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.

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.

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.

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

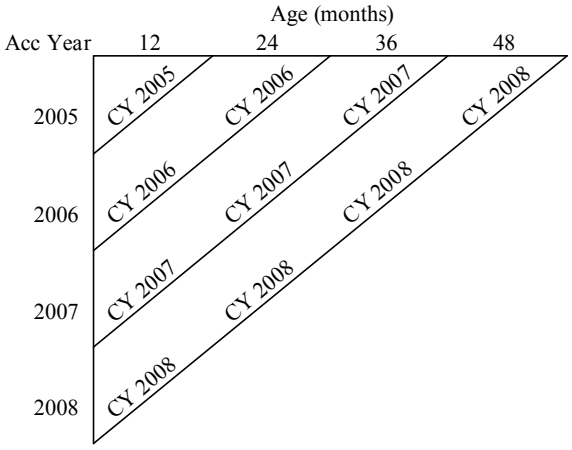
Each row in the triangle above represents one accident year. As we discuss in Chapter 3, organizing data by accident year refers to grouping claims according to the date of occurrence (i.e., the accident date). By grouping the data into accident years, each row consists of a fixed group of claims. In 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

INTRODUCTION TO PART 3 – BASIC TECHNIQUES FOR ESTIMATING UNPAID CLAIMS

The Components of Ultimate Claims

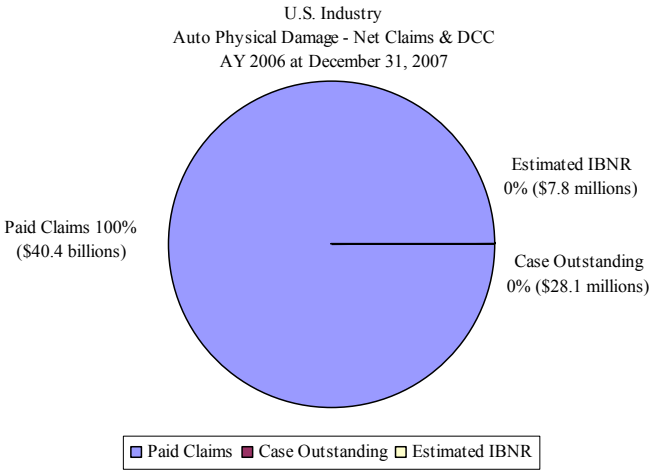
In Part 3, we present numerous methods for projecting ultimate claims. Ultimate claims are the sum of three components: cumulative paid claims, case outstanding, and IBNR. The relationships among these three components vary tremendously by line of insurance, by jurisdiction, and by time interval being 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.

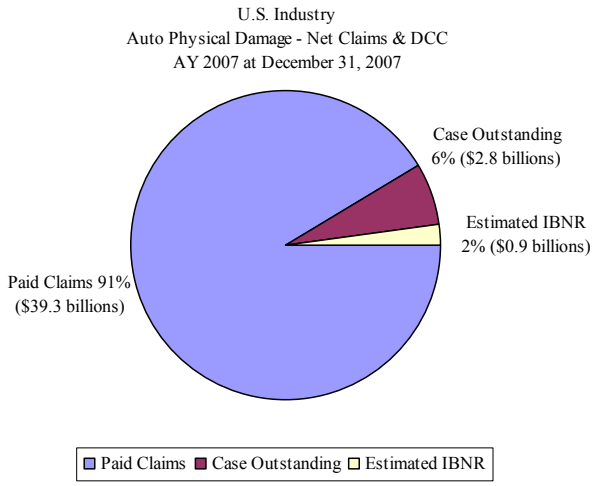
Paid claims and case outstanding typically represent a high proportion of ultimate claims at early maturities for lines of insurance such as automobile physical damage and property. These lines of insurance are characterized as *short-tail* lines of insurance due to the short period of time associated 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.

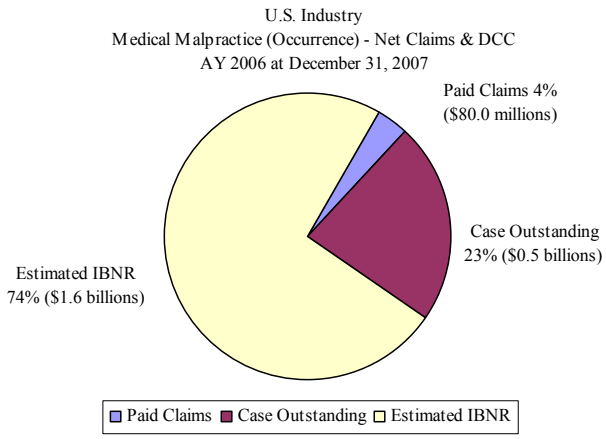
In the four pie charts on the following page, we compare the split between paid claims, case outstanding, and IBNR for accident years 2006 and 2007 as of December 31, 2007,[33] for the consolidated U.S. industry data for automobile physical damage and for medical malpractice occurrence.[34] While the 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.

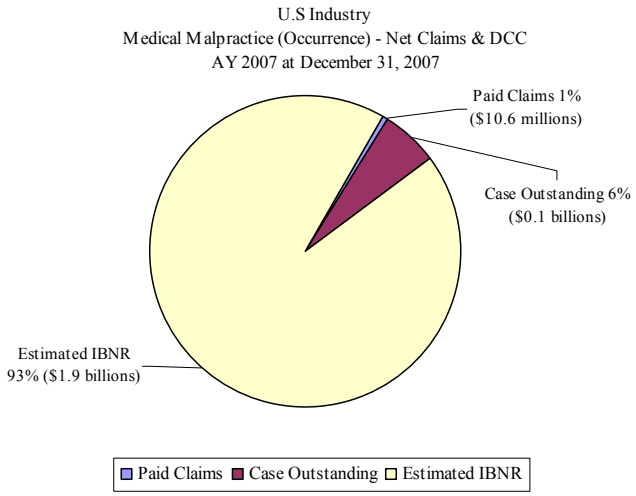
[33] The source of data for the four pie charts in this section is the consolidated U.S. annual statement for the year ending December 31, 2007, Schedule P (a claim development schedule of the U.S. annual statement) contained in *Best's Aggregates & Averages*. The data in the pie charts includes claims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

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.

APPENDIX A – STATEMENT OF PRINCIPLES REGARDING PROPERTY AND CASUALTY LOSS AND LOSS ADJUSTMENT EXPENSE RESERVES

The CAS adopted the "Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves" (CAS Statement of Principles) in May 1988. In this appendix, we include the CAS Statement of Principles in its entirety. Throughout this text we relied on the definitions included in the Statement of Principles. In Parts 3 and 4 of this book, we expand on the principles and considerations cited below.

* * * * *

The purpose of this statement is to identify and describe principles applicable to the evaluation and review of loss and loss adjustment expense reserves. Because of their size and the uncertainties in the estimation process, the evaluation of these reserves requires the use of proper actuarial and statistical procedures. The financial condition of a property and casualty insurer cannot be assessed accurately without sound reserve estimates.

This statement consists of three parts:

Definitions
Principles
Considerations

The definitions in the next section apply to both claims reserves and loss adjustment expense reserves. For the purpose of this statement the terms "loss" and "claim" are used interchangeably, and the term "insurer" is meant to represent any risk bearer for property and casualty exposures, whether an insurance company, self-insured entity or other.

I. Definitions

A *claims reserve* is a provision for its related liability. A total claims reserve is composed of five elements, although the five elements may not necessarily be individually quantified:

— case reserve
— provision for future development on known claims
— reopened claims reserve
— provision for claims incurred but not reported
— provision for claims in transit (incurred and reported but not recorded)

Before these five elements are discussed, certain key dates and terms need to be defined.

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.

The *valuation date* is the date through which transactions are included in the data base used in the evaluation of the liability, regardless of when the analysis is performed. For a defined group of claims as of a given accounting date, reevaluation of the same liability may be made as of successive valuation dates. A valuation date may be prior to, coincident with or subsequent to the accounting date.

The *carried claims reserve* is the amount shown in a published statement or in an internal statement of financial condition.

An *estimated claims reserve* is the result of the application of a particular claims reserving evaluation procedure. An estimated claims reserve for a given accounting date likely will change from one valuation date to another.

A division is often required between reserves for known claims and reserves for claims which have been incurred but not reported (IBNR). The *reserve for known claims* represents the amount, estimated as of the valuation date, that will be required for future payments on claims that already have been reported to the insurer. (The *reserve for known claims* is also sometimes referred to by other labels such as the reported reserve, the reserve for claims adjusted or in the process of adjustment, or the reserve for unpaid claims excluding IBNR.) The *IBNR reserve* represents the amount that must be provided for future payments on insured losses that have occurred but that have not been reported.

The *case reserve* is defined as the sum of the values assigned to specific known claims whether determined by claims adjusters or set by formula. (The term *case reserve* is sometimes used in place of the reserve for known claims. However, as defined, the case reserve does not include the provision for future development on known claims.) *Adjusters' estimates* are the aggregate of the estimates made by claims personnel for individual claims, based on the facts of the particular claims. *Formula reserves* are reserves established for groups of claims for which certain classifying information is provided. Formula reserving may be applied to individual claims or to aggregations of claims with similar characteristics through use of average claim values or factors applied to representative statistics (for example, premiums in force or earned premiums).

Development is defined as the change between valuation dates in the observed values of certain fundamental quantities that may be used in the claims reserve estimation process. For example, the observed number of reported claims associated with losses occurring with a particular calendar period often will be seen to increase from one valuation date to the next until all claims have been reported. The pattern of accumulating claims represents the development of the number of claims.

In a similar fashion the amount of claim payments for losses occurring within a specific calendar period also will be seen to increase at succeeding valuation dates. In this case the pattern of accumulating payments represents the development of claim costs and is usually referred to by the term *paid development*. The concept of development also applies to incurred losses. I*ncurred development* is defined as the difference between estimates of incurred costs at two valuation dates for a defined group of claims.

The *provision for future development on known claims* relates to incurred development on those claims reported to an insurer on or before a specific accounting date that are still open on that accounting date. Incurred development on such claims can be either increasing or decreasing.

The *reopened claims reserve* is a provision for future payments on claims closed as of the accounting date that may be reopened due to circumstances not foreseen at the time the claims were closed. In some instances, post-closing payments or recoveries for claims not actually reopened may be included with the development on known claims.

For many insurers a claim is considered to be reported when it is first recorded in the accounting records of the insurer. Conceptually, two elements form the *IBNR reserve*. The first of these elements is the *provision for claims incurred but not reported*, referred to as the *"pure" IBNR*. This provision results from the normal delay that occurs in reporting losses. The second element is the *provision for claims in transit*, which are incurred and reported but not recorded. This provision represents the additional time consumed by the insurer's recording procedures. As a practical matter it is not always feasible to measure these two elements separately, but it is important to understand the effect reporting procedures can have on the amount of IBNR reserve. For some insurers claims in transit are considered known claims. The IBNR reserve must provide for the ultimate value of IBNR claims including the development which is expected to occur on these claims after reporting.

Loss adjustment expenses include allocated loss adjustment expenses and unallocated loss adjustment expenses. *Allocated loss adjustment expenses* are those expenses, such as attorneys' fees and other legal costs, that are incurred in connection with and are assigned to specific claims. *Unallocated loss adjustment expenses* are all other claim adjustment expenses and include salaries, utilities and rent apportioned to the claim adjustment function but not readily assignable to specific claims. The definition of allocated and unallocated loss adjustment expenses for reserving purposes varies among insurers, and an individual insurer's practice for reserving may not always conform to its definition for statistical reporting or ratemaking purposes.

Since allocated expenses are assigned to specific claims, all of the analyses performed on claims data can also be performed on allocated loss expense data. Thus, the allocated loss adjustment expense reserve can be divided into known and IBNR components. All of the concepts discussed in the preceding paragraphs, as well as each of the five elements of the claims reserve, have similar meanings with regard to the allocated loss adjustment expense reserve.

Although the same statistical procedures normally do not apply to unallocated expenses, the unallocated loss adjustment expense reserve can still be divided into know reserve and IBNR components, and the concept of a particular valuation date is meaningful.

II. Principles

1) An actuarially sound claims reserve for a defined group of claims as of a given valuation date is a provision, based on estimates derived from reasonable assumptions and appropriate actuarial methods, for the unpaid amount required to settle all claims, whether reported or not, for which liability exists on a particular accounting date.

2) An actuarially sound loss adjustment expense reserve for a defined group of claims as of a given valuation date is a provision, based on estimates derived from reasonable assumptions and appropriate actuarial methods, for the unpaid amount required to investigate, defend and effect the settlement of all claims, whether reported or not, for which loss adjustment expense liability exists on a particular accounting date.

3) The uncertainty inherent in the estimation of required provisions for unpaid claims or loss adjustment expenses implies that a range of reserves can be actuarially sound. The true value of the liability for losses or loss adjustment expenses at any accounting date can be known only when all attendant claims have been settled.

4) The most appropriate reserve within a range of actuarially sound estimates depends on both the relative likelihood of estimates within the range and the financial reporting context in which the reserve will be presented.

Although specific reserve requirements may vary, the same basic principles apply in each context in which the reserves are stated, including statutory balance sheets, statements of opinion on claims reserves and reports to shareholders or securities regulators. Guidance in the application of these principles is provided in the Considerations section of this statement.

III. Considerations

Understanding the trends and changes affecting the data base is prerequisite of the application of actuarially sound reserving methods. A knowledge of changes in underwriting, claims handling, data processing and accounting, as well as changes in the legal and social environment, affecting the experience is essential to the accurate interpretation and evaluation of observed data and the choice of reserving methods.

A knowledge of the general characteristics of the insurance portfolio for which reserves are to be established also is important. Such knowledge would include familiarity with policy provisions that may have a bearing on reserving, as well as deductibles, salvage and subrogation, policy limits and reinsurance.

Data Organizations

The categorization of claims by time unit is extremely important. The successful organization of a data base for reserving revolves around five key dates:

— *accident date*, which is the date on which the loss occurred, or for those losses that cannot be identified with a single isolated event, the date on which the loss is deemed to have occurred

— *report date*, which is the date on which the loss is first reported to the insurer (in practice it is often taken to be the recorded date)

— *recorded date*, which is the date on which the loss is first entered in the statistical records of the insurer

— *accounting date*

— *valuation date*

Commonly, insurers compile claim data by accident periods (accident year, accident quarter, accident month, etc.), which group together all claims with accident dates falling within particular fiscal periods; or by policy periods, which group all claims relating to policies written during

particular fiscal periods. Claim information by accident year is required for various financial reporting schedules. Many insurers also compile claim data by report periods, which group together all claims with report dates failing within specified fiscal periods.

Claims with report dates equal to or prior to a particular accounting date would be classified as known or reported claims with respect to the accounting date, but claims with report dates later than a particular accounting date and with accident dates equal to or earlier than the accounting date would be classified as IBNR with respect to the accounting date.

The preceding paragraph gives the precise definition of IBNR claims. In practice a broader definition is sometimes used in which the IBNR reserve denotes the provision for late reported claims, development on known claims and a provision for reopened claims.

The ambiguity regarding the definition of IBNR can result from the differing strategies insurers may employ in approaching claims reserving. The two common strategies are the report period approach and the accident period approach. In the report period approach the adequacy of existing reserves on reported claims is estimated on the basis of the historical results. Further analysis is required in order to measure the emergence of IBNR claims. In a pure accident period approach the ultimate cost of all claims, both reported and unreported, arising from each accident period is estimated. This approach results in an estimate of the claims reserve without segregation of claims incurred but not reported. The estimated claims reserve is then apportioned between reserves for IBNR and known claims on a suitable basis. Because accident period techniques do not necessarily require separate treatment of reported and unreported claims, their use can lead to a broader definition of IBNR as mentioned above.

The method of assigning report dates to reopened claims can also affect the IBNR reserve. Because reopened claims are generated from claims previously reported and closed, there is general agreement that the provision for this liability should be included in the reserve for known claims. Some insurers, however, establish new report dates for reopened claims and thereby consider the provision for these claims as a component of the IBNR reserve.

Homogeneity

Claims reserving accuracy often is improved by subdividing experience into groups exhibiting similar characteristics, such as comparable claim experience patterns, settlement patterns or size of loss distributions. For a heterogeneous product, such as commercial multi-peril or miscellaneous liability insurance, consideration should be given to segregating the experience into more homogeneous groupings. Other example applications concern the distinctions between personal and commercial risks and between primary and excess coverage. Additionally, subdividing or combining the data so as to minimize the distorting effects of operational or procedural changes should be fully explored.

Credibility

Credibility is a measure of the predictive value that the actuary attaches to a body of data. The degree to which consideration is given to homogeneity is related to the consideration of credibility. Credibility is increased by making groupings more homogeneous or by increasing the number of claims analyzed within each group. A group of claims should be large enough to be statistically reliable. Obtaining homogeneous groupings requires refinement and partitioning of

the total data. There is a point at which partitioning divides data into groups too small to provide credible development patterns. Each situation requires a balancing of the homogeneity and amount of data in each grouping. Thus, line and coverage definitions suitable for the establishment of reserves for large insurers can be in much finer detail than in the case of small insurers. Where a very small group of claims is involved, use of external information such as industry aggregates may be necessary.

Data Availability

Data should meet requirements for the proper evaluation of reserves. Existing information systems may impose constraints while more suitable data are being developed. Whatever data are used in analysis of reserves, they must reconcile to the insurer's financial records. If reserves are established in less detail than necessary for reporting requirements, procedures for property assigning the reserves to required categories must be developed.

Emergence Patterns

The delay between the occurrence of claims and the recording of claims depends upon both the line of business and the insurer's practices. In general, property claims are reported quickly, whereas the reporting of liability claims may be substantially delayed.

A review of the insurer's claims practices should be made to assure that assumptions regarding the claims process are appropriate. If a change in claims procedures is identified, its impact on emergence patterns should be evaluated.

Settlement Patterns

The length of time that it normally takes for reported claims to be settled will affect the choice of the claims reserving methods. Lines of business for which claims settle quickly generally are less subject to reserve uncertainty. A claim arising under collision coverage, for example, tends to be settled quickly, and the amount of settlement is usually close to the original estimate. Conversely, a bodily injury liability claim often requires a long time to settle. Moreover, the amount of settlement often varies considerably from the original estimate, since it depends on the interaction of complex variables such as the type and severity of the injury and the intricacies of the judicial process.

Development Patterns

The pattern of development on known claims should be carefully reviewed. An insurer's claims procedures will affect the manner in which the case reserves develop for any group of claims, and changes in claims practices may affect the consistency of historical developments. Further, the length of time to settlement may affect the observed development.

If reserves have been established at present values, the payments of claims, by themselves, cause an appearance of upward development apart from development due to other factors. To interpret development patterns correctly, the development history should be restated to remove the effect of discounting.

Frequency and Severity

The same total dollars of losses may arise from a few very large claims or from many small claims. Reserve estimates will tend to be more accurate for losses resulting from a high frequency/low severity group of claims than from a low frequency/high severity group of claims. Therefore, the evaluation of reserves for low frequency/high severity groups of claims will ordinarily require more extensive analysis. If the exposure for the group of claims being considered includes the potential for claims of a magnitude not present in historical data, adjustments should be made to reflect the expectation of such claims.

Reopened Claims Potential

The tendency for closed claims to reopen varies substantially among lines of business. Judicial opinions and legislation can affect the reporting of claims, as can changes in an insurer's procedures.

Claims-Made

Some coverages may be provided on a policy form covering claims reported during a certain period rather than claims arising out of occurrences during that period. Claims-made data should be segregated from experience on occurrence policies. It may be necessary to augment claims-made statistics with appropriate report period statistics generated under occurrence programs.

Certain provisions may modify the claims-made policy upon fulfillment of conditions stipulated in the contract. Review of the contract wording is necessary to determine the appropriate reserve, if any, for occurrences prior to the policy effective date or claims reported after the policy expiration.

Aggregate Limits

For certain insurance coverages, such as products and professional liability, aggregate policy limits may act to restrict total potential incurred losses and therefore reserve requirements. In the review of groups of claims where aggregate limits apply, modeling techniques or audit tests of the data will reveal to what extent limit ceilings have been reached and assist in determining how reserve projections may have to be modified.

Salvage, Subrogation, and Collateral Sources

For a proper evaluation of an insurer's total reserve position, the potential impact of salvage and subrogation on the group of claims under consideration should be evaluated even though statutory accounting may prohibit a deduction from claims reserves. In addition, the impact of coinsurance, deductibles, coordination of benefits, second injury fund recoveries, as well as any other collateral sources, should be considered.

Generally Accepted Accounting Principles

Reports to shareholders and to securities regulators are governed by generally accepted accounting principles (GAAP). GAAP reserves may be defined differently from statutory reserves. For example, GAAP reserves are ordinarily reduced by anticipated salvage and subrogation. The same principles of analysis used for statutory estimates can be applied to GAAP reserve estimates.

Reinsurance

Reserves are affected by the types of reinsurance plans and retentions that were and are in force, and the impact of changes in net retentions should be evaluated. To determine the effect of reinsurance it may be appropriate to analyze direct and ceded experience separately. The recoverability of ceded reinsurance is a further consideration; generally, it is addressed separately from the reserve evaluation process.

Portfolio Transfers, Commutations and Structured Settlements

Portfolio transfers, commutations and structured settlements generally recognize the time value of money. Such transactions should be evaluated for their impact on the claims reserves and the development patterns.

Pools and Associations

The loss liabilities of an insurer depend to some degree on forces beyond its control, such as business obtained through participation in voluntary and non-voluntary underwriting pools and associations. The operating and reserving policies of these organizations vary, and adjustments to reserves reported by the pools and associations may be warranted.

Operational Changes

The installation of a new computer system, an accounting change, a reorganization of claims responsibility or changes in claims handling practices or underwriting programs are examples of operational changes that can affect the continuity of the claims experience. The computation of the reserves should reflect the impact of such changes.

Changes in Contracts

Changes in contract provisions, such as policy limits, deductibles or coverage attachment points, may alter the amounts of claims against an insurer. Such contractual changes may affect both the frequency and severity of claims.

External Influences

Due regard should be given to the impact of external influences. External influences include the judicial environment, regulatory and legislative changes, residual or involuntary market mechanisms, and economic variables such as inflation.

Discounting

There are circumstances where claims reserves are stated on a present value basis. To calculate or evaluate such reserves, it is generally appropriate to perform an analysis on an undiscounted basis and then apply the effect of discounting.

Provision for Uncertainty

A reserve estimate should take into account the degree of uncertainty inherent in its projection. A reserve stated at its ultimate value may include an implicit provision for uncertainty due to the time value of money. If a reserve is to be stated at a present value, it may be appropriate to include an explicit provision for uncertainty in its undiscounted amount. Further, an explicit provision for uncertainty may be warranted when the estimated ultimate reserve value is subject to a high degree of variability.

Reasonableness

The incurred losses implied by the reserves should be measured for reasonableness against relevant indicators, such as premiums, exposures or numbers of policies, and expressed wherever possible in terms of frequencies, severities, and claim ratios. No material departure from expected results should be accepted without attempting to find an explanation for the variation.

Loss-Related Balance Sheet Items

The claims reserve analysis may have implications for other loss-related balance sheet items. These include contingent commissions, retrospective premium adjustments, policyholder dividends, premium deficiency reserves, minimum statutory reserves and the deduction for unauthorized reinsurance.

Loss Reserving Methods

Detailed discussion of the technology and applicability of current claims reserving practices is beyond the scope of this statement. Selection of the most appropriate method of reserve estimation is the responsibility of the actuary. Ordinarily the actuary will examine the indications of more than one method when estimating the loss and loss adjustment expense liability for a specific group of claims.

Standards of Practice

This statement provides the principles of claims reserving. The actuary should also be familiar with standards of practice, which address the application of these principles.