

Educational Note

Use of Actuarial Judgment in Setting Assumptions and Margins for Adverse Deviations

Committee on Life Insurance Financial Reporting

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Educational Notes do not constitute standards of practice. They are intended to assist actuaries in applying standards of practice in respect of specific matters. Responsibility for the manner of application of standards in specific circumstances remains that of the member in the Life Insurance Practice Area.

Memorandum

To: All Members in the Life Insurance Practice Area
From: Tyrone Faulds, Chairperson
Committee on Life Insurance Financial Reporting
Date: November 30, 2006
Subject: **Educational Note – Use of Actuarial Judgment in Setting Assumptions and Margins for Adverse Deviations**

The Committee on Life Insurance Financial Reporting (CLIFR) has developed the attached educational note – Use of Actuarial Judgment in Setting Assumptions and Margins for Adverse Deviations. This educational note presents considerations and examples of the application of the Standards of Practice (SOP) to the use of judgment in the setting of actuarial assumptions and margins for adverse deviations (MfAD) in Canadian financial statements prepared in accordance with generally accepted accounting principles (GAAP).

CLIFR is also preparing an educational note on Considerations in the Valuation of Segregated Fund Products that it expects to publish shortly. This educational note references that document even though it has not been published yet.

The guidance in this educational note represents a majority view of the members of CLIFR with respect to appropriate practice consistent with CIA standards of practice. This educational note has met the requirements of Due Process for Approval of Practice-Related Material other than Standards of Practice. However, in accordance with paragraph 1220.04 of the Standards of Practice, this note is “not binding.” It received final approval for distribution by the Practice Council on November 28, 2006.

As outlined in subsection 1220 of the SOP, the “*actuary should be familiar with relevant educational notes and other designated educational material,*” considering that a practice described “*for a situation is not necessarily the only accepted practice for that situation and is not necessarily accepted actuarial practice for a different situation.*”

I would like to thank the following CLIFR members who were primarily responsible for the development of this educational note: Jacques Boudreau, Carl Kruglak, Dale Mathews, Christian-Marc Panneton, Michael Promislow and Anne Vincent.

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1. INTRODUCTION

1.1 Purpose and Scope

While Canadian Generally Accepted Accounting Principles (GAAP) in general and Canadian Asset Liability Method (CALM) in particular is prospective by nature, to appropriately project future experience, an understanding of past experience is crucial. Using this experience as a base, trends and changing circumstances are then taken into consideration to set the best estimate for the future.

A crude application of past experience without judgment is rarely appropriate; however, any application of judgment would be based on sound grounds. Sound judgment is to be applied in all forward looking projections and sound judgment applied to financial reporting to the public would not be conceptually different from sound judgment applied when advising management on pricing matters.

This educational note will review current ways judgment is brought in to the GAAP financial reporting process and provide guidance on the application of the Standards of Practice (SOP).

1.2 Consistency of Assumptions

One of the key areas where actuarial judgment is used is in the ongoing setting of assumptions and margins for adverse deviations (MfAD). Subsection 1750 of the General Standards gives some guidance in this regard:

1750 COMPARISON OF CURRENT AND PRIOR ASSUMPTIONS

- .01 *Unless the actuary reports the inconsistency, the assumptions for a calculation for a periodic report should in the aggregate be consistent with those of the prior calculation.* [Effective December 1, 2002]
- .02 The definition of consistency for the purpose of this recommendation varies among practice areas. For advice on funding a pension plan, the assumption at a calculation date is consistent with the corresponding assumption at the prior calculation date if the two are nominally the same. For example, if the investment return rate assumption is 6.5% at the current calculation date and was 7% at the prior calculation date, then the actuary would report the change even if the outlook had changed downward by .5% between the two dates.
- .03 For valuation of an insurer's policy liabilities for its financial reporting, an assumption at a calculation date is consistent with the corresponding assumption at the prior calculation date if the two assumptions
 - each reflect the conditions and outlook at their respective calculation dates in the case of a best estimate assumption,
 - each reflect the risks at their respective calculation dates in the case of a margin for adverse deviation, and
 - are located at the same point within the range of accepted actuarial practice.
- .04 The assumptions at a calculation date are in the aggregate consistent with the corresponding assumptions at the prior calculation date if
 - each assumption is so consistent, or

there are inconsistencies among the assumptions but the result of the calculation is the same as if each assumption were so consistent.

.05 If the assumptions are in the aggregate not so consistent, then the actuary would report the inconsistency. If practical and useful, the report would quantify the effect of the inconsistency.

Even with consistent assumptions, volatility is a financial reporting reality for Canadian insurance companies under current Canadian GAAP and the CIA Standards of Practice. In many circumstances, volatility of results is appropriate when the entity has unhedged or imperfectly hedged exposure to risks. This volatility would be appropriate where it is a result of the application of the standards.

This volatility would be inappropriate when it does not reflect the change in the risk exposure or circumstances of the entity.

Non-systemic volatility can result from error corrections, improvements to valuation systems, improvements to experience studies and other advances. Disclosure of the impact of these changes aids in the understanding of the results.

1.3 Principles

In setting best estimate assumptions and margins for adverse deviations the following principles would be considered:

- While assumptions and margins for adverse deviations are often based on historical data the appropriateness of these are justified on a prospective basis.
- Maintaining an assumption or a margin for adverse deviations is subject to the same level of scrutiny as implementing a change.
- The change in policy liabilities would not reflect a change in past experience that the actuary has sufficient reason to believe is temporary.
- The change in expected assumption would be supported with evidence that indicates a need for change.
- The change in the margin for adverse deviations would be supported by a change in the assessment of the level of risk.
- The change in assumption would not be manipulative. Methods to determine assumptions are predetermined and are not subject to irregular or inconsistent application over time.

2. CONSIDERATIONS FOR SETTING NON SCENARIO TESTED ASSUMPTIONS

2.1 Best Estimate Assumptions for Non Scenario-Tested Assumptions

The best estimate assumptions reflect the actuary's best estimate of how future experience will emerge, which is based on past experience, industry experience and other factors such as correlations with other parameters in the valuation.

In choosing the best estimate of future experience, actuaries would reflect emerging trends in experience, but would not reflect random fluctuations in recent past experience. In the determination of the best estimate assumptions for mortality, morbidity, expenses, lapses, asset defaults, etc., one of the most accepted practices is to reflect the insurer's experience over several

years to take due account of its credibility and to eliminate undue year-by-year fluctuations from the best estimate assumption. This is sometimes accomplished by using the average of several years' of experience (e.g., three to five years for mortality experience or the longest period available for equity returns) as the base from which to determine the best estimate assumption. This would not be applied to setting certain assumptions such as interest rates, inflation rates, foreign exchange rates and tax rates. Examples on setting best-estimate equity return assumptions can be found in the appendix. Assumptions which are cyclical in nature (e.g., asset defaults) are covered in section 2.20 below.

It is often difficult to know whether changes in past experience are caused by underlying trends, random fluctuations, or cyclical influences. Therefore, actuaries often reflect emerging trends once they have been clearly established. For example, a 4% drop in actual unit expenses might result in a 2% drop in the choice of best estimate expense assumption, with the other 2% drop reflected a year later if the unit expenses stay low. A 4% increase in actual unit expense might also be reflected in the same manner in the best estimate expense assumption, although some actuaries would be quicker to recognize adverse changes in past experience than beneficial changes.

Similarly, many actuaries would choose not to change the expected assumption for small movements in recent experience. However, this is balanced with the desire to avoid a material change in assumptions that might be required if the accumulated impact of many small changes indicates that current assumptions are no longer appropriate.

When it is difficult to determine whether changes in past experience reflect emerging trends or random fluctuations and faced with potentially offsetting changes in assumptions, actuaries would often consider keeping the assumptions unchanged until clear trends emerge. They would then ensure that the assumptions and the resulting liabilities are still appropriate in the aggregate. This aggregate approach eliminates undue year-by-year fluctuations in the assumptions while keeping the liabilities at an appropriate level. If emerging trends for different assumptions are going in the same direction, then actuaries would consider reflecting the trends, partially or entirely, as described above. In any case, the goal of the decision making process would not be to net out the impact of changes in assumptions at reporting dates.

2.2 Setting of Cyclical Assumptions

For any assumption for which there is credible evidence that the risk is cyclical in nature (examples are asset defaults and disability incidence rates), the best estimate assumption can be projected to change in the future, consistent with the expected cyclical behaviour. This may be more appropriate than assuming current experience will persist indefinitely. Some actuaries have developed long-term expected assumptions and, for valuation purposes assume that expected experience moves from current levels to long-term expected levels over the appropriate cycle period. Others reflect the projected cyclical behaviour more explicitly. For example, disability incidence and termination rates sometimes exhibit seasonality and some actuaries have developed non-level monthly incidence rates based on experience over a cycle of typically 12 months.

In some circumstances, it may be reasonable to establish additional positive or negative short-term provisions or margins to reflect the impact of an economic or behavioural cycle. A cyclical provision would be established by special modifications to the short-term cash flows, or as a separate stand-alone provision.

In keeping with the principles of the Standards, the following guidelines apply to setting liabilities for cyclical risks:

1. For this purpose the cycle considered is relatively short term and is expected not to exceed five years.
2. The determination of the policy liability is based on a forward-looking assessment of expected experience.
3. The policy liability would only include favourable or adverse experience caused by the cyclical behaviour. Other expected improvements or deteriorations in experience would be reflected in the expected long-term assumptions. The policy liability would be calculated on a consistent basis from period to period.
4. The actuary establishes and documents a policy for setting liabilities for cyclical risks. This policy addresses the purpose of and justification for the policy liability, how it is established and funded and the criteria used to change the policy liability.

In addition, the actuary ensures that the policy liability is determined consistently with any accounting provisions and the long-term assumptions in the policy liabilities.

2.3 Adjustments for Policyholder Pass-Through Features

Products with policyholder pass-through features, such as participating insurance and experience rated group policies, have policy benefits that vary with experience that may increase the certainty of the projected net cash flows. For example, if mortality rates increase, death benefits increase but dividends decrease, and the total projected cash outflow might be unchanged with changes in mortality rates. Therefore, liabilities on products with significant policyholder pass-through features are generally less volatile than liabilities on similar products with fixed contractual terms.

Consistent with policyholders' reasonable expectations, some actuaries recognize policyholder pass-through features by using so-called "implicit" valuation techniques, where the relationship between valuation assumptions and adjustable policy benefits is held constant from one valuation to the next, reflecting the long-term expected relationship thereof. The actuary would use caution in taking this approach, ensuring that the limitations on the insurer's ability to pass-through adverse experience listed below are properly reflected in the value of the policy liability. With the implicit approach, changes in liabilities occur if there is a change in the long-term expected relationship between valuation assumptions and adjustable policy benefits.

The actuary considers the following with respect to the insurer's ability to pass-through adverse experience:

- The insurer's dividend policy and the insurer's formal or informal policy for making changes to other policy elements;
- The extent of the insurer's freedom to make changes to policy elements in response to emerging experience, including contractual and practical limits on that freedom;
- Any illustrations and representations that may have been made by the insurer to the policyholders;
- The insurer's recent practice in adjusting policy elements for the class of policies in question or similar policies;

- Market conditions that might limit the freedom of the insurer to make changes to policy elements in response to emerging experience; and
- Delays that are likely to emerge between the emergence of adverse experience and the insurer's ability or willingness to make corresponding changes to policy elements.

2.4 Correlation of Other Assumptions with Scenario-Tested Assumptions

Some assumptions may be correlated with the scenario-tested assumptions (e.g., interest rates) depending on the circumstances. Reflecting such correlation may reduce or increase movements in liabilities. Varying the inflation rate with the interest rate levels is an example where reflecting the correlation between the two assumptions would normally dampen volatility of cash flows, while varying policyholder behavior (e.g., increasing UL premium persistency with increasing interest rates) would normally increase volatility of cash flows.

Interrelationships of assumptions may be difficult to measure and their impact may be difficult to predict or foresee. Correlating assumptions may increase the provisions for adverse deviations while not appropriately reflecting future expectations. Sensitivity testing may help understand the impact on liabilities.

Before reflecting the correlations of other assumptions such as withdrawals and partial withdrawals, premium persistency, and other policyholders' options with scenario-tested assumptions, the actuary would consider any relevant experience, potential for anti-selection, and policyholder behavior. It may be appropriate to assume that policyholders may not react quickly or fully even if it is to their advantage. This subject is covered in subsections 1130 and 1560 of the SOP.

2.5 Appropriateness of the Provisions for Adverse Deviations in the Aggregate

The actuary would select margins for adverse deviations that appropriately reflect the risk and uncertainty of their related best estimate assumptions. The actuary would also ensure that the application of a margin for adverse deviations results in an increase to the value of the policy liability and that the resulting provision is appropriate in the aggregate (paragraph 2120.061 of SOP).

The total amount of provision for adverse deviations (PfADs) would be reviewed to determine if it is appropriate in the aggregate and reflects the uncertainty in the choice of all expected assumptions. Similar to expected assumptions when it is difficult to determine whether a change in the margin for adverse deviation is warranted and faced with offsetting changes in margins, actuaries would consider keeping them unchanged until clear trends emerge. They would then ensure that the margins and the resulting provisions are still appropriate in the aggregate. When faced with changes in margins going in the same direction, actuaries would consider reflecting them.

When assessing the appropriateness of aggregate PfAD levels, actuaries would consider the interrelationships of the assumptions and any potential undesirable compounding of provisions. An illustration of this situation is a UL policy with investment options that offer minimum interest guarantees to the policyholder. For such a policy, an actuary could have three different margins: a margin on the policyholder's investment allocation, another margin on the crediting interest rate spread, and he or she could have an implicit margin by adversely shifting the policyholder's fund mix in unfavourable interest rate scenarios where the minimum guarantees kick in. The resulting aggregate provision may be excessive.

Actuaries would also give consideration to offsetting risk positions among blocks of business where the blocks are homogeneous or significantly correlated with respect to the risk in question. For example, an insurer has a homogeneous block of life insurance business and reinsures the mortality risk of a subset of this block. If a positive margin for adverse deviations would increase the liabilities of the non-reinsured business but a negative MfAD would increase the liabilities of the reinsured business, the aggregate PfAD would reflect that the best estimate mortality assumption for this block cannot be both underestimated and overestimated.

PfADs would not be used to dampen changes in liabilities directly by, for example, increasing PfADs when expected assumptions are improved, or decreasing PfADs when expected assumptions deteriorate. The provision is determined to reflect the risk/uncertainty in the choice of expected assumptions.

3. JUDGMENT IN THE MODELING OF REINVESTMENT AND DISINVESTMENT STRATEGIES FOR FIXED AND NON-FIXED ASSETS

This section presents challenges and gives guidance in implementing investment policies and practices into existing models, and identifies practical limitations in ensuring that period over period changes in the PfADs are appropriate in relation to changes in market returns. Section 4 goes into more detail for scenario tested liabilities focussing on fixed assets and Section 5 covers Segregated Funds in detail.

Changes in market returns on fixed and non-fixed yield assets could affect current and projected values on both sides of the balance sheet. On the asset side, market value movement may cause fluctuation in the value of any embedded options, as well as potentially affecting default risk in the future. On the policy liability side, movements in available yields may affect policyholder behaviour with respect to deposits and withdrawals, as well as changing the value of any embedded policyholder options such as minimum crediting rates or partial withdrawals not subject to market value adjustment.

The market returns and values assumed at the balance sheet date in any projection would be consistent with the actual portfolio of the company. Overall, period-to-period market return movement will likely cause some change in a company's risk position, and would be appropriately reflected in the level of policy liability being held. Practical limitations in implementing investment policies and practices in to the models may inadvertently exaggerate or dampen this effect.

3.1 Reinvestment Strategies

Paragraph 2330.03 of the Standards of Practice states:

“The investment strategy defines reinvestment and disinvestment practice for each type, default risk classification, and term of the invested assets which support policy liabilities. Assumption of the insurer's current investment strategy implies investment decisions of reinvestment and disinvestment in accordance with that strategy and, hence, the risk inherent in that strategy.”

Paragraph 2330.12 states:

“For a prescribed scenario, if the net cash flow forecasted for a period is positive,...., the actuary may assume reinvestment in non-debt investments

not to exceed their proportion of investments at the balance sheet date if the insurer controls investment decisions and if such reinvestment is consistent with its investment policy, or

in the proportion expected to be selected by policyholders if policyholders control investment decisions.”

When using non-debt investments, the actuary ensures that the proportion of non-debt investments, at each duration, is in accordance with the insurer’s current investment policies (regardless of whether net cash flows for the period are positive or negative). The review is performed without taking into consideration any business issued after the valuation date (new sales) even for a valuation done on a going concern basis as stipulated in paragraph 2130.02 of the SOP.

This may create a situation where the actuary needs to divest non-debt investments. This disinvestment is not limited to non-debt instruments acquired after the valuation date. In the case where the investment policy limits are set on a going concern basis, the actuary needs to be satisfied that the projected level of non-debt assets is appropriate to support only the level of in-force business at the valuation date, and does not explicitly or implicitly assume any future new business.

The actuary would pay particular attention to the following situations:

- The overall investment limits may apply to more than one block of business for which separate CALM projections are done. The policy liability pattern may vary significantly over time and/or the maturity of the blocks may be very different creating situations where it is more difficult to verify the application of the investment policy’s limits.
- The investment policy may include limits that vary over time. As an example, an investment policy may assume that investment in non-debt investments may be 20% of the total asset portfolio but reduces to 0% if the cash flows are within a certain number of years of maturity.
- The investment policy of some blocks of business may be more complex to model. As an example, modeling the investment policy of a UL Level COI block of business considers an investment strategy for the assets supporting the policyholder funds (under the control of the policyholders) and a different one for the insurance portion of the policy liability (under the control of the company). Those two investment policies may be subject to different limits.

3.2 Modeling Limitations

Practical modeling issues could lead the actuary to obtain unintended results, and cause movement in margins inconsistent with the change in risk. In constructing and projecting any scenario, the actuary would pay attention to potential limitations in the asset-liability projection model.

In modeling any scenario, the actuary would consider how best to reflect the current investment policy and practices as well as the defined constraints in the standards in future activity in order to capture an appropriate amount of risk. In projecting future investment and disinvestment activity, the model may limit the actuary to strategies that could result in activity outside of current investment policy, practice or standards. Typical strategies available include acquiring or

disposing of assets in a pre-defined manner, rebalancing the portfolio based on target asset allocations, or some combination thereof.

In the case where the actuary was employing a rebalancing or target allocation strategy, the actuary would review the reinvestment and disinvestment activity generated by the model to ensure it is consistent with both expected company practice and the appropriate standards. Items to be reviewed would include:

- the treatment of existing assets and whether they are held to maturity or made available for sale,
- the pattern of disinvestment and/or borrowing activity,
- the spreads and default rates of new assets being acquired, and
- the level of positive net cash flow invested in non-debt instruments as a percentage of the total net cash flow.

Use of a pre-defined cash flow investment strategy may not properly capture constraints within an investment policy to limit the value of a particular class of assets, or limit the duration mismatch between an asset portfolio and a policy liability portfolio. In either case, testing may be required to determine if the model captures the constraints within the policy while still ensuring compliance with the standards.

Implementing a disinvestment strategy consistent with future expected activity of the investment area is another area where the actuary needs to pay attention to the results of the model. In setting parameters to simulate disinvestment activity, the actuary chooses between variables such as book yield, the ratio of market value to book value, credit quality and time to maturity. Selecting the same set of criteria for all scenarios may result in some cases with model generated activity inconsistent with the company's investment policy. Furthermore, testing by scenario for the most optimal strategy would in effect assume prior knowledge of the future projected rates, which is inconsistent with the intent of the standards. The actuary is encouraged to review the results of the model, and set future activity consistent only with the information available at a point in time.

When investing or divesting in non-debt investments, the actuary would ensure that the proportion of such instruments to the total invested assets is in accordance with the company's current investment policy.

Generally, investment strategies may differ between general account funds backing the insurance component of a Universal Life policy and those backing policyholder funds. A negative general account policy liability could arise in the case where the policy liability for a block of policyholder funds is less than the total account value. A rebalancing approach may lead to the model establishing negative positions in certain asset classes, and possibly projecting the disinvestment of existing assets, which may be contrary to the company's investment policy. A strict cash flow allocation would make it difficult to match to the underlying movement in policyholder funds.

The prescribed scenarios require the actuary to assume that projected investments grade towards default free investments in a period of not more than 20 years. Determining defaults in the interim period requires the split of the graded rates into risk free rates and default rates. For equities, it is possible that the timing of the one-time equity drop may move from scenario to scenario. Further testing would be required to ensure that the results are appropriate.

Overall, this implies the actuary needs to analyze the projected composition of the balance sheet, and not focus solely on the initial required asset level.

4. USE OF JUDGMENT IN SCENARIO TESTING

This section covers principles the actuary might consider in determining appropriate policy liability when its mismatch position, asset quality and asset mix vary from one valuation period to the next. It covers general concepts, and the model and numbers would be thought of as illustrative of the spirit but not necessarily of the application of the concepts as these can be technically difficult to implement. For instance, in the examples below, references are made to modeling future reinvestments such that the company improves its future mismatch position in rather precise terms. It is certainly possible to identify, at the valuation date, assets to sell and buy so as to modify the mismatch position by the desired amount. However, as is also stated below, the transactions would be assumed to take place at a rate that is no quicker than past experience. Software may be limited in their ability to model future reinvestments such as to achieve a specific duration.

The examples would also not be taken too literally. For instance, many of the examples reference the average duration mismatch position over the prior 4 quarters, but that period could have been 8 quarters, or 10 quarters (i.e., a reasonably long period of time in the context of managing the portfolio). The model also assumes that the cash flow testing is done as at the valuation date.

4.1 Principles

1. The company has full control over its mismatch position, asset mix and asset quality.
2. As per the standards, the company's investment policy is one of the constraints the actuary would consider.
3. Everything else being equal, companies with riskier investment practices or with poorer mismatch, asset mix and asset quality would have greater PfADs than those of companies with more conservative investment practices or better controls.
4. It would be inappropriate for a company to hold a policy liability that is based on a mismatch/asset mix/asset quality starting position that is not the one in existence at the cash flow testing date. As per the standards, it is appropriate to assume that the reinvestment strategy will correct unusual situations such as mismatch positions or asset mixes outside the permitted range. For example, the actuary of a company that intends to be invested in mortgages but would temporarily invest in bonds while mortgages are acquired could assume that mortgages would be acquired after the cash flow testing date. The assumption as to the period of time needed to rectify the starting position would be based on past experience. It would be inappropriate for the actuary to assume that corrections can be made more quickly than they have been done in the past.
5. The standards require liabilities to be sufficient without being excessive.

4.2 Examples

Consider a portfolio of general account non-par annuities supported by a portfolio of fixed income investments. The company's investment policy requires that the asset/liability duration mismatch would not exceed six months. Scenario testing to incorporate appropriate C-3 margins is performed as described in the Standards of Practice.

In the examples we will discuss the duration mismatch as the variable under consideration. The same considerations would apply if we were discussing asset mix or asset quality. The examples assume the actuary know the current mismatch position and historical average mismatch and that the company's investment policy has a stated target mismatch position and maximum mismatch allowed.

4.2.1 Alternatives

Duration mismatch at $t=0$ is X months.

Average duration mismatch over last 4 quarters has been 4 months.

The duration mismatch target is 3 months.

The investment policy allows a maximum mismatch of 6 months.

We will discuss four alternatives for setting the policy liability:

1. Do the testing and set the policy liability assuming you will remain at the current mismatch position.
2. Do the testing and set the policy liability assuming you will move to the maximum mismatch position (6 months) over time.
3. Do the testing and set the policy liability assuming you will move to the target mismatch position (3 months) over time.
4. Do the testing and set the policy liability assuming you will move to the historical average mismatch position (4 months) over time

Note that there is quite a difference in the results produced among these approaches. If the liabilities of the portfolio were in the order of \$1 billion, with a duration of 6 years, the difference between assuming a move to the target mismatch and that assuming a move to the maximum mismatch position would be in the order of \$10 million.

The first alternative may be appropriate but is quite sensitive to the actual mismatch position at the date of testing. If the actual mismatch is reasonably close to the target and historical averages and below the maximum mismatch it would seem consistent with investment practice.

The second alternative produces liabilities that are clearly sufficient as the investment policy restricts mismatch to six months. The mismatch provision in this approach would show smaller change over time as long as the maximum mismatch position allowed remained stable. This alternative would likely be excessive and inconsistent with investment practice, and thus generally would be an unacceptable alternative.

The third alternative would generally be acceptable if there is a past history of achieving the target. The mismatch provision in this approach would show smaller change over time as long as the target mismatch position remained stable. If the historical average is consistently above the target this is likely to result in insufficient liabilities. Using the target in the above example would therefore be inappropriate as the target position is below the historical average unless further research showed the recent historical average was high. A slight variation on this alternative would be to assume the target was also met at the valuation date. Consistent with Principle #4, this would be inappropriate as the starting point would be the situation at the balance sheet date.

The fourth alternative would generally be acceptable unless there was a conscious plan to take more mismatch risk. The mismatch provision in this approach would show smaller change over time as well but the historical average may not be as stable as the target mismatch position. (A slight variation on this alternative would be to assume the historical average was also present at the valuation date.) Consistent with Principle #4, this is inappropriate as the starting point would be the situation at the balance sheet date.

4.2.2 Examples

The remainder of this section considers various examples of how the C-3 provision might move over time.

Example 1

At $t=0$,

Duration mismatch: 3 months

Target mismatch: 3 months

Historical average mismatch: 2.5 months

Maximum mismatch allowed: 6 months.

Policy liability was set using alternative 1. Alternative 3 would have produced the same policy liability.

At $t=1$,

Duration mismatch: 4.5 months

Average mismatch over last 4 quarters increased to 3 months.

Reviewing the alternatives for policy liability at $t=1$:

1. Reflect the increased risk associated with the current mismatch position by assuming this will persist. As the current position is higher than both the historical average and the target this may result in excessive liabilities as well as causing inappropriate volatility. However, if this is caused by a conscious plan to increase the mismatch position (i.e., the target also increased) this may be appropriate.
2. Reflect the increased risk associated with the current mismatch position while moving to the maximum mismatch position over time. This alternative is inconsistent with investment practice, and thus generally is an unacceptable alternative.
3. Reflect the increased risk associated with the current mismatch position while decreasing to the target level over time. This is appropriate as the investment policy is to target 3 months and this is consistent with historical averages.
4. Reflect the increased risk associated with the current mismatch position while decreasing to the historical average over time. This would also be appropriate as the historical average is consistent with the target.

Example 2

At $t=0$, the situation is the same as for example 1.

At $t=1$,

Duration mismatch: 1 month,

Average mismatch over the previous 4 quarters decreased to 2.0 months.

Possible alternatives for policy liability at $t=1$:

1. Reflect the decreased risk associated with the current mismatch position by assuming this will persist. As the current position is lower than both the historical average and the target this may result in understated liabilities as well as causing inappropriate volatility. However, if this is caused by a conscious plan to decrease the mismatch position (i.e., the target also decreased) this may be appropriate.
2. Reflect the decreased risk associated with the current mismatch position while moving to the maximum mismatch position over time. This alternative is inconsistent with investment practice, and thus generally is an unacceptable alternative.
3. Reflect the decreased risk associated with the current mismatch position while increasing to the target level over time. This would be appropriate if the recent mismatch experience is considered to be unusual and the investment policy is to continue to target 3 months.
4. Reflect the decreased risk associated with the current mismatch position while increasing to the historical average over time. While this moves the mismatch closer to the target, it would fall short of it and would be difficult to justify if the target remained unchanged.

Example 3

At $t=0$, same situation as example 1 and 2.

At $t=1$,

Duration mismatch: 6 months,

Average mismatch over the previous 4 quarters increased to 3.5 months.

Possible alternatives for policy liability at $t=1$:

1. Reflect the increased risk associated with the current mismatch position by assuming this will persist. As the current position is higher than both the historical average and the target this may result in overly conservative liabilities as well as causing inappropriate volatility. However, if this is caused by a conscious plan to increase the mismatch position (i.e., the target also increased) this may be appropriate.
2. In this example, this alternative would give the same result as the one above.
3. Reflect the increased risk associated with the current mismatch position while decreasing to the target level over time. This would be appropriate if the recent mismatch experience is considered to be unusual and the investment policy is to continue to target 3 months.

4. Reflect the increased risk associated with the current mismatch position while decreasing to the historical average over time. As the historical average is slightly higher than the target, this would be appropriate.

Example 4

At $t=0$, the situation is the same as the previous three examples.

At $t=1$,

Duration mismatch: 7 months,

Average mismatch over the previous last 4 quarters has increased to 3.5 months.

Possible alternatives for policy liability at $t=1$:

1. Reflect the increased risk associated with the current mismatch position by assuming this will persist. This would be difficult to justify since the position is beyond the maximum allowed and efforts would presumably be underway to rectify the position as soon as possible.
2. Reflect the increased risk associated with the current mismatch position while moving to the maximum mismatch position over time. This alternative is inconsistent with the target but may be in line with past experience if the company is often near the maximum allowed. Ultimately, the assumption would depend in part on what that experience has been.
3. Reflect the increased risk associated with the current mismatch position while decreasing to the target level over time. This would be appropriate if the recent mismatch experience is considered to be unusual and the investment policy is to continue to target 3 months.
4. Reflect the increased risk associated with the current mismatch position while decreasing to the historical average over time. As the historical average is slightly higher than the target, this would be appropriate. For alternatives 3 and 4, the actuary would want to feel reasonably confident that the mismatch will be close to the target most of the time.

4.3 Conclusion

The start of the policy liability calculation would be the mismatch/asset mix/asset quality in existence at the time of the calculation.

Reinvestment strategies that assume a return to normal or target mismatch/asset mix/asset quality positions would be acceptable, as long as they are consistently applied period to period unless there has been a conscious decision by management to change the investment policy. The period over which these actions are assumed to take place would reflect the company's past experience.

Finally, in addition to the limitations of the software to model reinvestments to achieve the desired level of mismatch, it may also be difficult to verify that the software is doing what is intended. Nonetheless, the actuary would ensure that it is indeed the case by measuring the mismatch at fixed points in the future.

5. APPLYING JUDGMENT TO SEGREGATED FUND LIABILITY

5.1 Source of Volatility in the Product

Segregated Funds can be a significant source of volatility on the Canadian GAAP Balance Sheet, and determining when this volatility is appropriate is particularly problematic.

Factors common in these products contributing to this natural volatility include:

- the single premium nature of the products which makes future revenue dependent on the future investment return on this initial deposit;
- the inherent instability of the revenue stream given that the assets are typically invested in mixes heavily weighted towards common stock, which have inherently volatile short-term returns, and the revenue is typically a percentage of the market value of these assets;
- the characteristics of the liabilities with death and surrender guarantees heavily dependent on market performance;
- the fixed “upfront” nature of acquisition expenses as contrasted with the unstable revenue stream to recover these expenses;
- the inverse correlation of the costs of the investment guarantees with the revenue stream (i.e., costs go up as projected revenue stream decreases).

5.2 Judgment in the Method

The base valuation methodology used for segregated fund products can have an impact on the degree of volatility reported. The actuary would review the Educational Note on Considerations in the Valuation of Segregated Fund Products for some of the considerations in choosing terms and methods. Within these methods there are a numbers of areas where judgment is required. Some of the important areas are outlined below.

5.2.1 Level of Aggregation Applied

The volatility of the valuation result can vary based on the degree of aggregation (i.e. grouping) across products that is done to perform the valuation. The greater the grouping, the greater the potential to reduce liabilities for the reason indicated above. But again, while it also changes the volatility patterns, greater aggregation may not necessarily reduce the volatility. The actuary is encouraged to review the Aggregation and Allocation of Policy Liabilities Educational Note for guidance. Once a level of aggregation has been chosen it is normally kept consistent period to period.

5.2.2 Selection of CTE Level

Paragraphs 2320.51 and 2320.52 of the Standards of Practice describe the general approach of establishing the policy liabilities when the valuation uses stochastic methods. Specifically, the actuary adopts a scenario whose policy liabilities are within the range defined by CTE60 and CTE80. PfADs (in experience) are provided for in the policy liabilities (a) in the case of scenario-tested assumptions, by selection of the effective CTE coverage level, and (b) in the case of non-scenario-tested assumptions, through the application of explicit MfADs.

The suggested approach establishes the PfADs for stochastic variables (i.e., the scenario-tested assumptions) based on coverage of a plausible range of outcomes using the CTE risk measure. Establishing the appropriate CTE “coverage level” for the policy liabilities is an important consideration. Guidance for the selection of the level of deterministic MfADs can be found in the

standards and in the draft MfAD educational note, but no similar guidance exists for the choice of an appropriate CTE “coverage level”.

In selecting an appropriate CTE “coverage level”, considerations are given to sources of uncertainties in the parameters and in the model. Greater uncertainties result in selection of a larger coverage level.

5.2.2.1 Parameter Uncertainty

The parameters used in the stochastic model are necessarily estimates. As stated in the standards, the estimates used here are best estimates as the PfAD is covered through selection of the CTE coverage level. The 2002 CIA Task Force Report on Segregated Fund Investment Guarantees (2002 Report) discusses how the determination of the CTE level would take into account “the risk profile of the business being valued...Generally, the impact of parameter uncertainty is smaller for closer-to-expiry, in-the-money guarantees.”

5.2.2.2 Model Risk

Notwithstanding the provisions incorporated for the stochastic model processes and parameter uncertainty, some residual model uncertainty remains. As such, a margin for model error is typically needed, and would not normally change period to period. Sources of uncertainties include:

- basis risk;
- inability of the model to capture exactly all relevant contract terms;
- use of approximations whose conservatism is not well understood in the valuation scenarios;
- omission of known risk factors, whose effect on the valuation is not well understood;
- missing or unknown risk factors; and
- number/sampling of scenarios run.

In deciding which coverage level is appropriate to account for the various components of uncertainty, the actuary would need to be particularly mindful of the margins in the valuation assumptions (explicit or otherwise) and the aggregate degree of conservatism in the model itself (including the parameters).

5.2.2.3 Changes in the CTE Level

A factor which can significantly affect period to period volatility related to segregated fund guarantees is whether the CTE level is kept constant or allowed to change. Such changes, if designed to achieve a measure of stability in the policy liabilities, are not appropriate. Where these changes are recognizing a change in the level of risk in the result (e.g., the degree to which the policy is in the money has changed, as illustrated in the example below) this practice can be appropriate. Keep in mind that lowering the CTE level as the policy guarantee moves into the money would not result in a lower policy liability. Quite the contrary, as the guarantee moves into the money, it is much more likely that more funds will be needed to pay off the liabilities and, therefore, the policy liability will increase. Lowering the CTE level recognizes that now there is more certainty around the calculation of the amount of those funds needed to cover the policy liability. As policy guarantees move out of the money, the opposite would occur; liabilities will decrease as the CTE level is increased.

Implementation of such an approach would also need to satisfy the criteria set out in section 5.4.

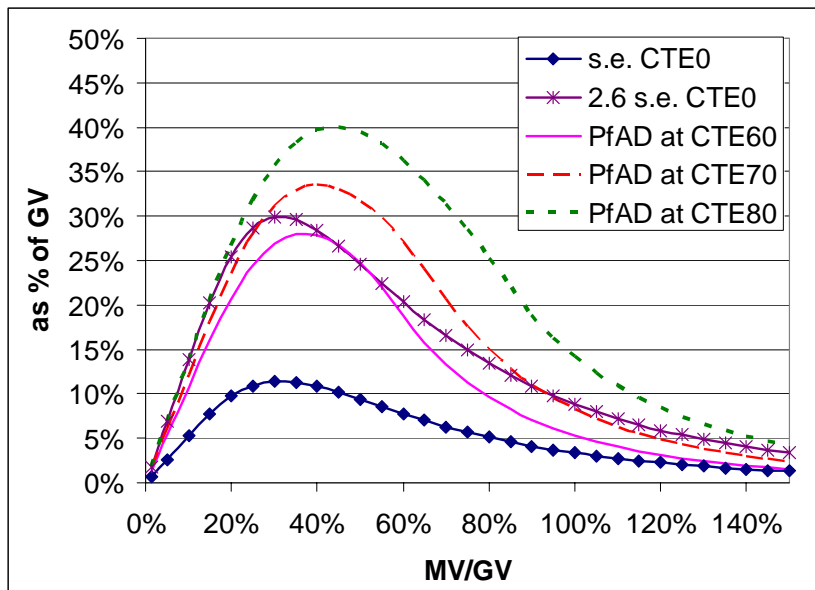
5.2.2.4 Examples

The following graphs illustrate possible ways to vary the CTE level based on the degree to which the policy is in the money has changed. The measure used to represent “in-the-moneyness” is the MV/GV ratio, where MV is the market value or account value of the underlying segregated funds, and GV is the minimum guaranteed value of those funds. The values in the graphs were determined using the closed-form formula from Hardy¹. Maturity CTE values were calculated assuming neither mortality nor lapses for a 10-year term to maturity and different market value/guaranteed value ratios (MV/GV). The PfAD is defined as the difference between the chosen CTE level and CTE₀, and is shown as a percentage of the guaranteed value. As already discussed above, the CTE level is constrained between 60 and 80. The necessary decision is how to vary the CTE between this corridor that appropriately takes into account the parameter and model risks.

Example 1:

One approach, using statistical measures, is to look at the standard error of CTE₀ as a representation of risk. A plotting of the standard error shows a different shape than a CTE plot. One could choose a multiple of the standard error line such that it becomes tangent to, but never goes below CTE₆₀. One such line is shown below. In this example, a multiple of 2.62 of the standard error results in such a tangent line as shown in figure 1. This line represents a process to vary the CTE level according to the MV/GV ratio. One can observe that the CTE level goes from 80% for a MV/GV ratio of 160% or higher to a level of 70% for a MV/GV ratio of 95%, then to a level of 60% for a MV/GV ratio of 50%. Once again, the CTE₆₀ and CTE₈₀ lines serve as the minimum and maximum limits.

Figure 1. Standard error of the maturity CTE for a 10-year maturity as a percentage of guaranteed value.

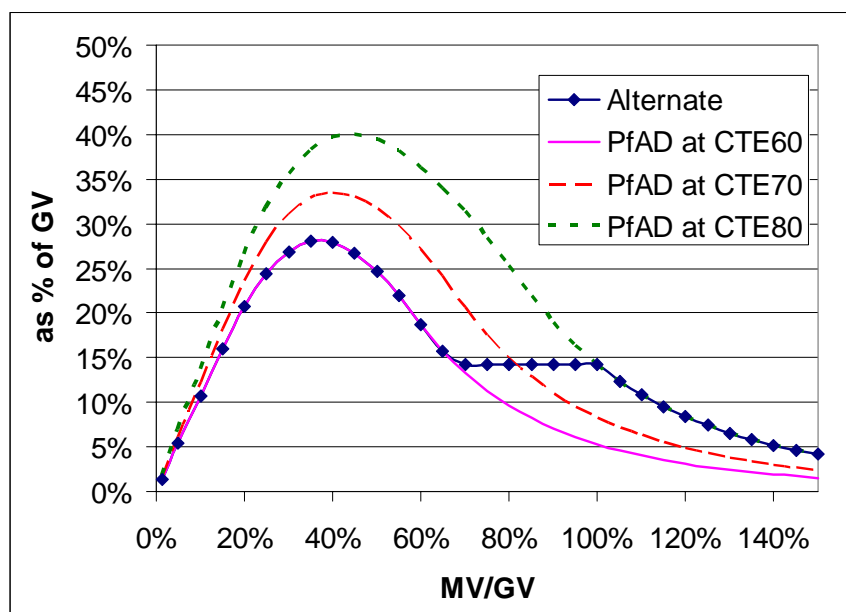


¹ Hardy, M.R. (2001). A regime switching model of long term stock returns. North American Actuarial Journal, 5 (2), 41-53.

Example 2:

One could arrive at the conclusion that the level of PfAD under CTE80 as a percentage of guaranteed value at an MV/GV of 100% (i.e., at-the-money) would be an appropriate PfAD. As the option moves out of the money, the PfAD as a percentage of the GV would shrink, but this is acceptable because you are holding the maximum CTE80. However, as the option moves into the money, remaining at CTE80 would cause the PfAD to increase. To keep the PfAD constant, one would lower the CTE level until CTE60 is reached. This is illustrated in Figure 2. In the graph below, at a given MV/GV ratio, the CTE level would be determined by the CTE curve that crosses the line labeled “Alternate”. For example, at an MV/GV ratio of 82%, CTE70 would be the chosen level.

Figure 2. Maturity PfADs for a 10-year maturity as a percentage of guaranteed value



The approach under this example would keep the maturity PfADs constant to 14.2% of the guaranteed value for MV/GV ratio between 100% and 70%.

5.3 Investment Return Assumption

The valuation result is generally very sensitive to movements in the starting market value of assets.

In particular for segregated fund guarantees, volatility is influenced by changes in the market value to guarantee value relationships as a result of market movement and by the time remaining to maturity.

A key issue is whether it is necessarily appropriate to reflect all the period-to-period fluctuations due to the movement in the market value of assets in the valuation results.

Relevant considerations include the following:

- The majority of the assets in segregated fund contracts are common equity. The short-term return fluctuations on a mark-to-market basis of common stocks can be considerably

greater than the fluctuations over a longer holding period (i.e., volatility reduces as holding period increases).

- Investment return guarantees are generally priced on the basis of longer term holding periods and these reflect longer term volatility expectations.
- The combination of the above two points can lead to greater volatility in the period-to-period calculated cost of guarantees when full period-to-period movement in market value is reflected, than theoretically is expected in the longer term.
- Notwithstanding the previous point, the period-to-period investment performance does directly change the best estimate revenues and costs under the contracts and therefore affects the adequacy of the valuation result.

Considering all the above points it may be reasonable to use mechanisms to dampen the impact of short-term fluctuations on the valuation result based on expectation that much of the short-term fluctuation is transitory.

5.3.1 Short-Term Investment Returns – Practical Approaches

The most commonly used approach to dampen short-term volatility arising from investment returns is to build a mechanism into the determination of future investment return paths that offsets the impact of currently or recently experienced investment performance.

In a stochastic modeling environment, for periods of good investment performance, this implies a mechanism that changes the shape of the return distribution by fattening the tail of return distributions and/or otherwise reducing the overall level of future returns. For most normal segregated fund contracts with acquisition expense recovery and/or investment guarantee exposures, reducing expectations of future investment returns will tend to increase policy liabilities, serving to offset the impact of the good actual returns experience, which will tend to reduce the policy liabilities.

The following guidance would be taken into consideration:

- Paragraph 2340.11 of the Standards of Practice states that the actuary's best estimate of investment return on non-fixed income assets would not be more favourable than a benchmark based on historical performance of assets of its class and characteristics. Paragraph 2340.13 specifies minimum MfAD requirements for modeling common share and real estate returns in a deterministic valuation.
- The Task Force on Segregated Fund Guarantees has included specific minimum tail size recommendations for common stock market return distributions and these recommendations have been endorsed by the Committee on Life Insurance Financial Reporting for valuation purposes.

5.3.2 Techniques in Use

With that background, in a stochastic modeling environment a number of techniques that have been used by actuaries to change the tail size and shape and thus dampen volatility are illustrated below.

These techniques involve changing future expected investment return assumptions and return paths.

- change in asset mean return assumption;

- change in asset return volatility assumption;
- imposition of initial market correction.

A reduction in the asset mean return assumption and the imposition of an initial market correction will, in general, “shift” the distribution of returns downward. An increase in the asset return volatility assumption will typically increase the downside deviation or dispersion of results. The techniques are not inconsistent with current valuation standards and other guidance, and are appropriate for the reasons outlined in this paper. Illustrative examples can be found in the appendix.

5.4 Criteria for Applying Techniques

In applying techniques to change the CTE level or the investment return assumption over time, a reasonable method would meet a number of criteria:

- The method would be non-manipulative – that is, it does not allow the actuary subjectively to manipulate the current period income. To this end, it would be laid out in advance and applied on a formula basis.
- The method would be consistently applied from period to period, and would not be changed without good reason and disclosure.
- The formula underlying the method would produce a policy liability within the CTE60 – CTE80 level consistent with the standards.
- The method needs to be actuarially sound by producing a change in the provision for adverse deviations that is consistent with the change in the level of risk.
- Resulting future returns are still the best estimate based on a forward looking assessment and would be reasonable in that context.

APPENDIX

ILLUSTRATION OF PROJECTED EQUITY RETURNS

The following examples illustrate different approaches in setting the best estimate equity return assumption on a consistent basis period to period and their implications. Similar approaches could be used for the asset volatility assumption.

The following examples assume the historical return over the last 50 years is 9.5%. The current index is at 1000 and was 900 one period prior and 850 two periods prior.

Company A decides to set its best estimate return at this historical average and updates this each period as the historical average changes.

Company B decides to set its best estimate return at a prudent historical long-term average. This prudent long-term average is reviewed from time to time to assess its ongoing appropriateness. For this example this rate is assumed to be 8.5%

Company C also uses a prudent long-term average as its best estimate but assumes an initial market correction by projecting each of this year and the previous two years market levels to the end of this year. The expected first-year return is set to reproduce the average of these projections. This results in a return of 7.67% for the first year and 8.5% thereafter.

Company D also uses a prudent long-term average as its best estimate but adjusts its rate for the first 25 years dependent on recent market performance. Similar to C, Company D solves for a return for the first 25 years that reproduces the average of the last three years actuals projected to the same point. This results in best estimate assumptions of 8.47% for 25 years, and 8.5% thereafter.

The resultant projected levels for each company are illustrated below

	T	T+1	T+2	T+3	T+5	T+10	T+25	T+50
A	1,000	1,095	1,199	1,313	1,574	2,478	9,668	93,477
B	1,000	1,085	1,177	1,277	1,504	2,261	7,687	59,086
C	1,000	1,077	1,168	1,268	1,492	2,244	7,628	58,636
D	1,000	1,085	1,177	1,276	1,501	2,254	7,628	58,636

The following year (t+1) the actual market return is 15%.

For Company A the historical long-term average (51 year geometric return) increased to 9.61%. It revised its best estimate to this return.

Company B reviewed its prudent estimate and determined no changes were required. It continued to use 8.5%

Company C continued its previous process with no change to the 8.5%. This resulted in a return of 3.6% in year one and 8.5% thereafter.

Company D continued its previous process with no change to the 8.5%. This resulted in a return of 8.3% for 25 years and 8.5% thereafter.

The resultant projected levels for each company are illustrated below

	T	T+1	T+2	T+3	T+5	T+10	T+25	T+50
A	1,000	1,150	1,260	1,382	1,660	2,625	10,391	102,906
B	1,000	1,150	1,248	1,354	1,594	2,396	8,147	62,626
C	1,000	1,150	1,192	1,293	1,522	2,288	7,780	59,803
D	1,000	1,150	1,245	1,349	1,582	2,357	7,794	59,803

The increase over values projected last year are:

	T	T+1	T+2	T+3	T+5	T+10	T+25	T+50
A		5%	5%	5%	5%	6%	7%	10%
B		6%	6%	6%	6%	6%	6%	6%
C		7%	2%	2%	2%	2%	2%	2%
D		6%	6%	6%	5%	5%	2%	2%

The following year (t+2) the actual market return is a loss of 20%.

For Company A the historical long-term average (52 year geometric return) decreased to 8.94%. It revised its best estimate to this return.

Company B reviewed its prudent estimate and determined no changes were required. It continued to use 8.5%.

Company C continued its previous process with no change to the 8.5%. This resulted in a return of 31.5% in year one and 8.5% thereafter.

Company D continued its previous process with no change to the 8.5%. This resulted in a return of 9.34% for 25 years and 8.5% thereafter.

The resultant projected levels for each company are illustrated below.

	T	T+1	T+2	T+3	T+5	T+10	T+25	T+50
A	1,000	1,150	920	1,002	1,190	1,826	6,598	56,166
B	1,000	1,150	920	998	1,175	1,767	6,007	46,176
C	1,000	1,150	920	1,210	1,424	2,141	7,280	55,963
D	1,000	1,150	920	1,006	1,203	1,879	7,169	55,963

The decrease over the values projected last year are:

	T	T+1	T+2	T+3	T+5	T+10	T+25	T+50
A			-27%	-27%	-28%	-30%	-36%	-45%
B			-26%	-26%	-26%	-26%	-26%	-26%
C			-23%	-6%	-6%	-6%	-6%	-6%
D			-26%	-25%	-24%	-20%	-8%	-6%

Upon review the appointed actuaries of Companies C and D noticed their initial return exceeded the prescribed maximum return and adjusted their process to ensure the projected values were not larger than the prescribed maximum thus yielding the following:

For Company C this resulted in a return of 8.94% for approximately 49 years and 8.5% thereafter.

For Company D this resulted in a return of 8.94% for approximately 49 years and 8.5% thereafter.

	T	T+1	T+2	T+3	T+5	T+10	T+25	T+50
A	1,000	1,150	920	1,002	1,190	1,826	6,598	56,166
B	1,000	1,150	920	998	1,175	1,767	6,007	46,176
C	1,000	1,150	920	1,002	1,190	1,826	6,598	55,963
D	1,000	1,150	920	1,002	1,190	1,826	6,598	55,963

This revised approach gives a decrease over the values projected last year of:

	T	T+1	T+2	T+3	T+5	T+10	T+25	T+50
A			-27%	-27%	-28%	-30%	-36%	-45%
B			-26%	-26%	-26%	-26%	-26%	-26%
C			-23%	-22%	-22%	-20%	-15%	-6%
D			-26%	-26%	-25%	-23%	-15%	-6%