- Best
- General Insurance Statistical Agency (GISA)
- Insurance Bureau of Canada (IBC)
- Reinsurance Research Council (RRC)
- Market-Security Analysis & Research Inc. (MSA)

Many insurers (of all sizes) use a combination of internally-generated data and external industry benchmarks. External information can be particularly valuable when selecting tail development factors, trend rates, and expected claim ratios (i.e., expected loss ratios). We address all of these topics in Part 3 of this book. Incorporating external information can also be useful when the actuary evaluates and attempts to reconcile the results of the various estimation methods in order to make a final selection of ultimate claims and unpaid claim estimate.

It is important that actuaries recognize the potential shortcomings in the use of data generated from external sources. The International Actuarial Association (IAA) strongly believes that entity-specific data is far preferred over external data. There is a risk that external data may be misleading or irrelevant due to differences relating to: insurance products, case outstanding and settlement practices, insurers' operations, coding, geographic areas, and mix of business and product types. Thus, the actuary must carefully evaluate the relevance and value of external data.[12]

Homogeneity and Credibility of Data[13]

Different lines of insurance exhibit different claim behaviors. For example, claims from insurance policies sold to businesses generally do not have the same characteristics as claims from insurance policies sold to individuals, even when the insurance coverages are identical. Likewise, claims for umbrella and excess insurance are different from claims for primary insurance. Even within a single line of insurance, the characteristics of claims by subcoverage can differ significantly. For example, claims involving only property damage for automobile liability policies are generally reported and paid very quickly and have a relatively low severity (i.e., average settlement value). On the other hand, claims arising from automobile accidents involving catastrophic spinal injuries may take years to settle in some jurisdictions and could ultimately cost millions of dollars.

It is often possible to improve the accuracy of estimating unpaid claims by subdividing experience into groups exhibiting similar characteristics, such as comparable claim experience patterns, settlement patterns, or size of claim distributions. As a result, when separating data into groups for an analysis of unpaid claims, actuaries focus on the following key characteristics:

— Consistency of the coverage triggered by the claims in the group (i.e., group claims that will generally be subject to the same or similar laws, policy terms, claims handling, etc.)

— Volume of claim counts in the group

— Length of time to report the claim once an insured event has occurred (i.e., reporting patterns)

— Ability to develop an appropriate case outstanding estimate from earliest report through the life of the claim

— Length of time to settle the claim once it is reported (i.e., settlement, or payment, patterns)

— Likelihood of claim to reopen once it is settled

— Average settlement value (i.e., severity)

[12] The Academy's Risk Management & Financial Reporting Council, Financial Reporting Committee argued to the International Actuarial Standards Board (IASB) that, in general, external data is typically used (and most appropriately used) only as a fallback where internal data is not sufficiently credible.

[13] The following section borrows from the CAS Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves, issued in May 1988.

Actuaries strive to group claims by lines and sublines of business which display similar traits with respect to the characteristics listed above. They may also group claims by policy limits to achieve similar claims attributes within a block of business.

The goal for the actuary is to divide the data into sufficiently homogeneous groupings without compromising the credibility of the data. Credibility refers to the predictive value given to a group of data. Increasing the homogeneity of the group of data or increasing the volume of data in the group tends to increase credibility. If the actuary divides the data into too many homogeneous groupings, however, there is a risk that the volume of data in the individual groups may become insufficient to perform a reliable analysis. This is a frequent challenge for the actuary. In "An Introduction to Credibility Theory," Longley-Cook states:

> We may liken our statistics to a large crumbly loaf cake, which we may cut in slices to obtain easily edible helpings. The method of slicing may be chosen in different ways – across the cake, lengthwise down the cake, or even in horizontal slices – but only one method of slicing may be used at a time. If we try to slice the cake more than one way at a time, we shall be left with a useless collection of crumbs.[14]

Consider automobile accident benefits coverage[15] as an example of how actuaries must decide how to divide the cake. Options include analyzing the claims in total or breaking out the claims into the individual components (e.g., medical/rehabilitation, disability income, death benefits, funeral services, and supplementary benefits). Certainly, the claims behavior is very different for funeral services claims than it is for medical/rehabilitation claims. There are differences in claims reporting patterns, settlement patterns, severity of claims, and frequency of claims between these subcoverages. However, if there is insufficient data by subcoverage, a detailed analysis may not produce a more accurate estimate of unpaid claims than the analysis based on the combined data for all of the accident benefits components. Further considerations for the actuary are efficiency and time and resource requirements of separate versus combined analyses. The funeral benefits may represent a stable portion of the total accident benefit claims and thus may not justify the time and resources required for independent analysis.

We can raise similar questions with regards to many other lines of insurance with a combination of coverages or benefits under one policy. For example, is it preferable to analyze claims for bodily injury and property damage separately or on a combined basis for general liability, or for automobile liability insurance?

Another consideration regarding the homogeneity and the grouping of data relates to changes in the portfolio. In some circumstances, it may be appropriate to combine personal automobile and commercial automobile data even though these lines typically exhibit different underlying claims patterns. However, if the relative volume of business is changing between these two lines of insurance, the grouping may not be appropriate. In Part 3, we present an example of the effect on various projection techniques of analyzing a portfolio where the volume of personal automobile is increasing at 5% per year while the commercial automobile volume is increasing at 30%. We will

[14] *PCAS*, 1962.

[15] As described in Chapter 1 – Overview, accident benefits coverage provides for the medical needs of the driver and passengers arising from an automobile accident. Insurers in the U.S. call this coverage automobile no-fault.

see that the consequence of the changing proportion on the various estimation techniques can be significant.

Types of Data Used by Actuaries

Claims and Claim Count Data

Actuaries rely on many different types of data in the establishment and testing of unpaid claim estimates for an insurer. Some of the most common types of data include:

- Incremental paid claims
- Cumulative paid claims
- Paid claims on closed claims
- Paid claims on open claims
- Case outstanding
- Reported claims (i.e., sum of cumulative paid claims plus case outstanding)
- Incremental reported claims
- Reported claim counts
- Claim counts on closed with payment
- Claim counts on closed with no payment
- Open claim counts
- Reopened claim counts

We can use all of the above data types with claims only (i.e., losses only), claim-related expenses, or claims and claim-related expenses combined.

Claim-Related Expenses

The actuary needs to know how the insurer handles expenses before using the data. Where the claim data and policy limits include claim adjustment expenses, many actuaries combine historical claims and ALAE experience when conducting analyses of unpaid claims. Unless otherwise indicated, we use the term claims to denote both claims and ALAE combined. When the claim analysis includes only ALAE and not ULAE, the actuary needs to perform a separate analysis to evaluate the unpaid ULAE estimate.

There are multiple ways to classify claim-related expenses, not just the one generic ALAE/ULAE split. As mentioned in Chapter 1 – Overview, in the U.S., for statutory reporting purposes, insurers categorize LAE as either *defense and cost containment* (DCC) or as *adjusting and other* (A&O). The DCC versus A&O split depends on the function of the expenses. A&O includes all claim adjuster costs regardless of whether or not they are attributable to internal adjusters (which may be viewed as overhead and difficult to attribute to an individual claim) or external independent adjusters (which are generally easily attributable to an individual claim). Various other reporting requirements may place different demands on how insurers categorize claims expenses. Insurers may also use their own internal approach to categorizing claim expenses, suitable to their own internal claim management processes. It is therefore sometimes necessary for the actuary to investigate which claim expenses are included in the data being used and how the terms are defined. For example, different people working for the same insurer may define the

term ALAE in different ways: one way by financial reporting systems so as to meet external reporting requirements and another way to meet internal claim management needs.

Multiple Currencies

Claims data for some insurers may exist in the information systems in different currencies. Depending on the volume of claims in differing currencies, the actuary may need to adjust the data prior to the analysis. One approach is to separate the data by currency and then combine it after translating it using the appropriate exchange rates at a common point in time. For example, assume that claims data are in Euros, pounds sterling, and U.S. dollars; if the actuary is conducting an analysis that requires a final unpaid claim estimate in Euros, the actuary could then convert all amounts to Euros using current exchange rates.

Large Claims

When conducting analyses of unpaid claims, it is important for actuaries to be aware of how *large claims* influence the various estimation techniques. As we will see in a later part of this book, the presence of unusually large claims can distort some of the methods used for estimating unpaid claims. In these situations, the actuary may choose to exclude the large claims from the initial projection and then, at the end of the unpaid claims analysis, add a case specific projection for the reported portion of large claims and a smoothed provision for the IBNR portion of large claims. In Part 3, we discuss alternative approaches that the actuary may use to adjust the estimation techniques for large claims.

The determination of the size criteria of a large claim is not a precise science. It may vary by line of business, by geographic region, and even between analyses of unpaid claims. Actuarial judgment is critical in determining how to adjust the analyses for large claims. Actuaries consider the following in establishing the large claim threshold:

- Number of claims over the threshold each year
- Size of claim relative to policy limits
- Size of claim relative to reinsurance limits
- Credibility of internal data regarding large claims
- Availability of relevant external data

One starting point for the actuary is large claims reports from the insurer's claims department. Claims departments often maintain reports that routinely track the individual experience of claims exceeding a certain threshold. The definition of a large claim, however, may differ between the claims department and the actuary. For example, the claims department may have set up internal controls that require monthly reporting on all claims greater than $100,000. However, to the actuary, a large claim may be any claim with a reported value (i.e., the sum of cumulative paid claims plus the current estimate of unpaid case) greater than $1 million. The actuary can also seek advice from the reinsurance department when deciding upon the large claim threshold.

Recoveries

There are numerous types of recoveries available to insurers that could affect an insurer's net claims experience. *Deductibles* are one of the most common types of insurer recoveries, and it is important for the actuary to understand how the insurer processes claims with respect to deductibles. For some lines of insurance, such as automobile physical damage, claim payments to insured policyholders are typically reduced due to the application of the deductible. Since this line of insurance is a first-party coverage, it is reasonable to apply the deductible before issuing payment to the insured. However, for general liability, insurers usually make claim payments before the application of the deductible. Since general liability is a third-party line of insurance, the injured party is not the insured party. The insurer normally issues a payment to the injured party and then, following the payment, seeks recovery of the deductible from the insured. Insurers differ in their practices with respect to case outstanding for deductibles. Some insurers establish a case outstanding net of the deductible while other insurers do not consider the deductible in the establishment of the case outstanding. Even within the same insurer, practices may vary between lines of insurance.

Salvage and *subrogation* are two other common forms of recoveries for insurers. When an insurer pays an insured for a claim considered to be a total loss, the insurer acquires the rights to the damaged property. Salvage represents any amount that the insurer is able to collect from the sale of such damaged property. Subrogation refers to an insurer's right to recover the amount of claim payment to a covered insured from a third-party responsible for the injury or damage. It is important for the actuary to understand the insurer's practices with respect to both salvage and subrogation. The actuary needs to know whether the insurer records paid claims net or gross of these recoveries. Questions to consider include:

— Are salvage and subrogation recoveries tracked separately from claim payments?
— Are claim payments only recorded net of salvage or subrogation recoveries?
— Is data for salvage and subrogation recoveries available to the actuary?

Claim operations may separate the responsibilities associated with a claim, such that people other than those responsible for claim adjustment and settlement are involved with the investigation, analysis, and pursuit of potential recoveries. This may have implications to the data the actuary is using.

Reinsurance

It is vital that the actuary understands the reinsurance program of the insurer and the effect of reinsurance on claims when conducting an analysis of ceded or net unpaid claims. Understanding the insurer's reinsurance program may be dictated by statute.[16]

Current and previous reinsurance plans and retentions directly affect an insurer's estimates of unpaid claims. Therefore, the actuary may need to analyze claims both gross and net of reinsurance recoveries (i.e., both before and after taking into account the reinsurance recoveries). Some actuaries separately analyze gross claims and ceded claims (i.e., claims ceded to reinsurers) and then determine the estimate of net unpaid claims as the difference between estimated gross unpaid claims and estimated ceded unpaid claims. Other actuaries separately analyze gross claims and net claims (i.e., gross claims minus claims ceded to reinsurers) and then determine the estimate of ceded unpaid claims as the difference between estimated gross unpaid claims and estimated net unpaid claims. In either situation, the actuary must review the implied net or ceded unpaid claim estimate for reasonableness. For insurers who do not cede claims to a reinsurer, there is no difference between claims net and gross of reinsurance, and in these situations separate analyses are not necessary.

One area that requires the actuary's close attention is the treatment of ALAE in excess of loss reinsurance contracts. Generally, there are three possible treatments of ALAE:

— Included with the claim amount in determining excess of loss coverage (which is the most common treatment today)

— Not included in the coverage

— Included on a pro rata basis; the ratio of the excess portion of the claim to the total claim amount determines coverage for ALAE

[16] The requirements for actuaries providing Statements of Actuarial Opinion in both the U.S. and Canada demonstrate the importance for the actuary to understand the reinsurance program. According to the NAIC's "Quarterly and Annual Statement Instructions for the year 2007, Property/Casualty," the Appointed Actuary must provide "RELEVANT COMMENT" paragraphs to address the specific topic of reinsurance. The Instructions state:

> RELEVANT COMMENT paragraphs should address retroactive reinsurance, financial reinsurance and reinsurance collectibility. Before commenting on reinsurance collectibility, the actuary should solicit information from management on any actual collectibility problems, review ratings given to reinsurers by a recognized rating service, and examine Schedule F for the current year for indications of regulatory action or reinsurance recoverable on paid losses over 90 days past due. The comment should also reflect any other information the actuary has received from management or that is publicly available about the capability or willingness of reinsurers to pay claims. The actuary's comments do not imply an opinion on the financial condition of any reinsurer.

OSFI, the Canadian regulator for federally registered insurance companies, requires the Appointed Actuary's Report (i.e., the report on policy liabilities) to contain a description of the insurer's reinsurance arrangements during the experience period used in the report. Specifically, the Appointed Actuary is required to report on:

— Types of arrangements
— Significant terms and conditions
— Order of application of treaties
— Changes in the arrangements, including changes in retentions or limits

Appointed Actuaries for Canadian insurers are also required to report on how any changes in reinsurance arrangements were taken into account in the development of unpaid claims for the insurer.

The treatment of ALAE will likely have an effect on data requirements, organization, and potentially the methodology selected for estimating unpaid claims.

Exposure Data

Some techniques used for estimating unpaid claims require a measure of the insurer's *exposure* to claims. Earned premium may be the most common type of exposure used in estimation techniques for both insurers and reinsurers. Other types of exposures used by insurers may include: written premium, policies in force, policy limits by region (for the early estimation of unpaid claims related to a natural catastrophe), the number of vehicles insured (for personal automobile insurance), and payroll (for workers compensation).

It is often valuable for actuaries to adjust historical premiums to current rate levels (i.e., on-level premiums). There are two ways in which actuaries typically derive on-level premiums. The first method essentially requires a re-rating of historical exposures at current rates. This is a computer-intensive exercise and may not be feasible in all situations. A second method is to use a summary of rate level changes over the experience period and adjust the premiums in the aggregate for historical rate changes. There are many instances, however, when the actuary is unable to collect reliable information regarding rate changes and must use the premium data from the insurer on an unadjusted basis.

Self-insured organizations do not generally collect premiums in the same way that an insurance company does. As a result, actuaries working with self-insurers generally use other readily observable and available exposure bases that they believe are closely related to the risk and thus the potential for claims.

The following table summarizes, by line of business, examples of the types of exposures that actuaries often use for the analysis of self-insurers' unpaid claims.

Table 1 – Examples of Exposures for Self-Insurers

Line of Insurance	Exposure
U.S. workers compensation	Payroll
Automobile liability	Number of vehicles or miles driven
General liability for public entities	Population or operating expenditures
General liability for corporations	Sales or square footage
Hospital professional liability	Average occupied beds and outpatient visits
Property	Property values
Crime	Number of employees

Exposures are important not only as an input to certain techniques used for estimating unpaid claims but also for evaluating and reconciling the results of the various techniques. We address this further in Part 3, Chapter 15.

Insurer Reporting and Understanding the Data

We cannot emphasize strongly enough how critical it is for the actuary to fully understand the types of data generated by the insurer's information systems. Different insurers, TPAs, IAs, or even different departments within the same organization may use the same term to mean different things. The actuary must know the true meaning of the types of claims data contained in the insurer's claims reports and information systems.

"Incurred loss" is an example of a term that the actuary may initially assume is used fairly consistently throughout the insurance industry. Upon closer examination, however, we see that incurred losses means different things to different people. To someone in the finance department, incurred losses usually refer to the transactional losses incurred during a defined period, usually a calendar (or fiscal) quarter or year. Thus, the incurred losses to someone in finance usually refer to the sum of payments made during the time period plus the change in total unpaid claims. Furthermore, finance departments usually include IBNR in their definition of incurred loss. To an actuary wanting to build an incurred claim development triangle, incurred losses are typically the cumulative claim payments through a valuation date plus the case outstanding at the same valuation date.[17] Some actuaries refer to these losses as case incurred or incurred on reported claims. We have also seen the term incurred losses used in TPA loss reports to refer to case outstanding only. To avoid any confusion, we use the term "reported claims" throughout this book to refer to case incurred losses. (Cumulative and incremental reported claims are introduced in Chapter 2 and are explored further in Chapter 5.)

The terms "unpaid claims" and "reserves" are other examples of terminology that have many different meanings. In a report from the finance department, unpaid claims (or reserves) generally refer to the estimate of total unpaid claims including both case outstanding and IBNR. For the claims department, however, reports showing unpaid claims (or reserves) generally refer to case outstanding only. Some TPA reports use the term reserves in detailed claims listings to represent the total reported value of the claims (i.e., cumulative payments plus current case outstanding estimates). In this situation, the actuary would need to subtract cumulative paid claims from the reserves in order to determine the value of unpaid case. The actuary also needs to understand if the unpaid claim estimate is net or gross of deductibles or other types of recoveries, including salvage, subrogation, and reinsurance recoveries, and where in the claims process those recoveries are included. Finally, the actuary needs to know whether or not case outstanding include claim-related expenses. Some insurers record case outstanding and payments for claim-related expenses separately from claim only case outstanding and payments; other insurers record expense payments separately (from claim payments) but do not carry case outstanding for expense.

Another example of differences in the use of the term "reserves" can be found in the actuarial and accounting professions in South Africa and the United Kingdom. It is typical for accountants in these countries to distinguish between provisions (i.e., unpaid claim estimates) and reserves; actuaries usually use the term "reserves" to refer to the unpaid claim estimates and do not distinguish between different types of reserves.

[17] In the U.S., the National Council on Compensation Insurance has Financial Data Calls that require incurred losses by accident year that include IBNR. Similarly, the incurred loss triangles in Schedule P of the U.S. statutory annual statement include IBNR. Hence, actuaries also prepare incurred loss triangles that do include IBNR. These provide further examples of why an actuary must seek a full understanding of the data prior to conducting any analysis or drawing any conclusions.

Even paid claims can mean different things to different people. The actuary must understand whether the paid claims are cumulative or incremental, whether they include or exclude claim-related expenses (and what kind of claims expenses), and whether they are net or gross of recoveries.

The actuary must also understand how the insurer's system tracks claim counts. The number of claims is an important type of data for several techniques used to estimate unpaid claims. Claim counts are also critical to several diagnostic analyses that may be appropriate to undertake upon commencing an analysis of unpaid claims. Claim counts may also be important at the conclusion of the estimation process when the actuary evaluates and selects a final value for the unpaid claim estimate. The actuary needs to understand whether the insurer counts an automobile accident with payments for multiple coverages (e.g., bodily injury liability and physical damage) or to multiple parties (i.e., claimants) as one claim or multiple claims. Another important consideration for the actuary is how reopened claims are treated and whether they are considered a new claim. Reopened claims can be particularly important for some lines of business, such as U.S. workers compensation and accident benefits coverages.

It is absolutely essential to the development of appropriate estimates of unpaid claims that actuaries clearly identify the specific data that exists and that they are requesting from the insurer, and that they fully understand the data that they receive.

Verification of the Data

An analysis based on incorrect or incomplete data can produce erroneous results. Therefore, while not requiring a formal audit of the data, actuarial standards of practice generally do require that actuaries establish suitable procedures to verify that the data utilized is reliable and sufficient for the intended purpose. This data review may include the following components:

— *Consistency with financial statement data* – Can the actuary reconcile the data with financial statement data (that may be subject to some form of external audit)?

— *Consistency with prior data* – Is the current data consistent with the data used in the prior analysis? If not, why?

— *Data reasonableness* – Are there certain values that appear questionable, such as large negative paid claims or apparent inconsistencies between data elements? Questionable values are not always incorrect values, but the actuary should generally investigate questionable values before using them, especially if material to the analysis.

— *Data definitions* – Does the actuary know how each of the data items is defined? The actuary should make a reasonable effort to determine the definition of each data element used in the analysis rather than assuming a certain definition given the label or name assigned to the element. As discussed earlier, similar labels do not always imply similar definitions. The actuary may also need to know what the default values are for certain items. If the default is used too often in the absence of true information for that element, the data element may not be sufficiently reliable for analysis purposes.

While data verification is essential to any actuarial analysis, proper documentation of the verification process and findings should also be part of the process. This can include discussions with external auditors and, at times, reliance on their work regarding data verification.

Organizing the Data

Key Dates

Having identified the types of data that actuaries use in determining unpaid claim estimates, we now discuss how to organize the data. Key dates for the organization of the claim data include:

- Policy effective dates
- Accident date
- Report date
- Accounting date
- Valuation date

The *policy effective dates* are the beginning and ending dates of the policy term (i.e., the period for which the policy triggered by the claim was effective). Some systems only capture the policy year (i.e., the year that the policy became effective). Reinsurers refer to the policy date as the underwriting date (or year).

The *accident date* is generally the date that the accident or event occurred that triggered the potential policy coverage. Some systems only capture the accident year (i.e., the year that the triggering event occurred). This term can be ambiguous with regard to certain policies such as claims-made policies. With claims-made policies, the accident date may be defined as the date that the claim was reported as this is the date of the event that triggered coverage. Alternatively, some may define the accident date for a claims-made policy as the date that an injury occurred with the injury not covered by the policy unless the resulting claim was reported during the policy period.

The *report date* is the date on which the claim was reported to the insurer and recorded in its claims system. Some databases may split this into two dates: report date and record date. There is even a potential for a third date – a *notification date*. The notification date is generally defined as the date that the insurer is put on notice that an event occurred that may result in a claim. For example, an insured motorist may notify their insurer that they got in an accident (but that they are not filing a claim); this is the notification date. A week later, the insurer may receive a claim from the other party in the accident; this is the report date, or the date on which the claim was reported. The following day, the claims department records the claim into their system; this is the record date. Notification dates are not commonly used in many actuarial analyses.

The *accounting date* is the date that defines the group of claims for which liability may exist, namely all insured claims incurred on or before the accounting date. The accounting date may be any date selected for a statistical or financial reporting purpose, but generally must follow a date for which the history is frozen in time, such as a month, quarter, or year-end (with the latter two being the more common accounting dates used).

An example may assist in understanding how claim activities relate to the accounting date. Assuming an accounting date for an occurrence-based policy of December 31, 2008, the total

unpaid claim estimate as of this accounting date must provide for all incurred claims, whether reported or not, as of December 31, 2008. An insured loss that occurred on December 30, 2008, for a policy written on December 15, 2008, would be included in the estimate of unpaid claims for the accounting date December 31, 2008, regardless of when the claim is reported to the insurer. However, an insured loss that occurred on January 5, 2009, for the same policy that was written on December 15, 2008, would not be included in the unpaid claim estimate for the accounting date December 31, 2008, because this accident occurred after the accounting date.

The *valuation date* is the date through which transactions are included in the database used in the evaluation of the liability, regardless of when the actuary performs the analysis. A valuation date may be prior to, coincident with, or subsequent to the accounting date. Actuaries typically use claims data at month-end, quarter-end, half-year-end, or year-end valuation dates.

Again, examples may assist in understanding the concept of valuation date. To determine total unpaid claims at December 31, 2008, actuaries may use data valued as of December 31, 2008. In this example, the valuation date and the accounting date are the same. For some insurers, however, internal financial reporting requirements at year-end are such that the actuary does not have time to wait for the December 31, 2008 data to be available. In such circumstances, actuaries often use data at an earlier valuation date to estimate what the requirement for unpaid claims at the accounting date of December 31, 2008 will be. For example, some insurers used data as of September 30, 2008 to estimate unpaid claims as of December 31, 2008. In this example, the valuation date is September 30, 2008, and the accounting date is December 31, 2008.

In certain situations, an actuary may conduct an analysis of unpaid claims where the valuation date is later than the accounting date. For example, assume that the actuary wants to re-estimate what the claim liabilities were at December 31, 2006, taking into account the actual experience of 2007 and 2008. The actuary can use a December 31, 2008 valuation date and thus include actual paid and reported claims experience through 2007 and 2008. When estimating the unpaid claims at December 31, 2006 (the accounting date), the actuary subtracts the actual payments at December 31, 2006 from the projected ultimate claims that he or she derives using data through December 31, 2008 (the valuation date).

Aggregation by Calendar Year

Calendar year data is transactional data. For example, calendar year 2008 paid claims refer to the claim payments made by the insurer between January 1, 2008 and December 31, 2008. Similarly, calendar year 2008 reported claims are the 2008 payments plus the change in case outstanding (ending case outstanding at December 31, 2008 minus beginning case outstanding at January 1, 2008[18]). Reported claim counts for the 2008 calendar year represent those claim counts reported during the January 1, 2008 to December 31, 2008 period; and closed claim counts represent the number of claims closed during the year.

The primary uses of calendar year data for the actuary are the aggregation of exposures and diagnostic testing when analyzing accident year claims data. Calendar year 2008 written premium is simply the sum of all written premium reported/recorded in the accounting systems during

[18] The actual accounting equation uses ending case outstanding at December 31, 2007, but this is generally synonymous with beginning reserves at January 1, 2008.

2008. The following formula defines calendar year earned premium:

Written Premium + Beginning Unearned Premium Reserve – Ending Unearned Premium Reserve

Advantages of Calendar Year Data

A major advantage of calendar year data is that there is no future development. The value remains fixed and does not change as time goes by as do claims and exposures aggregated based on accident year, policy year, and even report year bases. Another advantage of calendar year data is that it is readily available. Most insurers conduct financial reporting on a calendar year basis, thus data by calendar year is typically easily accessible to the actuary.

Disadvantages of Calendar Year Data

The fixed nature of calendar year data also presents a disadvantage. The inability to address the critical issue of development is a disadvantage of calendar year statistics. Very few techniques for estimating unpaid claims are based on calendar year claims. Calendar year exposures, on the other hand, are frequently used in estimation techniques along with accident year claims.

Aggregation by Accident Year

Aggregation by accident year is, by far, the most common grouping of claims data for the actuarial analysis of unpaid claims. *Accident year data* refers to claims grouped according to the date of occurrence (i.e., the accident date or the coverage triggering event). For example, accident year 2008 consists of all claims with an occurrence date in 2008.

Caution must be exercised when working with self-insurers' accident year data as their fiscal year ends may not coincide with the calendar year-end. For example, accident year 2008 may be defined to coincide with a self-insurer's August 1, 2007 to July 31, 2008 fiscal year or may include claims occurring during the January 1, 2008 to December 31, 2008 calendar year period. Again, the important message for the actuary is to understand the data, including how it is organized and presented.

Insurers compile claims data according to a variety of accident periods including accident month, accident quarter, accident half-year, and accident year. The insurer groups together all claims with accident dates within the particular time period.

Various financial reporting schedules and statistical organizations for insurers in the U.S. and Canada require claim information by accident year. In some areas, such as Lloyds of London, financial reporting by underwriting year is more common than accident year.

As indicated previously, actuaries often use calendar year exposures with accident year claims. Calendar year earned premiums provide an approximate matching of the claims that occur during the year with the insurance premiums earned by an insurer during the year in which the insurance coverage is effective. We will see below that claims and exposures aggregated by policy year provide an exact match. For self-insurers, however, calendar year exposures do represent an exact match with the accident year claims.

Advantages of Accident Year Aggregation

In many respects, accident year aggregation has become the accepted norm for P&C insurers in the U.S. and Canada. Accident year grouping is easy to achieve and easy to understand. It represents claims occurring over a shorter time frame than for the policy year or underwriting year aggregation, implying that ultimate accident year claims should become reliably estimable sooner than those for a policy or underwriting year. There are numerous industry benchmarks available to actuaries based on accident year experience. Finally, tracking claims by accident year is valuable when there is change due to economic or regulatory forces (such as inflation or law amendments) or major claim events (such as atypical weather or a major catastrophe) which can influence claims experience.

Disadvantages of Accident Year Aggregation

The most significant disadvantage of accident year aggregation is the potential mismatch between claims and exposures for insurers. It also includes claims from policies underwritten and priced at more varied times than policy or underwriting year aggregation. For self-insureds with high deductibles, accident year data can mask changes in retention levels and/or changes in insurers that could have an effect on claim development patterns.

Aggregation by Policy Year or Underwriting Year

Claims can also be grouped according to policy year. For *policy year data*, the actuary sorts claims according to the year in which the policy was written. Policy year aggregation directly matches the premiums and claims arising from a given block of policies.[19] The grouping of claims by policy year for insurers is similar to the grouping of claims by underwriting year frequently used by reinsurers. *Underwriting year data*, which is frequently used by reinsurers, refers to claims data grouped by the year in which the reinsurance policy became effective.

Claims arising from a policy year or underwriting year can extend over a 24-month calendar period if the policy is of a 12-month duration. For example, policy year 2008 refers to all policies with beginning effective dates between January 1, 2008 and December 31, 2008. For annual policies with a January 1, 2008 beginning effective date, covered claims will have accident dates between January 1, 2008 and December 31, 2008. However, claims for annual policies with a beginning effective date of December 31, 2008 will have occurrence dates between December 31, 2008 and December 30, 2009.

[19] The actuary should be aware of the insurer's treatment of multi-year policies. Insurers differ in their practices as to how such policies are coded in the information systems. Some insurers split the single multi-year policy into annual pieces and code this type of policy as multiple annual policies. Other insurers may follow different practices. The important point is that the actuary must understand the process for recording premium and claims associated with multi-year policies (to the extent such policies exist in the insurer's portfolio).

Advantages of Policy Year Aggregation

The greatest advantage of policy year (or underwriting year) aggregation is a true match between claims and exposures (e.g., premiums). Policy year experience can be very important when underwriting or pricing changes occur, such as a shift from full coverage to large deductible policies, a new emphasis on certain classes of business, or an increase/decrease in the price charged leading to a change in expected claim ratios and possibly a change in the type of policyholder insured. Policy year aggregation is particularly useful for self-insureds where only one policy may apply.

Disadvantages of Policy Year Aggregation

The primary disadvantage of policy year (or underwriting year) aggregation is the extended time frame. As seen in our previous example, a policy year can extend over a 24-month time period, generally resulting in a longer time until all the claims are reported and a longer time until the ultimate claims can be reliably estimated. Policy year data can also make it difficult to understand and isolate the effect of a single large event, such as a major catastrophe or a major court ruling, which changes how the insurance contracts are interpreted.

Aggregation by Report Year

For some lines of insurance, such as medical malpractice, products liability, errors and omission, and directors' and officers' liability, coverage may be dependent on the date on which the claim is reported to the insurer (i.e., claims-made coverage). For these lines of business, actuaries often prefer to use *report year data* for developing estimates of unpaid claims. Report year refers to grouping claims according to the date of report to the insurer. For example, report year 2008 consists of all claims with report dates in 2008. Actuaries use this grouping to estimate the ultimate value of known claims. Aggregation of claims by report year can also be used to test the adequacy of case outstanding on known claims over time.

Once again, we highlight that the actuary must understand the systems and procedures for the insurer. For some insurers, the accident date is the date that triggers coverage, which may be the claim report date for some claims-made policies. For some claims-made policies, the notification date rather than the report date triggers the coverage. Also, some claims-made policies have extended reporting endorsements that may not be coded as a new policy, and hence development beyond 12 months may be possible even for annual policies. An actuary must not only determine how to aggregate the data but must truly understand how the data enters and is tracked in the insurer's systems.

Advantages of Report Year Aggregation

A unique feature of report year claims data is that the number of claims is fixed at the close of the year (other than for claims reported but not recorded). As a result, a report year approach will generally result in more stable data and more readily determinable development patterns than an accident year approach in which the number of claims is subject to change at each successive valuation. The report year approach substitutes a known quantity (i.e., the number of reported claim counts) for an estimate.

Disadvantages of Report Year Aggregation

Estimation techniques based on claims aggregated by report year only measure development on known claims and not pure IBNR; and pure IBNR is frequently the more difficult part of the total unpaid claims estimate to determine. Other methods for developing unpaid claim estimates are required to derive the pure IBNR when using report year data.

CHAPTER 4 – MEETING WITH MANAGEMENT

This chapter discusses the interaction between the actuary and those involved with the processes that underlie the data. The dynamics of this interaction will frequently vary based on whether the actuary is an employee of the insurer or an outside consultant. For example, while an actuarial employee may be able to just call or walk over to meet those involved in the insurer's claims operation when a question arises, a consultant may have to go through a more formal process, such as scheduling a meeting with company management involved in the relevant processes. To simplify the discussion, this chapter is written predominately from the perspective of an outside consultant, using the term *management* when referring to discussions with those involved in the underlying claims and underwriting processes.

Understanding the Environment

Before applying mathematical models to develop estimates of unpaid claims for an insurer, the actuary must first understand the dynamics of the environment in which the insurer operates. This includes both the specific circumstances existing within the insurer's organization as well as the economic, social, legal, and regulatory environments that will also affect the liabilities of the insurer. Without a sound understanding of the environment, both internal and external to the insurer, an actuary may not be able to correctly interpret patterns and changes in the data.

There are countless changes that influence the claims experience of an insurer. Claims reporting and payment patterns, frequency, and severity can all be altered by changes in:

— Classes of business written or geographical focus

— Policy provisions such as policy limits and deductibles

— Reinsurance arrangements including limits and attachment points

— Claims management philosophy that often occur when managerial changes occur

— Claims processing lags that may occur when a new technology is implemented within an insurer or department staffing is disrupted, such as in the event of a merger or a major catastrophe that temporarily overwhelms the claim department's capacity

— Legal and social environment such as the introduction of no-fault automobile insurance, back-logs in the court systems, new court rulings, and implementation of tort reform[20] measures

— Economic environment such as an increase in the inflation rate or a decrease in the interest rate

[20] Tort reform refers to legislation designed to reduce liability costs through limits on various kinds of damages and/or through modification of liability rules.

The collection of data and information does not necessarily proceed in a sequential order as presented in this text. Not all actuaries start by gathering data, then meeting with management, and end with conducting an actuarial diagnostic review of the data. Generally the information gathering is an ongoing process with much back-and-forth dialogue between the actuary and management.

For actuaries responsible for estimating unpaid claims who work as employees of an insurer, the information gathering process will likely be continual and ongoing. Conversations with colleagues in various departments (such as claims, underwriting, reinsurance, and systems) may take place on a routine basis. These conversations may be formal through regular monthly or quarterly meetings, or informal and unscheduled. For actuaries who work as independent consultants, the communication with the insurer's employees in various departments tends to be less frequent. Often the consultant will schedule formal meetings at least once a year to review the departments' key activities that can have a significant influence on the estimation of unpaid claims.

There is no one right or wrong approach for the actuary to collect data and information. What is critically important, however, is that the process includes both a review of quantitative data and discussions with key members of the insurer's claim and underwriting departments. Both of these components will assist the actuary in selecting the appropriate techniques for estimating unpaid claims. Discussions with management will help the actuary understand anomalies in the data. The review of the data will help direct the actuary to ask management specific questions concerning issues that manifest themselves in the data. Such questions will help the actuary gain a better understanding of the organization and the specific circumstances of particular books of business, and thus guide the actuary to the most appropriate methodologies for determining unpaid claim estimates.

In 1977, J.R. Berquist and R.E. Sherman published the paper "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach."[21] Among the paper's many valuable contributions was an appendix with a list of possible interview questions for the various departments of an insurer. Actuaries throughout the world have used this list as part of the annual information gathering process in support of the analyses of unpaid claims. In a session entitled "Updating the Berquist-Sherman Paper – Thirty Years Later" presented at the CAS 2007 Casualty Loss Reserving Seminar, Mr. Sherman suggested some additional questions for department executives. We include below a copy of Appendix B from the original Berquist and Sherman paper, updated to incorporate the additional questions presented in 2007.

It is important to recognize that the following questions are presented primarily from the perspective of a consultant interviewing insurance company management. Some changes to these questions would be required for actuaries working with self-insurers as well as for internal actuaries working at insurance and reinsurance companies.

Sample Questions for Department Executives

Questions for a Claims Executive

1) What specific objectives and guidelines does your department have in setting unpaid case? Are unpaid case established on the basis of what it would cost to settle the case today, or has a provision for inflation between now and the estimated time of settlement of the claim been included in the case outstanding?

[21] PCAS, 1977.

2) Have there been any significant changes in the guidelines for setting and reviewing unpaid case during the last five years?

3) Have there been any changes in the definitions of or rules for establishing bulk or formula reserves for reported claims in the last five years?

4) Are any special procedures or guidelines applied in the reserving of large or catastrophic claims? If so, please describe.

5) Has the size of the caseload of the average claims adjuster changed significantly in the past several years?

6) When, in the sequence of events, is a claim file established?

7) Is a claim file established for each claimant or for each accident? What procedures are followed when there are multiple claimants from the same accident? Is a claim file established for each coverage or for all coverages combined?

8) What procedures are followed in recording reopened claims? Are such claims coded to the report date of the original claim or to the date of reopening? How will the reopening of a claim affect aggregate data for paid, open or reported claims and paid, outstanding or incurred losses?

9) Have there been any noticeable shifts in the reporting or non-reporting of very small or trivial claims? In the procedures for the recording of such?

10) Has there been any shift in emphasis in settling large versus small claims? In the relative proportion of such claims? In attitudes in adjusting such claims?

11) Have there been any changes in the guidelines on when to close a claim? For example, is a P.D. (property damage) claim kept open until the associated B.I. (bodily injury) claim is closed, or only until the P.D. portion is settled?

12) Have there been any noticeable changes in the rate of settlement of claims recently?

13) Has there been any shift from the employment of company adjusters to independent adjusters? Or vice versa? If so, how has this affected the operations of the claims department?

14) Has there been any change in the timing of the payment of allocated loss adjustment expenses? For example, are such payments made as these expenses are accrued (or incurred) or when the claim is closed?

15) Has there been any change in the definition and limit for one-shot or fast-track claims in recent years? What is that limit?

16) What safeguards against fraudulent claims are now employed? Are any special procedures followed in the event of the filing of apparently questionable or non-meritorious claims? Have these safeguards changed in recent years?

17) Have there been any shifts toward (or away from) the more vigorous defense of suits in recent years?

18) Could you provide copies of all bulletins to the field issued in the last five years in which details of the changes in claims procedures are provided?

19) Could you provide copies of recent claim audits?

20) For workers compensation, what mortality table was used (year and general population or disabled lives table) to set the unpaid case for permanently disabled claimants?

21) For large open claims, has there been any revision in the reserve since the latest evaluation date of the claims experience?

22) Are unpaid case set at an expected level, the most likely settlement amount, or the minimum possible amount (or some other standard)?

Questions for an Underwriting Executive

1) What significant changes have occurred in your company's book of business and mix of business in the past five to seven years? How are the risks insured today different from those of the past?

2) Do you underwrite any large risks which are not characteristic of your general book of business?

3) Have any significant changes occurred in your underwriting guidelines in recent years?

4) Has the proportion of business attributable to excess coverages for self-insurers changed in recent years? Can a distribution of such business be obtained by line, retention limit, class, etc.? Is a record of self-insured losses and claims available?

5) For how many different programs or types of risk are premium and claims experience tracked and compiled into claim ratio runs?

6) Are there any available summaries of the details of excess policies, such as attachment points, exclusions, per occurrence, sunset clauses, aggregate caps, etc.?

7) What is the frequency of availability of such experience summaries? How far back are these available?

8) How are the new programs priced? If you are relying on another insurer's filings, how similar are the underlying books of business?

Questions for a Data Processing or Accounting Executive

1) Has there been any change in the date on which the books are closed for the quarter? the year?

2) How are claim payments handled for claims which have already been paid, but which have not yet been processed to the point where they can be allocated to accident quarter? Are they excluded from the loss history until they are allocated to accident quarter or are they loaded into an arbitrary quarter?

3) Have new data processing systems been implemented in recent years? Have they had a significant impact on the rate of processing claims or on the length of time required from the reporting to the recording of a claim?

4) To what extent have each of the data sources supplied been crosschecked and audited for accuracy and for balancing to overall company statistics? Comment on the degree of accuracy with which each kind of statistic has been properly allocated to accident quarter, to line of business, to size of loss, etc.

5) Have there been any changes in coding procedures which would affect the data supplied?

6) Would it be possible for partial payments to exceed the case outstanding on a claim? In such an event, what adjustments are made? Are unpaid case taken down by the amount of partial payments?

7) How far back can the claims data be actively re-compiled by various key criteria?

8) What data elements are available for each claim? For each risk?

9) By what key criteria could the historical claims data be freshly compiled? Examples of criteria: size of loss breakdowns, type of claim breakdowns (e.g., liability vs. property for commercial multi-peril or homeowner multi-peril), separate compilations by policy limit, or deductible, or type of claim, or state.

10) Can data be compiled either by claimant or occurrence, if multiple claims are established for one occurrence?

Questions for Actuaries Specializing in Ratemaking

1) Have there been any changes in company operations or procedures which have caused you to depart from standard ratemaking procedures? If so, please describe those changes and how they were treated.

2) What data which is currently used for ratemaking purposes could also be used in testing unpaid claims?

3) Have you noted any significant shifts in the composition of business by type of risk or type of claim within the past several years?

4) Do you have any of the following sources of information which may be of value in reserve testing:

   a) External economic indices,
   b) Combined claims data for several companies (e.g., data obtainable from bureau rate filings),
   c) Special rating bureau studies,
   d) Changes in state laws or regulations, and
   e) Size of loss or cause of loss studies?

5) Could we obtain copies of recent rate filings?

6) Were there any changes in statues, court decisions, extent of coverage that necessitated some reflection in the rate analysis?

7) How are new programs priced? If you are relying on another insurer's filing, how similar are the underlying books of business?

Questions for In-House Actuaries

1) Could we obtain copies of any and all actuarial studies done by consultants, auditors or internal actuaries?

2) What areas of disagreement are there between these different studies?

3) What specific background information did you take into account in making your selections?

Additional Questions

In addition to the questions identified in the Berquist and Sherman paper, we recommend that the following questions be added for meetings with senior management of the insurer.

Questions for Those Managing Reinsurance

— Please provide details of reinsurance treaties and of reinsurance agreements in general, regarding both assumed and ceded business.

— Please provide details of all reinsurance ceded treaties including:

- Retention level or quota share percentage
- Reinsurers involved including participation
- Details of any sliding scale premium, commission, or profit commission including currently booked amounts
- Any problems or delays encountered in collecting reinsurance

— Please provide details of any internal or sister company reinsurance agreements that were not included above (cover notes, relevant amounts, and by-line breakdowns).

— Have you secured the continuation of your reinsurance program for next year? If so, under what terms?

Questions for Senior Management

Please provide a brief description of the company's operations including:

— An organization chart with recent changes highlighted
— Details of ownership
— Description of types of business written including all special programs
— Description of marketing (i.e., direct writer, independent agent, etc.)

CHAPTER 5 – THE DEVELOPMENT TRIANGLE

A *development triangle* is a table that shows changes in the value of various cohorts over time. For example, we create a table that summarizes how the cumulative amounts paid by insurance companies (the values) for claims arising out of automobile accidents that occurred during 2006, 2007, and 2008 (the cohorts) increased from year-end 2006 to year-end 2007 to year-end 2008.

Table 1 – Paid Claims and Expenses ($US Billions) by Year-End Accounting Date

Accident Year	Year-end 2006	Year-end 2007	Year-end 2008
2006	100	150	170
2007		110	161
2008			115

We define the *development* for any of these cohorts (i.e., the accident year claims mentioned above) as the change in the value for the cohort over time. For example, the paid claims and expense for accident year 2006 in the above triangle were $100 billion through year-end 2006, and increased to $150 billion through year-end 2007; the change from $100 billion to $150 billion is the *development* in this quantity.

Actuaries are frequently interested in the typical development for a cohort over time. This is generally easier to observe by looking at the age (or maturity) of the cohort rather than the accounting date for the cohort. The above triangle reformatted to reflect this approach is presented in Table 2 below.

Table 2 – Paid Claims and Expenses ($US Billions) by Age

Accident Year	12 Months	24 Months	36 Months
2006	100	150	170
2007	110	161	
2008	115		

The age (or maturity) is generally measured in terms of the time from the start of the cohort period. For example, the age of the 2006 accident year valued at year-end 2006 is 12 months (from the start of the accident year). Similarly, the age of the 2006 accident year valued at year-end 2007 is 24 months (from the start of the accident year).

Both of the above formatting approaches result in data in a triangle shape, hence the term development triangle. However, in the second triangle it is easier to see how the volume (or scale) of the accident year cohort changes from one accident year to the next and how the value of cumulative paid claims for an accident year changes from age to age.

We can show and analyze many different values through the use of development triangles, including but not limited to: reported claims, paid claims, claim-related expenses, and reported claim counts.

Development can be either positive or negative. For example, the number of claims associated with claims occurring in a particular accident year will often increase from one valuation point to another until all claims are reported. There are circumstances, however, when the number of claims decreases from one valuation point to another. In Chapter 11, we use an example with data for private passenger automobile collision coverage organized by accident half-year. The claim count data excludes claims closed without payment. In this particular example, we will observe that the number of claims decreases at successive valuations. Reported claim development can also show downward patterns if the insurer settles claims for a lower value than the case outstanding estimate or if the insurer includes recoveries with the claims data.

The development triangle is one of the most common tools that actuaries use to organize data in order to identify and analyze patterns in historical data. Actuaries use development triangles to quantify historical development. Development patterns are critical inputs to many techniques used to estimate unpaid claims. In this chapter, we demonstrate how to build development triangles for paid claims, case outstanding, reported claims, and reported claim counts. We use payment and case outstanding information for a sample of 15 claims over a four-year time horizon. Our example is not representative of any particular line of insurance. Its sole purpose is to demonstrate how to build development triangles based on detailed claims information.

Rows, Diagonals, and Columns

Table 3 contains a sample reported claim triangle for an organization that began operations in 2005.

Table 3 – Reported Claim Triangle

Accident Year	Reported Claims as of (months)			
	12	24	36	48
2005	1,500	2,420	2,720	3,020
2006	1,150	1,840	2,070	
2007	1,650	2,640		
2008	1,740			

There are three important dimensions in a development triangle:

— Rows
— Diagonals
— Columns

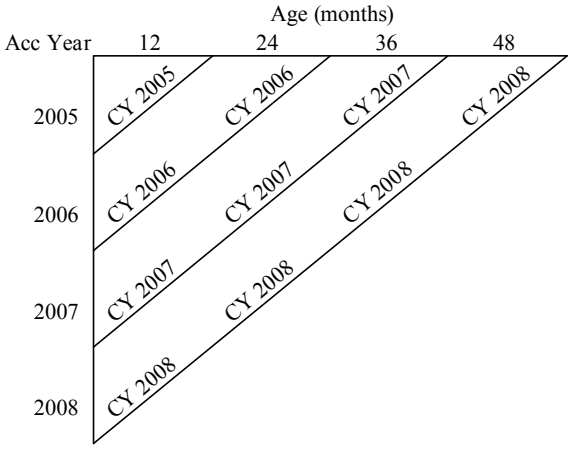
Each row in the triangle above represents one accident year. As we discuss in Chapter 3, organizing data by accident year refers to grouping claims according to the date of occurrence (i.e., the accident date). By grouping the data into accident years, each row consists of a fixed group of claims. In our example, the reported claim development triangle includes the reported claims for accident years 2005 through 2008. The first row of the triangle represents claims occurring in 2005; the second row, claims occurring in 2006; the third row, claims occurring in 2007; and the final row, claims occurring in 2008.

Each subsequent diagonal in the reported claim triangle represents a successive valuation date. There are four diagonals in the triangle shown in Table 3:

— The first diagonal (which is a single point) is the December 31, 2005 valuation
— The next diagonal is the December 31, 2006 valuation for accident years 2005 and 2006
— The next diagonal is the December 31, 2007 valuation for accident years 2005 through 2007
— The last diagonal is the December 31, 2008 valuation for accident years 2005 through 2008

The diagonals and corresponding valuation dates are shown pictorially in Table 4 below. (CY in the diagram below refers to calendar year.)

Table 4 – Diagonals of the Reported Claim Triangle Example



The first diagonal, which starts in the upper left corner of the triangle, is at the December 31, 2005 valuation date and represents accident year 2005 at 12 months of maturity. Again, the standard nomenclature is to count from the beginning of the accident year to the valuation date. Thus accident year 2005, which begins on January 1, 2005, is 12 months old at December 31, 2005.

The second diagonal in the triangle is at the December 31, 2006 valuation date. At December 31, 2006, accident year 2005 is 24 months old and accident year 2006 is 12 months old. To determine these ages, we again count the number of months from the beginning of each accident year (i.e., January 1, 2005 and January 1, 2006) to the valuation date of December 31, 2006. The third diagonal continues in a similar manner.

Concluding our example, the last diagonal of the triangle, at a valuation date of December 31, 2008, represent claims for accident year:

— 2005 as of 48 months (counting from the start of the accident year, January 1, 2005, to the valuation date of December 31, 2008)

— 2006 as of 36 months (counting from January 1, 2006 to December 31, 2008)

— 2007 as of 24 months (counting from January 1, 2007 to December 31, 2008)

— 2008 as of 12 months (counting from January 1, 2008 to December 31, 2008)

Each column in the claim development triangle represents an *age* (or *maturity*) and is directly related to the combination of accident year (row) and valuation date (diagonal) used to create the triangle. In our example, we present accident year data using annual valuations, and thus the ages in the columns are 12 months, 24 months, 36 months, and 48 months. Different valuations can be used by the actuary (e.g., 6 months, 12 months, 18 months, etc.).

Alternative Format of Development Triangles

Throughout this book, we present development triangles with the rows corresponding to the experience period[22] (e.g., accident year in the previous example) and the columns representing the maturity ages.[23] This is by far the most common presentation of development triangles. Some insurers, however, reverse this orientation and present accident years (or policy or underwriting years) as the columns and the maturity ages as the rows. Prior to commencing the analysis of unpaid claims, it is important for the actuary to understand the way in which the insurer aggregates the data and reports the data in the development triangle.

Detailed Example of Claim Development Triangles

Understanding the Data

To better understand how to create a claim development triangle, we turn our attention to the individual claims detail that underlies the reported claim triangle shown in Table 3. In our example, we demonstrate how to integrate the claims amounts shown in the claims listing below into the cells of the various claim development triangles. (In the table below, we use the abbreviation case O/S to mean case outstanding.)

Table 5 – Detailed Example – Claims Transaction Data

			2005 Transactions		2006 Transactions		2007 Transactions		2008 Transactions	
Claim ID	Accident Date	Report Date	Total Payments	Ending Case O/S	Total Payments	Ending Case O/S	Total Payments	Ending Case O/S	Total Payments	Ending Case O/S
1	Jan-5-05	Feb-1-05	400	200	220	0	0	0	0	0
2	May-4-05	May-15-05	200	300	200	0	0	0	0	0
3	Aug-20-05	Dec-15-05	0	400	200	200	300	0	0	0
4	Oct-28-05	May-15-06			0	1,000	0	1,200	300	1,200
5	Mar-3-06	Jul-1-06			260	190	190	0	0	0
6	Sep-18-06	Oct-2-06			200	500	0	500	230	270
7	Dec-1-06	Feb-15-07					270	420	0	650
8	Mar-1-07	Apr-1-07					200	200	200	0
9	Jun-15-07	Sep-9-07					460	390	0	390
10	Sep-30-07	Oct-20-07					0	400	400	400
11	Dec-12-07	Mar-10-08							60	530
12	Apr-12-08	Jun-18-08							400	200
13	May-28-08	Jul-23-08							300	300
14	Nov-12-08	Dec-5-08							0	540
15	Oct-15-08	Feb-2-09								

[22] Also referred to as "origin period."

[23] Also referred to as "development periods."

Table 5 contains detailed information for 15 claims that occurred in accident years 2005 through 2008. The first column of the table is a claim ID number. The next two columns are the accident date and the report date. The accident date is necessary for determining the appropriate row of the triangle. The report date is important for determining when the information about the claim first enters the triangle. The table includes claim payments made in the year and the ending case outstanding value. It is important to recognize that the claim payments in the table do not represent the cumulative paid values but the transactional payments made during the year. The case outstanding values contained in the table are the ending case outstanding values; they are not the transactional change in case outstanding that occurred during the year.

It is absolutely critical when constructing claim development triangles that the actuary fully understands the data available. The information systems used by different insurers vary tremendously. Thus, the types and format of data available to actuaries vary significantly from insurer to insurer. Defining and understanding the available data must be the first step in any actuarial analysis.

Step-by-Step Example

We now demonstrate, step by step, how to create the paid claims, case outstanding, reported claims, and reported claim count triangles. We begin with the incremental paid claim development triangle. Table 6 below summarizes the payment transactions presented in our example. This table is simply an excerpt of Table 5.

Table 6 - Detailed Example – Claims Transaction Paid Claims Data

			Incremental Payments in Calendar Year			
Claim ID	**Accident Date**	**Report Date**	**2005**	**2006**	**2007**	**2008**
1	Jan-5-05	Feb-1-05	400	220	0	0
2	May-4-05	May-15-05	200	200	0	0
3	Aug-20-05	Dec-15-05	0	200	300	0
4	Oct-28-05	May-15-06		0	0	300
5	Mar-3-06	Jul-1-06		260	190	0
6	Sep-18-06	Oct-2-06		200	0	230
7	Dec-1-06	Feb-15-07			270	0
8	Mar-1-07	Apr-1-07			200	200
9	Jun-15-07	Sep-9-07			460	0
10	Sep-30-07	Oct-20-07			0	400
11	Dec-12-07	Mar-10-08				60
12	Apr-12-08	Jun-18-08				400
13	May-28-08	Jul-23-08				300
14	Nov-12-08	Dec-5-08				0
15	Oct-15-08	Feb-2-09				

Using the above data, we create a triangle of incremental payments showing the amounts paid in each 12-month calendar period for the fixed group of claims in our example. For claims that occurred during 2005, the insurer paid a total of $600 during the first 12-month period (2005), $620 during the second 12-month period (2006), and $300 in each of the following two 12-month

periods (2007 and 2008). For claims that occurred during 2006, the insurer paid $460 during 2006 and 2007 and $230 during 2008. We use the same approach for each accident year grouping of claims to derive the following triangle of incremental paid claims.

Table 7 – Incremental Paid Claim Triangle

Accident	Incremental Paid Claims as of (months)			
Year	12	24	36	48
2005	600	620	300	300
2006	460	460	230	
2007	660	660		
2008	700			

The incremental paid claim triangle is important for diagnostic purposes and for some frequency-severity techniques. However, actuaries tend to use cumulative paid claim triangles more often than incremental paid claim triangles. We can readily create the following cumulative paid claim triangle from the incremental paid claim triangle.

Table 8 – Cumulative Paid Claim Triangle

Accident	Cumulative Paid Claims as of (months)			
Year	12	24	36	48
2005	600	1,220	1,520	1,820
2006	460	920	1,150	
2007	660	1,320		
2008	700			

We derive the cumulative paid claim triangle by simple arithmetic from the incremental paid claim triangle. The first column in both triangles, age 12 months, is the same for both paid claim triangles (i.e., incremental paid claims are equal to cumulative paid claims at the first maturity age). To derive the second column of the cumulative paid claim triangle, we add the second column (i.e., age 24 months) of the incremental paid claim triangle to the first column of either triangle. The cumulative paid claims at 36 months are equal to the cumulative paid claims at 24 months plus the incremental paid claims at 36 months. Finally, the cumulative paid claims at 48 months are equal to the cumulative paid claims at 36 months plus the incremental paid claims at 48 months.

Before moving on to the other development triangles (e.g., case outstanding, reported claims, and reported claim counts), we stop to explain where the payments in the original summary appear in the cumulative paid claim development triangle. We now describe how to create numerous cells of the cumulative paid claim triangle using the original detailed paid claims information summarized in Table 6 as an alternative to simply cumulating the incremental paid triangle.

The first cell of the accident year cumulative paid claim development triangle is accident year 2005 at a valuation date of December 31, 2005. Actuaries refer to this point in the triangle as accident year 2005 at 12 months. In the claims detail presented in Table 6, we note that there are four claims that occurred in 2005 (Claim IDs 1, 2, 3, and 4). The first three claims (Claim IDs 1, 2, and 3) all occurred and were reported to the insurer during 2005. The last claim (Claim ID 4) occurred on October 28, 2005, but was only reported on May 15, 2006. Thus, when we calculate the value of accident year 2005 paid claims at 12 months, we do not include Claim ID 4 since this claim was not

yet reported as of the December 31, 2005 valuation date. We also note that Claim ID 3 did not have any payments as of December 31, 2005. Thus, the $600 paid claims which appear in the first cell of the triangle represent payments for Claim IDs 1 and 2 during the year 2005.

We now construct the second diagonal of the cumulative paid claim triangle; this is the December 31, 2006 valuation. The second diagonal of the triangle contains two points: accident year 2005 at 24 months and accident year 2006 at 12 months. Continuing along the first row, we first calculate the value of paid claims at 24 months for accident year 2005. Total payments made during 2006 for Claim IDs 1, 2, 3, and 4 are $620 ($220 + $200 + $200 + $0). Cumulative claim payments for accident year 2005 through December 31, 2006 are equal to the sum of the payments made during 2005 and the payments made during 2006 for a total of $1,220.

The second point along the December 31, 2006 diagonal is accident year 2006 at 12 months. In the table we observe three claims with 2006 accident dates. However, only Claim IDs 5 and 6 were reported in 2006. Thus, we do not include Claim ID 7 in the calculation for the December 31, 2006 valuation[24]. The paid claims for accident year 2006 as of December 31, 2006 are equal to the sum of claim payments ($260 + $200) for Claim IDs 5 and 6.

Our example continues with the third diagonal, the December 31, 2007 valuation, which is also known as the 2007 diagonal. The third diagonal consists of three points:

- Accident year 2005 at 36 months
- Accident year 2006 at 24 months
- Accident year 2007 at 12 months

We follow a similar procedure of cumulating claim payments made through December 31, 2007. For accident year 2005, there are additional claim payments of $300 made during 2007. Thus, cumulative claim payments for accident year 2005 as of December 31, 2007 are $1,520. For accident year 2006, we cumulate the claim payments ($460 in 2006 plus $460 in 2007) for a total cumulative paid claims of $920. Similar to other accident years in our example, there is one claim for accident year 2007 that is not reported by year-end. Thus, the paid claims for accident year 2007 at 12 months only include Claim IDs 8, 9, and 10. We note that there is no payment for Claim ID 10 as of December 31, 2007. Thus, the paid claims value entered in the triangle is the sum of claim payments for Claim IDs 8 and 9 ($200 + $460).

We leave it to the reader to calculate the final diagonal of the cumulative paid claim triangle.

[24] In some applications, it may be far easier to just include Claim 7 as a zero value than to write programming logic to exclude it from the application.

Case Outstanding Triangle

In the following table, we summarize the detailed case outstanding from our 15-claim example. Table 9 is simply an excerpt from Table 5 presented earlier in this chapter.

Table 9 – Detailed Example – Claims Transaction Ending Case Outstanding Data

			Ending Case Outstanding			
Claim ID	**Accident Date**	**Report Date**	**2005**	**2006**	**2007**	**2008**
1	Jan-5-05	Feb-1-05	200	0	0	0
2	May-4-05	May-15-05	300	0	0	0
3	Aug-20-05	Dec-15-05	400	200	0	0
4	Oct-28-05	May-15-06		1,000	1,200	1,200
5	Mar-3-06	Jul-1-06		190	0	0
6	Sep-18-06	Oct-2-06		500	500	270
7	Dec-1-06	Feb-15-07			420	650
8	Mar-1-07	Apr-1-07			200	0
9	Jun-15-07	Sep-9-07			390	390
10	Sep-30-07	Oct-20-07			400	400
11	Dec-12-07	Mar-10-08				530
12	Apr-12-08	Jun-18-08				200
13	May-28-08	Jul-23-08				300
14	Nov-12-08	Dec-5-08				540
15	Oct-15-08	Feb-2-09				

We use the table above to create the case outstanding development triangle below.

Table 10 – Case Outstanding Triangle

Accident	**Case Outstanding as of (months)**			
Year	**12**	**24**	**36**	**48**
2005	900	1,200	1,200	1,200
2006	690	920	920	
2007	990	1,320		
2008	1,040			

The first value in the case outstanding development triangle is accident year 2005 at 12 months. We add the ending case outstanding values for Claim IDs 1, 2, and 3 to derive the case outstanding value of $900. We do not include Claim ID 4 since it is not reported until May 15, 2006. Case outstanding for accident year 2005 at 24 months (i.e., valuation date December 31, 2006) are equal to the case outstanding values for Claim IDs 3 and 4 or $1,200 ($200 + $1,000). Case outstanding for Claim IDs 1 and 2 are both $0 at December 31, 2006. For accident year 2005 at 36 months and 48 months, only Claim ID 4 has an ending case outstanding value. For both these valuation dates, December 31, 2007 and December 31, 2008, the ending case outstanding is $1,200.

For accident year 2006 at 12 months (i.e., valuation date December 31, 2006), the case outstanding value of $690 is equal to the sum of the ending case outstanding for Claim IDs 5 and 6 ($190 + $500). Case outstanding at 24 months (i.e., valuation date December 31, 2007) is equal to the sum of case outstanding on all three accident year 2006 claims ($0 + $500 + 420). The final value in the triangle for accident year 2006 is at 36 months (i.e., valuation date December 31, 2008). Claim IDs 6 and 7 have ending case outstanding values of $270 and $650, respectively. Thus, total case outstanding for accident year 2006 at 36 months is $920.

You can continue in a similar manner to build the remainder of the case outstanding development triangle.

Reported Claim Development Triangle

We define reported claims to be equal to cumulative paid claims through the valuation date plus case outstanding at the valuation date. Thus, we are able to build the reported claim development triangle by adding the cumulative paid claim triangle to the case outstanding triangle. Table 11 below presents the reported claim triangle for our sample 15 claims.

Table 11 – Reported Claim Development Triangle

Accident	Reported Claims as of (months)			
Year	12	24	36	48
2005	1,500	2,420	2,720	3,020
2006	1,150	1,840	2,070	
2007	1,650	2,640		
2008	1,740			

It is interesting to return to the original data and observe what happened to accident year 2005 claims over time. Claim ID 1 occurred early in 2005 and was reported shortly thereafter. Through December 31, 2005 (i.e., the first year of development), there were $400 in claim payments and the insurer established a case outstanding of $200. In the following year, this claim settled for slightly more than the case outstanding value. A claim payment of $220 was made during 2006 and the case outstanding was reduced to $0. There was no further activity on this claim through year-end 2008.

Claim ID 2 occurred in May 2005 and was also reported in May 2005. The insurer made a claim payment of $200 in 2005 and established a case outstanding of $300 by year-end 2005. During 2006, the insurer settled Claim ID 2 for $200, which was less than the $300 case outstanding. Thus, on this claim there was a saving from the initial case outstanding estimate.

The final settlement for Claim ID 3, however, was higher than the initial estimate. When the insured reported the claim near the end of 2005, the claims adjuster established an initial case outstanding of $400. During 2006, the insurer made a payment of $200 and reduced the case outstanding to $200. Thus, the reported claim estimate for this particular claim did not change during 2006; the payment of $200 offsets a similar reduction of $200 in the case outstanding. During 2007, there was a final settlement for Claim ID 3 of $300. The final incurred value for this claim was $500, or $100 more than the reported claim estimates at year-ends 2005 and 2006.

We continue looking at the activity of accident year 2005 claims during 2008. There was no activity on Claim IDs 1 through 3. However the reported claim for Claim ID 4 continues to increase. This was a late-reported claim. At December 31, 2006, the case outstanding was $1,000 for this claim. By December 31, 2007, the case outstanding had increased to $1,200. There were no payments in either 2006 or 2007. In 2008, claim payments were $300 but there was no change in the ending case outstanding. Thus, the reported claim for this particular claim increased by $300 during 2008 from $1,200 (the sum of cumulative claim payments through December 31, 2007, $0, and ending unpaid case at December 31, 2007, $1,200) to $1,500 (the sum of cumulative claim payments through December 31, 2008, $300, and ending unpaid case at December 31, 2008, $1,200).

A similar review can take place with the claims experience of each accident year.

Reported Claim Count Development Triangle

We also use the data in Table 5 to build a reported claim count triangle.

Table 12 – Reported Claim Count Development Triangle

Accident Year	Reported Claim Counts as of (months)			
	12	24	36	48
2005	3	4	4	4
2006	2	3	3	
2007	3	4		
2008	3			

We describe how to build the claim count development triangle by using accident years 2005 and 2008 as examples. Based on the data in Table 5, we note that while there are 4 claims for 2005, only 3 of the claims were reported as of December 31, 2005. Thus, the first cell in the reported claim count triangle which represents accident year 2005 as of December 31, 2005 shows 3 claims reported. By December 31, 2006, all four claims were reported. No further claims were reported for accident year 2005, and thus the number of reported claims remains unchanged at 4 for ages 36 months and 48 months.

The final row of the reported claim count triangle is for accident year 2008 as of December 31, 2008. As of 12 months, there were 3 claims reported for accident year 2008. Claim ID 15 was not reported until 2009 and thus is not included in the triangle.

Other Types of Development Triangles

As mentioned earlier, actuaries use development triangles with a wide variety of data. The first step in creating triangles is to determine the time interval for organizing the data. The time interval represents the rows of the triangles. In our previous example, we use accident year. Other common intervals include:

— Report year
— Underwriting year

— Treaty year[25]
— Policy year
— Fiscal year

By far, accident year is the most common organization of claims data actuaries in the U.S. and Canada use when creating development triangles. Actuaries also often rely on report year development triangles for the analysis of claims-made coverages such as U.S. medical malpractice and errors and omissions liability. Reinsurers often organize claims data by underwriting year. Policy year is a similar concept to underwriting year.

For self-insurers, the policy year, fiscal year, and accident year are often the same. For example, a self-insured public entity with a fiscal year April 1 to March 31 may issue documents of coverage to covered departments and agencies with an April 1 to March 31 coverage period; such entity may also arrange excess insurance with a policy year of April 1 to March 31. Finally, this public entity may aggregate development triangles using accident year periods of April 1 to March 31.

Claims can be categorized by time intervals other than annual intervals. Actuaries also use monthly, quarterly, and semi-annual data for developing estimates of unpaid claims. When selecting the time interval, important considerations for the actuary include the credibility of the experience or the stability of development or both.

There are numerous possibilities for the types of claims data that are presented in development triangles. Common types of data include:

— Reported claims
— Case outstanding
— Cumulative total paid claims
— Cumulative paid claims on closed claim counts[26]
— Incremental paid claims
— Reported claim counts
— Claim counts on closed with payment
— Claim counts on closed with no payment
— Total closed claim counts
— Outstanding claim counts

Actuaries also use the data types listed previously to create triangles of ratios and average claim values. Examples of these triangles include:

— Ratio of paid-to-reported claims

— Ratio of total closed claim counts-to-reported claim counts

— Ratio of claim counts on closed with payment-to-total closed claim counts

— Ratio of claim counts on closed without payment-to-total closed claim counts

[25] *Treaty year* is defined as a period of twelve months covered by a reinsurance treaty or contract.

[26] These values may be problematic to obtain in cases where interim or pre-closing payments are possible.

— Average case outstanding (case outstanding divided by outstanding claim counts)

— Average paid on closed claims (cumulative paid claims on closed claims divided by claim counts closed with payment)[27]

— Average paid (cumulative total paid claims divided by total closed claim counts)

— Average reported (reported claims divided by reported claim counts)

The triangles of ratios and average values provide useful insight into the relationships that exist between the various types of data at different points in time during the experience period. In Chapter 6, we explain how actuaries use these types of triangles as diagnostic tools.

For some insurers, the actuary analyzes LAE data independently of claims only. In such situations, the actuary may also create development triangles with the ratios of paid LAE-to-paid claims only and the ratios of reported LAE-to-reported claims only.

In our discussion so far, we have not mentioned how many development periods the actuary needs to evaluate. Is it necessary to analyze development through the 3rd maturity year, the 5th maturity year, the 10th or the 20th maturity year? If possible, the actuary should analyze development out to the point at which the development ceases (i.e., until the selected development factors are equal to 1.000). The number of development periods required generally varies by line, jurisdiction, and also by data type. For example, paid claims typically require a greater number of development periods than reported claims, and reported claims often require a greater number of development periods than reported claim counts. Also, automobile physical damage claims settle much more quickly than general liability claims, and therefore an analysis of unpaid claims for automobile physical damage requires fewer development periods than a similar analysis for general liability.

In the following chapters, we use the development triangle both as a diagnostic tool and as the primary input for numerous estimation techniques for unpaid claims.

Naming Convention for Examples

In our examples, we use the terms “reported claims” to refer to cumulative reported claims and “paid claims” to refer to cumulative paid claims. Similarly, we use the terms “reported claim counts” and “closed claim counts” to refer to cumulative reported and closed claim counts, respectively. For some examples in Chapters 11 through 13, we use incremental values of claims and claim counts. Any development triangles containing incremental values, of claims or claim counts, are specifically labeled as incremental.

[27] As noted on the previous page, cumulative paid claims on closed claim counts may be difficult to obtain. In such cases, actuaries may determine that interim or pre-closing payments are immaterial enough to justify the inexact match from including all payments, even those from open claims, divided by closed claim counts.

CHAPTER 6 – THE DEVELOPMENT TRIANGLE AS A DIAGNOSTIC TOOL

Part 2 of this book is about information gathering. We begin Chapter 3 with a description of the types of data and how data is organized. In Chapter 4, we discuss the importance of meeting with those involved with the operations and processes underlying the data (labeled in this text as management) and understanding the environment in which the insurer operates – both the internal and external environments. In Chapter 5, we construct development triangles. We conclude Part 2 with Chapter 6 in which we combine the knowledge we obtain by analyzing the development triangles with the information we receive during meetings with the insurer's claims and underwriting departments. In this chapter, we use the development triangles as a tool to further understand how changes in an insurer's operations and the external environment can influence the claims data. This is the final step before we delve into specific techniques for estimating unpaid claims.

It is very important for the actuary to communicate with the insurer's management if the changes that management reports to have implemented are not supported by the data. It is quite common for an insurer's management to report significant changes in both the claims settlement area and the strength (i.e., adequacy) of its case outstanding. Insurers may try to accomplish such changes through new policies, procedures, and/or information systems. Many times actuaries do see evidence of operational change in the quantitative data that they are reviewing. However, in some situations, the best intentions of senior claims management may not have worked through the organization as planned; in these situations a direct effect on the claims data may not be evident to the actuary. Sometimes, it is just a matter of time before signs of the operational changes start to show in the claims data. Other times, there may be cultural blocks within the organization that are resisting the intended changes. Through open discussions with claims management and staff as well as a detailed review of the claims data, the actuary should be able to gain a clear understanding of the situation and then choose the best technique(s) to match the particular situation at hand.

Detailed Example – Background Information

In the following example, we demonstrate how to use development triangles for diagnostic review. For this purpose, we use the experience of an insurer's private passenger automobile portfolio in one geographic region (e.g., a single state or a province). Specifically, we look at the historical claims experience for automobile bodily injury liability over the 2002 to 2008 experience period. In this chapter and throughout Part 3, we refer to this example as XYZ Insurer.

The purpose of our example is not to raise every possible question or to identify every possible issue that may exist for XYZ Insurer. Instead, our goal is to teach you how to look at relationships and how to begin to develop your own observations and questions.

In this example, we assume that meetings with various members of the insurer's operations have already taken place. At these meetings, we were told that there were significant changes within the claims department over the last several years, including changes at the most senior levels of management. The new Senior Vice President – Claims told us that one of her main priorities is to carry adequate case outstanding. Management insists that the strength of current case outstanding is much greater than in prior years. During our meetings, we also learned that the insurer

implemented new information systems in the past three years for the purpose of speeding up the claims reporting and settlement processes. Management at XYZ Insurer believes very strongly in the saying "a good claim is a closed claim" and has instituted policies and procedures to expedite the claim settlement process.

In addition to the changing environment within the insurer's operations, we know that there were significant changes to the automobile insurance product in this geographic region. Major tort reforms were implemented in 2006 resulting in caps on awards as well as pricing restrictions and mandated rate level changes for all insurers operating in the region. As a result of these reforms, management decided to reduce its presence in this market.

Having met with management, it is now time to begin our diagnostic review of the data. One goal of such a review is to determine if we can observe the effect of the changes implemented by management in the claims data provided by the insurer. We expect that our review will likely lead to further questions and result in more discussions with members of the management team. We also hope that based on our diagnostic review, we will be able to determine what types of data and which techniques will be most appropriate to estimate unpaid claims for XYZ Insurer under its current circumstances.

Premium History

In Table 1 below, we summarize earned premium as well as XYZ Insurer's historical rate changes for this line of business. XYZ Insurer provided the earned premium and rate level changes by year. We calculate the cumulative average rate level and annual change in exposures from year to year.[28]

Table 1 – Summary of Earned Premium and Rate Changes

Calendar Year	Earned Premiums ($000)	Rate Changes	Cumulative Average Rate Level	Annual Exposure Change
2002	61,183		0.0%	
2003	69,175	+5.0%	5.0%	7.7%
2004	99,322	+7.5%	12.9%	33.6%
2005	138,151	+15.0%	29.8%	21.0%
2006	107,578	+10.0%	42.8%	-29.2%
2007	62,438	-20.0%	14.2%	-27.5%
2008	47,797	-20.0%	-8.6%	-4.3%

(To simplify the analysis in this chapter and in Part 3, assume that the rate changes in the above table represent the average earned rate level for the year. For further information about

[28] The average rate level is calculated by successive multiplication of the annual rate changes. For example, for 2004, the cumulative average rate level is equal to {[(1.00 + 5.0%) x (1.00 + 7.5%)] – 1.00}, or 12.9%. Similarly, the average rate level change for 2007 is equal to {[(1.00 + 42.8%) x (1.00 – 20.0%)] – 1.00}, or 14.2%. The annual exposure change is equal to the annual change in earned premiums divided by the rate change in the year. For example, the annual exposure change for 2003 is equal to {[(69,175 / 61,183) / (1 + 5.0%)] – 1.00}, or 7.7%. For 2008, the annual exposure change is equal to {[(47,797 / 62,438) / (1 – 20.0%)] – 1.00}, or -4.3%.

adjustments for rate level changes, we refer the reader to C. L. McClenahan, "Ratemaking," Chapter 3 in *Foundations of Casualty Actuarial Science,* Fourth Edition, CAS, 2001.)

The Reported and Paid Claim Triangles

Reported and paid claim development data are the two most common types of data actuaries have access to. Tables 2 and 3 below present the reported and paid claim development triangles, respectively, for XYZ Insurer.

Table 2 – Reported Claim Development Triangle

Accident	Reported Claims ($000) as of (months)						
Year	12	24	36	48	60	72	84
2002	12,811	20,370	26,656	37,667	44,414	48,701	48,169
2003	9,651	16,995	30,354	40,594	44,231	44,373	
2004	16,995	40,180	58,866	71,707	70,288		
2005	28,674	47,432	70,340	70,655			
2006	27,066	46,783	48,804				
2007	19,477	31,732					
2008	18,632						

Table 3 – Paid Claim Development Triangle

Accident	Paid Claims ($000) as of (months)						
Year	12	24	36	48	60	72	84
2002	2,318	7,932	13,822	22,095	31,945	40,629	44,437
2003	1,743	6,240	12,683	22,892	34,505	39,320	
2004	2,221	9,898	25,950	43,439	52,811		
2005	3,043	12,219	27,073	40,026			
2006	3,531	11,778	22,819				
2007	3,529	11,865					
2008	3,409						

When conducting a diagnostic review with claim development triangles, the actuary is generally looking down the columns of the triangle. The actuary is looking at the experience of different accident years at the same age of development (i.e., same maturity age). In a stable environment, the actuary expects to see stability in the claim experience down each column.

We combine the premium data with the claim data and calculate two more diagnostic triangles: the ratio of reported claims to earned premium (also known as the reported claim ratio) and the ratio of reported claims to on-level earned premium. We calculate the on-level premium using the average rate level changes by year and restating the earned premium for each year as if it was written at the 2008 rate level.

Table 4 – Ratio of Reported Claims to Earned Premium

Accident	Ratio of Reported Claims to Earned Premium as of (months)						
Year	12	24	36	48	60	72	84
2002	0.209	0.333	0.436	0.616	0.726	0.796	0.787
2003	0.140	0.246	0.439	0.587	0.639	0.641	
2004	0.171	0.405	0.593	0.722	0.708		
2005	0.208	0.343	0.509	0.511			
2006	0.252	0.435	0.454				
2007	0.312	0.508					
2008	0.390						

Table 5 – Ratio of Reported Claims to On-Level Earned Premium

Accident	Ratio of Reported Claims to On-Level Earned Premium as of (months)						
Year	12	24	36	48	60	72	84
2002	0.229	0.364	0.477	0.674	0.794	0.871	0.862
2003	0.160	0.282	0.504	0.674	0.735	0.737	
2004	0.211	0.500	0.732	0.892	0.874		
2005	0.295	0.488	0.723	0.726			
2006	0.393	0.679	0.709				
2007	0.390	0.635					
2008	0.390						

A thorough review of the above triangles, leads us to the following questions/observations:

— What happened in accident year 2003? Why are the reported claims so low after 12 and 24 months of development? When comparing the changes in claims by year to the changes in premiums by year, we need to first consider the rate level history for the insurer. According to Table 1, we know that the insurer had a 5% higher rate level in 2003 than 2002. Thus, it appears that the insurer experienced an exposure growth of approximately 8% in 2003 ([(($69,175 / 1.05) / $61,183) – 1.00]). Knowing that the insurer actually increased its exposure base, it is surprising to see a 25% drop in reported claims for 2003 after 12 months of development. For the 36-, 48-, and 60-month valuations, reported claims for accident year 2003 appear to return to levels similar to those experienced in 2002. What led to the lower level of reported claims for the first 24 months? Was there a change in systems? Were paid claims or case outstanding driving the decrease in reported claims? If we look at the paid claim triangle for accident year 2003, we observe that paid claims are also down at 12 and 24 months of development and that the reduction is roughly of the same magnitude as for the reported claims.

— What happened in accident year 2004, particularly at and after the 24-month valuation? While we observe that earned premiums are up 44% over 2002 and 34% over 2003 (after adjustment for rate changes), the reported claims for 2004 after 24 months of development are up by 97% [($40,180 / $20,370) – 1.00] over 2002 and 136% [($40,180 / $16,995) – 1.00] over 2003. Are large claims or more claim counts or both driving the increase? Was there a change in case outstanding adequacy that had an effect on the December 31, 2005 valuation? (Remember that the 24-month valuation for accident year 2004 corresponds to the December 31, 2005 valuation.)

— What happened in accident years 2005 and 2006 to drive reported claims up so much at 12 months of development? A quick look at the higher volume of earned premiums for these two years provides some of the explanation for the increase. However, we observe that, at the 12-month valuation, reported claims are again increasing at a rate that is greater than the increase in exposures and our knowledge of the inflationary environment. For example, we compare reported claims between accident years 2004 and 2005:

$$[(AY_{2005} / AY_{2004}) - 1.00] = [(\$28,674 / \$16,995) - 1.00] = 69\%$$

The 69% increase observed in reported claims between 2004 and 2005 is greater than the increase in exposures between these years, which is 21%. Similarly, we compare reported claims between accident years 2004 and 2006:

$$[(AY_{2006} / AY_{2004}) - 1.00] = [(\$27,066 / \$16,995) - 1.00] = 59\%$$

The 59% increase observed in reported claims between 2004 and 2006 is greater than the change in exposures between these years, which is actually a decrease of 14%.

— If we look down the 24-month column, we observe unusually large volumes of reported claims for accident years 2004 through 2006. For each of these years, reported claims are greater than $40 million, and the on-level reported claim ratios are greater than 0.40. For these same three accident years, we see that XYZ experienced larger volumes of paid claims with values of approximately $10 million for 2004 and $12 million for 2005 and 2006. We also note that, at 24 months, accident year 2007 reported claims are lower than the preceding three accident years. Could the lower claims in 2007 be a result of the tort reforms introduced during 2006?

— When we analyze the experience for accident year 2006, we should keep in mind that the insurer experienced a significant reduction in exposures during the year. Earned premiums dropped from $138,151 in 2005 to $107,578 even with a 10% rate increase. This indicates a drop in exposures of almost 30%. However reported claims after 12 months of development differ from 2005 by less than 6% [($27,066 / $28,674) – 1.00] and at 24 months of development by less than 2% [($46,783 / $47,432) – 1.00]. After 36 months, we do see a significant difference between claims for accident years 2005 and 2006.

— Now turning our attention to accident years 2007 and 2008, we see that reported claims are significantly lower than for 2005 and 2006 though the claim ratios are not. We can determine the change in exposures based on the given premium information. While there was another reduction of approximately 30% in the exposures during 2007 (from 2006), the change in earned premiums between 2007 and 2008 was primarily due to the rate change and not due to changes in exposure volume. The volume of reported claims at 12 months for accident years 2007 and 2008 is consistent with the earned premium information.

At this point it is valuable for the actuary to analyze additional development triangles to look for answers to some of the questions raised in this initial review of the claims data.

The Ratio of Paid-to-Reported Claims

There are many situations under which reported and paid claim development triangles are the only triangles available to the actuary. Using these two triangles the actuary can calculate a ratio of the paid claims-to-reported claims (also known as the paid-to-reported ratio). Building a triangle using such ratios allows the actuary to analyze the evolution of this relationship over the experience period.

As a diagnostic tool, this ratio examines the consistency of paid claims relative to reported claims. It is an important tool for testing whether there might have been changes in case outstanding adequacy or in settlement patterns. Since we are analyzing a ratio, we need to investigate further any changes observed to determine if the change is occurring in paid claims (i.e., the numerator) or in the case outstanding, which are a critical component of the reported claims (i.e., the denominator). However, if we do not observe changes in the ratio of paid-to-reported claims, it does not necessarily mean that changes are not occurring. There could be offsetting changes in both claim settlement practices and the adequacy of case outstanding that result in no change to the ratio of paid-to-reported claims.

In our example, claims department management believes that the new claims settlement practices resulted in a speed-up in claims closure. Based on this information, we would expect paid claims to be increasing along the latest diagonals relative to prior years. Management also reported that the new policies related to case outstanding are resulting in stronger unpaid case than in prior years. Therefore, reported claims should also be increasing along the latest diagonals of the triangle. With both paid claims and reported claims increasing, the ratio of paid-to-reported claims may be unchanged along the latest diagonals when compared with prior years' diagonals.

Now, we look at the triangle summarizing the historical ratios of paid-to-reported claims for XYZ Insurer.

Table 6 – Ratio of Paid Claims-to-Reported Claims

Accident	Ratio of Paid Claims-to-Reported Claims as of (months)						
Year	12	24	36	48	60	72	84
2002	0.181	0.389	0.519	0.587	0.719	0.834	0.923
2003	0.181	0.367	0.418	0.564	0.780	0.886	
2004	0.131	0.246	0.441	0.606	0.751		
2005	0.106	0.258	0.385	0.567			
2006	0.130	0.252	0.468				
2007	0.181	0.374					
2008	0.183						

We continue to look down each column and to compare the experience from accident year to accident year. Based on the experience in Table 6, it is difficult to discern changes in this ratio. While the ratio was decreasing at 12 months for accident years 2004 through 2006, it has returned to historical levels for accident years 2007 and 2008. Similar observations can be made at 24 months.

We recall that since we are reviewing a ratio, we need to look at the potential for changes in both the numerator and the denominator. A downward trend in the ratio of paid-to-reported claims could be the result of decreasing paid claims or of increasing case outstanding adequacy. We understand from our discussions with management of the claims department that the rate of

claims settlement has increased. Is the change in case outstanding adequacy masking the changes in the settlement process? We also ask if the type of claims reported is changing. Different types of claims have different settlement and reporting characteristics. This could have an effect on both paid and reported claims.

The Ratio of Paid Claims to On-Level Earned Premium

Next, we decide to review the ratio of cumulative paid claims to on-level earned premium. We hope that a review of this diagnostic triangle will provide insight as to whether there was a speed-up in claims payment or possibly deterioration in underwriting results.

Table 7 – Ratio of Cumulative Paid Claims to On-Level Earned Premium

Accident	Ratio of Cumulative Paid Claims to On-Level Earned Premium as of (months)						
Year	12	24	36	48	60	72	84
2002	0.041	0.142	0.247	0.395	0.571	0.727	0.795
2003	0.029	0.104	0.211	0.380	0.573	0.653	
2004	0.028	0.123	0.323	0.540	0.657		
2005	0.031	0.126	0.278	0.412			
2006	0.051	0.171	0.331				
2007	0.071	0.238					
2008	0.071						

There does appear to be evidence of a possible speed-up in payments, particularly at 12 and 24 months. The question still remains as to whether or not there has been a shift in the type of claim settled at each age. At this point, we request additional data (reported and closed claim counts) and create new development diagnostic triangles for further review.

Claim Count Triangles

Just as we review the reported and paid claim triangles above, we also review the triangles of reported and closed claim counts.

Table 8 – Reported Claim Count Development Triangle

Accident	Reported Claim Counts as of (months)						
Year	12	24	36	48	60	72	84
2002	1,342	1,514	1,548	1,557	1,549	1,552	1,554
2003	1,373	1,616	1,630	1,626	1,629	1,629	
2004	1,932	2,168	2,234	2,249	2,258		
2005	2,067	2,293	2,367	2,390			
2006	1,473	1,645	1,657				
2007	1,192	1,264					
2008	1,036						

Table 9 – Closed Claim Count Development Triangle

Accident	Closed Claim Counts as of (months)						
Year	12	24	36	48	60	72	84
2002	203	607	841	1,089	1,327	1,464	1,523
2003	181	614	941	1,263	1,507	1,568	
2004	235	848	1,442	1,852	2,029		
2005	295	1,119	1,664	1,946			
2006	307	906	1,201				
2007	329	791					
2008	276						

Before commencing the analysis of the claim count development triangles, it is important that the actuary understand the types of data contained within such triangles. How does the insurer treat reopened claims? Are they coded as a new claim or is a previously closed claim re-opened? If the insurer treats reopened claims in the latter, there could potentially be a decrease across a row in the closed claim count development triangle. Does the insurer include claims closed with no payment (CNP) in the reported and closed claim count triangles? How are claims classified that have only expense payments and no claim payment?

XYZ Insurer indicated that the closed claim count development data excludes CNP claim counts. The reported claim count development data is based on the sum of closed claim counts (excluding CNP) and claims with case outstanding values; thus, the reported claim count development triangle also excludes CNP counts.

Our review of these triangles leads to the following observations and questions:

— At 12 months, we see that the reported claim counts experienced an increase of 40% [(1,932 / 1,373) – 1.00] and closed claim counts had an increase of 30% [(235 / 181) – 1.00] between accident years 2003 and 2004. Over this same time period, we observe a 76% increase in reported claims. Similarly, the increases in claim counts at 24 months for accident year 2005 [(2,293 / 2,168) – 1.00 = 5.8%] are not as significant as the increases in reported claims [($47,432 / $40,180) – 1.00 = 18.0%]. Why are claims increasing so much more than the number of claims? Could large claims be driving the increases?

— Reported claim counts for accident years 2004 and 2005 stand out as the highest values at all ages. This is generally consistent with the experience shown in the reported claim triangle. However, we do not observe a similar increase in the closed claim count triangle where 2006 and 2007 are highest at 12 months. At 24 months, the highest closed claim count values are for accident years 2005 and 2006. Are the higher closed claim counts due to the new systems implemented at the insurer?

— The decrease in reported claim counts for 2006 and 2007 is consistent with the decrease in exposures for these years. We do not see a similar decrease in closed claim counts, however. Perhaps, this is due to the speed-up in claims settlement processes that management discussed in our meetings. It is worth investigating this issue further.

— For accident year 2008, reported and closed claim counts are lower than we would expect given reported claims, paid claims, and the relative steady-state of exposures between 2007 and 2008. This leads us to further investigation of why the number of claims is down for the latest year.

Ratio of Closed-to-Reported Claim Counts

If the actuary suspects that there are changes in the settlement rate of claims, either based on information gained from meetings with management or changes observed in the ratio of paid-to-reported claims, the ratio of closed-to-reported claim counts is an important diagnostic tool to review. Many factors can have an effect on the reporting and closing of claims. For example, a large catastrophic storm, such as a hurricane, has the potential to temporarily limit an insurer's operations with telephone and computer system shutdowns. In such a situation, there may be a one-time blip with a decrease in the ratio of closed-to-reported claim counts. Other forces that could result in a change in the ratio of closed-to-reported claim counts include:

— Change in the guidelines for the establishment of a claim

— Decrease in the statute of limitations, which often accompanies major tort reform

— Delegation of a higher limit for settlement of claims to a TPA

— Restructuring of the claim field offices, such as through the merging of existing offices or the addition of new offices

— Introduction of a new call center to handle claims (This could affect both reported and closed claim counts and thus the actuary would need to further investigate whether changes were affecting the numerator, closed claim counts, the denominator, reported claim counts, or both.[29])

Management at XYZ Insurer told us that they implemented a new claims processing system and that claims are now settling much more quickly than in the past. Management indicated that the new system is having an effect on the entire portfolio of outstanding claims not just claims from the latest accident year. With respect to the ratio of closed-to-reported claim counts, we would then expect to see greater ratios for the latest diagonals than for prior years.

[29] Changes in claims handling procedures can result in decreases and increases in the rate of claim payments. Sometimes, a change in procedures results in a temporary increase in closing patterns, such as when a claim department makes an extra effort to get the backlog as low as possible before making a transition to a new system. Sometimes, the speed-up is due to faster processing under the new system. Sometimes the new system leads to a slowdown in closing, due to a learning curve necessary before the new system is fully operational.

We generate the following triangle based on the claims information presented earlier for XYZ Insurer.

Table 10 – Ratio of Closed-to-Reported Claim Counts

Accident	Ratio of Closed-to-Reported Claim Counts as of (months)						
Year	12	24	36	48	60	72	84
2002	0.151	0.401	0.543	0.699	0.857	0.943	0.980
2003	0.132	0.380	0.577	0.777	0.925	0.963	
2004	0.122	0.391	0.645	0.823	0.899		
2005	0.143	0.488	0.703	0.814			
2006	0.208	0.551	0.725				
2007	0.276	0.626					
2008	0.266						

Change is clearly evident in this diagnostic triangle. For the first four years in the experience period (2002 through 2005) at 12 months of development, the ratio of closed-to-reported claim counts was roughly 0.14. For each of the last three years (at 12 months), the ratio is in excess of 0.20; and for the latest year it is 0.266. We observe the same type of increases for the 24-month through 48-month development periods. At 24 months, the ratio of closed-to-reported claim counts for the latest accident year, 2007, is 0.626 and for the earliest year, 2002, is 0.401; at 36 months, the ratio for the latest accident year, 2006, is 0.725 and for the earliest year, 2002, is 0.543.

The experience of closed and reported claim counts is consistent with management's report of greater emphasis on settling claims faster. After concluding that management's efforts have indeed had an effect on the claims settlement patterns, the actuary must then consider the consequences of such a change. Generally, insurers are able to close the less complicated and less expensive claims the quickest. The closure of more complicated claims, which tend to involve litigation and expert witnesses, are often less in the control of the insurer since third parties play a significant role in the claims settlement process. If the insurer's greater focus on closing claims is having its greatest influence on the settlement of smaller claims, there will likely be a shift in the type of claims closed or open at any particular age in the claim development triangle. We discuss this further in the next section on average claims.

Average Claims

We use the reported and paid claim development triangles as well as the reported and closed claim count triangles to calculate various average values. For XYZ Insurer, we calculate the following:

Table 11 – Definitions of Average Values

Average Value	Definition
Average reported claim	Reported claim triangle / reported claim count triangle
Average paid claim	Paid claim triangle / closed claim count triangle
Average case outstanding	$\frac{\text{Reported claim triangle – paid claim triangle}}{\text{Reported claim count triangle – closed claim count triangle}}$

Before summarizing the observations from XYZ Insurer, we highlight two important issues related to average values. First, it is important for the actuary to have a clear understanding of the definition of closed and reported claim counts. Some insurers include claims with no payment (CNP) in the definition of closed claim counts and other insurers exclude CNP. Similarly, some insurers include claims with no case outstanding and no payments in the definition of reported claim counts, and other insurers define reported claim counts as only those claims with a case outstanding greater than $1 or with a claim payment. The result of including CNPs in closed claim count statistics or claims with no case outstanding or payments in reported claim counts is a much lower average value. For the actuary, what is most important is that he or she knows what definition the insurer uses and that the insurer is consistently using the same definition throughout the experience period. A change in the definition of claim counts can have a significant consequence on the results of diagnostic analyses using claim counts and on estimation techniques that rely on the number of claims. It is also important that the actuary is aware of differences between the insurer's definition of claim counts and any external benchmarks that would be used for comparison purposes.

Second, large claims, both the presence and absence of such claims, can have a distorting effect on average claims. Actuaries may remove unusually large claims from the database before conducting both ratio and average value calculations and handle the unpaid claim estimate required for such large claims separately. Another alternative is to prepare development triangles using limited claims. For example, claims can be limited to $500,000 or $1 million per occurrence in the reported and paid claim development triangles. The determination of the claim limit is a matter of significant actuarial judgment and is beyond the scope of this book. (See previous discussion of determining a large claims threshold in Chapter 3.)

Policy deductibles can also cause a distorting effect on the analysis of average values. Again, the actuary must understand what is included and excluded from the data source, in terms of claims, recoverables, and claim counts. Retentions can also distort severities.

For XYZ Insurer, closed claim counts exclude claims closed without any payment; similarly, reported claim counts exclude claims in which there are no case outstanding and no payments. Paid claims, for XYZ Insurer, include partial payments as well as payments on closed claims. Thus, our average paid claim triangle will be a combination of payments on settled claims as well as payments on claims that are still open.

We present the average reported claim triangle for XYZ Insurer in the following table. The average reported claim triangle is frequently used to detect possible changes in case outstanding adequacy. It is not quite as valuable as the average case outstanding triangle since reported claims include both paid claims and unpaid case. As we discussed previously, changes in paid claims have the potential to mask changes in case outstanding adequacy. However, for some insurers, open claim counts are not available in triangular format and the average reported claim triangle may be all that the actuary has available for diagnostic purposes.

Table 12 – Average Reported Claim Development Triangle

Accident	Average Reported Claims as of (months)						
Year	12	24	36	48	60	72	84
2002	9,546	13,455	17,219	24,192	28,673	31,379	30,997
2003	7,029	10,517	18,622	24,966	27,152	27,239	
2004	8,796	18,533	26,350	31,884	31,129		
2005	13,872	20,686	29,717	29,563			
2006	18,375	28,440	29,453				
2007	16,340	25,104					
2008	17,985						

When reviewing triangles of average values for a stable insurer, we expect to see changes down the columns limited to inflationary forces only. As we look down the columns of the average reported claim triangle in our example above we observe changes that are greater than the annual inflation (assumed to be 5% for this region's automobile bodily injury liability).[30] We do not know, however, if the increases are due to greater levels of payments or stronger case outstanding.

In Table 13, we show the average paid claim triangle. We remind you that there is a mismatch in the average paid claim triangle since the numerator (cumulative paid claims) includes partial claim payments and the denominator (closed claim counts) represents only claims with final settlement. We must consider this limitation when drawing any conclusions from this particular diagnostic triangle.

Table 13 – Average Paid Claim Development Triangle

Accident	Average Paid Claims as of (months)						
Year	12	24	36	48	60	72	84
2002	11,417	13,067	16,436	20,290	24,073	27,752	29,178
2003	9,631	10,163	13,478	18,125	22,896	25,077	
2004	9,452	11,673	17,996	23,455	26,028		
2005	10,315	10,920	16,270	20,569			
2006	11,502	13,000	19,000				
2007	10,726	15,000					
2008	12,351						

In this diagnostic triangle, we observe that the average values along the latest diagonal are generally the highest value in each column (particularly at 12 to 36 months). Based on the knowledge acquired from our meetings with claims department representatives and our review of other diagnostics, we ask whether or not there has been a change in the type of claim that is being closed at these particular ages. This is an important question for the actuary to discuss with management of the claims department as it could affect the actuary's selection of estimation techniques and claim projection factors.

[30] It is important to recognize that there are many factors that have an effect on severity trends for any particular line of business. Examples include changes in: policy limits purchased, geographic mix, type of policyholders insured, definition of claim counts, etc.

The average paid claim triangle appears relatively stable for ages 48 and older. The evidence of change in average paid claims only at 12, 24, and 36 months is consistent with our earlier comment that insurers typically have the greatest control on closure rates of the less complicated and less expensive claims. Closing more complex claims is usually dependent on the actions of third parties that are not within the insurer's control.

Finally, we review the average case outstanding (or average open claim amount) triangle. The average case outstanding triangle is one of the most important diagnostic tools for testing changes in case outstanding adequacy. In this triangle, a decreasing pattern down the column is an indicator of potential weakening in the case outstanding, and an increasing pattern down the column is an indicator of possible strengthening in the case outstanding.

Table 14 – Average Case Outstanding Development Triangle

Accident	Average Case Outstanding as of (months)						
Year	12	24	36	48	60	72	84
2002	9,213	13,714	18,151	33,273	56,167	91,729	120,366
2003	6,634	10,733	25,647	48,766	79,718	82,826	
2004	8,706	22,941	41,561	71,204	76,320		
2005	14,464	29,994	61,547	68,983			
2006	20,185	47,368	56,984				
2007	18,480	42,002					
2008	20,031						

Before drawing any conclusions, however, it is important that the actuary understands the dynamics of the insurer. Has there been a change in case outstanding practices, policies, philosophy, staff, or senior management of the claims department? Any of these changes could affect case outstanding adequacy. The average case outstanding could also be changing due to changes in the mix of business in the portfolio that have nothing to do with changes in case outstanding strength.

This is why it is so important that the actuary looks at more than one diagnostic tool before drawing conclusions and that the actuary returns to the insurer's claims department for further input regarding his or her observations.

To analyze the data in the average case outstanding triangle for XYZ Insurer, we look down the columns and compare the average case outstanding at the same age by accident year. For an insurer that is operating in a stable environment, we expect that the average case outstanding would be increasing down the column at the relevant annual inflation rate.[31] A quick look at the average case outstanding in our example tells us that the average case outstanding is generally increasing by more than the 5% inflation in this example.

For the earliest years in our experience period (2002 through 2004), the average case outstanding at 12 months of development was less than $10,000. For two of the latest three accident years at 12 months, the average case outstanding is greater than $20,000. We see similar increases at 24 and 36 months. At 24 months, the average case outstanding for accident years 2002 and 2003 was less than $15,000; for accident years 2006 and 2007 at the same development age, the average case outstanding values are both greater than $40,000. At 36 months, the average case

[31] Note that the relevant annual inflation rate may be something other than the overall inflation rate, as it may reflect a different mix of components than found in the overall economy's inflation.

outstanding for accident years 2002 and 2003 was less than $26,000; for accident years 2005 and 2006 at the same age, the average value is close to $60,000. We also observe increasing values of average case outstanding at 48 and 60 months.

We understand from our meetings with XYZ Insurer management that increased case outstanding strength is a priority. We also know that a review of the average case outstanding shows increasing average values for outstanding claims. However, before accepting that there has been a change in the adequacy of case outstanding, we must ask what effect, if any, is the change in claims settlement having on the average case outstanding. If smaller claims are settling more quickly, we are then left with only the more complex and more expensive claims. This, in and of itself, would lead to an increase down the columns in the average case outstanding. It is very important for the actuary to determine how much of the increase in the average case outstanding is truly due to a systemic change in the overall level of case outstanding adequacy and how much is due to a different mix of claims.

Summary Comments for XYZ Insurer

Clearly XYZ Insurer has experienced change over the recent several years. Management communicated these changes in our last meeting and every claim development diagnostic that we review shows that the changes noted by management are evident. It is now up to the actuary to determine how to incorporate all this information in the development of an unpaid claim estimate to be carried on XYZ Insurer's financial statements. The changing environment will have an effect on the actuary's choice of estimation techniques, types of data, and actuarial factors within the techniques. We continue to use this example in Part 3 as we introduce basic techniques for estimating unpaid claims.

Conclusions

In this chapter we present, as an example, an insurer who has the capability of producing development triangles for many types of data, including claims and claim counts. Many insurers do not have this ability. In these situations, actuaries may be limited to development triangles of reported and paid claims only. Actuaries are then faced with the challenge of finding other sources of data and information to ensure that they have sufficient knowledge of the insurer in order to determine the unpaid claims.

In "Loss Reserving," Mr. Wiser states: "Exploring the data begins by understanding the trends and changes affecting the database. Understanding the data is a prerequisite to estimating sound loss reserves. This exploration will help the analyst select appropriate loss reserving methods and interpret the results of the methods."[32]

The goal of this chapter is to demonstrate that the development triangle is an excellent tool for exploring the data. We discuss how important it is for the actuary to take the information obtained during meetings with management and then seek confirmation in the actual claims experience. The actuary should not simply accept reports of change or reports of no change without confirmation. Without some form of verification, management's assertion of changes in the strength of case outstanding or changes in the rate of claims settlement could lead to inaccurate estimates of unpaid claims by the actuary.

[32] *Foundations of Casualty Actuarial Science*, 2001.

The actuary must be able to question management when they see changes in the data that are not consistent with what management says has occurred, is occurring, or will be occurring. The dialogue between the actuary and those involved with the insurer's operations (especially claims operations) must be ongoing. Understanding the data is a complex process that requires the input of many people and ultimately requires the judgment of the actuary to interpret the findings from both quantitative and qualitative information.

PART 3 – BASIC TECHNIQUES FOR ESTIMATING UNPAID CLAIMS

INTRODUCTION TO PART 3 – BASIC TECHNIQUES FOR ESTIMATING UNPAID CLAIMS

The Components of Ultimate Claims

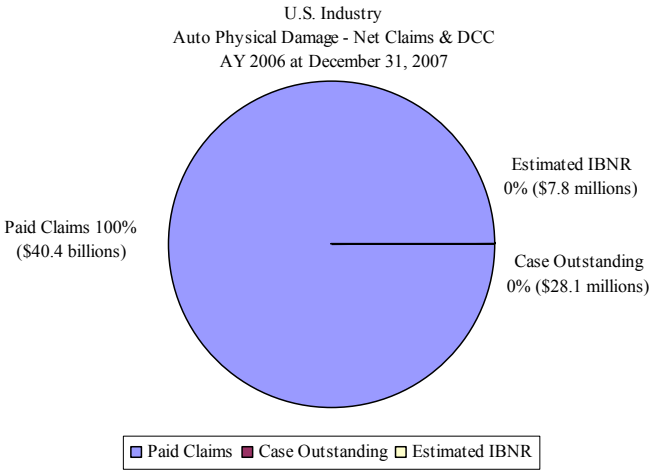
In Part 3, we present numerous methods for projecting ultimate claims. Ultimate claims are the sum of three components: cumulative paid claims, case outstanding, and IBNR. The relationships among these three components vary tremendously by line of insurance, by jurisdiction, and by time interval being reviewed (e.g., recent accident years versus mature accident years). The relationships also vary from insurer to insurer depending on the insurers' claims management philosophies and procedures.

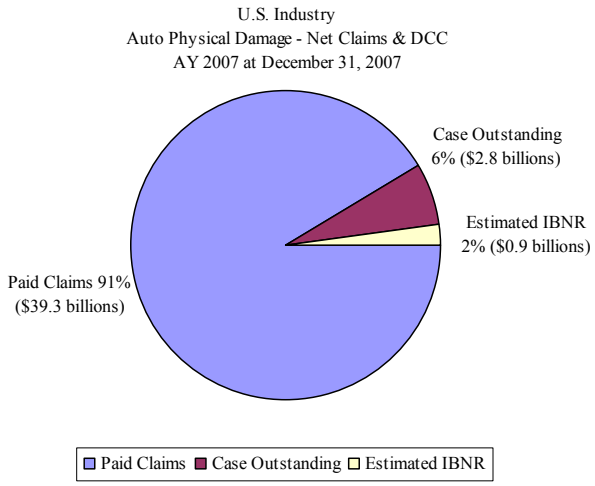
Paid claims and case outstanding typically represent a high proportion of ultimate claims at early maturities for lines of insurance such as automobile physical damage and property. These lines of insurance are characterized as *short-tail* lines of insurance due to the short period of time associated with the claims reporting and settlement processes. In contrast, medical malpractice occurrence is an example of a line of insurance that is classified in the U.S. as a *long-tail* line of insurance due to the lengthy period of time associated with the reporting and settlement of these types of claims. U.S. workers compensation and general liability, including products liability and errors and omissions, are other examples of long-tail lines of insurance in the U.S.

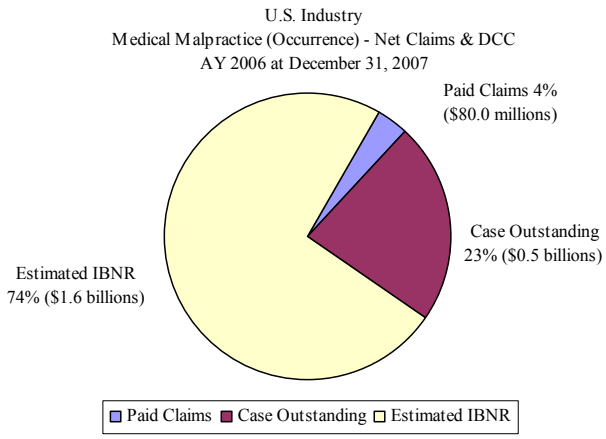
In the four pie charts on the following page, we compare the split between paid claims, case outstanding, and IBNR for accident years 2006 and 2007 as of December 31, 2007,[33] for the consolidated U.S. industry data for automobile physical damage and for medical malpractice occurrence.[34] While the examples refer to specific U.S. coverages, the intent of the pie charts is to demonstrate the significant differences in the proportions between paid, case outstanding, and IBNR for different accident years, and the differences between short-tail lines and long-tail lines of coverage.

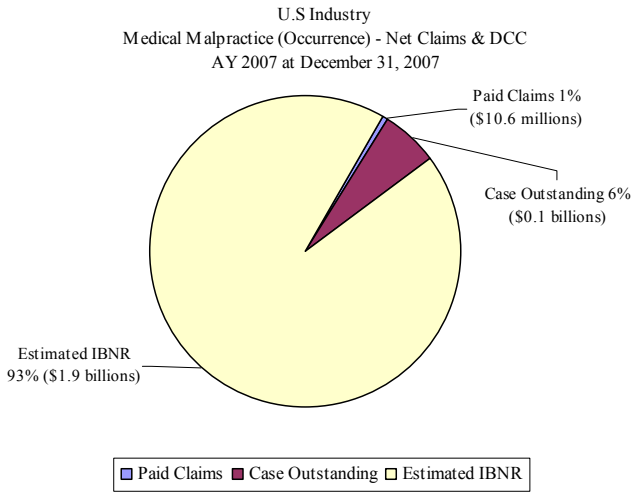
[33] The source of data for the four pie charts in this section is the consolidated U.S. annual statement for the year ending December 31, 2007, Schedule P (a claim development schedule of the U.S. annual statement) contained in *Best's Aggregates & Averages*. The data in the pie charts includes claims and DCC net of reinsurance, gross of salvage and subrogation.

[34] Medical malpractice is the name of the coverage used in *Best's Aggregates & Averages*. This coverage is also known as medical professional liability. In the U.S., there is separate financial reporting for medical malpractice occurrence and medical malpractice claims-made coverages.









Throughout Part 3, we use numerous methods to project ultimate claims. We then derive estimated IBNR as the difference between projected ultimate claims and reported claims as of the valuation date. The total unpaid claim estimate is calculated as the sum of the estimated IBNR and case outstanding; alternatively, we can calculate the estimated total unpaid claims as the difference between projected ultimate claims and cumulative paid claims as of the valuation date.

Actuarial Judgment

In the Berquist and Sherman paper "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach,"[35] there is a discussion of the vital role of actuarial judgment in the analysis of unpaid claims. Berquist and Sherman begin their paper with the following:

> While specific guidelines for reserve adequacy testing may be established and specific examples of an actuarial approach to the testing of loss reserves may be offered for particular situations, loss reserving cannot be reduced to a purely mechanical process or to a "cookbook" of rules and methods. The utilization and interpretation of insurance statistics requires an intimate knowledge of the insurance business as well as the actuary's ability to quantify complex phenomena which are not readily measurable. As in the case of ratemaking, while certain general methods are widely accepted, actuarial judgment is required at many critical junctures to assure that reserve projections are neither distorted nor biased.

Berquist and Sherman identify the following specific areas where actuarial judgment is required:

— Determining the optimal combination of the kinds of claims data to be used in the estimation of unpaid claims

— Assessing the effect of changes in an insurer's operations on the claims data that is used in estimating unpaid claims

— Adjusting the claims data for the influences of known and quantifiable events

— Evaluating the strengths and weaknesses of various estimation techniques

— Making the final selection of the unpaid claim estimate

Part 3 – Basic Techniques for Estimating Unpaid Claims addresses all of these areas. Through the use of numerous examples, which span multiple chapters, we examine different combinations of data and use them with a wide range of actuarial projection methods. We study the influence of changes in case outstanding adequacy, settlement patterns, underlying claims experience, and product mix on the various projection methods. When an insurer has experienced significant changes in operations, we seek alternative methods through data reorganization, selection of alternative data types, and quantitative manipulation of existing data. In the final chapter of Part 3, we bring the results of all the various projection methodologies together for evaluation and final selection of ultimate claims and unpaid claim estimate.

[35] *PCAS*, 1977.

The following table summarizes the examples that we use in Part 3 and the chapters in which they can be found. For ease of reference throughout Part 3, we identify each example by an abbreviated name.

Example Number	Example Name	Description	Chapters
1	U.S. Industry Auto	U.S. private passenger automobile insurance as reported in *Best's Aggregates & Averages*	7, 8, 9, 10, 12
2	XYZ Insurer	Private passenger automobile bodily injury liability portfolio for an insurer who has experienced numerous internal changes in operations, management, and claims philosophy as well as external influences from regulatory reform in the insurance product	7, 8, 9, 10, 11, 12, 13, 15
3	U.S. PP Auto Steady-State	U.S. private passenger automobile insurance in a steady-state environment where claim ratios are stable and there are no changes from historical levels of case outstanding strength	7, 8, 9, 10
4	U.S. PP Auto Increasing Claim Ratios	U.S. private passenger automobile insurance in an environment of increasing claim ratios and no change in case outstanding strength	7, 8, 9, 10
5	U.S. PP Auto Increasing Case Outstanding Strength	U.S. private passenger automobile insurance in an environment of stable claim ratios with an increase in case outstanding strength	7, 8, 9, 10
6	U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength	U.S. private passenger automobile insurance in an environment where there are increases in both claim ratios and case outstanding strength	7, 8, 9, 10
7	U.S. Auto Steady-State	Combined portfolio of U.S. private passenger and commercial automobile insurance in a steady-state environment where there is no change in the product mix	7, 8, 9, 10
8	U.S. Auto Changing Product Mix	Combined portfolio of U.S. private passenger and commercial automobile insurance in an environment where the volume of commercial automobile insurance is increasing at a faster rate than the private passenger automobile insurance	7, 8, 9, 10
9	Auto BI Insurer	Insurer's private passenger automobile bodily injury portfolio in one jurisdiction	8
10	GL Self-Insurer	Self-insurer's general liability program	8
11	Auto Collision Insurer	Insurer's private passenger automobile collision portfolio	11
12	WC Self-Insurer	Self-insurer's U.S. workers compensation program	11
13	GL Insurer	Insurer's occurrence basis general liability insurance portfolio	11
14	Self-Insurer Case Only	Self-insurer with case outstanding only data available for historical years for general liability coverage	12
15	Berq-Sher Med Mal Insurer	Insurer's occurrence basis U.S. medical malpractice insurance portfolio	13, 15
16	Berq-Sher Auto BI Insurer	Insurer's U.S. automobile bodily injury liability insurance portfolio	13, 15
17	Auto Physical Damage Insurer	Salvage and subrogation for auto physical damage insurance portfolio	14
18	DC Insurer	Interim Reporting	15

Readers should be aware that figures in the supporting exhibits for both Parts 3 and 4 are often carried to a greater number of decimals than shown. Thus, totals and calculations may not agree exactly due to rounding differences.

CHAPTER 7 – DEVELOPMENT TECHNIQUE

In Chapter 5, we explain how to create a development triangle. Specifically, we build development triangles for paid claims, case outstanding, reported claims, and reported claim counts based on detailed information for a set of 15 claims observed over a four-year time horizon. In this chapter, we develop estimates of ultimate claims and unpaid claims based on the reported and paid claim development methods. The development technique, also known as the chain ladder technique, is one of the most frequently used methodologies for estimating unpaid claims.

Key Assumptions

The distinguishing characteristic of the development method is that ultimate claims for each accident year are produced from recorded values assuming that future claims' development is similar to prior years' development. In this method, the actuary uses the development triangles to track the development history of a specific group of claims. The underlying assumption in the development technique is that claims recorded to date will continue to develop in a similar manner in the future – that the past is indicative of the future. That is, the development technique assumes that the relative change in a given year's claims from one evaluation point to the next is similar to the relative change in prior years' claims at similar evaluation points.

An implicit assumption in the development technique is that, for an immature accident year, the claims observed thus far tell you something about the claims yet to be observed. This is in contrast to the assumptions underlying the expected claims technique (Chapter 8), the Bornhuetter-Ferguson technique (Chapter 9), and the Cape Cod technique (Chapter 10).

Other important assumptions of the development method include: consistent claim processing, a stable mix of types of claims, stable policy limits, and stable reinsurance (or excess insurance) retention limits throughout the experience period.

Common Uses of the Development Technique

Actuaries apply the development technique to paid and reported claims as well as the number of claims. This technique is used with all lines of insurance including short-tail lines and long-tail lines. In order to use the development method, actuaries organize data in many different time intervals, including:

— Accident year
— Policy year
— Underwriting year
— Report year
— Fiscal year[36]

[36]Actuaries for self-insurers often conduct the actuarial analysis using the organization's fiscal year time frame. For example, for a self-insured public entity with a fiscal year ending March 31, the actuary will likely organize the claim development data by April 1 to March 31 fiscal year.

Actuaries also apply this technique to monthly, quarterly, and semiannual data.

Mechanics of the Development Technique

The development method consists of seven basic steps:

- Step 1 – Compile claims data in a development triangle
- Step 2 – Calculate age-to-age factors
- Step 3 – Calculate averages of the age-to-age factors
- Step 4 – Select claim development factors
- Step 5 – Select tail factor
- Step 6 – Calculate cumulative claim development factors
- Step 7 – Project ultimate claims

To demonstrate these seven steps, we begin with an example based on industry-aggregated accident year claim development data for U.S. private passenger automobile insurance.[37] This example is labeled "U.S. Industry Auto."

Step 1 – Compile Claims Data in a Development Triangle

In Exhibit I, Sheets 1 and 2, we present the cumulative reported and paid claim development triangles, respectively. Each of these sheets contains four parts that follow the first five steps of our description of the development method. Part 1 of each exhibit includes the data triangle. In our example, the data triangles contain reported and paid claim development experience for accident years 1998 through 2007. There are ten diagonals in each triangle with annual valuation dates of December 31, 1998 through December 31, 2007. The reported and paid claims data contained in these exhibits are net of reinsurance and include the defense cost portion of claim adjustment expenses (labeled DCC for U.S. statutory accounting).

Step 2 – Calculate Age-to-Age Factors

The next step is to calculate age-to-age factors. These factors are also known as report-to-report factors or link ratios. They measure the change in recorded claims from one valuation date to the next. In Part 2 of Exhibit I, Sheets 1 and 2, we present the age-to-age factors for U.S. Industry Auto. The standard naming convention for age-to-age factors is *starting month-ending month*. For example, the age-to-age factor for the 12-month period-to-the 24-month period is often referred to as the 12-24 factor (which is read as the 12-to-24 factor) or the 12-24 month factor.

To calculate the age-to-age factors for the 12-month-to-24-month period, we divide the claims as of 24 months by the claims as of 12 months. Therefore, the triangle of age-to-age factors has one less row and one less column than the original data triangle.

[37] The source of data is *Best's Aggregates & Averages*.

Using the reported claims presented in Exhibit I, Sheet 1, we calculate the following:

12-24 factor for accident year 1998

$$= \frac{\text{reported claims at 24 months for accident year 1998}}{\text{reported claims at 12 months for accident year 1998}} = \frac{\$43,169,009}{\$37,017,487}$$

$$= 1.166$$

We provide a second example for the 36-month-to-48-month factor for accident year 2002:

36-48 factor for accident year 2002

$$= \frac{\text{reported claims at 48 months for accident year 2002}}{\text{reported claims at 36 months for accident year 2002}} = \frac{\$57,703,851}{\$56,102,312}$$

$$= 1.029$$

We proceed in the same manner down the columns and across the rows of both the reported and paid claim triangles.

Step 3 – Calculate Averages of the Age-to-Age Factors

After completing the triangle of age-to-age factors, our next step is to calculate averages of the age-to-age factors. Actuaries use a wide variety of averages for age-to-age factors. Some of the most common averages include:

- Simple (or arithmetic) average
- Medial average (average excluding high and low values)
- Volume-weighted average
- Geometric average (the n^{th} root of the product of n historical age-to-age factors)

In Part 3 of Exhibit I, Sheets 1 and 2, we present the following averages for U.S. Industry Auto:

- Simple averages for the latest five years and the latest three years

- Medial average for the latest five years excluding one high and one low value (medial latest 5x1)[38]

- Volume-weighted averages for the latest five years and the latest three years

- Geometric average for the latest four years

For reported claims, the 12-24 month simple average of the latest five factors is based on the average of the 12-24 month factors for accident years 2002 through 2006 and is equal to 1.168 ((1.184 + 1.162 + 1.159 + 1.160 + 1.173) / 5). The simple average of the latest three factors is

[38] In the examples in this text, the medial average for two data points is the same as the simple average, and the medial average for one data point is simply the value of the data point.

based on the 12-24 month factors for accident years 2004 through 2006 and is 1.164 ((1.159 +1.160 + 1.173) / 3).

To calculate the reported claims 24-36 month medial average development factor of the latest 5x1, we consider the 24-36 month factors for accident years 2001 through 2005; we exclude the highest value (1.062 for accident year 2001) and the lowest value (1.055 for accident year 2004) and take an average of the remaining three values. The 24-36 month medial average of the latest 5x1 is 1.057 ((1.059 + 1.057 + 1.056) / 3).

The volume-weighted average is the weighted average using the amounts of reported claims (or paid claims) as weights. The formula for this type of average uses the sum of the claims for the specific number of years divided by the sum of the claims for the same years at the previous age. For example, the 36-48 month volume-weighted average of the latest three years is equal to the sum of the reported claims for accident years 2002 through 2004 as of 48 months ($57,703,851 + $57,015,411 + $56,976,657 = $171,695,919) divided by the sum of the reported claims for accident years 2002 through 2004 as of 36 months ($56,102,312 + $55,468,551 + $55,553,673 = $167,124,536), or 1.027.

The geometric average (also known as the geometric mean) for the latest four years is equal to the fourth root of the product of the last four age-to-age factors. For example, the geometric average for the latest four years at 12-24 months is equal to $(1.162 \times 1.159 \times 1.160 \times 1.173)^{.25}$, or 1.164. Similarly, for 48-60 months, the geometric average for the latest four years is equal to $(1.010 \times 1.014 \times 1.011 \times 1.010)^{.25}$, or 1.011.

For U.S. Industry Auto, we present various averages for the more recent diagonals. Actuaries often place greater reliance on the most recent experience as this data most likely reflects the effect of the latest changes in the insurer's internal and external environments. The circumstances underlying the specific data grouping (including the nature of the line of business, the credibility of the available claims data, and changes in the insurer's environment) should dictate the number of experience periods to include in the various averages. Similar to many actuarial decisions, there is often a trade-off between stability, which is represented by a greater number of experience periods included in the average values, and responsiveness, where only the most recent experience periods are considered.

Step 4 – Select Claim Development Factors

The selected age-to-age factor (also referred to as the selected claim development factor or selected loss development factor) represents the growth anticipated in the subsequent development interval. When selecting claim development factors, actuaries examine the historical claim development data, the age-to-age factors, and the various averages of the age-to-age factors. It is also common practice to review the prior year's selection of claim development factors.[39]

[39] A comparison to prior factors is important for several reasons. First, the actuary is able to compare his or her expectations at the prior valuation for development in the interval with actual experience. Second, an actuary is often balancing the conflicting goals of stability and responsiveness. By having the prior selected factors as a reference point, the actuary can consider the extent to which he or she wants to change selected claim development factors. Finally, it is valuable information to understand the effect of changes in development factors alone (or methodology) on the projected ultimate claims versus the effect of changes in the actual claim experience.

When the credibility of the insurer's own historical experience is limited, there may be a need to supplement the insurer's own historical experience with certain benchmarks. One possible benchmark includes experience from similar lines with similar claims handling practices within the insurer. Another source of benchmarks is claim development patterns from the insurance industry when observable and considered to be comparable. Any benchmark must be utilized with caution, as there may be significant differences between the line of business being analyzed and the benchmark with regard to claims practices, policy coverages, underwriting, geographic mix, claim coding, policyholder deductibles and/or limits, legal precedents, etc. Such differences could make the development patterns noncomparable and increase the variability in the estimates of unpaid claims. (For further discussion on the use of industry benchmark experience, see Chapter 3.[40])

When selecting claim development factors, actuaries review the claim development experience for the following characteristics:

— *Smooth progression of individual age-to-age factors and average factors across development periods.* Ideally, the pattern should demonstrate steadily decreasing incremental development from valuation to valuation (i.e., as we move further away from the accident period), especially in the later valuations. For U.S. Industry Auto, we observe decreasing values of age-to-age factors in virtually every interval (moving across the columns) for both reported claims and paid claims.

— *Stability of age-to-age factors for the same development period.* Ideally, there should be a relatively small range of factors (small variance) within each development interval (i.e., down the columns). We look for stability of age-to-age factors and within the various averages for the same development period. In our example, there is considerable stability of factors especially for the factors in age intervals of 24-36 months and later. For both reported and paid claims, we observe the greatest variability in age-to-age factors at the 12-24 month period. This is not unexpected as claims at the earlier ages are at their most immature state, when the claims professional has the least amount of information about the circumstances of the insured event as well as the potential damages and injuries of claimants.

— *Credibility of the experience.* Actuaries generally determine credibility based on the volume and the homogeneity of the experience for a given accident year and age. If the claim development experience of the insurer has limited credibility because of the limited volume of claims, organizational changes, or other factors, it may be necessary to use benchmark development factors from the insurance industry. (See the earlier discussion about the use of industry benchmarks.)

— *Changes in patterns.* Actuaries review the age-to-age factors to identify systematic patterns that may suggest changes in the internal operations or external environment. We address this issue at length in Chapter 6.

— *Applicability of the historical experience.* Actuaries determine the appropriateness of historical age-to-age factors for projecting future claim development based on qualitative information regarding changes in the book of business and insurer operations over time. Actuaries also consider the effect of changes in external factors that have not yet manifested themselves in the reported claims experience.

[40] The Academy is on record for recommending against the reliance and heavy use of insurance industry benchmarks, unless necessary due to low credibility.

In Part 4 of Exhibit I, Sheets 1 and 2, we present our selected claim development factors for each age-to-age interval as well as the selected tail factors. (Tail factors are described in greater detail in the next section.) We use actuarial judgment to select these factors after reviewing all of the age-to-age factors, the various averages, and the prior year's selected factors. In the exhibits, we use the label "To Ult" (i.e., To Ultimate) to designate the tail factor; in the following tables, we label the tail factors "120-Ultimate" (i.e., 120 months-to-ultimate). Both labels are commonly used by actuaries to indicate the selected tail development factor.

We recognize that the selections of development factors are subjective and will likely differ from one actuary to another, perhaps materially, as the selection process involves significant actuarial judgment. When different actuaries apply their own experience and insight to the analysis of the same data, the selected age-to-age factors typically differ – sometimes by a small amount and sometimes by a large amount. It is important to appreciate that there is more than one reasonable selection of age-to-age and tail factors.

Table 1, which is an excerpt from Exhibit I, Sheets 1 and 2, summarizes the selected reported and paid claim development factors by age-to-age interval for U.S. Industry Auto.

Table 1 – Selected Age-to-Age Factors

	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	120-ultimate
Reported	1.164	1.056	1.027	1.012	1.005	1.003	1.002	1.001	1.000	1.000
Paid	1.702	1.186	1.091	1.044	1.019	1.009	1.005	1.002	1.002	1.002

Step 5 – Select Tail Factor

Earlier in this book we introduced the topic of the number of development periods needed for the analysis of unpaid claims. We asked whether it is necessary to analyze development through the 3rd maturity year, the 5th maturity year, the 10th or the 20th maturity year. If the data is available, the actuary should analyze development out to the point at which the development ceases (i.e., until the selected development factors are equal to 1.000). The number of development periods required generally varies by line, jurisdiction, and data type.

Sometimes the data does not provide for enough development periods. This occurs when the development factors for the most mature development periods available are still significantly greater than 1.000.[41] When this occurs, the actuary will need to determine a tail factor to bring the claims from the latest observable development period to an ultimate value.

For some lines of insurance and some types of claims data, the tail factor can be especially difficult to select due to the limited availability of relevant data. The point of development beyond which no tail factor is required varies tremendously by line of business. For short-tail coverages, insurers generally settle claims within months or a few years of the accident date. However, for long-tail lines of business, such as U.S. medical professional liability and workers compensation, some claims can take more than fifteen years to reach final settlement.

[41] There are some cases in which the development at the end of the triangle is often less than one, such as for a line of business with significant subrogation activity after claims are paid. For these lines of business, the desire is still to have sufficient periods in the development triangle so that non-zero development ceases, but in this case the development factors may approach 1.000 from below.

In 1978, Joseph O. Thorne discussed the potential difficulty in selecting tail factors based on historical data in his review of the Berquist and Sherman paper "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach." Mr. Thorne noted:

> Care must be taken in projecting the tail from older accident years to recent accident years. For example, in Workers' Compensation the tail percentage may increase due to trends in cumulative injury, shifts to unlimited medical benefits, and increases in the proportion of pension claims. On the other hand, the percentage may decrease due to trends in settlement practices for lump sum awards of for compromise and release of claims. The effects of certain factors may be quantified by analysis of loss experience (such as claims by size or injury type) or by specific sampling; other factors may require considerable judgment.[42]

Thorne's comments are equally applicable today. The tail factor is crucial as it influences the unpaid claim estimate for all accident years (in the experience period) and can create a disproportionate leverage on the total estimated unpaid claims. The tail factor, or a similar concept, plays an important role not only in the development technique but in almost every technique discussed in Part 3 – Basic Techniques for Estimating Unpaid Claims.

Actuaries use several approaches to evaluate the tail factor. One approach is to rely on industry benchmark development factors. (See previous discussions regarding use of industry benchmarks.) Another common approach is to fit a curve to the selected or observed development factors to extrapolate the tail factors; exponential decay is a common assumption for such curve fitting. A third approach, used for paid development where the comparable reported development is already considered to be at ultimate, is to utilize reported-to-paid ratios at the latest observed paid development period. A more in-depth discussion of this topic is beyond the scope of this text. We recommend that the actuary seek additional information on this topic through the actuarial literature available on the CAS Web Site and the CAS Tail Factors Working Party.

For the U.S. Industry Auto example, we select a reported claim tail factor of 1.000; we also select an age-to-age factor of 1.000 for the 108-120 month interval. This means that we do not expect any further development on reported claims after 108 months. For paid claims, however, we expect future development beyond 108 months; we select a 1.002 age-to-age factor for 108-120 months and a tail factor of 1.002 (based on the typical ratio of reported to paid claims at this age).

Step 6 – Calculate Cumulative Claim Development Factors (CDF)[43]

We calculate cumulative claim development factors by successive multiplications beginning with the tail factor and the oldest age-to-age factor. The cumulative claim development factor projects the total growth over the remaining valuations. Cumulative claim development factors are also known as age-to-ultimate factors and claim development factors to ultimate.

[42] *PCAS*, 1978.

[43] As noted previously, we specifically choose to use the terminology claims instead of losses in this text. Thus, we use CDF for claim development factor to ultimate. Many actuaries use the term losses and thus LDF to represent the loss development factor to ultimate. In South Africa, actuaries often use LDF to refer to the incremental loss development factor and UDF to refer to the cumulative loss development factor or loss development factor to ultimate. The important message for the actuary is that he or she must understand the terminology, including abbreviations, for any analysis.

Based on the selected age-to-age factors from Step 4 and the tail factor in Step 5, we calculate the following:

Reported CDF at 120 months
= selected tail (120-ultimate) factor
= 1.000

Reported CDF at 108 months
= (selected tail factor) x (selected development factor 108-120 months)
= 1.000 x 1.000
= 1.000

Reported CDF at 96 months
= (selected tail factor) x (selected development factor 108-120 months) x
(selected development factor 96-108 months)
= (CDF at 108 months) x (selected development factor 96-108 months)
= 1.000 x 1.001
= 1.001

And so on, until we get to

Reported CDF at 12 months
= (CDF at 24 months) x (selected development factor 12-24 months)
= 1.110 x 1.164
= 1.292

We calculate cumulative claim development factors for paid claims in the same manner.

Table 2, which is an excerpt from Exhibit I, Sheets 1 and 2, summarizes the cumulative claim development factors based on the selected age-to-age factors.

Table 2 – Cumulative Claim Development Factors

	12	**24**	**36**	**48**	**60**	**72**	**84**	**96**	**108**	**120**
Reported	1.292	1.110	1.051	1.023	1.011	1.006	1.003	1.001	1.000	1.000
Paid	2.390	1.404	1.184	1.085	1.040	1.020	1.011	1.006	1.004	1.002

Tables 1 and 2 demonstrate a typical relationship between reporting and payment patterns for many lines of P&C insurance: cumulative paid claim development factors are usually greater than cumulative reported claim development factors at the same maturity age.

Step 7 – Project Ultimate Claims

Ultimate claims are equal to the product of the latest valuation of claims (the amounts shown on the last diagonal of the claim triangles) and the appropriate cumulative claim development factors. In our example, the latest diagonal of the triangle is the December 31, 2007 valuation. Each accident year has an associated age at December 31, 2007. For example, accident year 2007 as of December 31, 2007 is 12 months old. Accident year 2006 as of December 31, 2007 is 24 months old. Similarly, in this example, the oldest accident year in our experience period is 1998

which, at December 31, 2007, is 120 months old. We determine the appropriate cumulative claim development factor based on the age of each accident year; we then multiply each accident year's reported (and paid) claims at the latest valuation by its age-to-ultimate factor (i.e., cumulative claim development factor).

Detailed calculations are presented in Exhibit I, Sheet 3. The first column of Exhibit I, Sheet 3, is the accident year. Our example for U.S. Industry Auto includes accident years 1998 through 2007. In the second column, we show the age of each accident year as of the latest valuation of claims (i.e., December 31, 2007). Columns (3) and (4) summarize reported and paid claims, respectively, by accident year at December 31, 2007. Column (3) is the last diagonal of the reported claim development triangle in Exhibit I, Sheet 1, and Column (4) is the last diagonal of the paid claim development triangle in Exhibit I, Sheet 2. Columns (5) and (6) are the cumulative claim development factors that are calculated in Step 5. Each cumulative claim development factor refers to a specific age.

Projected ultimate claims based on the reported claim development method are equal to the latest valuation of reported claims multiplied by the cumulative reported claim development factors. (See Column (7) of Exhibit I, Sheet 3.) For example, projected ultimate claims for accident year 1998 are calculated as follows:

> Projected ultimate claims for accident year 1998
> = (reported claims for 1998 as of 12/31/07) x (reported CDF at 120 months)
> = $47,742,304 x 1.000
> = $47,742,304

And for accident year 2007,

> Projected ultimate claims for accident year 2007
> = (reported claims for 2007 as of 12/31/07) x (reported CDF at 12 months)
> = $48,853,563 x 1.292
> = $63,118,803

We perform similar calculations for the projection of ultimate claims using the paid claim development technique (Column (8) of Exhibit I, Sheet 3). For example, projected ultimate claims for accident year 2007 are calculated as follows:

> Projected ultimate claims for accident year 2007
> = (paid claims for 2007 as of 12/31/07) x (paid CDF at 12 months)
> = $27,229,969 x 2.390
> = $65,079,626

Unpaid Claim Estimate Based on the Development Technique

For each technique presented in this text, we derive an unpaid claim estimate. Using the development technique, actuaries calculate the unpaid claim estimate as the difference between projected ultimate claims and actual paid claims. Because we are using accident year data, this value of the unpaid claim estimate represents total unpaid claims including both case outstanding and the broad definition of IBNR. To determine estimated IBNR based on the development technique, we subtract reported claims from the projected ultimate claims. Alternatively, IBNR is equal to the estimate of total unpaid claims less case outstanding.

In Exhibit I, Sheet 4, we summarize the calculations for the unpaid claim estimate based on the example for U.S. Industry Auto. Columns (2) and (3) contain reported and paid claims data as of December 31, 2007, which are the latest diagonals in our claim development triangles. Columns (4) and (5) are the projected ultimate claims, which we developed in Exhibit I, Sheet 3. We summarize case outstanding in Column (6); case outstanding is equal to the difference between reported and paid claims as of December 31, 2007 (Column (2) – Column (3)). Estimated IBNR is equal to projected ultimate claims minus reported claims. Estimated IBNR based on the reported claim development technique is calculated in Column (7), and Column (8) shows the results of the paid claim development technique. The estimate of total unpaid claims is equal to the sum of case outstanding and estimated IBNR. We present the total unpaid claim estimate in Columns (9) and (10) based on the reported and paid claim development techniques, respectively.

Reporting and Payment Patterns

Actuaries describe the reporting pattern of claims as the percentage of ultimate claims that are reported in each year. We can derive implied reporting patterns from the cumulative reported claim development factors.[44] The following table shows the cumulative reported claim development factors and the associated reporting pattern for U.S. Industry Auto.

Table 3 – Reporting Pattern

Age (Months)	Cumulative Reported Claim Development Factors	Cumulative % Reported	Incremental % Reported
12	1.292	77.4%	77.4%
24	1.110	90.1%	12.7%
36	1.051	95.1%	5.0%
48	1.023	97.8%	2.7%
60	1.011	98.9%	1.1%
72	1.006	99.4%	0.5%
84	1.003	99.7%	0.3%
96	1.001	99.9%	0.2%
108	1.000	100.0%	0.1%
120	1.000	100.0%	0.0%

The percentage reported is equal to the inverse of the cumulative claim development factor. For example, at 12 months, the percentage reported is equal to 1.000 divided by 1.292 or 77.4%; in other words, our selected reported claim development factors imply that 77.4% of ultimate claims are reported through 12 months. Similarly at 24 months, the percentage reported is equal to 1.000 divided by 1.110 or 90.1%; the selected reported claim development factors indicate that 90.1% of claims are reported through 24 months.

In the preceding table, we also show the incremental percentage reported. These values are equal to the difference in the cumulative percentage reported at successive ages. For example, the incremental percentage reported for the first 12 months is 77.4%, which is equal to the

[44] In Chapter 15 – Evaluation of Techniques, we present an alternative approach for determining reporting and payment patterns based on a comparison of the reported and paid claim development triangles to selected ultimate claims. This alternative approach is routinely used by actuaries in Canada to determine payment patterns (also known as emergence patterns in Canada) for present value discounting purposes.

cumulative percentage reported at 12 months. The incremental percentage reported for the 12-24 month period is equal to 90.1% minus 77.4%, or 12.7%.

We can also determine an implied payment pattern based on the cumulative paid claim development factors. In the following table, we present the cumulative paid claim development factors and the associated payment patterns (cumulative and incremental) for U.S. Industry Auto.

Table 4 – Payment Pattern

Age (Months)	Cumulative Paid Claim Development Factors	Cumulative % Paid	Incremental % Paid
12	2.390	41.8%	41.8%
24	1.404	71.2%	29.4%
36	1.184	84.5%	13.3%
48	1.085	92.2%	7.7%
60	1.040	96.2%	4.0%
72	1.020	98.0%	1.8%
84	1.011	98.9%	0.9%
96	1.006	99.4%	0.5%
108	1.004	99.6%	0.2%
120	1.002	99.8%	0.2%

In the U.S. Industry Auto example, which contains the aggregated results for U.S. private passenger automobile liability, we observe that the incremental percentages reported and paid in each successive interval are less than or equal to that of the previous age interval. Actuaries often observe such patterns for many lines of P&C insurance, consistent with reasonable expectations for the underlying process of settling a portfolio of claims. Where the underlying development patterns are erratic, actuaries frequently incorporate increased levels of actuarial judgment into the selection process to achieve claim development patterns that exhibit such a steady, decreasing pattern.

It is worthwhile to note that while the above payment and reporting patterns might serve as a reasonable model for the expected payment and reporting of future claims, the development method implies somewhat different patterns for each of the accident years from 1998 through 2007. This is due to the fact that the emerged portion of each accident year does not precisely fit the selected age-to-age factors.

The reporting and payment patterns may be valuable input for other actuarial calculations. They can be used in other techniques for estimating unpaid claims and in monitoring the development of claims during the year. The payment pattern[45] is also often used for present value (i.e., discounting) calculations.

[45] In Canada, actuaries typically refer to an emergence pattern as the payment pattern used for discounting purposes. This is a different terminology from that used by U.S. actuaries who generally use the term emergence to refer to the reporting pattern of either claims or claim counts.