International Accounting Standards Applied to Property and Casualty Insurance— Overview of Reserving Issues

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Abstract

This paper provides an overview of the newly developing International Accounting Standards (IAS or IFRS) for Insurance, with emphasis on issues impacting property and casualty insurers and the reserving work that actuaries do to support that. Those standards will emerge in two phases, with the more challenging actuarial issues deferred to Phase II. This paper focuses on the Phase II actuarial issues but also provides a brief overview of Phase I issues. The paper is intended to serve two purposes – providing background information for those actuaries not yet familiar with IAS developments, and encouraging discussion and research on new challenges that casualty actuaries will face in determining reserves on the new bases required to implement these standards.

1. INTRODUCTION

The International Accounting Standards Board (IASB) is spearheading a global effort to transform financial reporting that has significant implications for insurance companies worldwide. The IASB's objective is to develop a single set of global accounting standards that provide useful, understandable and comparable information in financial statements, thereby helping participants in the world's capital markets make sound economic decisions. The direction of these standards is toward fair value or "fair value like" measurement of financial assets and liabilities. Some expect the new IAS standard for insurance to eventually be carried into U.S. GAAP.

The European Commission (EC) has mandated that by 2005 all companies with shares trading on stock markets within the European Union (EU) must report using IASB standards. This requirement may also be extended to some other financial institutions operating in the EU, even if not listed.

There is currently no International Financial Reporting Standard (IFRS) covering insurance. Thus accounting for insurance has been a top priority project for the IASB. While considerable work had been done on developing a new IAS standard which would value insurance contracts at Fair Value, by 2002 it became clear that the task could not be completed in time for the EU 2005 deadline. Consequently, the IASB decided to split the insurance project into two Phases.

Phase I is intended for implementation in 2005, along with all the other IFRS's applicable to insurer operations. This will allow EU insurers to produce full IAS statements for 2005 (and comparative statements for 2004). The general intent of the IASB was to make as few changes as possible to existing accounting for insurance contracts, since there would be major changes needed again shortly thereafter when Phase II is introduced.

Phase II will introduce Fair Value accounting for insurance contracts. While the timing of Phase II is not yet set, the intent of the IASB seems to be to have it effective for 2007 or 2008.

Much of the work on developing a Fair Value standard was summarized in the **Draft Statement of Principles for Insurance Contracts (DSOP)**, released in 2001. This DSOP is likely to form the basis for the Phase II International Financial Reporting Standard (IFRS) on insurance contracts, moving to Fair Value. It reflects discussions since 1997 by the Insurance Accounting Steering Committee of the IASC (predecessor of the IASB), with substantial input from the International Actuarial Association and many others. The DSOP applies to all forms of insurance (life, property/casualty, and health) and is a set of principles upon which an IFRS can be built.

While most of the recent work of the IASB on insurance has focused on Phase I, some "tentative" conclusions have been reached on the direction of Phase II although the project has been more or less dormant since January 2003. The IASB has agreed that the project should be restarted in May 2004 with the aim of completing an Exposure draft by June 2005. On restarting the project the Board will return to a study of the major issues and use the assistance of experts from national standard setters and selected industry participants.

An overview of the implications of Phase I for P&C insurers is given in the next section. For most property and casualty insurers, Phase I will not present major issues. That is followed by a discussion of another important standard for insurers, IAS 39, on financial instruments, which will govern accounting for insurer assets. This description is based on IAS 39 as of early 2004. There may be subsequent amendments. Thereafter, we discuss in more detail some key technical and business implications of Phase II, based largely on the DSOP. While the timing of Phase II is still not set, it is important to remember that these principles will impact insurers soon. Phase II will likely raise many new issues for casualty actuaries, with many new concepts introduced into the reserving process. This paper focuses on those, with most of the discussion focused on these four broad areas:

- Insurance Contract Definition
- Estimating the Timing and Amount of Cash Flows
- Adjustments for Risk and Uncertainty
- Discounting

This paper is intended both to educate those not familiar with IAS, and to stimulate discussion and research among casualty actuaries on how to handle these new issues.

2. PHASE I - 2005 REQUIREMENTS

The Staff of the IASB was previously working on a Fair Value based approach to accounting for insurance, but concluded that, due to the lack of time and to fierce opposition to a fair value standard, that would not be ready for 2005. Consequently, the IASB has introduced a "two-phased" approach and released a Phase I Exposure Draft (ED 5) for insurance contract reporting. Comments on ED 5 were due 31 October 2003. At its November, December and January meetings, the IASB reviewed the comment letters and made some decisions. The final Phase I Standard, IFRS 4, *Insurance Contracts*, was released on 31 March 2004, reflecting those decisions.

Product Classification

The first step for valuing a contract is to determine whether it is classified as insurance and valued under the insurance contracts guidance. Contracts issued by insurers that do not meet the definition of insurance will be classified as investment contracts and valued under IAS 39. For contracts to meet the definition of insurance, they must include significant insurance risk— namely, a plausible event that adversely affects the policyholder or beneficiary. The definition includes most property/casualty insurance contracts. The definition is intended to be very broad. In addition, "unbundling" is required in certain circumstances. Many insurance contracts can be viewed as a "bundle" of insurance and a non-insurance financial instrument. This is most obvious in the case of many life insurance contracts, but a similar view could be taken of some retrospectively rated property and casualty insurance contracts. "Unbundling" means splitting these two components of the bundle, and accounting for them separately. In that case, the non-insurance deposit component would be accounted for using deposit accounting and IAS 39 valuation rules.

Unbundling of contracts is required to recognize deposit components or features of insurance contracts that are "hidden" on the balance sheet, where those can be separately measured. It would apply to many large retrospectively rated commercial lines or reinsurance contracts, where portions of the premium or loss payments could be viewed as deposits, if the existing accounting did not appropriately recognize them.

Phase I Insurance Contract Accounting

IFRS 4, *Insurance Contracts,* provides the guidance for accounting for insurance contracts during Phase I. The general intent is to allow companies to continue to use existing accounting policies, while at the same time introducing some key modifications. The Board considers the modifications necessary to ensure that existing accounting methods more closely conform to the principles of the IAS framework. Consequently, the IASB expects these modifications to continue to be in effect in Phase II. The main modifications impacting property and casualty insurers that must be made to existing accounting policies include:

- **Catastrophe provisions** for future claims beyond the term of the existing contracts are not allowed
- **Claims equalization provisions** to cover random fluctuations in claims costs are not allowed
- **Recognition of future losses,** measured by analysis of future cash flows, is mandated
- **Liabilities must be shown gross of reinsurance,** with the reinsurance asset shown separately

Some accounting systems, for example, US GAAP, already comply with most of the modifications or concepts described above. Significant changes are necessary for others, including the removal of catastrophe and claims equalization reserves as often found in French, German, Spanish and UK GAAP reporting.

The rules for derecognizing financial assets and liabilities also apply to insurance contracts. Therefore, insurance liabilities and assets can be removed from the balance sheet only if fully extinguished, discharged, cancelled, or expired. This means that reinsurance will not enable a company to derecognize a direct liability; rather gross presentation of liabilities and the recognition of reinsurance assets is required. Revenues, benefits, and expenses must be presented gross of reinsurance, with reinsurance amounts affecting the accounts shown in the profit or loss.

Existing Accounting Policies Allowed to Continue

Some existing accounting policies that are likely to be disallowed in Phase II may continue in Phase I if they are already in place. However, if an entity currently does not apply these policies, it cannot adopt them, even though other entities may be permitted to use them. The accounting policies that are allowed to continue in Phase I include:

- **Undiscounted measurement basis** for claims reserves — there is no requirement for discounting now, although it is very likely to be required in Phase II
- **Excessive prudence or deliberate overstatement** of insurance liabilities that may be a result of applying local regulatory requirements
- **Reflecting future investment margins** in the measurement of insurance liabilities — for instance, assuming a realistic portfolio investment return as a discount rate
- **Investment management fees** recognized at amounts above fair value
- **Recognition of deferred acquisition costs (DAC)**
- **Non-uniform accounting policies** for insurance subsidiaries

Changing Accounting Policies

A company may change their existing accounting methods under Phase I, if the change is more relevant, prudent, without bias, and more faithfully represents the economic substance of the insurance contracts. In practice, it is unlikely that companies will change their existing accounting very much for Phase I. There may be some exceptions, such as where the regulatory reserves are already moving towards a fair value-type standard.

Reinsurance

A reinsurance contract that contains significant insurance risk (i.e. is not merely a financial contract) is classified as an insurance contract and falls within the scope of IFRS 4. As originally proposed in ED 5, cedants could not recognize a gain at the inception of a reinsurance treaty. The break-even position was to be achieved by deferring and amortizing the difference between:

- The net amounts paid by the cedant, adjusted for any amount that represents a reimbursement for expensed acquisition costs; and
- The carried amount of the related portion of the cedant's liability.

While this was proposed in ED 5, at the November IASB meeting, the Board softened the position to just requiring disclosure of the gains at inception, although the details of how to do this have yet to be finalized.

Recognition of Future Losses

Impairment testing and loss recognition are similar concepts. The aim of such tests is to assess whether a liability valuation is inadequate or an asset value is overstated.

Loss recognition testing applies to insurance contracts under ED 5 and requires (i) the application of the loss recognition test under existing accounting policies, or (ii) where a test does not exist under existing accounting, IAS 37 must be applied, as discussed below.

Loss Recognition on Insurance Contracts

For insurance contracts, loss recognition or liability adequacy tests may follow existing accounting policies where such a test exists that meets specified criteria. The test examines whether the liability held on the valuation date is sufficient to cover the expected future loss payments. The loss recognition test should cover insurance liabilities, including loss reserves and unearned premium reserves, as well as related deferred acquisition costs (if any) and related intangible assets recognized in a business combination or portfolio transfer. The traditional actuarial approaches to determining loss reserves clearly meet this requirement. For unearned premium reserves, it would be necessary to examine whether the unearned premium reserve less the DAC asset is sufficient to cover the future loss payments on future losses under the contract.

Where such formal loss recognition tests do not exist under existing accounting policies, the adequacy requirements of IAS 37 must be applied. Inconsistencies may result between companies that are able to use an existing accounting loss recognition test and those required to apply IAS 37.

Application of IAS 37

The adequacy requirements under IAS 37 are applied to insurance contracts where no formal loss recognition test currently exists. The minimum liability under IAS 37 is essentially a fair value type provision. The fair value is calculated as the present value of future projected loss and expense cash flows.

The cash flows should include margins for uncertainty, so the minimum liability may be greater than the liability when measured by the discounted present value of future cash flows using realistic assumptions. It is unclear whether a market discount rate is limited to a risk-free discount rate adjusted for credit standing (as in the current Phase II proposals, discussed later in this paper). For property/casualty companies, undiscounted best estimate loss reserves (without any implicit allowance for the effects of discounting) would likely exceed a fair value type IAS 37 minimum requirement, although testing should be done to confirm that this is the case. Adding provisions for uncertainty and projected future administration expenses and reflecting rate inadequacies on unearned premiums act to increase the reserve required, and in some cases may more than offset the lack of discounting.

If current estimates of future cash flows indicate the existence of a loss, the insurer should increase the carrying amount of the liability in question to the amount that would be required under IAS 37. Any loss recognition resulting from this test and subsequent changes in the best estimate liability is reflected in earnings for the period. The amount of the loss provision can decrease, but the liability cannot be less than the value under the initial accounting basis.

IAS 37 is written in the context of a single contract or single event. For investment or insurance contracts, the testing will likely be made for a group of contracts. The results may depend on the level of aggregation, so companies will need to develop a policy for the aggregation, and apply it consistently from period to period.

ED 5 Expanded Disclosure Requirements

ED 5 contained three high-level disclosure principles that are likely to significantly increase the current level of qualitative and quantitative financial statement disclosures:

- **Principle 1: Explanation of reported amounts** — "an insurer shall disclose information that identifies and explains the amounts in its balance sheet and income statement that arise from insurance contracts" (paragraph 26)
- **Principle 2: Amount, timing and uncertainty of cash flows** — "an insurer shall disclose information that enables users to understand the estimated amount, timing and uncertainty of future cash flows from insurance contracts" (paragraph 28)
- **Principle 3: Fair value of insurance liabilities and insurance assets** — "an insurer shall disclose the fair value of its insurance liabilities and insurance assets" (paragraph 30)

This third principle was very controversial, as it seemed the IASB was requiring disclosure of something that it found impossible to define. The IASB agreed to remove this requirement at its November 2003 meeting. But IFRS 4 did retain the first two Principles, and implementing them will prove to be a major challenge for many insurers.

Practical Implications of Disclosure Requirements

The implementation of the detailed requirements of Principles 1 and 2 is likely to lead to a significant increase in the length and complexity of insurance contract disclosures. These additional disclosures are also likely to be of significant interest to analysts and, as such, their presentation will require careful consideration. The disclosures likely to generate the greatest added effort or the greatest interest include:

- Risk management objectives and the policies established to mitigate insurance risk
- Terms and conditions of insurance contracts that are likely to have a material impact on the amount, timing and certainty of future cash flows
- Information on credit risk that is likely to be particularly important for reinsurance contracts
- Insurance risk, including sensitivity analysis, and information about concentration of insurance risk

- Details of actual claims compared to previous estimates (e.g., claims development for a general insurer for periods where incurred claims are still outstanding)

3. ACCOUNTING FOR ASSETS - IAS 39

While the focus of this paper is accounting for insurance, an understanding of the accounting for insurer's invested assets is important to understand the likely earnings impact of the new requirements valuing insurance reserves. The main standard that applies for the accounting of insurers' invested assets is IAS 39, *Financial Instruments: Recognition and Measurement*. Many aspects of IAS 39 are common to all financial institutions and other entities, including measurement principles for invested assets and macro-hedging, recognition and derecognition guidance, and disclosure requirements.

Measurement of Invested Assets

IAS 39 requires many, but not all financial assets to be carried at fair value in the financial statements, and allows an amortized cost approach for most financial liabilities. Similar to US GAAP FAS 115, financial assets (except for originated loans) are classified as held-to-maturity (HTM), trading, or available-for-sale (AFS). Trading and AFS financial assets are valued at fair value, while HTM assets are valued at amortized cost. For trading assets, unrealized gains and losses are recorded in the income statement. Unrealized gains and losses for AFS assets are recorded directly in equity except for impairment losses that are taken into income. Loans and receivables originated by the entity are measured at amortized cost.

Although the basis of classification of financial assets is similar to US GAAP, the IAS 39 Exposure Draft permits entities the option of designating any financial instrument (including originated loans) as trading at inception. Further, ED5 permits insurers who change their accounting policies for insurance liabilities the option to reclassify some or all financial assets into the trading category.

In all likelihood, most insurers will classify most financial assets as AFS during Phase I. For most insurers, Phase I liability values will not vary with changes in market interest rates, so insurers will want asset values to be similarly unaffected. This is the approach commonly taken now by U.S. GAAP reporters.

In the longer-term, companies will need to consider the ability and impact of redesignating assets to be consistent with the ultimate measurement basis under Phase II for insurance contracts. As discussed below, insurance liability values will be based on the yield curve on the valuation date. That is consistent with the fair value used for assets classified as trading. When a fair value standard is implemented for insurance contracts, companies will likely want to classify assets as trading to achieve consistency in the measurement between assets and liabilities. Assuming assets and liabilities are reasonably matched, this will reduce the volatility of earnings.

4. PHASE II INSURANCE STANDARD - OVERVIEW

This section contains a brief overview of the major changes to financial reporting that Phase II is likely to introduce and some key business implications relating to these changes. These are each described in further detail in later sections.

The requirement for fair value or "fair value like" accounting represents a significant departure from current accounting practice, based on the deferral and matching approach. Implementation of the new reporting framework will be a major challenge, surpassed in difficulty only by the challenge of explaining reported earnings after the new principles are implemented.

Insurance Contract Definition

As with Phase I, Phase II will apply to insurance contracts not insurance companies. In addition, the definition of an insurance contract requires the presence of "significant insurance risk." The Definition provided would include some contracts that are not considered to be insurance policies under most current accounting standard, while excluding some that are.

Single Measurement Approach

A single measurement approach applies to valuing all insurance contracts, whether they are long or short term, life, annuity, health or property/casualty. This approach contrasts with some current practice, for example, under US GAAP, where different products are accounted for under different standards.

Valuing Options and Guarantees

Options and guarantees contained in contracts should be explicitly valued and reserved for. For example, this includes minimum interest rate guarantees, guaranteed annuity rates, and guaranteed death benefits on variable or unit-linked products. For most property and casualty insurance contracts, the value of options and guarantees is probably not material. But in some cases, it will be necessary to value these.

In such cases, option pricing and stochastic valuation techniques, which use random scenarios to project outcomes, would be required when such techniques are likely to have a material impact on the result. This would require many companies to significantly enhance their existing financial measurement and modeling systems.

Estimating Cash Flows and Adjustment for Risk and Uncertainty

The liability valuation begins with projections of expected cash flows under the contract. The present value of those cash flows, discounted at the risk-free rate plus a spread to reflect the insurer's credit risk, is the liability value prior to any adjustment for risk and uncertainty. Both fair value and entity-specific value should always both contain a market-based adjustment for risk. The risk adjustment is preferably made through adjusting the cash flows, or adjusting the discount rate, or both, without double counting.

The risk adjustments are referred to as "market value margins" and should be set to be consistent with market-risk preferences. The market-based adjustment for risk and uncertainty effectively act as a market mechanism for pricing uncertainty. However, there is no guidance in the DSOP on how this should be done.

Financial Statement Disclosures

The disclosure requirements in the DSOP are voluminous and burdensome. Companies will need to disclose expected earnings based on prior period valuation assumptions together with the effects on earnings of new business written, release of margins, deviations due to differences between actual and expected experience by source, and changes in assumptions. In addition, new business impact may need to be split between contracts sold to existing customers and contracts sold to new customers.

Business Implications

The business implications of the Phase II reporting framework are far reaching. Some of the most significant are described below:

- **Increased financial volatility:** reported financial results will be more volatile, making it more difficult to understand results and explain them to management, investors and other stakeholders.

- **Tighter matching of assets and liabilities:** as a means to reduce earnings volatility, assets and liabilities will tend to be more tightly matched and assets backing surplus may be less risky. In the process, policyholders and investors may lose some potential upside gain.

- **Fewer constraints on portfolio management:** there may be fewer constraints on managing asset portfolios on a total-return basis if insurers classify assets backing insurance liabilities as Trading, to keep their valuation consistent with the liabilities measured at Fair Value.

- **Investment portfolio and credit quality:** the credit quality of the fixed-income portfolio will become more transparent as changing credit spreads may materially impact reported income.

- **Forecasting challenges:** it will become nearly impossible to forecast results accurately, since results will depend on future economic conditions. In this new environment, stakeholders may require multiple forecasts based on differing future economic assumptions. As a result, companies will need to develop techniques to quickly estimate the impacts of changing economic scenarios. By the time reported financials are published, they may already be "out of date".

The DSOP is the primary source of explanation of, and rationale for, the Phase II standard. The IASB reached various "tentative conclusions" in its discussions that appear in the Basis for Conclusions section of IFRS 4, which in some cases differ from the DSOP. Those are reflected here as well.

The DSOP contains 14 chapters, each of which addresses specific principles that apply to insurance accounting. The principles are numbered within each chapter; for example, Principle 4.2

is the second principle of chapter four. We refer to the main principles we discuss throughout the report by these numbers so that you can readily refer back to the relevant section of the DSOP.

In the next sections, we consider the key financial reporting principles of the DSOP that have the greatest potential impact on property and casualty insurers.

5. INSURANCE CONTRACT DEFINITION

Insurance Contracts Not Companies

The DSOP applies to insurance contracts not insurance companies. Therefore, the same rules will apply regardless of the type of company that issues the contract. For example, a bank that issues insurance contracts must apply the same rules as an insurance company that issues insurance contracts. The rules apply to assets and liabilities that arise from insurance contracts, so-called "insurance assets and insurance liabilities". An example of an insurance liability is a liability for future benefits under the contract. An example of an insurance asset is reinsurance recoverable. A bond held by an insurance company is not an "insurance asset".

Definition of Insurance Contracts

For Phase I, a very broad definition of insurance contracts was adopted. In part, this was done to avoid forcing insurers to define fair value for contracts not qualifying as insurance (and therefore to be valued under IAS 39), where the valuation principles were not yet clear, and would likely be addressed in Phase II. At this time, it is not known if the definition of insurance will be narrowed in Phase II.

Under Phase I a contract qualifies as an insurance contract if the insurer accepts "significant insurance risk". If only "financial risk" is present, the contract will be classified as a financial liability (investment contract) and will be accounted for under IAS 39.

Certain criteria have to be met in order for a risk to be an insurance risk under the Phase I definition:

- The risk must arise from a specified uncertain future event that adversely affects the policyholder. For example, death adversely affects a life insurance policyholder and living too long adversely affects an immediate annuity policyholder.
- Changes in a specified interest rate, security price, commodity price, foreign exchange rate and similar items are specifically excluded as being "financial risks."
- It must be plausible that the uncertain future event will cause a significant adverse change in the present value of the insurer's cash flows under the contract. This condition is met even if the insured event is extremely unlikely.

This definition would include most property and casualty insurance contracts.

The DSOP covers many types of contracts not issued by insurers. Examples are automobile club repair services, warranty contracts issued by non-insurance companies, (but not warranties provided by the manufacturers) and contracts of some health care organizations such as CCRC's and HMO's.

The DSOP also covers some contracts that are not financial instruments. For example, contracts that provide payments in kind or services rather than cash payments in the event of an insured event are covered. This includes performance bonds, and some types of health insurance arrangements.

The DSOP would also exclude many types of contracts that have been issued by insurers. There is a requirement of risk shifting similar to that in the US GAAP under FAS 113. Weather derivatives and some catastrophe bonds would be excluded, if the payment amount is not linked to the actual losses by the insured.

In general, unbundling of the investment and insurance elements of an insurance contract would not be permitted under the DSOP.

6. ESTIMATING THE TIMING AND AMOUNT OF CASH FLOWS

The Starting Point - Expected Value

The starting point for measuring insurance assets and insurance liabilities is the expected value of future pre-tax, pre-reinsurance cash flows associated with the closed book of insurance contracts in force on the valuation date. These expected cash flows are then adjusted for risk and uncertainty (discussed in the next section), and the result is then discounted to get the present value (discussed in the following section).

These projected cash flows would, of course, include loss payments and loss adjustment expenses, and insurance premiums. In addition, other company expenses for marketing and administrative would be included, which is not current practice in most property and casualty insurance accounting systems. Overhead expenses that can be allocated to the policies on a "reasonable and consistent" basis would be included in the projections as well. There would seem to be wide room for judgment in doing that.

Salvage and subrogation rights are to be recognized as assets when they meet certain criteria – e.g. the insurer controls those rights and can measure them reliably. Prior to that time, the potential future salvage and subrogation rights should be provided for in the estimated cash flows used to calculate the liability.

Under the DSOP, there is no unearned premium reserve or deferred acquisition cost asset. Instead, there is a provision for future payments on in force contracts in addition to the payments provided for in the loss reserve, the estimated future expenses and payments on claims related to future coverage periods under contracts in the closed book. This provision is sometimes referred to as the "unexpired risk reserve" but it is different from what a similar term (provision for unexpired risk) refers to under U.K. GAAP rules.

The unexpired risk reserve as of the date of issue does not have to be equal to the premium less acquisition costs. The insurer may recognize a gain or loss at issue. However, the Board believes that in the absence of market evidence to the contrary the estimated Fair Value (FV) of an insurance liability shall not be less, but may be more, than the entity would charge to accept new contracts with identical contractual terms and remaining maturity from new policyholders.

Therefore, an insurer should not recognize a net gain on inception of an insurance contract unless such market evidence is available.

The expected present value of cash flows is not necessarily the same as the present value of expected cash flows. If there are significant options or guarantees provided under the contract, these two may be very different values. In that case, it may be necessary to use stochastic models or option pricing approaches to determine the liability. For most property and casualty products that will not be an issue, but for some such as longer-term savings oriented products, that may be necessary.

In some cases property and casualty policies generate unusual types of cash flows - e.g., residual market assessments or obligations to insure poor risks, guarantee fund assessments. These obligations should also be reflected in the liabilities, and approaches to doing that must be developed.

Setting Appropriate Assumptions

Assumptions may be classified as economic assumptions (such as interest rates and equity prices) and non-economic assumptions (such as expenses and mortality). Economic assumptions have to be set to be consistent with current market prices and data. Non-economic assumptions are set consistent with the market's expectations of experience that will result on that block of business are used for fair value.

In practice, there may not be market-based assumptions that are observable or available. In such cases a company's own estimates can serve as a proxy for market estimates, unless there is specific evidence that this is not appropriate. Some have suggested that reinsurance rates might be used as a source of market-based mortality assumptions. However, reinsurers differ greatly in their assessments of risk and often have different assessments than direct writing companies. On the other hand, data on industry expense levels may be more readily available than other types of information.

The assumptions should reflect "all future events, including changes in legislation and future technology changes, that may affect future cash flows." In contrast, under US GAAP, only legislation that has already been enacted, or for which enactment is imminent and certain, would normally be reflected.

Inflation should be reflected in the cash flows, in a way that is consistent with the interest rates used for discounting. That linkage does not exist in most loss reserve methods now in use.

The assumptions should reflect constructive obligations to make payments, as well as the explicit contractual obligations.

Assumptions should be reviewed and reset at each valuation date, at the then current best estimates. For economic assumptions, this will be necessary to maintain consistency with current market values of assets. That may require a change in the inflation assumptions underlying projected losses as well.

The Closed Book

The closed book concept poses several interesting questions for property and casualty insurers, both with respect to when a liability is recognized, and to what extent cash flows in future contract renewal periods are reflected in the liability.

The liability should be recognized at the time that an insurance contract is established. The event that creates insurance assets and liabilities is becoming a party to the insurance contract. That will generally not be the same as the starting date of the coverage. For some types of business, it will often be in a different year. That would be the case, for example, for January 1 reinsurance renewals agreed the previous year.

Becoming a party to an insurance contract is an event that gives the insurer and the policyholder control over their contractual rights and creates contractual obligations that gives them little, if any, discretion to avoid the net cash flows resulting from their contractual obligations. In some cases, it may not be clear when a contract is established. Is it necessary for the actual policy to be signed, or is a signed application or reinsurance slip sufficient? What about a verbal assurance that coverage will be provided, or even draft agreed contracts (e.g., World Trade Center)? Or a signed application binding coverage, but giving the insurer a specified period to underwrite and reject? Is the contract created when the application is signed, or when the insurer's right to reject expires? Policy renewals where the insurer must give advance notice (e.g., 30 days) in order to non-renew raise similar issues. Whatever the answers to these questions may be, most insurers do not now have business processes or information systems that would enable them to implement those answers.

Under the DSOP, an insurer may recognize a loss at issue, although gains should be recognized on issue only if there is clear market evidence to justify them. So determining when the contract comes into existence will be more important than is the case now.

Renewals

The closed book includes cash flows in future renewal coverage periods in determining the liability only to the extent that:

(a) the policyholder has non-cancelable continuation or renewal rights constraining the insurer's ability to reprice; and

(b) those rights lapse if the policyholder ceases to pay premiums.

Considerable effect will be needed to determine exactly what that means, and how it should apply to the multitude of different regulatory and contractual approaches to renewal that exist in the market. Note that this definition has been significantly changed by the IASB discussions from what was proposed in the DSOP. This is indicative of the difficulty of the issue.

Unexpired Risk Reserve

As noted above, the Unearned Premium Reserve and Deferred Acquisition Cost items used now in deferred and matching accounting approaches will disappear. They will be replaced by a new Unexpired Risk Reserve (URR). It would be the present value of loss and expense payments to be provided for by premiums covering the period from the valuation date to expiry on all contracts in force on the valuation date, whether those premiums have been paid or not. If they have not yet been paid, there would be an offsetting receivable for premium due.

Calculating this URR would resemble a simplified ratemaking exercise, with the loss reserve analysis as a base. For example, the last few accident year selected ultimate loss ratios and claim payment patterns, from the loss reserve analysis, would be the starting point. A trend factor would project those to the average exposure date of the unearned premium. Rate level adjustment factors would reflect the impact of rate changes. The "averages" of these projected loss payment streams (e.g., average of last 3, 3-2-1 weights, etc.) would give the expected loss ratio on current rate level. In some cases, it may be desirable to credibility weight recent actual amounts with payments based on an a priori expected loss ratio. And in some cases judgmental adjustments may be appropriate – e.g., to reflect an actual or expected change in the law that will impact losses.

Everything in the previous paragraph is standard ratemaking technique, and readers of this paper will likely know many variations of the approach used to fit various circumstances.

The URR calculation will also require a number of new elements, not now common in ratemaking.

1. The level of aggregation of the business will be different – most likely more similar to that commonly used for loss reserve analysis. Perhaps ratemaking and reserving processes will become more integrated.

2. Additional elements of cash flows will need to be projected – e.g., future maintenance and acquisition expenses for contracts in force on the valuation date.

3. Market Value Margins (MVM's) to reflect risk and uncertainty will need to be added to the expected cash flows. Under some approaches to MVM's (e.g., setting gain at issue to zero), the MVM's will be reset at each valuation date for the new business issued since the prior valuation date. In practice, many companies may leave those MVM's unchanged for the life of those contracts, so the selection of MVM's for the URR will also determine the levels of MVM's for loss reserves. MVM issues are discussed in more detail in a later section.

4. The projected payments must be discounted using the risk-free yield curve on the valuation date, plus a spread for the insurer's own credit risk on that date.

5. The process described so far is a deterministic, best-estimate approach. But where the policy contains significant options or guarantees, those must be reflected as well. Stochastic methods may be required to do that, but this should not be a material issue for most property and casualty insurance contracts.

6. Renewal provisions must be considered for contracts where the closed book includes future renewal periods. These will be many cases where property and casualty insurance falls in a gray area in this respect.

7. This has to all be done on a gross (of reinsurance) basis, and then again for the amounts reinsured. But for the reinsured business, the assumptions may change - e.g., credit rating spreads may change, MVM's will change sign, and perhaps amount, maintenance expenses may not be included.

Projected Expenses

As noted in point 2 above this calculation will require projections of future expenses on contracts in force - both maintenance expenses and acquisition expenses. That is a new area for most P&C insurers. It will raise a number of challenging issues. How should overhead expenses be reflected? What should be done to project expense trends? What about anticipated changes in expenses levels - e.g., planned cost level reductions. To the extent those are reflected by changes in the URR, they impact earnings at the time they are planned, not at the time they are carried out.

7. ADJUSTMENTS FOR RISK AND UNCERTAINTY

Definition

The fair value of a liability consists of the expected value of the cash flows discounted for the time value of money, and a risk adjustment. This risk adjustment to liabilities will be referred to as the Market Value Margin (MVM). "Own credit risk", i.e., the risk that the insurer will default, will not be considered here.

The MVM is not directly observable for a P&C insurer's policy liabilities because they are not actively traded. Consequently, the MVM needs to be estimated. In this section, the MVM will consider three types of risk:

1) process risk - random statistical fluctuations will cause the value of the liability to be different than expected. Process risk may often be regarded as diversifiable risk.
2) parameter risk - misestimation of parameters used in the modeling process
3) model risk - the wrong model was used to estimate the liability

In the current DSOP, Principle 5.4 states, "The entity-specific value or fair value of an insurance liability or insurance asset should always reflect both diversifiable and non-diversifiable risk." This implies that the insurer should estimate process risk, parameter risk, and model risk. However, Section 5.10 states that while it is "conceptually preferable" to reflect parameter risk and model risk, "it is appropriate to exclude such adjustments unless there is persuasive evidence that enables an insurer to [quantify] them by reference to observable market data." Consequently, it may be at the insurer's discretion whether it wants to estimate model and parameter risk.

Here are four examples of practical approaches to estimating the MVM's. This is clearly an area where more research by CAS members would be useful.

1) Canadian Provision for Adverse Deviation (for non-diversifiable risk only)
2) Initial Expected Profit Margin (for both non-diversifiable and diversifiable risk)
3) Poisson Frequency / Lognormal Severity Simulation (for diversifiable risk only)
4) Mack's Approach using historical loss triangles (for both non-diversifiable and diversifiable risk)

1) Canadian Provision for Adverse Deviation

The Canadian Institute of Actuaries (CIA) introduced a standard of practice covering provisions for adverse deviations (PFAD's) for P&C insurers effective January 1, 1994. Before this, the general direction from the CIA advised,

> *"For several reasons, it is not possible to determine expected experience with complete confidence. The member should, therefore, define a margin for adverse deviation in each assumption to add a provision to the liabilities. This provision should be appropriate for income statement purposes and appropriate to the company circumstances... For each assumption, the margin is for the misestimation of its mean and for possible deterioration of this mean. Statistical fluctuation, catastrophic or similar major unexpected events should not be covered by the margin.*

The 1994 CIA standard of practice described three major valuation variables: claims development, reinsurance recovery, and discount rate, which the PFAD's should cover. The standard described low margin and high margin situations for each variable and asked the actuary to determine where within that continuum a particular insurer fell. The standard set a range for the PFAD for each variable, namely,

- claims development from 2.5% to 15%,
- reinsurance recovery from 0% to 15%, and

- discount rate from 50 to 200 basis points.

In practice Canadian actuaries first estimate policy liabilities on the traditional ultimate undiscounted basis and then determine payment patterns. A discount rate is selected, generally based on the expected future book returns of the insurer's invested assets including, if necessary, assumptions about the yield on reinvestments. The expected book yield is used for the discount rate so that the policy liabilities and corresponding assets are on a comparable basis. This is a difference from the DSOP approach, under which the discount rate would not reflect the assets held by the insurer.

The claim liabilities are discounted once at the discount rate and a second time at a rate equal to the discount rate less the basis points required in the circumstances. The difference between the two estimates is the PFAD for interest rate.

The PFAD for claim development is typically a percentage of the discounted gross unpaid claim liabilities.

The PFAD for reinsurance recovery is typically a percentage of the discounted ceded unpaid claim liabilities.

2) Initial Expected Profit Margin

Under the DSOP and the conclusions of subsequent IASB discussion, the discounted value of expected future cash outflows (claims and operating expenses) from a policy, or group of policies, is in most circumstances less than the discounted value of expected future cash inflows (premiums and policy service fees). This difference would be the present value of expected profit. When MVM's are added to the policy liabilities, they effectively defer the recognition of profit until the passage of time replaces fact for estimates and the MVM's are removed. There is no guarantee that any theoretical MVM will exactly offset the expected profit margin at issue. Nevertheless, if markets are efficient, the DSOP suggests there should be no gain at issue. Consequently if a profit is indicated at issue, any theoretical MVM should be scaled so that the result is simply breakeven, unless there is clear market evidence supporting a gain at issue.

There are cases when a gain at issue is permitted. For example if one group of policies is sold a price X and shortly afterwards the market price for other policyholders with identical risk characteristics is reduced, this may suggest that there is a legitimate gain at issue for the first group.

Conversely, if prices are later increased, it may imply there should be a loss at issue for the earlier policies.

3) Poisson Frequency / Lognormal Severity Simulation

Loss reserves are calculated based on a Monte Carlo simulation. Parameters for this simulation are based on future claims with payment and pending severity estimates from the insurer.

Future claims with payment are assumed to be Poisson distributed. The lambda parameter for the Poisson future claims with payment distribution is determined by projecting ultimate claims with payment and subtracting closed claims with payments.

Pending severities are assumed to be lognormally distributed. The expected value of the pending severity equals ultimate losses less paid losses divided by future claim counts. Loss data should be gross of reinsurance. The coefficient of variation for the pending severity distribution can be derived from the increased limit factors of the insurer or appropriate industry standards such as ISO.

An example of the calculations for this method can be found in Appendix A, Exhibit A.

The advantages of this method are:

- The data needed to calculate this method are readily available (most of this data can be found in the US Schedule P by line of business)
- The simulations could be run on Microsoft Excel or other readily available software
- The method is already in use by some insurance entities to estimate process risk.
- Parameters used in simulation are fairly easy to disclose and results can be replicated by outsiders.

Disadvantages of this method are:

- Loss data may not have claim data that is Poisson distributed and it may not have severity data that is log-normally distributed.

- The method only measures process risk. This can be a potential advantage if the insurer cannot accurately measure non-diversifiable risk or the insurer already has a method that calculates only non-diversifiable risk (e.g., the Canadian Provision for Adverse Deviation, the CAPM method, etc.)
- All claims with payment may not have the same coefficient of variation parameters.
- The method is dependent on the insurer having adequate reserves. If the insurer's reserves are inadequate, the MVM from this method will be inadequate.

4). Mack's Approach Using Historical Loss Triangles

In this approach, we use historical loss triangles of the insurer to calculate the MVM. Full documentation of this approach can be found in Thomas Mack's article, "Measuring the Variability of Chain Ladder Estimates". This approach relies on the chain-ladder technique to develop expected ultimate losses. It then uses the actual data's variation around the insurer's expected losses to estimate the variance of the insurer's losses.

This method can be applied to paid losses, case incurred losses, and ultimate losses. The paid loss triangle is independent of claim adjusters, actuaries, and upper management's opinions on reserves but is vulnerable to changes in payout patterns. The case incurred loss triangle is independent of actuaries' and upper management's opinions on reserves, but is vulnerable to both changes in payout patterns and claim adjusters' case reserving practices. The ultimate loss triangle is dependent on the opinions of actuaries and upper management as well as changes in payout patterns and reserve level.

Expected loss reserves from these three versions of Mack's approach can provide widely disparate results. However the ratio of the standard deviation of reserves to the expected value of reserves (or, as shown in the example in Appendix A, the ratio of the 75th percentile of reserves to expected reserves) can provide more consistent results. The ratio of standard deviation to expected reserves should be smaller for the incurred loss and ultimate methods if the judgments of claims adjusters, actuaries, and upper management provide some insight into the true estimate of ultimate losses (and if the implicit assumptions of the chain-ladder method are true for the insurer's data; see the list of disadvantages below).

Advantages of this method:

- The data needed to calculate this method are readily available (most of this data can be found in the US Schedule P by line of business).
- This method calculates both process risk and parameter risk. The ultimate loss method also measures the historical method risk for the company.
- This method does not make any assumptions about the underlying distribution of the insurer's losses.
- This method can be readily calculated on a spreadsheet, although a number of formulas are needed to determine the standard error of ultimate lossess.
- An insurer that historically under-reserves will have a larger MVM than one that accurately estimates its reserves if the ultimate loss version of this approach is used.

Disadvantages of this method:

- This method assumes that future losses will develop in the same way that losses have developed historically. Dramatic changes in current payout patterns, case incurred reporting patterns, and ultimate loss reporting patterns can render this method unusable.
- Mack shows that the chain-ladder relies on a number of implicit assumptions, most notably that accident year data are independent of one another. Mack provides a number of tests that can be used to test whether these implicit assumptions are true for an individual insurer's data.
- For long tailed reserves, a number of years of experience are needed to estimate the variance in reserves.
- This method can provide strange results for lines of business with sparse data.
- This approach is not commonly used for valuing process risk. Further research is needed to determine the viability of the suggested approach.

8. DISCOUNTING

Discount Rates

Discounting estimates of future cash flows is a significant step in estimating the fair value of an insurance liability. Whilst the process of discounting does not pose the same level of technical difficulties as estimating market value margins it still requires a degree of care and it will be a new process for many property and casualty insurers.

The starting point for the discount rate, before any adjustment for risk and uncertainty, is the pre-tax market yield on risk-free assets at the balance sheet date.

Some observers have suggested that yields on high-grade corporate bonds, properly adjusted for expected default costs, are a better measure of risk-free rates than are yields on government securities. However, this approach is not permitted under the DSOP unless "there is no active market in government securities".

The liability value should reflect the company's own credit, and this would probably be accomplished by adjusting the discount rate. This was a very controversial issue during much of the discussion leading up to the DSOP, with many objecting strongly to a system in which an insurer's deteriorating financial condition automatically leads to a reduction in the value assigned to its liability. Many actuaries objected strongly. Others assert that this is merely reflecting reality, and refer to situations in which companies have been able to buy back their own debt at prices reflecting reduced credit rates. Whatever the views one has, it seems now that the decision has been made to reflect the insurer's own credit rating in the discount rate.

However, there is no guidance on what the proper adjustment to the risk-free rate should be. The credit spread that corresponds to the company's debt rating is not necessarily the right answer because insurance contracts have a different priority in liquidation. The spread corresponding to the company's claims paying ability rating may be more appropriate.

Many IAS reporters will have assets and liabilities in foreign currencies, often in currencies where meaningful risk-free yield curves and credit spreads are difficult or impossible to determine.

Discounting Reflecting Option and Guarantees

In theory, the DSOP calls for a discounting approach that properly values options and guarantees. A stochastic approach as follows would accomplish that.

- Each scenario of cash flows for an insurance liability would be discounted and then the present values added together weighted by the probability of each scenario. The cash flows should include the appropriate market value margins if it has been decided to incorporate them by altering cash flows rather than adjusting the discount rate.

- The discount rate should be the risk-free rate consistent with the timing and currency of the cash flows, adjusted for the insurer's own credit risk. (If market value margins are not included within the cash flows then the discount rate needs to be reduced appropriately).

- The present value of foreign cash flows would be converted into the measurement currency using the spot rate at the reporting date.

In practice, the expected cash flows can be discounted in most cases without significant loss of accuracy for most P&C insurance contracts.

An example of how to do this discounting is provided in Appendix B.

Choosing the Discount Rate

For most developed countries the interest rate paid on Government securities can be reasonably used as the benchmark for the risk-free rate. This is because the risk of default is usually regarded as negligible and also in those countries such securities have a lower credit risk than other securities.

This will not be appropriate for some developing countries where such a benchmark rate may not be appropriate as the risk of default is not minimal. One possibility is to use the rate implied by highly rated corporate bonds if such bonds carry a lower default risk than Government securities.

However quite often in such jurisdictions high quality corporate bonds are also not available. One way around this may be to try to convert the yield available on the highest quality securities available into a risk-free rate. This can be done by adding the value of the expected default level of such securities onto the market price of the security to estimate a risk-free rate. The expected default value can be estimated using write-off factors from credit rating agencies for a particular credit rating of the security. If it is relatively straightforward to estimate, the risk premium for bearing the risk of volatile defaults should also be added onto the market price of the security when estimating the risk-free rate of return.

Similarly, in many foreign currencies it will be more difficult to judge the credit spread required to reflect the insurer's own credit risk than is the case in developed markets.

9. OTHER ISSUES

Performance-linked Contracts

The DSOP defines performance-linked contracts as an insurance contract under which the payments to policyholders depend partly on one or more of:

- Performance of the contract itself, a specified pool of contracts or a specified type of contract
- Realized and/or unrealized investment returns on a specific pool of assets held by the insurer
- The net profit or loss of the company, fund or other entity that issues the performance-linked insurance contract

Traditional participating (with profits) and variable (unit linked) life insurance and annuity contracts are the most obvious examples of performance-linked contracts.

Property and casualty insurers also have performance-linked plans e.g. retrospective rating, experience based dividend plans. They also have plans that to some may appear to be performance – linked but probably do not fit here – e.g., prospective experience rating, bonus/malus systems. Many property and casualty insurance retrospectively rated contracts may be taken out of this category by the Unbundling approach proposed for retrospectively rated contracts in Phase I.

Reinsurance Ceded

The Phase II approach for reinsurance largely carries forward the principles introduced for direct insurance in Phase I. The same general approach should be used to value reinsurance ceded as used for direct insurance. Again, "one size fits all" and there is no difference in the treatment of reinsurance and direct insurance.

In addition, the effect of reinsurance ceded should be carved out and presented separately as below:

- Reinsurance amounts recoverable are shown as assets on the balance sheet. They may not be set up as negative reserves to offset against direct liability.

- Reinsurance premiums are shown as expenses and reinsurance claims are shown as income. They may not be netted from direct premiums and claims.

Contracts that do not transfer a significant amount of "insurance risk" will not qualify for reinsurance accounting.

The accounting approach for reinsurers will be the same as for insurance companies. However, there is no requirement for "mirror reserving" between reinsurers and ceding companies. In fact, since the insurer's and reinsurer's credit ratings will likely differ, and since MVM's should increase the liability and decrease the asset (i.e., MVM's are additions to expected insurance cash flows in valuing liabilities, and reductions from expected cash flow in valuing insurance assets), the direct and ceded values for the same business may be quite different. Where large portions of the business are reinsured on a quota share basis, a common practice in many P&C markets, this may tend to produce a loss at inception of the coverage.

Savings-oriented and other long-term policies

In many countries, property and casualty insurers issue long-term policies, and in many cases there is an explicit savings function involved in the policy. These policies raise many of the same issues that apply to life insurance contracts. They are beyond the scope of this paper, and will not be discussed here. These contracts will require property and casualty insurers to develop financial modeling tools and skills that they do not have now, perhaps including stochastic modeling tools.

Deferred and fund methods of accounting

These approaches, historically used at Lloyd's, will not be permitted by the DSOP. The Lloyd's market will drop this in 2005 anyway under UK accounting rules.

10. CONCLUSION

The new requirements for International Accounting Standards for insurers will present challenges to reserving actuaries for property and casualty insurance companies over the next few years, especially when Phase II is introduced. Already, the profession is busy in both a research and an advocacy role, trying to influence the IASB and its staff, to help them develop new standards that are practical and meaningful for property and casualty insurers, and that will provide useful information to the investing public and other users of IAS financial reports. As the new standards are finalized, the profession will need to develop practical approaches to doing the required reserve analyses. This paper focused on some of the issues involved in that. There are clearly many open issues that will need to be resolved as this moves forward. And just developing the new reserve methods alone is not enough – it will be necessary for a large number of reserving actuaries to be educated about them, and to develop the tools and skills necessary to apply them as part of the regular support to the financial reporting process.

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Guide to Abbreviations Used

DSOP - Draft Statement of Principles, a document setting forth some basic principles for Phase II

ED 5 - Exposure Draft 5, a document exposing the proposed Phase I accounting standard

IAS - International Accounting Standards

IASB - International Accounting Standards Board

IAS 37 - International Accounting Standard dealing with accounting for contingencies

IAS 39 - International Accounting Standard dealing with accounting for financial instruments

IFRS - International Financial Reporting Standards

IFRS 4 - International Financial Reporting Standard dealing with accounting for insurance, Phase I

MVM - Market Value Margin, a provision for risk and uncertainty

PFAD - Provision for Adverse Deviations, a Canadian term for MVM's

URR - Unearned Revenue Reserve, a new reserve providing for future costs on contracts in force

EXAMPLES OF MVM APPROACHES

Summary of Exhibits

Poisson/Lognormal Simulation

Exhibit A, Sheet 1
Summarizes Market Value Margin Calculation for Process Risk

Exhibit A, Sheet 2
Shows Results of Poisson/Lognormal Simulation

Exhibit A, Sheet 3
Shows Calculation of Parameters for Simulation

Mack's Approach

Exhibit 1, Sheet 1
Summarizes Market Value Margin Calculation for Process, Parameter & Model Risk

Exhibit 2, Sheet 1
Calculates Reserves at the 75th percentile for paid loss & ALAE triangle

Exhibit 2, Sheet 2
Calculates standard deviation of total reserves for paid loss & ALAE triangles

Exhibit 2, Sheet 3
Calculates standard deviation of reserves for each year for paid loss & ALAE triangles

Exhibit 2, Sheet 4
Calculates parameters used in standard deviation calculations for paid loss & ALAE triangles

Exhibit 3, Sheet 1
Calculates Reserves at the 75th percentile for incurred loss & ALAE triangle

Exhibit 3, Sheet 2
Calculates standard deviation of total reserves for incurred loss & ALAE triangles

Exhibit 3, Sheet 3
Calculates standard deviation of reserves for each year for incurred loss & ALAE triangles

Exhibit 3, Sheet 4
Calculates parameters used in standard deviation calculations for incurred loss & ALAE triangles

Exhibit 4, Sheet 1
Calculates Reserves at the 75th percentile for ultimate loss & ALAE triangle

Exhibit 4, Sheet 2
Calculates standard deviation of total reserves for ultimate loss & ALAE triangles

Exhibit 4, Sheet 3
Calculates standard deviation of reserves for each year for ultimate loss & ALAE triangles

Exhibit 4, Sheet 4
Calculates parameters used in standard deviation calculations for ultimate loss & ALAE triangles

Exhibit A
Sheet 1

Insurer X

Reserve Analysis As of December 31, 1997
Summary of Simulation Results
Poisson/Lognormal Simulation

Loss & ALAE @ 75th percentile	Expected Loss & ALAE	MVM Process Risk Load
265,234	263,210	0.8%

Notes:

(1) From Exhibit 1, Sheet 2
(2) From Exhibit 1, Sheet 2
(3) = (1) / (2)

Insurer X
Reserve Analysis As of December 31, 1997
Summary of Simulation Results
Modeling Future Closed Claims (IBNR and Open)
Poisson/Lognormal Simulation

Exhibit A
Sheet 2

	(1)	(2)
Percentile Levels	Loss & ALAE Reserve ($000s)	Risk Margin
Expected	263,210	0
Low	257,409	(5,801)
10%	260,686	(2,524)
20%	261,841	(1,369)
30%	262,447	(763)
40%	263,234	24
50%	263,742	532
55%	263,889	679
60%	264,043	833
65%	264,285	1,075
70%	264,984	1,774
75%	**265,234**	**2,024**
80%	265,501	2,291
85%	265,904	2,694
90%	267,030	3,820
95%	267,702	4,492
High	268,256	5,046

(1) Monte Carlo Simulation with underlying loss assumptions:

Claim count distribution is approximated by a Poisson Distribution with mean 98,25
Claim severity distribution is approximated by a Lognormal Distribution with mean =
$2,679 and coefficient of variation = 3.0

(2) = (1) - mean ultimate loss

Insurer X
Data as of December 31, 1997
Gross of Reinsurance
Determination of Frequency and Severity Parameters for Poisson / Lognormal Simulation
Poisson/Lognormal Simulation

1) Gross Ultimate Loss & ALAE Reserves ($000s)	1,418,282
2) Gross Paid Loss & ALAE Reserves ($000s)	1,155,072
3) Gross Loss & ALAE Reserves ($000s)	263,210
4) Ultimate Counts Closed With Payments	486,079
5) Counts Closed With Payments to Date	387,820
6) Future Closed With Payments to Date (λ parameter for Poisson dist.	98,259
7) Pending Severity	2,679
8) Coefficient of Variation	3.00
9) Pending Severity - σ lognormal parameter	1.51743
10) Pending Severity - μ lognormal parameter	6.74181

Notes:
(1) Amount Booked by Insurer X
(2) Amount Booked by Insurer X
(3) = (2) - (1)
(4) We projected ultimate counts with payments ourselves; documentation available upon request
(5) Provided by Insurer X
(6) = (4) - (5)
(7) = (3) / (6)
(8) Determined by Analyzing Increased Limit Factors used to price Insurer X's policies
(9) = square root of $(\ln[(8)^2+1])$
(10) = $\ln[(7)] - (9)^2/2$

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Selection of Market Value Margin
Based on ratio of 75th percentile to expected reserves
Mack's Approach

(1) Paid Method	9.4%
(2) Incurred Method	8.1%
(3) Ultimate Method	6.9%
(4) Selected MVM	8.1%

Notes:

(1) From Exhibit 2, Page 1
(2) From Exhibit 3, Page 1
(3) From Exhibit 4, Page 1
(4) Judgmentally Selected Based on (1), (2), & (3)

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
Accident Year	Paid Losses To Date	Loss Development Factor	Ultimate Losses	Total Reserves	Standard Error of Reserves	Ratio of Standard Error to Expected Reserves	σ_i^2	μ_i	Reserves @ 75th percentile	% Larger Than Expected Reserves	Ultimates @ 75th percentile
1988	145,282	1.000	145,282	0	0						145,282
1989	179,147	1.004	179,798	651	514	79.0%	0.485	6.236	713	9.5%	179,860
1990	151,891	1.017	154,448	2,557	930	36.4%	0.124	7.784	2,845	11.2%	154,736
1991	111,829	1.038	116,051	4,222	1,560	36.9%	0.128	8.284	4,700	11.3%	116,529
1992	108,757	1.075	116,921	8,164	2,527	30.9%	0.091	8.962	9,014	10.4%	117,771
1993	135,502	1.130	153,157	17,655	4,939	28.0%	0.075	9.741	19,389	9.8%	154,891
1994	108,001	1.261	136,233	28,232	8,128	28.8%	0.080	10.208	31,053	10.0%	139,054
1995	101,862	1.519	154,774	52,912	13,187	24.9%	0.060	10.846	57,742	9.1%	159,604
1996	75,558	2.226	168,189	92,631	18,246	19.7%	0.038	11.417	99,780	7.7%	175,338
1997	35,251	4.889	172,325	137,074	41,621	30.4%	0.088	11.784	151,193	10.3%	186,444
TOTAL	1,153,080		1,497,179	344,099	51,906	15.1%	0.022	12.737	376,503	9.4%	1,384,227

(1) From Exhibit 2, Page 3
(2) From Exhibit 2, Page 3
(3) = (1) * (2)
(4) = (3) - (1)
(5) Annual Standard Error from Exhibit 2, Page 3
Total Standard Error from Exhibit 2, Page 2
(6) = (5) / (4)

(7) $= \ln[(1 + (6)^2)]$
(8) $= \ln[(4)] - (7)/2$
(9) total reserves = (4)*exp(.675*sqrt[(7)]-(7)/2)
annual reserves = (4)*exp(0.479*sqrt[(7)]-(7)/2)
0.479 is the factor needed so that the sum of annual reserves = total reserves
(10) = (9) / (4)
(11) = (9) + (1)

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

Calculation of Variance for Total Reserves

	k: 1	2	3	4	5	6	7	8	9
(1) α_{k-1}	7,042.27	708.25	520.02	280.76	81.74	28.04	12.83	2.91	0.66
(2) All-Yr Wtd Ave Incremental LDF	2.196	1.465	1.205	1.116	1.051	1.036	1.021	1.013	1.004
(3) Sum of Paid Losses as of Time k for 1988 to 1997-k	271,013	519,625	659,378	686,266	630,368	553,992	462,081	319,698	144,756

Accident Year	*(4)* Ultimate Losses	*(5)* Annual Standard Error	*(6)* Annual Variance	*(7)* Total Reserves Variance Component$_{k-1}$	*(8)* Total Reserves Variance Component$_{k-2}$	*(9)* Total Reserves Variance Component$_{k-3}$	*(10)* Total Reserves Variance Component$_{k-4}$	*(11)* Total Reserves Variance Component$_{k-5}$	*(12)* Total Reserves Variance Component$_{k-6}$	*(13)* Total Reserves Variance Component$_{k-7}$	*(14)* Total Reserves Variance Component$_{k-8}$	*(15)* Total Reserves Variance Component$_{k-9}$	*(16)* Total Reserves Total Variance	*(17)* Total Reserves Standard Deviation
1988	145,282	0	0											
1989	179,798	514	264,196									1,905,158	2,169,354	
1990	154,448	930	865,445								2,785,148	1,420,899	5,071,492	
1991	116,051	1,560	2,432,696							5,576,991	1,854,091	945,901	10,809,679	
1992	116,921	2,527	6,383,609						8,653,164	4,890,136	1,625,744	829,405	22,382,058	
1993	153,157	4,939	24,397,987					22,691,396	9,122,517	5,155,380	1,713,925	874,393	63,955,599	
1994	136,233	8,128	66,065,615				44,328,865	15,829,826	6,363,992	3,596,463	1,195,657	609,988	137,990,406	
1995	154,774	13,187	173,890,645			57,291,335	34,624,256	12,364,313	4,970,767	2,809,115	933,900	476,448	287,360,779	
1996	168,189	18,246	332,905,880		36,813,885	31,506,664	19,041,182	6,799,601	2,733,612	1,544,838	513,587	262,017	432,121,266	
1997	172,325	41,621	1,732,343,026	0	0	0	0	0	0	0	0	0	1,732,343,026	
	1,497,179												2,694,203,659	51,906

(1) From Exhibit 2, Page 4
(2) From Exhibit 2, Page 4
(3) From Exhibit 2, Page 4
(4) From Exhibit 2, Page 3
(5) From Exhibit 2, Page 3
(6) From Exhibit 2, Page 3

(7) No Component for k = 1
(8) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)] * [1/(3)] for k = 2
(9) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)] * [1/(3)] for k = 3
(10) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)] * [1/(3)] for k = 4
(11) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)] * [1/(3)] for k = 5
(12) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)] * [1/(3)] for k = 6

(13) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)] * [1/(3)] for k = 7
(14) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)] * [1/(3)] for k = 8
(15) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)] * [1/(3)] for k = 9
(16) = sum of (6) to (15)
(17) = square root of (the sum of (16) for all accident years)

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

Calculation of Standard Deviation by Accident Year

k	1	2	3	4	5	6	7	8	9
(1) α_k^2	7,042.27	708.25	520.02	280.76	81.74	28.04	12.83	2.91	0.66
(2) All-Yr Wtd Ave Incremental LDF_k	2.196	1.465	1.205	1.116	1.051	1.036	1.021	1.013	1.004
(3) Sum of Paid Losses as of Time k for 1988 to 1997-k	271,013	519,625	659,378	686,266	630,368	553,992	462,081	319,698	144,756

Accident Year	*(4)* Paid Losses	*(5)* LDF	*(6)* Ultimate Losses	*(7)* Annual Reserves Variance Component$_{k=1}$	*(8)* Annual Reserves Variance Component$_{k=2}$	*(9)* Annual Reserves Variance Component$_{k=3}$	*(10)* Annual Reserves Variance Component$_{k=4}$	*(11)* Annual Reserves Variance Component$_{k=5}$	*(12)* Annual Reserves Variance Component$_{k=6}$	*(13)* Annual Reserves Variance Component$_{k=7}$	*(14)* Annual Reserves Variance Component$_{k=8}$	*(15)* Annual Reserves Variance Component$_{k=9}$	*(16)* Annual Reserves Total Variance	*(17)* Annual Reserves Standard Deviation
1988	145,282	1.000	145,282											
1989	179,147	1.004	179,798									264,196	264,196	514
1990	151,891	1.017	154,448								656,196	209,250	865,445	930
1991	111,829	1.038	116,051							1,842,027	453,582	137,087	2,432,696	1,560
1992	108,757	1.075	116,921						3,928,608	1,858,544	457,882	138,575	6,383,609	2,527
1993	135,502	1.130	153,157					15,552,117	5,407,864	2,582,441	648,959	206,607	24,397,987	4,939
1994	108,001	1.261	136,233				44,835,154	13,563,110	4,701,550	2,235,628	556,819	173,354	66,065,615	8,128
1995	101,862	1.519	154,774			97,304,025	51,879,868	15,745,669	5,476,761	2,616,375	658,028	209,919	173,890,645	13,187
1996	75,558	2.226	168,189		141,514,302	106,964,242	57,117,727	17,375,097	6,057,864	2,903,282	735,053	238,313	332,905,880	18,246
1997	35,251	4.889	172,325	1,390,029,992	145,447,245	109,982,235	58,756,563	17,886,014	6,240,458	2,993,678	759,446	247,395	1,732,343,026	41,621
	1,153,080		1,497,179											

(1) From Exhibit 2, Page 4
(2) From Exhibit 2, Page 4
(3) From Exhibit 2, Page 4
(4) From Exhibit 2, Page 4
(5) From Exhibit 2, Page 4
(6) = (4) * (5)

(7) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 1
(8) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 2
(9) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 3
(10) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 4
(11) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 5
(12) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 6

(13) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 7
(14) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 8
(15) = [(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)] for k = 9
(16) = sum of (7) to (15)
(17) = square root of (16)

Insurer X
Commercial Auto Liability
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Mack's Approach

Paid Loss Data

	Evaluation Period k									
	1	2	3	4	5	6	7	8	9	10
1988	27,683	72,332	102,742	122,927	133,314	138,612	141,647	143,350	144,756	145,282
1989	36,190	84,658	120,453	144,360	164,614	168,391	173,056	176,348	179,147	**179,798**
1990	21,457	65,935	97,648	122,587	131,843	140,522	147,378	151,891	**153,889**	**154,448**
1991	17,892	50,911	84,750	88,043	97,681	106,467	111,829	**114,130**	**115,631**	**116,051**
1992	24,154	46,187	66,032	84,314	102,916	108,757	**112,667**	**114,985**	**116,498**	**116,921**
1993	24,007	62,224	100,473	124,035	135,502	**142,463**	**147,585**	**150,621**	**152,602**	**153,157**
1994	30,797	57,273	87,280	108,001	**120,529**	**126,720**	**131,276**	**133,977**	**135,739**	**136,233**
1995	46,368	80,105	101,862	**122,700**	**136,933**	**143,967**	**149,143**	**152,212**	**154,214**	**154,774**
1996	42,465	75,558	**110,691**	**133,335**	**148,801**	**156,445**	**162,070**	**165,405**	**167,580**	**168,189**
1997	35,251	**77,416**	**113,413**	**136,614**	**152,461**	**160,292**	**166,055**	**169,472**	**171,701**	**172,325**

Note: Numbers in bold font are projections based on the All Yr Wtd Ave Incremental LDF;
numbers in regular font are actual historical data

Historical Paid Incremental Loss Development Factors (LDFs)

	Evaluation Period k								
	1:2	2:3	3:4	4:5	5:6	6:7	7:8	8:9	9:10
1988	2.613	1.420	1.196	1.084	1.040	1.022	1.012	1.010	1.004
1989	2.339	1.423	1.198	1.140	1.023	1.028	1.019	1.016	
1990	3.073	1.481	1.255	1.076	1.066	1.049	1.031		
1991	2.845	1.665	1.039	1.109	1.090	1.050			
1992	1.912	1.430	1.277	1.221	1.057				
1993	2.592	1.615	1.235	1.092					
1994	1.860	1.524	1.237						
1995	1.728	1.272							
1996	1.779								

*Squared Residuals of Historical Loss Development Factors (All Year Weighted Average Incremental LDFs used as expected LDFs)**

	Evaluation Period k								
	1	2	3	4	5	6	7	8	9
1988	4,807	144	7	122	18	27	10	2	0
1989	741	150	4	85	133	11	0	1	
1990	16,494	17	252	201	28	23	15		
1991	7,544		2,327	4	145	22			
1992	1,948	58	345	923	3				
1993	3,760	1,395	90	69					
1994	3,486	199	94						
1995	10,180	2,995							
1996	7,379								

	k=1	k=2	k=3	k=4	k=5	k=6	k=7	k=8	k=9
All Year Squared-Sum Incremental LDF**	2.096	1.451	1.204	1.113	1.048	1.035	1.021	1.013	1.004
All Year Wtd Ave Incremental LDF	2.196	1.465	1.205	1.116	1.051	1.036	1.021	1.013	1.004
All Year Ave Incremental LDF	2.305	1.479	1.205	1.120	1.055	1.037	1.021	1.013	1.004
LDF to Ult									
All Year Squared-Sum Cumulative LDF**	4.587	2.189	1.509	1.253	1.126	1.074	1.038	1.017	1.004
All Year Wtd Ave Cumulative LDF	4.889	2.226	1.519	1.261	1.130	1.075	1.038	1.017	1.004
All Year Ave Cumulative LDF	5.225	2.267	1.533	1.272	1.135	1.076	1.037	1.017	1.004
k	1	2	3	4	5	6	7	8	9
α_{k^2}***	7,042.27	708.25	520.02	280.76	81.74	28.04	12.83	2.91	0.66

Notes:

* Squared Residuals = Paid Losses_k*(Paid Losses_{k+1}/Paid Losses_k - All Year Wtd Ave Incremental LDF_k)^2

** Squared-Sum Incremental LDF = $\Sigma(\text{Paid Losses}_k * \text{Paid Losses}_{k+1}) / \Sigma(\text{Paid Losses}_k^2)$

*** α_{k^2} = 1/(9-k)*(Sum of Squared Residuals for all years for k)

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

Accident Year	*(1)* Paid Losses To Date	*(2)* Incurred Losses To Date	*(3)* Loss Development Factor	*(4)* Ultimate Losses	*(5)* Total Reserves	*(6)* Standard Error of Reserves	*(7)* Ratio of Standard Error to Expected Reserves	*(8)* σ_i^2	*(9)* μ_i	*(10)* Reserves @ 75th percentile	*(11)* % Larger Than Expected Reserves	*(12)* Ultimates @ 75th percentile
1988	145,282	146,228	1.000	146,228	946	0						145,282
1989	179,147	181,604	1.001	181,747	2,600	14	0.6%	0.000	7.863	2,607	0.3%	181,754
1990	151,891	158,529	1.011	160,236	8,345	185	2.2%	0.000	9.029	8,429	1.0%	160,320
1991	111,829	116,892	1.029	120,289	8,460	2,460	29.1%	0.081	9.002	9,272	9.6%	121,101
1992	108,757	114,776	1.045	119,984	11,227	3,071	27.4%	0.072	9.290	12,268	9.3%	121,025
1993	135,502	147,836	1.081	159,792	24,290	5,774	23.8%	0.055	10.070	26,350	8.5%	161,852
1994	108,001	126,101	1.153	145,365	37,364	6,972	18.7%	0.034	10.511	40,025	7.1%	148,026
1995	101,862	122,446	1.208	147,975	46,113	11,986	26.0%	0.065	10.706	50,257	9.0%	152,119
1996	75,558	115,141	1.340	154,345	78,787	18,992	24.1%	0.056	11.246	85,532	8.6%	161,090
1997	35,251	76,019	1.934	147,032	111,781	29,573	26.5%	0.068	11.590	121,938	9.1%	157,189
TOTAL	1,153,080	1,305,572		1,482,992	329,912	42,278	12.8%	0.016	12.698	356,677	8.1%	1,364,476

(1) From Exhibit 2, Page 3
(2) From Exhibit 3, Page 3
(3) From Exhibit 3, Page 3
(4) = (2) * (3)
(5) = (3) - (1)
(6) Annual Standard Error from Exhibit 3, Page 3
Total Standard Error from Exhibit 3, Page 2
(7) = (6) / (5)

(8) = $\ln[(1 + (7)^2)]$
(9) = ln[(5)] - (8)/2
(10) total reserves = (5)*exp(.675*sqrt[(8)]-(8)/2);
annual reserves = (5)*exp(0.464*sqrt[(8)]-(8)/2)
0.464 is the factor needed so that the sum of annual reserves = total reserves
(11) = (10) / (5)
(12) = (10) + (1)

Insurer X
Commercial Auto Liability
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Calculation of Variance for Total Reserves

	k = 1	2	3	4	5	6	7	8	9
(1) α_{k-1}	3,515.46	1,104.26	505.54	109.83	101.59	23.33	40.51	0.14	0.00
(2) All-Yr Wtd Ave Incremental LDF	1.443	1.109	1.048	1.067	1.034	1.016	1.018	1.010	1.001
(3) Sum of Incurred Losses as of Time k for 1988 to 1997-k	690,723	881,480	855,314	770,560	673,975	582,089	474,425	324,482	146,113

Accident Year	(4) Ultimate Losses	(5) Annual Standard Error	(6) Annual Variance	(7) Total Reserves Variance Component$_{k=1}$	(8) Total Reserves Variance Component$_{k=2}$	(9) Total Reserves Variance Component$_{k=3}$	(10) Total Reserves Variance Component$_{k=4}$	(11) Total Reserves Variance Component$_{k=5}$	(12) Total Reserves Variance Component$_{k=6}$	(13) Total Reserves Variance Component$_{k=7}$	(14) Total Reserves Variance Component$_{k=8}$	(15) Total Reserves Variance Component$_{k=9}$	(16) Total Reserves Total Variance	(17) Total Reserves Standard Deviation
1988	146,228	0	0											
1989	181,747	14	208									1,465	1,673	
1990	160,236	185	34,166								138,534	1,112	173,812	
1991	120,289	2,460	6,053,468							17,331,581	91,422	734	23,477,205	
1992	119,984	3,071	9,430,197						7,032,817	14,915,705	78,678	632	31,458,029	
1993	159,792	5,774	33,344,779					26,796,676	7,382,596	15,657,542	82,591	663	83,264,848	
1994	145,365	6,972	48,612,461				16,371,131	18,418,795	5,074,455	10,762,270	56,770	456	99,296,338	
1995	147,975	11,986	143,669,579			47,967,977	11,177,149	12,575,162	3,464,510	7,347,781	38,759	311	226,241,227	
1996	154,345	18,992	360,710,613		46,212,067	24,409,441	5,687,710	6,399,116	1,762,983	3,739,062	19,723	158	448,940,875	
1997	147,032	29,573	874,589,708	0	0	0	0	0	0	0	0	0	874,589,708	
	1,482,992												1,787,443,715	42,278

(1) From Exhibit 3, Page 4
(2) From Exhibit 3, Page 4
(3) From Exhibit 3, Page 4
(4) From Exhibit 3, Page 3
(5) From Exhibit 3, Page 3
(6) From Exhibit 3, Page 3

(7) No Component for k = 1
(8) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)^2 * [1/(3)] for k = 2
(9) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)^2 * [1/(3)] for k = 3
(10) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)^2 * [1/(3)] for k = 4
(11) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)^2 * [1/(3)] for k = 5
(12) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)^2 * [1/(3)] for k = 6

(13) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)^2 * [1/(3)] for k = 7
(14) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)^2 * [1/(3)] for k = 8
(15) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2)^2 * [1/(3)] for k = 9
(16) = sum of (6) to (15)
(17) = square root of (the sum of (16) for all accident years)

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

Calculation of Standard Deviation by Accident Year

	k = 1	2	3	4	5	6	7	8	9
(1) α_{k-1}	3,515.46	1,104.26	505.54	109.83	101.59	23.33	40.51	0.14	0.00
(2) All-Yr Wtd Ave Incremental LDF$_k$	1.443	1.109	1.048	1.067	1.034	1.016	1.018	1.010	1.001
(3) Sum of Incurred Losses as of Time k for 1988 to 1997-k	690,723	881,480	855,314	770,560	673,975	582,089	474,425	324,482	146,113

Accident Year	*(4)* Incurred Losses	*(5)* LDF	*(6)* Ultimate Losses	*(7)* Annual Reserves Variance Component$_{k=1}$	*(8)* Annual Reserves Variance Component$_{k=2}$	*(9)* Annual Reserves Variance Component$_{k=3}$	*(10)* Annual Reserves Variance Component$_{k=4}$	*(11)* Annual Reserves Variance Component$_{k=5}$	*(12)* Annual Reserves Variance Component$_{k=6}$	*(13)* Annual Reserves Variance Component$_{k=7}$	*(14)* Annual Reserves Variance Component$_{k=8}$	*(15)* Annual Reserves Variance Component$_{k=9}$	*(16)* Annual Reserves Total Variance	*(17)* Annual Reserves Standard Deviation
1988	146,228	1.000	146,228											
1989	181,604	1.001	181,747									208	208	14
1990	158,529	1.011	160,236								33,994	171	34,166	185
1991	116,892	1.029	120,289							6,029,925	23,431	112	6,053,468	2,460
1992	114,776	1.045	119,984						3,395,111	6,011,618	23,356	111	9,430,197	3,071
1993	147,836	1.081	159,792					20,011,881	4,768,641	8,530,216	33,869	171	33,344,779	5,774
1994	126,101	1.153	145,365				18,829,163	17,909,358	4,256,626	7,587,266	29,900	148	48,612,461	6,972
1995	122,446	1.208	147,975			94,034,416	19,215,649	18,285,382	4,348,058	7,755,317	30,605	152	143,669,579	11,986
1996	115,141	1.340	154,345		209,945,788	98,611,399	20,166,100	19,211,196	4,573,435	8,170,184	32,350	162	360,710,613	18,992
1997	76,019	1.934	147,032	533,061,003	198,903,065	93,360,585	19,075,816	18,149,304	4,314,963	7,694,471	30,349	150	874,589,708	29,573
	1,305,572		1,482,992											

(1) From Exhibit 3, Page 4
(2) From Exhibit 3, Page 4
(3) From Exhibit 3, Page 4
(4) From Exhibit 3, Page 4
(5) From Exhibit 3, Page 4
(6) = (4) * (5)

(7) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 1
(8) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 2
(9) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 3
(10) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 4
(11) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 5
(12) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 6

(13) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 7
(14) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 8
(15) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 9
(16) = sum of (7) to (15)
(17) = square root of (16)

Insurer X
Commercial Auto Liability
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Mack's Approach

Incurred Loss Data

	Evaluation Period k									
	1	2	3	4	5	6	7	8	9	10
1988	66,042	109,982	131,364	130,763	134,169	140,803	143,732	144,777	146,113	146,228
1989	99,902	150,119	149,956	154,698	169,729	177,697	177,812	179,705	181,604	**181,747**
1990	83,606	108,107	120,211	140,978	150,807	150,170	152,881	158,529	**160,109**	**160,236**
1991	56,825	91,368	102,206	101,617	106,564	113,419	116,892	**119,007**	**120,194**	**120,289**
1992	86,924	89,280	102,918	102,216	112,706	114,776	**116,596**	**118,706**	**119,889**	**119,984**
1993	94,293	130,363	131,972	140,288	147,836	**152,857**	**155,280**	**158,090**	**159,667**	**159,792**
1994	50,428	89,009	116,687	126,101	**134,488**	**139,056**	**141,260**	**143,817**	**145,251**	**145,365**
1995	74,850	113,252	122,446	**128,365**	**136,903**	**141,553**	**143,797**	**146,399**	**147,859**	**147,975**
1996	77,853	115,141	**127,717**	**133,891**	**142,797**	**147,646**	**149,987**	**152,701**	**154,224**	**154,345**
1997	76,019	**109,685**	**121,666**	**127,547**	**136,030**	**140,650**	**142,880**	**145,466**	**146,916**	**147,032**

Note: Numbers in bold font are projections based on the All Yr Wtd Ave Incremental LDF;
numbers in regular font are actual historical data

Historical Incurred Incremental Loss Development Factors (LDFs)

	Evaluation Period k								
	1:2	2:3	3:4	4:5	5:6	6:7	7:8	8:9	9:10
1988	1.665	1.194	0.995	1.026	1.049	1.021	1.007	1.009	1.001
1989	1.503	0.999	1.032	1.097	1.047	1.001	1.011	1.011	
1990	1.293	1.112	1.173	1.070	0.996	1.018	1.037		
1991	1.608	1.119	0.994	1.049	1.064	1.031			
1992	1.027	1.153	0.993	1.103	1.018				
1993	1.383	1.012	1.063	1.054					
1994	1.765	1.311	1.081						
1995	1.513	1.081							
1996	1.479								

*Squared Residuals of Historical Loss Development Factors (All Year Weighted Average Incremental LDFs used as expected LDFs)**

	Evaluation Period k								
	1	2	3	4	5	6	7	8	9
1988	3,269	798	368	214	32	3	17	0	0
1989	357	1,827	42	145	29	41	10	0	
1990	1,876	1	1,861	1	220	1	54		
1991	1,547		299	32	98	25			
1992	15,026	169	313	133	27				
1993	343	1,224	28	23					
1994	5,235	3,622	122						
1995	369	89							
1996	101								

	k=1	k=2	k=3	k=4	k=5	k=6	k=7	k=8	k=9
All Year Squared-Sum Incremental LDF**	1.421	1.095	1.049	1.067	1.033	1.014	1.018	1.010	1.001
All Year Wtd Ave Incremental LDF	1.443	1.109	1.048	1.067	1.034	1.016	1.018	1.010	1.001
All Year Ave Incremental LDF	1.471	1.123	1.047	1.066	1.035	1.018	1.018	1.010	1.001
LDF to Ult									
All Year Squared-Sum Cumulative LDF**	1.878	1.321	1.207	1.150	1.078	1.044	1.029	1.011	1.001
All Year Wtd Ave Cumulative LDF	1.934	1.340	1.208	1.153	1.081	1.045	1.029	1.011	1.001
All Year Ave Cumulative LDF	1.998	1.359	1.210	1.156	1.084	1.047	1.029	1.011	1.001

k	1	2	3	4	5	6	7	8	9
α_{k^2}***	3,515.46	1,104.26	505.54	109.83	101.59	23.33	40.51	0.14	0.00

Notes:

* Squared Residuals = Incurred $Losses_k$*(Incurred $Losses_{k+1}$/Incurred $Losses_k$ - All Year Wtd Ave Incremental LDF_k)^2

** Squared-Sum Incremental LDF =Σ(Incurred $Losses_k$*Incurred $Losses_{k+1}$)/Σ(Incurred $Losses_k^2$)

*** α_{k^2} = 1/(9-k)*(Sum of Squared Residuals for all years for k)

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

Accident Year	(1) Paid Losses To Date	(2) Actual Ultimate Losses To Date	(3) Loss Development Factor	(4) Projected Ultimate Losses	(5) Total Reserves	(6) Standard Error of Reserves	(7) Ratio of Standard Error to Expected Reserves	(8) σ_i^2	(9) μ_i	(10) Reserves @ 75th percentile	(11) % Larger Than Expected Reserves	(12) Ultimates @ 75th percentile
1988	145,282	146,782	1.000	146,782	1,500	0						145,282
1989	179,147	182,732	0.995	181,796	2,649	1,680	63.4%	0.338	7.713	2,930	10.6%	182,077
1990	151,891	161,836	1.001	162,079	10,188	2,045	20.1%	0.040	9.209	10,954	7.5%	162,845
1991	111,829	118,718	1.006	119,474	7,645	1,936	25.3%	0.062	8.911	8,320	8.8%	120,149
1992	108,757	117,746	1.017	119,725	10,968	3,809	34.7%	0.114	9.246	12,119	10.5%	120,876
1993	135,502	151,101	1.044	157,715	22,213	8,191	36.9%	0.127	9.945	24,600	10.7%	160,102
1994	108,001	133,297	1.073	142,996	34,995	8,294	23.7%	0.055	10.436	37,956	8.5%	145,957
1995	101,862	133,436	1.074	143,273	41,411	10,567	25.5%	0.063	10.600	45,089	8.9%	146,951
1996	75,558	139,987	1.100	154,054	78,496	14,598	18.6%	0.034	11.254	84,073	7.1%	159,631
1997	35,251	128,763	1.131	145,670	110,419	17,616	16.0%	0.025	11.599	117,372	6.3%	152,623
TOTAL	1,153,080	1,414,398		1,473,562	320,482	34,655	10.8%	0.012	12.672	342,679	6.9%	1,351,212

(1) From Exhibit 2, Page 3
(2) From Exhibit 4, Page 3
(3) From Exhibit 4, Page 3
(4) = (2) * (3)
(5) = (3) - (1)
(6) Annual Standard Error from Exhibit 4, Page 3
Total Standard Error from Exhibit 4, Page 2
(7) = (6) / (5)

(8) $= \ln[(1 + (7)^2)]$
(9) = ln[(5)] - (8)/2
(10) total reserves = (5)*exp(.675*sqrt[(8)]-(8)/2);
annual reserves = (5)*exp(0.464*sqrt[(8)]-(8)/2)
0.464 is the factor needed so that the sum of annual reserves = total reserves
(11) = (10) / (5)
(12) = (10) + (1)

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

Calculation of Variance for Total Reserves

	k = 1	2	3	4	5	6	7	8	9
(1) α_{k-1}	637.94	501.83	244.29	53.94	246.00	75.36	6.90	7.60	6.90
(2) All-Yr Wtd Ave Incremental LDF	1.028	1.025	1.001	1.028	1.027	1.010	1.005	1.007	0.995
(3) Sum of Incurred Losses as of Time k for 1988 to 1997-k	1,173,771	1,066,649	959,810	827,370	699,248	600,046	487,553	328,086	147,538

Accident Year	*(4)* Projected Ultimate Losses	*(5)* Annual Standard Error	*(6)* Annual Variance	*(7)* Total Reserves Variance Component$_{k=1}$	*(8)* Total Reserves Variance Component$_{k=2}$	*(9)* Total Reserves Variance Component$_{k=3}$	*(10)* Total Reserves Variance Component$_{k=4}$	*(11)* Total Reserves Variance Component$_{k=5}$	*(12)* Total Reserves Variance Component$_{k=6}$	*(13)* Total Reserves Variance Component$_{k=7}$	*(14)* Total Reserves Variance Component$_{k=8}$	*(15)* Total Reserves Variance Component$_{k=9}$	*(16)* Total Reserves Total Variance	*(17)* Total Reserves Standard Deviation
1988	146,782	0	0											
1989	181,796	1,680	2,822,572									19,671,457	22,494,029	
1990	162,079	2,045	4,182,976								7,281,963	15,055,350	26,520,288	
1991	119,474	1,936	3,748,266							2,891,768	4,715,322	9,748,858	21,104,213	
1992	119,725	3,809	14,508,625						21,907,985	2,496,026	4,070,025	8,414,717	51,397,379	
1993	157,715	8,191	67,088,292					61,710,650	22,739,508	2,590,764	4,224,504	8,734,099	167,087,817	
1994	142,996	8,294	68,784,378				7,819,952	42,297,941	15,586,197	1,775,771	2,895,575	5,986,558	145,146,373	
1995	143,273	10,567	111,669,657			21,820,187	5,301,097	28,673,510	10,565,786	1,203,784	1,962,892	4,058,251	185,255,162	
1996	154,054	14,598	213,113,650		20,100,881	11,402,962	2,770,288	14,984,425	5,521,550	629,083	1,025,783	2,120,792	271,669,414	
1997	145,670	17,616	310,317,132	0	0	0	0	0	0	0	0	0	310,317,132	
	1,473,562												1,200,991,807	34,655

(1) From Exhibit 4, Page 4
(2) From Exhibit 4, Page 4
(3) From Exhibit 4, Page 4
(4) From Exhibit 4, Page 3
(5) From Exhibit 4, Page 3
(6) From Exhibit 4, Page 3

(7) No Component for k = 1
(8) = 2 * [(4)]*[sum of (4) for all acc. Yrs After Current Acc. Yr]*[(1) / (2) * [1/(3)] for k = 2
(9) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2) * [1/(3)] for k = 3
(10) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2) * [1/(3)] for k = 4
(11) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2) * [1/(3)] for k = 5
(12) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2) * [1/(3)] for k = 6

(13) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2) * [1/(3)] for k = 7
(14) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2) * [1/(3)] for k = 8
(15) = 2 * [(4)]*[sum of (4) for all acc. Yrs. After Current Acc. Yr]*[(1) / (2) * [1/(3)] for k = 9
(16) = sum of (6) to (15)
(17) = square root of (the sum of (16) for all accident years)

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

Calculation of Standard Deviation by Accident Year

	k = 1	2	3	4	5	6	7	8	9
(1) α_{k-1}	637.94	501.83	244.29	53.94	246.00	75.36	6.90	7.60	6.90
(2) All-Yr Wtd Ave Incremental LDF_k	1.028	1.025	1.001	1.028	1.027	1.010	1.005	1.007	0.995
(3) Sum of Incurred Losses as of Time k for 1988 to 1997-k	1,173,771	1,066,649	959,810	827,370	699,248	600,046	487,553	328,086	147,538

Accident Year	*(4)* Actual Ultimate Losses	*(5)* LDF	*(6)* Projected Ultimate Losses	*(7)* Annual Reserves Variance Component_{k-1}	*(8)* Annual Reserves Variance Component_{k-2}	*(9)* Annual Reserves Variance Component_{k-3}	*(10)* Annual Reserves Variance Component_{k-4}	*(11)* Annual Reserves Variance Component_{k-5}	*(12)* Annual Reserves Variance Component_{k-6}	*(13)* Annual Reserves Variance Component_{k-7}	*(14)* Annual Reserves Variance Component_{k-8}	*(15)* Annual Reserves Variance Component_{k-9}	*(16)* Annual Reserves Total Variance	*(17)* Annual Reserves Standard Deviation
1988	146,782	1.000	146,782											
1989	182,732	0.995	181,796									2,822,572	2,822,572	1,680
1990	161,836	1.001	162,079								1,817,539	2,365,437	4,182,976	2,045
1991	118,718	1.006	119,474							1,021,709	1,223,435	1,503,122	3,748,266	1,936
1992	117,746	1.017	119,725						10,749,952	1,024,278	1,226,693	1,507,702	14,508,625	3,809
1993	151,101	1.044	157,715					46,734,771	14,898,142	1,433,273	1,752,875	2,269,230	67,088,292	8,191
1994	133,297	1.073	142,996				9,095,961	41,670,434	13,248,801	1,270,009	1,541,179	1,957,993	68,784,378	8,294
1995	133,436	1.074	143,273			42,728,157	9,116,025	41,764,379	13,279,340	1,273,024	1,545,071	1,963,660	111,669,657	10,567
1996	139,987	1.100	154,054		91,617,280	46,365,619	9,904,564	45,461,854	14,483,003	1,392,105	1,699,305	2,189,919	213,113,650	14,598
1997	128,763	1.131	145,670	110,395,482	86,084,081	43,531,901	9,290,129	42,579,864	13,544,522	1,299,222	1,578,908	2,013,023	310,317,132	17,616
	1,414,398		1,473,562											

(1) From Exhibit 4, Page 4
(2) From Exhibit 4, Page 4
(3) From Exhibit 4, Page 4
(4) From Exhibit 4, Page 4
(5) From Exhibit 4, Page 4
(6) = (4) * (5)

(7) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 1
(8) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 2
(9) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 3
(10) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 4
(11) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 5
(12) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 6

(13) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 7
(14) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 8
(15) = $[(6)^2]*[(1)/(2)^2]*[1/(4)+1/(3)]$ for k = 9
(16) = sum of (7) to (15)
(17) = square root of (16)

** Squared-Sum Incremental LDF = $\Sigma(\text{Ultimate Losses}_k * \text{Ultimate Losses}_{k+1})/\Sigma(\text{Ultimate Losses}_k^2)$

Insurer X
Commercial Auto Liability
Data as of December 31, 1997
Mack's Approach

Actual Ultimate Loss Data

	Evaluation Period k									
	1	2	3	4	5	6	7	8	9	10
1988	130,227	132,540	133,667	132,518	134,515	141,630	146,095	145,783	147,538	146,782
1989	151,110	158,917	169,141	165,735	175,061	182,584	180,334	182,303	182,732	**181,796**
1990	149,231	148,077	152,365	156,660	162,867	156,766	161,124	161,836	**162,913**	**162,079**
1991	116,227	119,345	113,790	111,500	111,686	119,066	118,718	119,295	**120,089**	**119,474**
1992	132,417	121,936	121,802	113,047	115,119	117,746	**118,968**	**119,546**	**120,341**	**119,725**
1993	152,845	152,205	143,114	147,910	151,101	**155,108**	**156,717**	**157,479**	**158,527**	**157,715**
1994	108,590	109,329	125,931	133,297	**136,999**	**140,632**	**142,091**	**142,782**	**143,732**	**142,996**
1995	114,326	124,300	133,436	**133,555**	**137,264**	**140,905**	**142,366**	**143,058**	**144,011**	**143,273**
1996	118,798	139,987	**143,478**	**143,606**	**147,594**	**151,508**	**153,080**	**153,824**	**154,848**	**154,054**
1997	128,763	**132,368**	**135,669**	**135,790**	**139,561**	**143,263**	**144,749**	**145,452**	**146,420**	**145,670**

Note: Numbers in bold font are projections based on the All Yr Wtd Ave Incremental LDF;
numbers in regular font are actual historical data

Historical Incurred Incremental Loss Development Factors (LDFs)

	Evaluation Period k								
	1:2	2:3	3:4	4:5	5:6	6:7	7:8	8:9	9:10
1988	1.018	1.009	0.991	1.015	1.053	1.032	0.998	1.012	0.995
1989	1.052	1.064	0.980	1.056	1.043	0.988	1.011	1.002	
1990	0.992	1.029	1.028	1.040	0.963	1.028	1.004		
1991	1.027	0.953	0.980	1.002	1.066	0.997			
1992	0.921	0.999	0.928	1.018	1.023				
1993	0.996	0.940	1.034	1.022					
1994	1.007	1.152	1.058						
1995	1.087	1.073							
1996	1.178								

*Squared Residuals of Historical Loss Development Factors (All Year Weighted Average Incremental LDFs used as expected LDFs)**

	Evaluation Period k								
	1	2	3	4	5	6	7	8	9
1988	14	36	12	21	94	63	7	4	0
1989	85	247	75	135	47	94	7	3	
1990	191	2	114	22	667	48	0		
1991	0		50	76	175	21			
1992	1,520	83	645	10	2				
1993	158	1,091	152	6					
1994	49	1,761	418						
1995	401	293							
1996	2,686								

	k=1	k=2	k=3	k=4	k=5	k=6	k=7	k=8	k=9
All Year Squared-Sum Incremental LDF**	1.025	1.023	1.002	1.030	1.024	1.009	1.005	1.006	0.995
All Year Wtd Ave Incremental LDF	1.028	1.025	1.001	1.028	1.027	1.010	1.005	1.007	0.995
All Year Ave Incremental LDF	1.031	1.027	1.000	1.025	1.029	1.011	1.004	1.007	0.995
LDF to Ult									
All Year Squared-Sum Cumulative LDF**	1.125	1.097	1.073	1.071	1.040	1.016	1.006	1.001	0.995
All Year Wtd Ave Cumulative LDF	1.131	1.100	1.074	1.073	1.044	1.017	1.006	1.001	0.995
All Year Ave Cumulative LDF	1.138	1.104	1.074	1.074	1.048	1.018	1.006	1.002	0.995

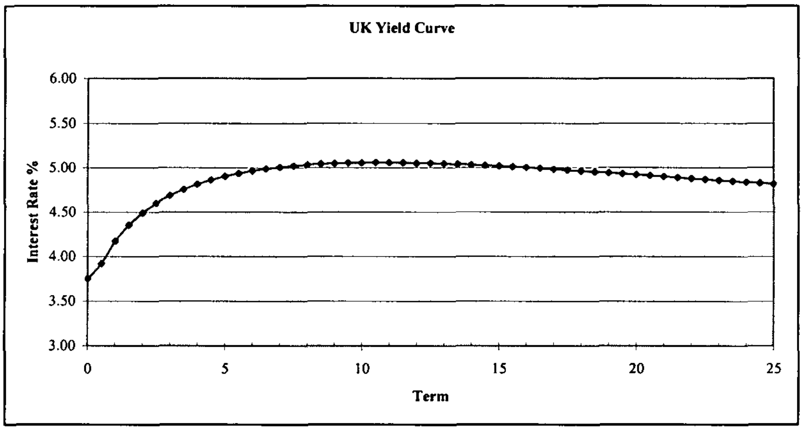
k	1	2	3	4	5	6	7	8	9
α_{k}^{2}***	637.94	501.83	244.29	53.94	246.00	75.36	6.90	7.60	6.90
minimum LDF from historical LDF triangle	0.921	0.940	0.928	1.002	0.963	0.988	0.998	1.002	0.995
maximum LDF from historical LDF triangle	1.178	1.152	1.058	1.056	1.066	1.032	1.011	1.012	0.995
minimum age-ult LDF	0.761	0.827	0.879	0.948	0.946	0.983	0.995	0.997	0.995
maximum age-ult LDF	1.699	1.441	1.251	1.182	1.119	1.050	1.018	1.007	0.995

Notes:
* Squared Residuals = Ultimate Losses$_k$*(Ultimate Losses$_{k+1}$/Ultimate Losses$_k$ - All Year Wtd Ave Incremental LDF$_k$)^2
** Squared-Sum Incremental LDF = Σ(Ultimate Losses$_k$*Ultimate Losses$_{k+1}$)/Σ(Ultimate Losses$_k^2$)
*** α_{k}^{2} = 1/(9-k)*(Sum of Squared Residuals for all years for k)

DISCOUNTING EXAMPLE

Example of Discounting

Consider the following example of the liabilities of a US insurer writing general liability business in the UK. The UK yield curve is as illustrated below and in common with other developed economies is publicly available, for example from the Central Bank. From this the relevant discount rates needed for each term can be ascertained.



The actual calculations are relatively straightforward as illustrated below. The cash flows have been calculated by standard actuarial techniques and the market value margins would be calculated as described in the section of the paper "Adjustments for Risk and Uncertainty". We need to make the assumption that the cash flows occur on average in the middle of each year and make our chosen discount rate for these cash flows in the middle of the year as well. Each cash flow can then be discounted and the resulting total added up to come up with an expected present value of the cash flow. This is then converted to US$ as the prevailing spot rate as this is the measurement currency of the US insurer.

Year	Expected Cashflows (£000's)	Market Value Margins (£000's)	Total (£000's)	Discount Rate to Middle of Year	Discounted Cashflows (£000's)	Discounted Cashflows ($000's) (1£=$1.66)
1	319	32	351	3.92%	344	
2	3,877	388	4,265	4.35%	4,001	
3	10,548	1,055	11,603	4.60%	10,369	
4	21,688	2,169	23,856	4.60%	20,382	
5	49,935	4,993	54,928	4.76%	44,563	
6	42,895	4,290	47,185	4.86%	36,340	
7	40,612	4,061	44,673	4.94%	32,661	
8	42,481	4,248	46,729	4.99%	32,440	
9	47,848	4,785	52,633	5.02%	34,708	
10	12,207	1,221	13,428	5.04%	8,415	
11	7,324	732	8,056	5.05%	4,801	
12	3,653	365	4,018	5.06%	2,278	
13	1,536	154	1,690	5.06%	912	
14	732	73	805	5.04%	415	
15	265	27	292	5.03%	143	
	285,921	**28,592**	**314,513**		**232,773**	**140,224**