



RESEARCH PAPER

**MORTALITY REQUIREMENTS
IN MCCSR, TAAM AND CAR**

**COMMITTEE ON RISK MANAGEMENT
AND CAPITAL REQUIREMENTS**

FEBRUARY 2005

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MEMORANDUM

TO: All Life Insurance Practitioners

FROM: Simon Curtis, Chair, Committee on Risk Management and Capital Requirements
Ben Meckler, Chair, MCCSR Review Sub-committee

DATE: February 18, 2005

SUBJECT: Mortality Requirements in MCCSR, TAAM and CAR

The Committee on Risk Management and Capital Requirements has prepared the attached research paper as support for changes to be considered by the federal and Québec regulators in the determination of life insurers' capital requirements for the insurance mortality risk.

In accordance with the Institute's policy for Due Process, this research paper has been approved by the Committee on Risk Management and Capital Requirements, and has received final approval for distribution by the Practice Standards Council (PSC). As documented in the CIA Due Process paper (November 2001), this research paper is "not binding". This research paper has not gone through due process and therefore is not part of the Standards of Practice.

The proposed approach outlined in this research paper is the result of a consultative process involving representatives of the regulators and the Capital Adequacy Committee of the Canadian Life and Health Insurance Association (CLHIA). The working team included representatives from these groups.

The general membership has been kept abreast of the project through presentations at recent CIA meetings and seminars. In addition, two surveys have been conducted this year. As the research paper notes, the feedback from these surveys was very instrumental in shaping the ultimate proposals.

A draft of this research paper was circulated to the general membership in October, 2004. Based on the feedback received as well as subsequent discussions within our Committee, the following changes have been incorporated in this final version:

- a) We recommend that the existing limits on hold harmless and stop loss arrangements be reviewed and/or eliminated (see section 7);

- b) We emphasize the need for the regulators to be flexible in allowing the use of approximations (see section 8) given the potentially significant data capture issues to apply the formula on an exact basis quarter to quarter.

In addition, there were other minor refinements to correct typographical errors or to provide additional clarification.

The committee's view is that the proposed changes to the required capital for mortality, as presented in this paper, reflect improvements over the existing rules and should be considered for implementation by the regulators. We believe that the proposed formula produces results reasonably consistent with simulation modeling, is relatively straightforward to use and is more reflective of the underlying mortality risk.

This paper operated under the premise that companies were not interested in investing the time and resources to develop their own modeling capabilities, and accordingly, a revised formula was preferred. This premise was largely confirmed by the survey respondents. But attitudes on this subject may change over time, particularly if valuation software vendors begin to offer features to facilitate the modeling work. Work will then be required to establish a protocol for the incorporation of models into the MCCR framework.

Lastly, the committee wishes to thank the following members of the MCCR Review Subcommittee for their efforts in this project: Ben Meckler, chair of the sub-committee, Marc-André Belzil, Bill Brath, Gord Challes, Dan Doyle, Jean-Guy Lapointe, Les Rehbeli, Sylvain St-Georges and Jim Witol.

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BACKGROUND

The Committee on Risk Management and Capital Requirements has been working closely with representatives from the Office of the Superintendent of Financial Institutions (OSFI), Autorité des marchés financiers (AMF) and Canadian Life and Health Insurance Association (CLHIA) to propose an alternative to the existing capital rules with respect to life insurance mortality. This report provides a description of the proposal as well as background information concerning its development and rationale.

1. OVERVIEW OF CURRENT RULES

The current rules generally consist of factors multiplied by the Net Amount at Risk (NAAR), with an aggregate adjustment for size. The current factors range from 0.0005 to 0.0020 and depend on the number of years remaining in the mortality guarantee period or whether the product is adjustable. There are further adjustments for hold harmless and other similar arrangements, as well as qualified stop loss agreements. The factors for accidental death are 30% of the factors for basic death.

The current approach has been in effect since 1992.¹

The view of the committee is that the current approach should be reviewed for the following reasons:

a) Mortality Improvements

The factors were developed based on data from the early to mid 1980s. Since that time, there have been steady improvements in mortality, which may render the original factors out-of-date. As an example, the age adjusted central death rates for the “under 65” group as reported in the “Life Tables for the United States Social Security Area” (August 2002), show an 18% decline between 1984 and 1999.

b) Insured Population and Product Mix Shifts

The current factors are applied regardless of age, sex and smoking status. The distribution mix may have shifted over time. Furthermore, new products have evolved over the past two decades. Differences in expected lapse experience and policy size would, in theory, affect the mortality risk, yet the current factors do not capture these elements.

c) Effect of Reinsurance

The current rules treat reinsurance in much the same way as direct business, provided that the degree of rate guarantees is comparable. The form of reinsurance (e.g., quota share vs. excess of retention) can affect the variability of net claims. However, these distinctions are not reflected in the existing rules.

d) Risk Drivers Not Reflected

The current rules were not designed to address the specific mortality risk profile of each insurer. This results from the use of average risk factors, rather than an approach which considers various elements of risk for which provision would be made.

2. RISK ELEMENTS CONSIDERED

Conceptually, variations in actual mortality experience relative to what was assumed in the valuation may be due to any, or all, of the following:

¹ There was a “temporary” increase of \$0.50 per thousand of NAAR in individual nonpar which was removed in 2002.

a) Volatility

This represents statistical fluctuations from the mean, but not a change in the mean.

b) Catastrophe

This represents temporary aberrations attributable to specific external events such as an epidemic or a terrorist act. After the aberration concludes, experience returns to the mean.

c) Misestimation of the Mean

This represents a misestimation of the underlying mortality assumption. This error may arise due to a number of reasons, e.g., lack of credible data used in the experience studies, poor data collection, etc.

d) Permanent Deterioration in the Mean

Unlike the catastrophe component, the mean is altered permanently due to an event. This might be attributable to environmental factors or possibly company specific issues (e.g., severe policyholder antiselection).

In practice, it may be difficult, if not impossible, to identify the source for mortality variation.

It is the view of the committee that the capital requirements should deal with volatility and catastrophe only. Neither of these components was considered in the development of the margins for adverse deviation (MfAD) for mortality, so there is no concern of double counting. Conversely, items c) and d) are traditionally meant to be covered by the MfAD. In addition to the explicit margins, actuaries are precluded from reflecting mortality improvements in the valuation of life insurance, even though we are required to do so for annuities. Over the course of the past century, we have observed a fairly established trend for mortality improvement. While there is no guarantee that mortality will continue to improve, even the most pessimistic published projections of mortality display some level of improvement. Our view, therefore, is that items c) and d) are adequately covered through explicit and implicit margins. Items a) and b), on the other hand, need to be provided through the capital requirements.

The risk elements need to be further defined with respect to the time horizon and the impact of the adverse claims experience. For the time horizon, the committee concludes that the relevant period would be the term of the liability, which would normally be consistent with the period to value the policy liabilities.

It is the view of the committee that the impact to be modeled is the present value of additional cash flows resulting from the adverse claims. This is more comprehensive than simply considering the present value of additional death claims, as it would include the effect of reduced levels of future premiums, the impact of cash surrender payments, and other affected cash flows. This approach of considering all relevant cash flow differences is more consistent with other capital requirements, such as the lapse risk and the segregated fund guarantee risk.

The nature of the catastrophe risk needed clarification. Would it be based on general population considerations, or would it be based on insurer specific issues, such as the concentration of risk in group business, or regional vulnerabilities to adverse claims (e.g., earthquake zones)? Our committee's view is that while the insurer specific issues are indeed relevant for risk management purposes, it may be impractical to implement in a more general capital formula applicable to all insurers. We, thus, restricted the catastrophe component to general population considerations. It should also be noted that the current Minimum Continuing Capital Surplus Requirements (MCCSR) rules in general do not explicitly provide for risk concentration. For example, the asset default requirements do not vary with

geographical, sector, or single party concentrations. Similarly, liability requirements are not dependent on concentrations by line of business. Our position is that the concentration of risk issue would be addressed in a comprehensive manner, perhaps concurrently with similar issues, such as correlations between different categories of risk.

The degree of adversity to be covered by the capital requirements was a subject generating lively discussion among the committee members. Ultimately, the issue boiled down to the level of confidence with which the regulators would be comfortable. We followed the recent precedent established in connection with the segregated fund guarantee risk, namely coverage at CTE (95). Our committee believes that covering each and every conceivable risk at the CTE (95) level is likely to be excessive from a capital requirements perspective. As a result, some judgment was applied in the modeling. For example, we didn't attempt to model additional requirements for misestimation and permanent deterioration over and above the amount already provided in the valuation. In addition, we establish capital for catastrophe in the model at the CTE (95) level, given some assumptions about the frequency and severity of catastrophes, but these assumptions themselves are not based on specific catastrophe models. The frequency of catastrophes (i.e., the number of "catastrophic" events) was limited to one for the term of the liability.

3. MODELING THE CAPITAL REQUIREMENTS

Modeling of the volatility component was performed using Monte Carlo simulations, assuming each life's mortality is subject to a binomial distribution, and then determining the amount required for coverage at the CTE (95) level. The catastrophe component was modeled assuming a 10% spike in the expected mortality level in the next year. The 10% level was selected as it was close to the average unfavourable movement in crude mortality ratios for the five worst years in the twentieth century. An alternative to the immediate spike would be to apply a probability distribution to the catastrophic event occurring at any time in the future. The approach taken was simpler to implement, and is more in line with the approach being adopted by the International Actuarial Association (IAA) Working Party. In addition, limited testing suggested that there was not much difference in the present values of a spike occurring in the next year as compared with a spike occurring in 10 years time. While it is true that the later spike is applied to an older population with higher mortality rates, there are offsetting effects due to discounting for lapses and interest. Of course, this relationship will vary from company to company and within companies by product, but our committee was comfortable with the average approach.

For the input data, we started with data from the CIA Intercompany Mortality Study, which gave us useful splits of the business by major product type, age, duration and smoking status. Given that we were investigating the impact on total cash flows, we supplemented these data with assumptions regarding premium rates, cash values, expenses, etc. Reasonable assumptions were developed based on feedback from our sub-committee. We also used the initial data distributions as a springboard to create fictional distributions of business. Our ultimate goal was to transform the modeling results into a factor-based formula that would be robust enough to work reasonably well regardless of the mix of business.

Modeling was done both before and after reinsurance. We focused our analysis on the following three forms of reinsurance:

- a) Quota share, company retention of 25%, Yearly Renewable Term (YRT) premiums;
- b) Quota share, company retention of 25%, coinsurance premiums;
- c) Excess of retention of \$1 million, YRT premiums.

It is understood that numerous other reinsurance arrangements exist. However, our main interest was the effect of reinsurance on the mortality risk, and the degree of fit that any formula developed had relative to the simulation results.

Our modeling was done based on the current inforce block of business, i.e., no new entrants were assumed. This is consistent with Canadian Generally Accepted Accounting Principles (GAAP) valuations, and with other elements of the capital rules, such as the lapse risk, the segregated fund guarantee provision, the C-3 component, etc. New business growth will vary from company to company and within company, by product. In the view of our committee, any assumption regarding new business would be arbitrary and not add meaningfully to the analysis.

The modeling was restricted to Canadian individual life business with mortality guarantees. We have no reason to believe that similar risk drivers would not apply to foreign business. In addition, the current rules do not distinguish between Canadian and foreign business.

Our committee debated the merits of explicitly modeling adjustable products. We concluded that there were too many additional variables to consider with respect to the specific product features, policyholder as well as management behaviour, which would make the modeling difficult to perform and the analysis difficult to interpret or apply. Based on these considerations and input from the regulator, our approach was to not model explicitly the adjustable products. Consistent with other elements of the capital rules, these products would receive a reduction in the capital requirements equal to 50%, provided that certain criteria are met.

Group business was also not modeled explicitly, but it was felt that the impact would be similar to individual products of similar duration.

The analysis was done primarily on the basic death benefit. The results from very limited testing done on accidental death coverages suggested that the current approach of taking 30% of the basic factors is reasonable. In most cases, the accidental component would be fairly incidental to the total mortality requirement.

A summary of the key assumptions included is found in Appendix A.

4. SIMULATION RESULTS

The following observations were gleaned from the simulation results:

- We found more variability in the results than the range in the current rules. Some blocks generated capital requirements which were higher than the current factors, whereas others produced lower requirements.
- Results were found to be very sensitive to the distribution of projected claims (which in turn is a function of the distribution of face amounts, age, and other factors).
- Blocks consisting of contracts with long remaining terms appeared to have higher requirements than those with shorter terms. Intuitively, this observation seems reasonable. In a similar vein, blocks with very high assumed persistency rates had higher requirements than those with lower persistency rates. The combination of these points suggested that some measure of duration would be a variable in the formula.
- We also observed that the size of the block plays an important role, i.e., the greater the number of lives in the pool, the smaller the resulting requirement. Again, this is not a surprising outcome.

- Portfolio simulations were done both with and without reinsurance. The observations confirmed our suspicions that reinsurance can alter the net claims distribution and can thus have a dramatic effect on the requirements.
- Although there was some interplay between the volatility and the catastrophe components, for the most part, they could be treated as stand-alone elements.

Summary graphs of selected simulation results are included in Appendix B.

5. DESCRIPTION OF INITIAL PROPOSAL

After the simulations were performed and the initial observations about trends were made, the challenge was to convert these observations into a workable formula. The desirable features we were looking for included:

- a) The formula would produce a reasonable fit to the simulation results. Given all the differences which exist in the insured groups, the product designs and the actuarial assumptions employed, it was clear that no formula can completely reproduce a stochastic model. However, we wanted to minimize the extent of outliers.
- b) The formula would be relatively straightforward to use. The number of elements required to be calculated would be limited and not overly onerous to generate. While there may be initial implementation issues in some instances, the exercise should be more or less routine on an ongoing basis.
- c) Credit would be given for policies where the insurer can effectively pass the risk to the policyholder. As noted in Section 3, anything other than a simple adjustment would be difficult to test, justify and implement.

Based on the observations noted in Section 4, we began to investigate a variety of different variables. For the catastrophe component, the relationship was clear that the variable to consider was next year's projected death claims. For the volatility component, the standard deviation of next year's death claims appeared to provide a reasonable reflection of the claims distribution, and it also captured the block size. The Macaulay Duration of the projected claims seemed to capture the elements of remaining term and persistency. With regression analysis, we found that linear combinations of these two variables produced very reasonable fits for the volatility component across a spectrum of products on a gross basis. However, the formula did not consistently produce a good fit when reinsurance was introduced. We then experimented with combinations involving some form of the product of these variables. This ultimately led to the development of the following formula:

$$\text{Required Capital (RCBD)} = ((2.5 \times A \times B) + (0.1 \times C)) \times G/H \quad \text{where}$$

A is the standard deviation of next year's net death claims for the insurer,

B is the natural log (ln) of the Macaulay Duration of projected death claims for the insurer (with a minimum value of 1),

C is next year's projected death claims for the insurer,

G is the Net Amount at Risk for the insurer, and

H is the net face amount for the insurer.

All of the amounts are determined on a net of reinsurance basis. Furthermore, the net death claims and face amounts only reflect basic death claims, i.e., accidental deaths are not included.

While this formula was developed through experimentation with respect to its fit, we can offer some general comments on the "rationale" behind the formula.

In a normal distribution, achievement of 97.5% confidence (roughly comparable to CTE (95)) occurs at 1.96 standard deviations. Given that we are investigating the impact on total cash flows (as discussed in Section 2), and not just the additional death claims, it makes sense that the multiple of standard deviations would be a bit higher. In addition, given the fact that we are using as a proxy the standard deviation of next year's claims, rather than looking at the variability throughout the term of the policies, it seems reasonable that the multiple would exceed 1.96. With respect to the duration element, it was found that a simple multiple overstated the requirements for very long durations and understated at the shorter durations. We experimented with the square root of the duration as an alternative, but found that the ln produced a better fit. To ensure that companies provide for at least one year's worth of adverse claims, a minimum value of 1 was established for B.

As noted in Section 4, the catastrophe component is largely a simple add-on to the capital requirements. The 10% factor is consistent with the level assumed in the simulations.

The last adjustment in the formula multiplies the result by the ratio of the net amount at risk to the net face amount. The purpose of this adjustment is to recognize that policies which are fully- or close to fully-funded represent less exposure to the insurer. We experimented with having the standard deviation and Macaulay Durations directly take into account the NAAR, but found that the aggregate adjustment in our proposal produced a better fit. In a sense, the current capital rules also employ an approach giving recognition for the net amount at risk.

Appendix C includes graphs which compare the formula results against the simulation results. The graphs demonstrate that the formula produces reasonable results when the requirements are in the range of \$1 to \$3 per thousand of NAAR. There are some outliers, but the fit appears to be superior to the current rules, which are also displayed on the graph.

It should be emphasized that the analysis was done strictly for individual, mortality guaranteed life products. The formula needs to be modified for products where adverse mortality experience may be passed on to policyholders in terms of dividends, premium adjustments, or other mechanisms. As noted in Section 3, the modification to the formula is essentially a 50% credit for the adjustable business. The revised formula, with the new terms defined, becomes:

Required Capital (RCBD) = $((2.5 \times A \times B) + (0.1 \times C) - D) \times \frac{G}{H}$, where

$D = 2.5 \times A \times \min(\max(0, B - 1), 0.5 \times B) \times \frac{E}{G}$ and

E = the NAAR for Adjustable Products.

A separate formula is necessary for required capital for accidental death benefits. In our proposal, this was calculated as 30% of the capital required for basic deaths multiplied by the ratio of the NAAR for accidental deaths divided by the NAAR for the whole company for net basic deaths.

To ensure consistency in approach, our formula contemplates that the Macaulay Duration be calculated using a flat 5% interest rate. In addition, the projections are to be based on valuation assumptions, i.e., best estimates plus MfAD, and that all valuation decrements are to be reflected.

Our committee did not have strong views about other adjustments found in the current rules. Examples include the 85% credit for hold harmless agreements and the up to 100% adjustment for funds on deposit. Our proposal maintains the 85% credit by only including 15% of the values for values associated with hold harmless and similar agreements. As our formula is meant to be applied on an aggregate basis, the adjustment for funds on deposit has been lifted from the current rules. We acknowledge that this is not really a satisfactory approach, that would be revisited as part of a final proposal.

6. INITIAL SURVEY OF INSURERS AND FEEDBACK

A survey was circulated to all life insurers in March 2004. The objectives of the survey were:

- To provide information regarding the impact of the proposed formula on capital requirements; and
- To obtain feedback from companies regarding the practical implementation issues of the formula, as well as theoretical considerations.

A copy of this initial survey is included in Appendix D.

Forty-three companies participated in the survey. Companies were encouraged to employ approximations if precise calculations were not available due to systems or data constraints. Because of concerns regarding consistency in the application of the formula or in the approximations, the actual quantitative results need to be taken with a grain of salt. Notwithstanding this caveat, a few general remarks may be made. The weighted average ratio improved with the proposed formula for respondents under federal regulation (i.e., those filing MCCSR or Test of Adequacy of Assets in Canada and Margin Requirements (TAAM) returns), but decreased for the Québec-based companies. However, the results did vary significantly by company. More than 60% of all companies showed lower ratios under the proposed formula.

Our sub-committee found it more beneficial to review the feedback offered with respect to the application of the formula. Many companies believed that the proposed formula, in general, represented an improvement over the current rules, in that it captures the major drivers which affect the mortality risk. Indeed, there was very little interest on the part of the companies to explore a stochastic modeling alternative, at least for the near future. Only two companies reported to have experimented with an internal model for the mortality risk, and two additional companies indicated a willingness to consider developing models if the rules would so permit, and even then would require years for implementation.

With respect to the formula proposed, the following areas were identified for re-consideration.

a) Aggregation

The formula called for the computation of:

- A standard deviation for the entire company;
- A duration for the entire company;
- A credit for adjustable based on the total company requirements, scaled for the NAAR;
- NAAR adjustments applied at the total company level;
- An accidental death component based on the total company basic death requirements.

Several companies felt that these aggregations in the formula created distortions and anomalies. For example, it was perceived that products with large volumes, low standard deviations and short durations were not receiving appropriate capital recognition due to the use of the total company duration, which tends to be more heavily weighted to the products with longer duration. As another example, some companies argued that the formula could potentially penalize niche players in Accidental Death Benefit (ADB) by not considering the specific product line characteristics.

b) Independence of Coverage

Related to the question of aggregation is the issue of independence. In the calculation of the standard deviation, there is an assumption that the mortality for each policy or coverage is independent. That is not strictly true when there are multiple coverages per life.

c) Credit for Adjustable - Catastrophe

The original formula proposed only provided the 50% reduction for adjustable business on the volatility component. Companies felt strongly that any source of mortality deviation could and would be passed through, so credit would be applied to both volatility and catastrophe.

d) Lack of Seriatim Data – Group Business

The most significant practical concern raised by certain companies was the unavailability of data to calculate the standard deviation and duration. This issue was cited in particular for group business. With respect to individual lines of business, it was felt that most companies either had the ability to calculate the measures without too much difficulty, or at least had the ability to do so with sufficient lead time.

It is interesting to note that some companies believed that the 30% total company factor used for the ADB mortality component was excessive in their situations. In any event, companies wanted the opportunity to calculate the ADB mortality component using seriatim data.

e) Treatment of Hold Harmless Agreements, Stop Loss Arrangements and Catastrophe Covers

It was requested that our sub-committee revisit these special arrangements to ensure that appropriate recognition is made in the formula.

f) Adjustable Reinsurance on Guaranteed Direct

This issue was raised more for completeness, as it was not perceived to be a prevalent problem. The formula is calculated on a net of reinsurance basis, but no direction is provided in situations where the gross mortality premiums are guaranteed but the reinsurance premiums are adjustable.

7. FORMULA REVISIONS

Based on the feedback received, the following changes were made to arrive at the revised proposal.

a) Aggregation

With respect to the aggregation issue, volatility and catastrophe components are to be computed separately by product line groupings (i.e., having similar attributes regarding adjustability and duration). The formula for volatility, which has been streamlined to reflect the adjustable element directly in the duration becomes:

$$\text{Volatility Component Basic} = 2.5 \times A \times B \times \frac{G}{H}, \text{ where}$$

B is the greater of $\ln(\text{duration})$ and 1 for nonadjustable products,
and
 B is the greater of $(0.5 \times \ln(\text{duration}))$ and 1 for adjustable products.

The volatility components are then aggregated by taking the square root of the sum of the squares.

This can be expressed as:

$$\sqrt{\sum (2.5 \times A \times B \times G/H)^2}$$

These formula revisions are superior to the original formula in the following respects:

- A more appropriate weighting is provided for the shorter duration products;
- Line specific totals allow for more appropriate handling of the reductions for adjustable, the credit Claims Fluctuation Reserves and the ADB volatility component;
- This form of aggregation was tested in our model portfolios and the fit relative to the actual simulation results improved.

b) Independence of Coverages

It is true that the proposed formula assumes independence of coverages for the basic volatility component. However, it is our understanding that the data to do otherwise may not be available in most cases. In addition, it can be demonstrated that a simple adjustment such as multiplying the factors by the square root of the average ratio of number of coverages to lives is very likely to be inappropriate for a number of reasons, including the following:

- The coverage/life ratio is not typically uniform across policies;
- The results are hugely dependent on the relative face amounts of the multiple coverages;
- Reinsurance can significantly affect the net face amounts;
- Multiple coverages on the same life may have different adjustability and/or duration features.

Accordingly, we do not believe that the independence simplification will result in a gross understatement of the capital requirements. Furthermore, we are proposing that the ADB volatility component be added to the basic volatility component in recognition of the fact that many of those covered under ADB also have basic death coverages (This might result in a slight overstatement of the requirements).

c) Credit for Adjustable - Catastrophe

We are now proposing that the credit for adjustable be applied as well to the catastrophe component. The formula for this component becomes:

$$\begin{aligned} \text{Catastrophe Component} &= 0.1 \times C \times G/H, \text{ for nonadjustable} \\ \text{and } \text{Catastrophe Component} &= 0.05 \times C \times G/H, \text{ for adjustable.} \end{aligned}$$

Requirements by line of business would simply be added, i.e., not aggregated through squaring, summing and taking the square root. In our model portfolios, the fit worsened when we attempted to apply the aggregation approach used for volatility in the catastrophe component.

d) Lack of Seriatim Data – Group Business

To deal with the lack of seriatim data in group business, we considered the following options:

- Retain the current rules;

- Determine standard deviations based on the insurer's actual death claim experience;
- Apply proxy methods to estimate A and B.

Our sub-committee's view was that we did not have a justifiable basis to retain the existing factors. As well, there was not a split between volatility and catastrophe which was necessary for aggregating the risks. We also rejected the historical observations approach, as some participants indicated there may be difficulties in obtaining the data, or even if the data had credibility.

We concluded that a proxy method had the most appeal. We used Statistics Canada data on the distribution of ages and salaries in the working age population². We then calculated the standard deviations under a variety of scenarios and found a fairly close relationship between the standard deviation and two variables: the projected claims over 12 months ("C" in our required capital formula) and the number of lives. The formula for A is as follows:

$$A = \frac{39}{\sqrt{\text{lives}}} \times C$$

With respect to B, where the rates are adjustable or where the guarantee period is less than 2 years (presumed to be the vast majority of cases), we are proposing a value of 1. In situations where the remaining guarantee period is more than 2 years, we are proposing a default value of 2. The value of 2 was arrived at by calculating the $\ln(\text{duration})$ using an assumption of claim rates increasing at approximately 5% per annum and annual lapse rate of 12% (i.e., renewals are assumed). It should be stressed that the default values for A and B are only to be used when seriatim data are not available.

The catastrophe component for ADB has been modified to reflect a more representative level of mortality for this coverage relative to basic deaths. If seriatim data are not available, we are proposing the use of 30% of the basic factor for volatility and only 15% for catastrophe. Earlier testing had demonstrated that the volatility component is not totally proportional to the level of mortality rates. In addition, in our revised proposal, companies would be allowed to calculate the ADB requirements using the same formula employed for basic deaths, if they have the appropriate seriatim data.

e) Treatment of Hold Harmless, Stop Loss and Catastrophe Covers

Under the current rules, hold harmless and other similar arrangements only provide an 85% reduction in the mortality requirements. Our understanding is that the purpose of this 15% clawback is to provide for counterparty risk. While our Committee acknowledges that a thorough analysis of counterparty risk is outside the scope our review of the mortality factors, we strongly recommend that the flat 15% reduction be revisited by the regulators. At the very minimum, there would be reflection that certain counterparties, such as the federal government, attract no asset default requirements, and accordingly, the 15% reduction for hold harmless is excessive.

Our initial survey indicated that stop loss arrangements are not used to a great extent by insurers. Perhaps a contributing factor to the lack of popularity of stop loss arrangements is the fact that the current rules impose a maximum 40% limit (before the application of credits for claim fluctuation reserves and the like) on the credit received. There does not appear to be any justification for this

² The references used were: <http://www.gov.on.ca/FIN/english/demographics/cenpe0311ea.htm> and Statistics Canada – Cat. No. 97F0019XCB01060

arbitrary 40% limit. It is our Committee's view that the credit given would be based on the reduction in the mortality risk achieved. These agreements can be quite customized with respect to attachment points, durations, premiums, experience adjustments, etc. Limited testing by our Committee indicates that these features cannot be easily translated into simple adjustments of our proposed formula. Accordingly, we propose that companies be required (as per the current rules) to perform modeling on these arrangements and obtain regulator approval before any credit would be granted. The modeling would consider the combined effect on volatility and the one time spike in claims, consistent with the approach described in Section 3 and Appendix A of this Research Paper. With respect to catastrophe covers, our sub-committee concluded that they would continue to be excluded from consideration, at least for now. The catastrophe component proposed was based on general population considerations, and not on risk concentration considerations. Given that risk concentration was not included in the requirements, it is not meaningful to look at potential credits arising from catastrophe agreements. Our group believes that risk concentration would be addressed as part of the bigger issue of risk diversification and correlation of risks, which is not confined to mortality, but in fact is pervasive of the capital requirements in general.

f) Adjustable Reinsurance on Guaranteed Direct

We are proposing that this issue be dealt with by computing the requirements with and without this reinsurance, and then taking the average. This, in effect, gives 50% credit for the reinsurance, which is consistent with the approach taken for adjustable gross mortality charges. We acknowledge that there is an element of arbitrariness in the use of the average, as the degree of adjustability may vary by reinsurance agreement. But it should be emphasized that similar simplification was employed for the adjustability of gross premiums. In addition, the current rules do not distinguish with respect to the nature of the adjustability of reinsurance. We suggest that the issue of credits for adjustability on both the gross and the reinsured premiums be investigated as part of a future initiative to improve the capital rules.

8. SUBSEQUENT SURVEY FEEDBACK

A revised survey covering the issues identified in Section 7 was circulated in June 2004. For the purposes of this survey, no changes were included in the respective limits for hold harmless agreements and stop loss arrangements. Given our desire for a reasonably quick turnaround, the target group for this survey consisted of those companies that participated in the first survey. Two additional companies also participated. A copy of this subsequent survey is included in Appendix E.

There was interest in seeing how the results varied by size of company. Accordingly, the company responses were grouped by the following size groups:

Group 1: Total Required Capital greater than or equal to \$1 billion

Group 2: Total Required Capital greater than or equal to \$250 million, but less than \$1 billion

Group 3: Total Required Capital greater than or equal to \$50 million, but less than \$250 million

Group 4: Total Required Capital less than \$50 million.

The key statistic of interest was the multiple of the proposed ratio to the current ratio. Results are summarized in the following tables:

TABLE 1 – Results by Capital Category and Size Group

Category	Size Group	Number	Average Prop/Curr	Range Prop/Curr	# Cases With Improved Ratio
MCCSR	1	3	105%	102% to 111%	3
MCCSR	2	1	102%	102%	1
MCCSR	3	6	106%	86% to 107%	4
MCCSR	4	9	95%	53% to 102%	3
MCCSR	Total	19	104%	53% to 111%	11
TAAM	1	0			
TAAM	2	2	134%	120% to 144%	2
TAAM	3	2	129%	107% to 151%	2
TAAM	4	3	77%	39% to 89%	0
TAAM	Total	7	130%	39% to 151%	4
CAR	1	0			
CAR	2	2	107%	104% to 109%	2
CAR	3	1	99%	99%	0
CAR	4	6	99%	85% to 108%	2
CAR	Total	9	105%	85% to 107%	4
Total	Total	35	106%	39% to 151%	19

TABLE 2 – Distribution of Companies by Range of Multiple

Range	MCCSR	TAAM	CAR	Total
<80%	1	2	0	3
[80%, 90%)	2	1	2	5
[90%, 100%)	5	0	3	8
[100%, 110%)	10	1	4	15
[110%, 120%)	1	1	0	2
>=120%	0	2	0	2
Total	19	7	9	35

As can be seen, for all companies combined, the overall ratio improved by 6%. As well, the overall ratio improved for each of the three filing categories. However, the results were clearly not uniform, as 46% of the respondents experienced lower ratios under the proposal. Sixty-five percent of the companies had ratios that were within 10% of the ratios under the current rules, and 86% were within 20%. Companies in the smallest size group tended to fare worse with the proposed formula, with 72% of those surveyed reporting lower ratios. The regulators are following up with the extreme outliers to gain a better understanding of the results and to ensure consistency of application of the rules.

The variability in results should not necessarily be surprising. Our earlier modeling had indicated that we would likely observe differences relative to the existing formula. The fact that smaller sized companies tended to do worse suggests that the current formula does not adequately reflect the

underlying risks. It should also be emphasized that we did not impose a goal of capital neutrality in arriving at our proposal.

Notwithstanding the variability in results, the general feedback was, on the whole, more positive than the comments received from the first survey. This would suggest that the proposed formula in the revised survey addressed many of the concerns identified in the first submission. However, the following additional comments were received:

a) Concerns regarding the groupings by the $\ln(\text{duration})$

Some respondents felt that the groupings included in the survey for $\ln(\text{duration})$ were arbitrary and could lead to inconsistent handling by insurers. In our committee's view, the intent is that companies can and preferably would calculate the requirements with similar durations together. Provided that the instructions are clear for aggregation, it really is not necessary to have the category splits by $\ln(\text{duration})$.

b) No explicit credit for level of mortality MfADs or for premiums

Despite the fact that the proposed formula captures more of the risk drivers than the existing rules, some respondents were of the view that additional company specific considerations need to be reflected. One example cited was the extent of margin already recognized in the mortality MfAD, e.g., companies would be permitted to hold lower capital requirements if they were already providing for high levels of margins within the policy liabilities. Another example given was that the level of premiums was not a parameter in the proposed formula. The company charging a higher premium rate may be more insulated from mortality adversity than the company that charges a lower premium rate for the same product.

In general, our committee agrees that more company specific inputs could theoretically enhance the precision of the exercise to determine the mortality capital requirements. In the extreme, we could simply dispense with the formula approach and simply recommend that companies calculate the requirements through their own modeling. Our committee has attempted to strike a balance: introduce a number of relevant risk drivers but not to the point where the exercise becomes virtually impractical to implement and maintain. All material cash flows were reflected in the modeling work done and the resulting development of the formula, but they were based on "average" or typical assumptions for the particular products modeled. The mortality capital requirements will vary from company to company based on product and company specific considerations such as the population distribution, the degree that reinsurance changes the volatility, the effective duration, and whether the company offset the unfavourable experience through rate increases and/or dividend reductions.

Our committee did review the specific examples noted earlier by the respondents. With respect to the mortality MfAD within the policy liabilities, our view remains that companies would establish their policy liability provision based on the risks of misestimation and permanent deterioration. Our premise is that there are additional risks covered in the capital requirements and these would be provided for separately. It does not follow that a high margin within the policy liabilities would lead to a lower capital requirement. Indeed, some of the criteria which lead to higher requirements within the policy liabilities may be indicative of a need for higher capital requirements as well. There is no double counting here. Rather, it is a recognition that a company is vulnerable to various forms of risk.

With respect to the comment that capital requirements would be reduced for products with high premium rates, our view is that the full premium has already been reflected in the development of

the policy liabilities under Canadian GAAP. Accordingly, there is no additional source of premium that can be used to offset the claims experience contemplated by the capital requirements. If anything, it can be argued that under a consideration of all cash flows, the capital requirements should reflect the potential loss of these excess premiums (which have already been included in the liability determination) due to adverse deaths. In addition, it would not be appropriate to simply focus on premiums – higher premiums could be accompanied with higher level of distribution and other expenses, or additional benefits.

c) Continued use of approximations

Many respondents applauded the changes incorporated in the second survey to allow companies alternative approaches in situations where seriatim data may not be available. However, some companies continued to express concern that significant approximations were still necessary to submit to the revised survey and are concerned that the data and infrastructure requirements to produce the data to comply on an ongoing basis with the proposed formula are excessive. We accept this comment and would therefore strongly encourage the regulators to accept the continuing use of reasonable approximations in applying the proposed formulas. As with approximations used elsewhere, actuaries will be expected to justify the appropriateness of such approximations.

Our committee has already made modifications in the formula in areas where many companies would need an alternative method, such as ADB and group. We have also become aware that software vendors have already given some thought as to how their systems could be used to obtain needed pieces. For example, GGY recently has issued some guidance to companies wishing to calculate the standard deviation of next year's death claims using AXIS, specifically for the purpose of determining the mortality requirements under the proposed rules.

We agree that actuaries need to apply judgment regarding the use of approximations for ADB. In particular, the forms need to be changed so that the scaling does not automatically link to the basic NAAR. Scaling would be based on the basic death component having similar characteristics. For example, if there is significant reinsurance in place with the basic death coverages, but little or no reinsurance on the ADB coverages, then it would be more appropriate to base the ADB requirement on the basic without reinsurance. As another example, the scaling for complementary group ADB contracts is reasonable only if the ADB coverages are relatively incidental to the basic coverages. However, when ADB contracts are material relative to the basic, they would be handled as stand alone contracts.

d) Difficulties in projecting future required capital

Even if the logistical obstacles of calculating the required capital for this proposed approach can be overcome, some companies were concerned regarding the potential challenges involved in performing projections for pricing, embedded value, planning or Dynamic Capital Adequacy Testing (DCAT) purposes.

Our committee agrees that projections may not be as straightforward as under the current rules. However, that concern, on its own, is not a valid reason to reject the proposal. There are other instances where projections are challenging, e.g., projecting liabilities and capital for segregated fund guarantees. There is no doubt that companies will look for effective solutions to perform projections, such as assuming a reasonably stable ratio of required capital to NAAR, at least for a short period. As with the issue of approximations, the actuary would be able to justify the approach taken.

Appendix F contains a revised proposal which reflects the changes described in a) and c).

9. CONCLUSIONS

Our committee's view is that the proposed changes to the required capital for mortality, as presented in this paper, reflect improvements over the existing rules and should be considered for implementation by the regulators. We believe that the proposed formula contains the desirable features identified in Section 5, namely, that it produces results reasonably consistent with simulation modeling, is relatively straightforward to use, and that credit is given for adjustable business.

We recognize that some companies may require some lead time to fully implement any systems changes necessary to accurately generate the data necessary for the calculations, and we suggest that the regulators take this into account in deciding when to make the changes effective, and also that the regulators be sensitive that approximations may be necessary in certain situations.

It has been demonstrated that some companies will experience reductions to the capital ratio as a result of these proposed changes. While we believe the results under the proposal are more reflective of the underlying risk inherent in the block, it seems reasonable to allow companies time for transition to the new rules. The transitional period would provide companies the opportunity to modify the risk profile of their business through product changes, more effective forms of reinsurance, or other means. There have been precedents for transitional arrangements in capital rule changes, and we would recommend that the regulators pursue a similar track here. We also propose that the current limits for hold harmless agreements and stop loss arrangements be reviewed and/or eliminated, as discussed in Section 7.

We encourage additional investigation to further improve the requirements. Expansion of the catastrophe component to include regional risk concentration is one area which warrants review, coupled with an appropriate credit for catastrophe reinsurance. Another item which could be looked at is the reduction regarding adjustable business. We have taken a fairly simplistic approach for adjustable business, essentially providing for a 50% reduction in the capital rules, which is consistent with other aspects of the current capital rules. This investigation would include a review of the appropriateness of the reinsurance credits, when reinsurance premiums are adjustable. Yet another area to be explored is the appropriateness of the margins in the policy liabilities. This paper has worked with the assumption that the margins embedded in the policy liabilities are adequate to cover the risks of misestimation and permanent deterioration of the mean, and accordingly, no additional amounts need to be provided for within the capital requirements in connection with these risks. This would be reviewed. Similarly, the merits of a Total Balance Sheet approach, as adopted for segregated fund guarantee provisions, should be investigated for the mortality risk.

Lastly, this paper operated under the premise that companies were not interested in investing the time and resources to develop their own modeling capabilities, and accordingly, a revised formula was preferred. This premise was largely confirmed by the survey respondents. But attitudes on this subject may change over time, particularly if valuation software vendors begin to offer features to facilitate the modeling work. Work will then be required to establish a protocol for the models.

APPENDIX A: SUMMARY OF KEY ASSUMPTIONS USED IN SIMULATIONS

Monte Carlo simulations were performed on a series of portfolios of various sizes, distributions of sum assured and demographic characteristics, based on the statistics from the latest CIA Intercompany Mortality Study. The portfolios varied primarily in the distributions of sum assured, as this was found to be the key driver in the results. Limited testing of portfolios of alternate demographic characteristics was conducted to ensure that the formula remained appropriate for these other distributions. The capital requirements were determined as the difference between the present value of liability cash flows at CTE (95) and the corresponding present value at CTE (0). The interest rate used in the present value calculations was 5% per year.

a) Portfolio Demographics

Each portfolio was assumed to be broken down by age, sex and smoking status as indicated in the following table:

Distribution by Smoking Status

Male non-smoker	56%
Male-smokers	14%
Female non-smokers	24%
Female smokers	6%
Total	100%

By issue age

17	27	30	37	42	47	52	57	62	67	74
3%	5%	7%	14%	17%	15%	13%	9%	6%	5%	6%

By Duration since issue

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
4%	5%	7%	7%	8%	9%	10%	9%	6%	6%	7%	7%	5%	2%	2%	6%

b) Distribution of sum assured by portfolio

The following table summarizes the distribution by sum assured of 20 sample portfolios. Testing was conducted assuming that each of these 20 portfolios has 50,000 independent lives, and then again assuming that they have 100,000 lives. In total, 40 portfolios were tested.

	30,000	80,000	100,000	150,000	225,000	300,000	400,000	550,000	1,400,000	6,000,000	14,600,000	Total
1	47.2%	2.2%	29.7%	4.4%	9.1%	2.1%	0.6%	3.1%	1.6%	0.1%	0.0%	100.000%
2	78.9%	2.8%	12.5%	1.8%	2.5%	0.5%	0.2%	0.6%	0.2%	0.0%	0.0%	100.000%
3	47.1%	2.1%	13.7%	2.7%	21.2%	3.3%	1.2%	5.6%	3.1%	0.2%	0.0%	100.000%
4	47.4%	3.6%	29.8%	2.6%	8.4%	3.2%	1.5%	2.1%	1.5%	0.0%	0.0%	100.000%
5	54.5%	3.4%	28.0%	4.0%	5.9%	1.2%	0.4%	1.7%	0.8%	0.0%	0.0%	100.000%
6	20.6%	1.6%	46.4%	5.9%	16.1%	3.3%	1.0%	3.7%	1.3%	0.0%	0.0%	100.000%
7	49.7%	1.7%	30.9%	5.9%	8.2%	1.8%	0.5%	1.1%	0.2%	0.0%	0.0%	100.000%
8	86.5%	1.7%	10.0%	0.7%	0.8%	0.1%	0.0%	0.2%	0.0%	0.0%	0.0%	100.000%
9	45.0%	5.4%	35.9%	5.0%	5.9%	1.1%	0.3%	1.1%	0.4%	0.0%	0.0%	100.000%
10	76.4%	3.7%	11.3%	2.0%	3.7%	1.0%	0.3%	1.0%	0.7%	0.1%	0.0%	100.000%
11	71.7%	1.4%	23.3%	1.6%	1.5%	0.2%	0.1%	0.2%	0.1%	0.0%	0.0%	100.000%
12	69.4%	1.9%	21.8%	2.1%	3.3%	0.5%	0.2%	0.6%	0.2%	0.0%	0.0%	100.000%
13	57.8%	2.6%	24.4%	3.2%	7.2%	1.5%	0.5%	1.7%	0.8%	0.0%	0.0%	100.000%
14	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.000%
15	0.0%	70.0%	0.0%	30.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.000%
16	46.0%	4.2%	33.4%	5.4%	1.6%	3.2%	0.3%	4.8%	0.9%	0.2%	0.0%	100.000%
17	64.6%	3.4%	21.8%	1.5%	5.7%	1.9%	0.5%	0.5%	0.1%	0.1%	0.0%	100.000%
18	64.5%	2.9%	18.1%	4.4%	6.1%	1.6%	0.9%	0.7%	0.6%	0.1%	0.1%	100.000%
19	43.8%	4.7%	32.8%	3.5%	6.9%	3.3%	0.6%	3.0%	1.0%	0.1%	0.1%	100.000%
20	54.5%	1.7%	30.8%	5.0%	1.5%	2.1%	0.6%	3.1%	0.6%	0.1%	0.0%	100.000%

c) Product Assumptions

The 40 portfolios were tested five times, each time assuming that the individuals held a different type of individual life policy. The product forms that were tested include:

- Term to 100 (with no cash values)
- 10-year renewable term
- Annually Renewable Term
- Whole life non-participating with cash values
- Universal Life (Level COI)

The product features of each policy type were selected to be reasonably representative of currently sold products in the Canadian market. The committee recognizes that many products are currently in-force on older policies that are not represented by these newer product forms, but believes that these product differences do not materially alter the results of the testing.

1. Product coverage

All products were assumed to provide coverage for the whole of life (i.e., to the end of the mortality table), with the exception of the 10-year renewable term product, whose coverage ceased at age 70. Premiums were assumed to be payable in each year. No modeling of paid-up life or limited pay life was performed.

2. Mortality

In all of the testing, we assumed that mortality would follow 70% of the CIA 86-92 select and ultimate ANB table. Testing was also done at 80% of the table, which identified no material difference in results.

3. Expenses

	T100	RT10	YRT	Whole Life	UL
Per policy *	\$45	\$35	\$35	\$55	\$75
Per Premium	5.0%	5.0%	5.0%	5.0%	5.0%
Per Death Claim *	\$175	\$175	\$175	\$175	\$175
Per lapse claim *	\$40	\$25	\$25	\$40	\$40
Premium tax	2.0%	2.0%	2.0%	2.0%	2.0%

* Note: these costs were subject to a 3% annual inflation rate.

Investment income taxes and other expenses were ignored in the modeling.

4. Lapses

These assumptions vary by product, as indicated in the following tables:

Duration	1	2	3	4	5	6-10	11+	*
T100	10%	8%	6%	5%	4%	3%	1%	
RT10 *	15%	10%	8%	6%	5%	5%	5%	
YRT	10%	10%	10%	10%	10%	10%	10%	
Whole Life	10%	8%	6%	5%	5%	5%	5%	
UL (Level COI)	10%	8%	6%	5%	4%	3%	1%	

*At each renewal, there is an additional 40% lapse rate, of which 75% is considered selective.

5. Sample premium rates

Sample premium rates per \$1,000 sum assured are shown in the following tables. In the modeling, separate premium tables were used for sex/smoker statuses (i.e., male non-smoker, male smoker, female non-smoker, female smoker).

In addition, an annual policy fee of \$75.00 per policy was assumed, regardless of product type, with the exception of UL (for which a \$9.00 per month policy charge was applied against the policyholder fund balance).

T100 sample premium rates

Issue Age	MNS	MS	FNS	FS
20	3.88	5.85	2.83	3.95
30	5.50	8.91	4.19	6.18
40	8.55	14.63	6.54	9.91
50	13.90	24.41	10.54	15.70
60	22.26	37.67	17.19	24.05

RT10 MNS sample premium rates

Issue Age	Dur 1-10	Dur 11-20	Dur 21-30	Dur 31-40
20	0.68	0.87	1.44	3.52
30	0.70	1.44	3.52	9.78
40	1.05	3.52	9.78	n/a
50	2.46	9.78	n/a	n/a
60	6.62	n/a	n/a	n/a

YRT sample premium rates

Attained Age	MNS	MS	FNS	FS
20	1.68	2.04	1.44	1.80
30	1.68	2.28	1.56	1.92
40	2.40	3.60	2.28	3.00
50	4.68	7.92	3.84	5.88
60	10.09	18.04	7.68	12.36

Whole Life sample premium rates

Attained Age	MNS	MS	FNS	FS
20	4.91	3.80	5.75	4.30
30	7.35	5.86	8.86	6.75
40	11.31	9.14	14.39	10.82
50	17.84	14.54	24.22	17.82
60	29.16	24.02	41.03	29.43

UL Level COI sample premium rates

Attained Age	MNS	MS	FNS	FS
20	4.73	6.06	3.90	4.55
30	6.94	8.86	5.72	6.67
40	10.62	14.77	8.76	11.09
50	18.60	25.95	15.31	19.43
60	31.84	44.42	26.19	33.26

6. Cash value scale for whole life

The CSV's have been determined using 90% of the CIA 86-92 aggregate tables (male and female) and 5% interest.

7. Universal Life: Cash Values on policyholder funds

Sample cash value tables per \$1,000 of sum insured for male non-smoker universal life policies (i.e., fund balances net of surrender charges) are shown in the following tables. In the modeling, different tables were used for different sex / smoker status combinations.

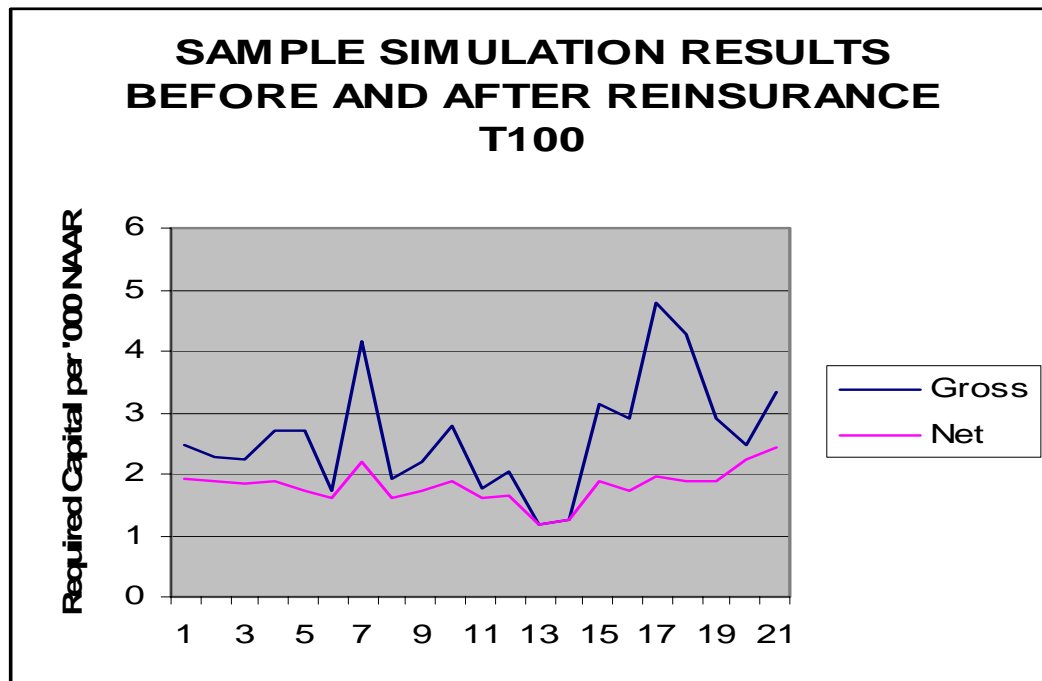
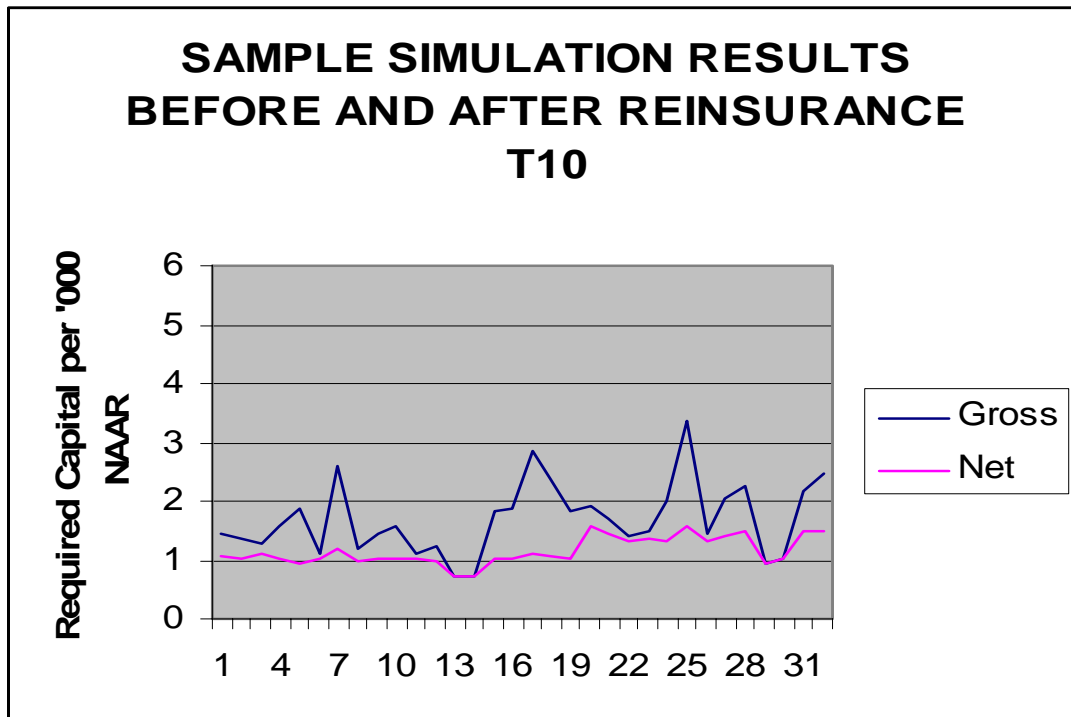
MNS cash values	Duration						
	1	5	10	15	20	30	40
Issue Age							
20	0.11	1.75	6.63	11.36	17.39	34.84	63.14
30	0.17	2.88	10.90	18.68	28.58	57.26	103.77
40	0.29	4.77	18.08	30.97	47.39	94.94	172.06
50	0.48	8.03	30.42	52.12	79.75	159.76	289.53
60	0.84	13.86	52.53	90.00	137.72	275.90	500.00

d) Reinsurance Assumptions

Each simulation was conducted on a gross of reinsurance basis, as well as under three different reinsurance types. We assumed that the reinsurance terms applied to all policies in the portfolio and was guaranteed for the life of the policy. The reinsurance types that were tested are:

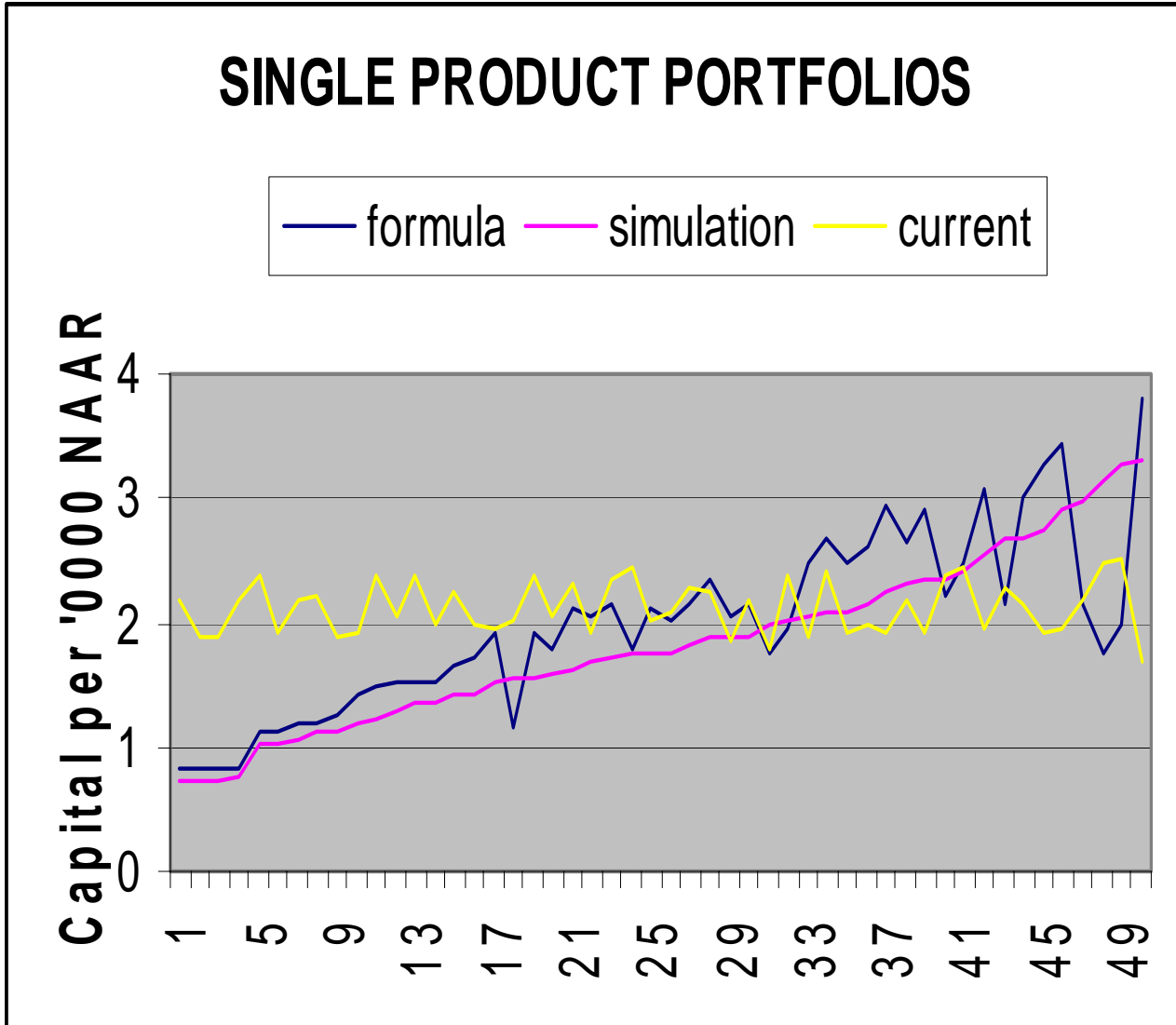
- YRT reinsurance on a quota share basis, in which the company retains 25% of the sum assured, to a maximum retention per life of \$200,000. Reinsurance premiums are payable annually in advance, on a YRT basis, at the rate of 65% CIA 86-92 select and ultimate ANB table in the case of whole life, UL and T100, and 70% CIA 86-92 select and ultimate ANB table in the case of the renewable term products.
- Coinsurance, in which the company retains 25% of the sum assured (to a maximum of \$200,000) and a proportionate share of the gross premiums.
- YRT reinsurance on an excess of retention basis, in which the company cedes the excess sum assured over \$1 million. Reinsurance premiums are payable annually in advance at the rate of 65% of CIA 86-92 select and ultimate ANB table in the case of whole life, UL and T100, and 70% CIA 86-92 select and ultimate ANB table in the case of the renewable term products.

APPENDIX B: SAMPLE SIMULATION RESULTS



APPENDIX C: COMPARISON OF REQUIREMENTS BASED ON PROPOSED FORMULA FOR SAMPLE PORTFOLIO WITH:

- **SIMULATION RESULTS**
- **CURRENT FORMULA**



APPENDIX D: INITIAL SURVEY (www.actuaries.ca/publications/2004/204061e-d.xls)

Questions and comments

1. Company Name:

ABC COMPANY

2. Filing date of information provided:

31-déc-03

3. Does your company use MCCSR, TAAM or CAR (Quebec Companies):

MCCSR

4. Is your company a subsidiary which, under the current rules, has used a factor for statistical fluctuation equivalent to the parent's factor, as per 4-1-5 of the current MCCSR guidelines (D2.3 of the current CAR guidelines)?

5.. Please fill the yellow cells in the attached spreadsheets. If for any reason, you cannot provide all the requested details, it is expected that you provide as much as you can, with explanations regarding the remaining details.

6.. Please indicate any approximation that were used for the calculation of any number, including the durations.

7. Please comment on the difficulties you had to understand or apply the proposed approach.

8.. Please provide comments on the merits you perceive with the proposed approach.

9.. Indicate what type of credit has been taken for any stop loss. Comment on this please.

10. Do you use any internal model and approach to measure the mortality risk? If yes, please describe it.

11. Assuming the regulator would give approval, would you develop and use any internal model? In what time frame? For what purpose?

12. With respect to question 10, provide any information or analysis you believe may be helpful to the subcommittee.

True duration

ABC COMPANY

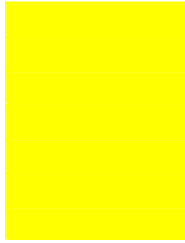
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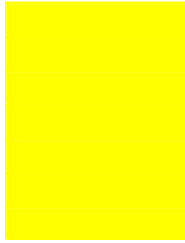
MCCSR

Comparison of True Duration with Approximate Duration

The proposal includes "default" duration values for product lines where Macaulay durations are not available. In order to assist us in assessing the appropriateness of the default values, please complete the following:

Product Type	True Duration
--------------	---------------

All renewable term	
Whole life	
YRT UL	
Level COI UL	
Term to 100	
All other individual life	
All group life	



Required Capital = Required capital for basic deaths + Required capital for accidental deaths

Required capital for basic deaths (RCBD) = $(2.5 \times A \times B + .1 \times C - D) \times G/H$

Required capital for accidental death benefit = $.3 \times \text{RCBD} \times F/G$

Where:

- A :** The Standard Deviation of the next year's Projected Value of the net basic death claims.
- B :** The natural log (ln) of the Macaulay Duration of the Projected Value of the net basic death claims. The interest rate used in this calculation is an annual rate of 5%. Note that B has a minimum value of 1.
- C :** The Projected Value of next year net basic claim amounts.
- D :** A reduction for Adjustable Products equal to: $2.5 \times A \times \min(\max(0, B-1), .5 \times B) \times E/G$. This adjustment is intended to give a 50% reduction in the requirements for adjustable business, subject to the B component for the adjustable business after the reduction being at least 1.
- E :** The NAAR for Adjustable Products for net basic deaths
- F :** The NAAR for net accidental death benefit (ADB) coverages
- G :** The NAAR for the company, for net basic deaths
- H :** Total Face Amount for the company for net basic deaths

Definitions

Projected Value : Expected values based on valuation assumptions (i.e. best estimate plus MfAD). Note that projections should include all valuation decrements.

NAAR : Total net death benefit less net statutory policy liabilities.

Standard Deviation (A) defined as :

$$A = \sqrt{E(x^2) - E(x)^2}$$

Where $E(x)$ is the expected value of next years death benefit payments. It is equal to C;
and

$E(x^2)$ is the expected value of the square of the death benefits.

Note that death benefits payments are based on face amount.

An alternative method of determining A is as follows:

$$A = \sqrt{\sum_{i=1}^n q_i (1 - q_i) b_i^2}$$

Where b_i is the face amount for policy i (net of reinsurance); and
 q_i is the valuation mortality including MfAD.

Adjustable Products : Products where mortality experience can be passed on to policyholder values in terms of dividends, premium adjustment or other mechanisms.

Special cases : In the case where projections are not available in order to calculate duration for the block then the duration is defined as M:

M = Minimum (time until the last projected death benefit cash flow, N)

Where N is:

Product Type	N
All renewable term	12
Whole Life, YRT UL	25
Term to 100, Level COI UL	30

Other products can be interpolated.

Group business : Should be included in Required Capital calculation. Note that group business does not necessarily fit into the adjustable product category.

Duration for the whole company : The calculation of the duration for the whole company can be derived as the weighted average of the duration of the various product lines where the weighting is based on the present value of projected net basic deaths.

Notes:

- No additional credit is given for catastrophe coverage.
- Please contact the regulators for credit on qualified stop-loss arrangements.
- Projected Values are multiplied by 15% for any group benefit that carries on of the following features:
 - 1) a "guaranteed no risk";
 - 2) deficit repayment by policyholder; or
 - 3) "hold harmless" agreement where the policyholder has a legally enforceable debt to the insurer.

APPENDIX E: SUBSEQUENT SURVEY

www.actuaries.ca/publications/2004/204061e-e.xls

General Information

1. Company Name :

[Redacted]

2. Filing date of information provided :

[Redacted]

3. Contact person :

[Redacted]

4. Email address of contact person :

[Redacted]

5. Phone number of contact person :

[Redacted] Extension : [Redacted]

6. Does your company use MCCSR, TAAM or CAR (Quebec companies) :

- MCCSR
- TAAM
- CAR

7. Please fill the yellow cells in the attached spreadsheets. If for any reason, you cannot provide all the requested details, it is expected that you provide as much as you can, with explanations regarding the remaining details.

8. Please indicate any approximation that were used for the calculation of any number.

9. Please comment on the difficulties you had to understand or apply the proposed approach.

10. Please provide comments on the merits you perceive with the proposed approach.

11. Any other comments?

Individual Life

INDIVIDUAL Basic death

0
1900-01-00

a) Adjustable

In(duration)	A	B	C	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1		1,000				0	0	0
1 - 2		1,000				0	0	0
2 - 3						0	0	0
3 +						0	0	0

b) Other

In(duration)	A	B	C	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1		1,000				0	0	0
1 - 2						0	0	0
2 - 3						0	0	0
3 +						0	0	0

Volatility for Individual Basic death :	0
Catastrophe for Individual Basic death :	0
Capital for Individual Basic death :	0

INDIVIDUAL Accidental death & dismemberment (AD&D)

a) Adjustable

Seriatim								
In(duration)	A	B	C	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1		1,000				0	0	0
1 - 2		1,000				0	0	0
2 - 3						0	0	0
3 +						0	0	0
Not seriatim								
In(duration)	A	B	C	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1						0	0	0
1 - 2						0	0	0
2 - 3						0	0	0
3 +						0	0	0

b) Other

Seriatim								
In(duration)	A	B	C	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1		1,000				0	0	0
1 - 2						0	0	0
2 - 3						0	0	0
3 +						0	0	0
Not seriatim								
In(duration)	A	B	C	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1						0	0	0
1 - 2						0	0	0
2 - 3						0	0	0
3 +						0	0	0

Volatility for Individual AD&D :	0
Catastrophe for Individual AD&D :	0
Capital for Individual AD&D :	0

Capital for Individual Life :	0
--------------------------------------	----------

GROUP Basic death

0
1900-01-00

a) Adjustable

Seriatim									
In(duration)	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1		1,000					0	0	0
1 - 2		1,000					0	0	0
2 - 3							0	0	0
3 +							0	0	0
Not seriatim									
Guarantee	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
All		1,000					0	0	0

b) Other

Seriatim									
In(duration)	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1		1,000					0	0	0
1 - 2							0	0	0
2 - 3							0	0	0
3 +							0	0	0
Not seriatim									
Guarantee	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
? 2 years		1,000					0	0	0
> 2 years		2,000					0	0	0

Volatility for Group Basic death :	0
Catastrophe for Group Basic death :	0
Capital for Group Basic death :	0

GROUP Accidental death & dismemberment (AD&D)

a) Adjustable

Seriatim									
In(duration)	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1		1,000					0	0	0
1 - 2		1,000					0	0	0
2 - 3							0	0	0
3 +							0	0	0
Not seriatim - basic AD&D contracts									
Guarantee	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
All		1,000					0	0	0
Not seriatim - complementary AD&D contracts									
In(duration)	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1							0	0	0
1 - 2							0	0	0
2 - 3							0	0	0
3 +							0	0	0
Guarantee	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
All							0	0	0

b) Other

Seriatim									
In(duration)	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1		1,000					0	0	0
1 - 2							0	0	0
2 - 3							0	0	0
3 +							0	0	0
Not seriatim - basic AD&D contracts									
Guarantee	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
? 2 years		1,000					0	0	0
> 2 years		2,000					0	0	0
Not seriatim - complementary AD&D contracts									
In(duration)	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
1							0	0	0
1 - 2							0	0	0
2 - 3							0	0	0
3 +							0	0	0
Guarantee	A	B	C	# of lives	NAAR	Net DB	Volatility	Volatility ^ 2	Catastrophe
? 2 years							0	0	0
> 2 years							0	0	0

Volatility for Group AD&D :	0
Catastrophe for Group AD&D :	0
Capital for Group AD&D :	0

Capital for Group Life :	0
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Life Insurance

0
1900-01-00

	Volatility basic	Volatility AD&D	Cat
Capital for Individual Life :	0	0	0
Capital for Group Life :	0	0	0
Gross capital for life insurance :	0		
Credit for Stop Loss Arrangements* :			
Credit for Risk Reduction Features* :			(Guaranteed No Risk, Deficit Repayment, Hold Harmless)
Credit for Special Policyholder Deposits* :			(Claim Fluctuation Reserves, Premium Stabilization Reserves Accrued Provision for Experience Refunds)
Net capital for life insurance :	0		

* Use detailed schedule of calculation (See Stop Loss and Group Credits worksheets) for each contract.
The details by contract do not have to be submitted.

Stop Loss

0
1900-01-00

Use this form for each stop loss arrangement.

Stop loss arrangement number :	
Stop loss arrangement on individual basic death products	
Credit percentage used :	
Capital for individual basic death :	0
NAAR for individual basic death products covered by this stop loss arrangement :	
NAAR for all individual basic death products :	0
Credit for this stop loss arrangement on individual basic death products :	0
Stop loss arrangement on individual AD&D products	
Credit percentage used :	
Capital for individual AD&D :	0
NAAR for individual AD&D products covered by this stop loss arrangement :	
NAAR for all individual AD&D products :	0
Credit for this stop loss arrangement on individual AD&D products :	0
Stop loss arrangement on group basic death products	
Credit percentage used :	
Capital for group basic death :	0
NAAR for group basic death products covered by this stop loss arrangement :	
NAAR for all group basic death products :	0
Credit for this stop loss arrangement on group basic death products :	0
Stop loss arrangement on group AD&D products	
Credit percentage used :	
Capital for group AD&D :	0
NAAR for group AD&D products covered by this stop loss arrangement :	
NAAR for all group AD&D products :	0
Credit for this stop loss arrangement on group AD&D products :	0
Credit for this stop loss arrangements :	0

To include in Group Credits worksheet for contracts with Risk Reduction Features and/or Policyholder Deposits

To include in Group Credits worksheet for contracts with Risk Reduction Features and/or Policyholder Deposits

To report in the Life insurance sheet

Note: Stop Loss arrangements assumed should be recorded as negative.

Group Credits

Calculation of Adjustments for Risk Reduction Features and Special Deposits (as per MCCSR 4-1-3)													
(Administrative Services Only groups are assumed to be excluded from the basic risk calculations so no further adjustment is required.)													
All amounts in Thousands of Canadian Dollars													
Group Number	Deposits	Group Life Capital	NAAR for contract	NAAR for all Group	Capital for Contract	Arrangements	Credit for Stop Loss	Adjusted Capital for Contract after Stop Loss Credits	Risk Reduction Features Present ? (Y or N)	Credit for Risk Reduction Features (85%)	Adjusted Capital for Contract after Risk Reduction Credits	Credit for Policyholder Deposits	Remaining Policyholder Deposits
1	0	0	0	0	0	0	0	0	Y	0	0	0	0
2	0	0	0	0	0	0	0	0	Y	0	0	0	0
3	0	0	0	0	0	0	0	0	Y	0	0	0	0
4	0	0	0	0	0	0	0	0	N	0	0	0	0
5	0	0	0	0	0	0	0	0	N	0	0	0	0
6	0	0	0	0	0	0	0	0	N	0	0	0	0
Total Adjustments (Enter into Life Insurance worksheet)										0		0	
[Insert additional rows as required.]													
Notes: Stop Loss Credits for each contract are determined using the Stop Loss worksheet. They only need to be input into this worksheet for groups with Risk Reduction Features and/or Policyholder Deposits so that the credits for these components can be determined properly.													
If a Stop Loss arrangement applies to more than one group contract, the associated credit would be allocated on this sheet based on the NAAR.													
Risk Reduction Features include Guaranteed No Risk, Deficit Repayment, and Hold Harmless Agreements as per MCCSR 4-1-3													
Policyholder Deposits include Claim Fluctuation Reserves, Premium Stabilization Reserves, and Accrued Provision for Experience Refunds as per MCCSR 4-1-3													
Remaining Policyholder Deposits may be used to offset any Morbidity Risks on health coverages under the same contract.													

- A :** The Standard Deviation of the next year's Projected Value of the net death claim for the group of products.
- B :** The natural log (ln) of the Macaulay Duration of the Projected Value of the net death claim for the group of products. The interest rate used in this calculation is an annual rate of 5%. B is halved for adjustable products. Note that B has a minimum value of 1.
- C :** The Projected Value of next year net death claim for the group of products.
- # of lives :** The number of lives covered in the group of products.
- NAAR :** The NAAR for the group of products. It is equal to net death benefit less net statutory policy liabilities.
- Net DB :** The death benefit for the group of products, net of reinsurance.

Definitions

Projected Value : Expected values based on valuation assumptions (i.e. best estimate plus MfAD). Note that projections should include all valuation decrements.

Standard Deviation (A) defined as :

$$A = \sqrt{\sum_{i=1}^n q_i (1 - q_i) b_i^2}$$

Where b_i is the death benefit for policy i (net of reinsurance); and q_i is the valuation mortality including MfAD.

Group of products : Products with similar mortality guarantee duration. In the survey, there can be more than one group of products by line. If so :

- calculate A and B then Volatility by group of products;
- calculate A and Volatility for the line = $\sqrt{\text{sum}(A^2)}$ and = $\sqrt{\text{sum}(\text{Volatility}^2)}$
- calculate B for the line = $\text{Volatility} / (2.5 \times A \times (G / H))$
- provide all the information in an attachment to the survey

Adjustable Products : Products where mortality experience can be passed on to policyholder values in terms of dividends, premium adjustment or other mechanisms.

Explanations

Capital = Volatility + Catastrophe

This calculation is done independently for the following types of products :

- Individual basic death
- Individual AD&D
- Group basic death
- Group AD&D

and is then added to obtain the **Gross capital for life insurance**.

Volatility = $\sqrt{\text{sum}((2.5 \times A \times B \times \text{NAAR} / \text{Net DB})^2)}$ for each of the four types of products.

Basic death : For individual life, it is assumed that all the data are available.
For group life when all the data are not available, the following approximations are used:

- A = $C \times 39 / \sqrt{\text{\# of lives}}$
- B = 1 for all adjustable products and for products with mortality guarantee ? 2 years
- = 2 for all other products

AD&D : When all the data are not available, the following approximation is used for each Group of products :

$$\text{Volatility AD\&D} = 30\% \times \text{Volatility Basic death} \times \text{NAAR AD\&D} / \text{NAAR Basic death}$$

Catastrophe = $\text{sum}(0.1 \times C)$ for each of the four types of products.

Adjustable products : For Adjustable products, 0.1 is replaced by 0.05.

AD&D : When all the data are not available, the following approximation is used for each Group of products :

$$\text{Catastrophe AD\&D} = 15\% \times \text{Catastrophe Basic death} \times \text{NAAR AD\&D} / \text{NAAR Basic death}$$

Net capital for life insurance = Gross capital for life insurance
- Credit for stop loss arrangements
- Credit for claims fluctuation reserves

Credit for stop loss arrangements :

- Credit on qualified stop-loss arrangements can be taken on basis similar to those find in the current guideline.
- For each stop loss arrangement, the calculation is :

$$X\% \times \text{Capital for type of products} \times \text{NAAR products covered} / \text{NAAR for type of products}$$

where X% is limited to 40%.

- A different Excel sheet should be used for each stop loss arrangement.

Credits for Risk Reduction Features and Policyholder Deposits (MCCSR 4-1-3) can be calculated using the Group Credits workshee

The total credits are entered on the Life Insurance worksheet, but the details do not have to be submitted.

Notes :

- If the direct/assumed contract is not adjustable but the reinsurance contract is, A, B and C should be calculated for the Group of products affected by this situation both with reinsurance (as if not adjustable) and without reinsurance. The average of both calculations should then be used.
- No additional credit is given for catastrophe coverage.

APPENDIX F: FINAL PROPOSAL

www.actuaries.ca/publications/2004/204061e-f.xls

Individual and Group Life

INDIVIDUAL Basic death

	A	B	C	# of lives	NAAR	Net DB	Volatility	Catastrophe
a) Adjustable							0	0
b) Other							0	0
Total - Individual basic death							0	0

INDIVIDUAL Accidental death & dismemberment (AD&D)

	A	B	C	# of lives	NAAR	Net DB	Volatility	Catastrophe
a) Adjustable	Seriatim						0	0
	Not seriatim	Basis					0	0
		Calculation						0
b) Other	Seriatim						0	0
	Not seriatim	Basis					0	0
		Calculation						0
Total - Individual AD&D							0	0

GROUP Basic death

	A	B	C	# of lives	NAAR	Net DB	Volatility	Catastrophe
a) Adjustable	Seriatim						0	0
	Not seriatim		1,000				0	0
b) Other	Seriatim						0	0
	Not seriatim						0	0
Total - Group basic death							0	0

GROUP Accidental death & dismemberment (AD&D)

	A	B	C	# of lives	NAAR	Net DB	Volatility	Catastrophe	
a) Adjustable	Seriatim						0	0	
	Not seriatim	Basic contracts	1,000					0	0
		Basis - seriatim						0	0
		Calculation						0	0
		Basis - not seriatim	1,000					0	0
		Calculation						0	0
b) Other	Seriatim						0	0	
	Not seriatim	Basic contracts						0	0
		Basis - seriatim						0	0
		Calculation						0	0
		Basis - not seriatim						0	0
		Calculation						0	0
Total - Group AD&D							0	0	

Stop Loss

Use this form for each stop loss arrangement.

<i>Stop loss arrangement number :</i>	
---------------------------------------	--

Stop loss arrangement on individual basic death products	
Credit percentage used :	
Capital for individual basic death :	0
NAAR for individual basic death products covered by this stop loss arrangement :	
NAAR for all individual basic death products :	0
Credit for this stop loss arrangement on individual basic death products :	0

Stop loss arrangement on individual AD&D products	
Credit percentage used :	
Capital for individual AD&D :	0
NAAR for individual AD&D products covered by this stop loss arrangement :	
NAAR for all individual AD&D products :	0
Credit for this stop loss arrangement on individual AD&D products :	0

Stop loss arrangement on group basic death products	
Credit percentage used :	
Capital for group basic death :	0
NAAR for group basic death products covered by this stop loss arrangement :	
NAAR for all group basic death products :	0
Credit for this stop loss arrangement on group basic death products :	0

To include in Group Credits worksheet for contracts with Risk Reduction Features and/or Policyholder Deposits

Stop loss arrangement on group AD&D products	
Credit percentage used :	
Capital for group AD&D :	0
NAAR for group AD&D products covered by this stop loss arrangement :	
NAAR for all group AD&D products :	0
Credit for this stop loss arrangement on group AD&D products :	0

To include in Group Credits worksheet for contracts with Risk Reduction Features and/or Policyholder Deposits

Credit for this stop loss arrangements :	0
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To report in the Life insurance sheet

Note: Stop Loss arrangements assumed should be recorded as negative.

Group Credits

Calculation of Adjustments for Risk Reduction Features and Special Deposits (as per MCCSR 4-1-3)												
(Administrative Services Only groups are assumed to be excluded from the basic risk calculations so no further adjustment is required.)												
All amounts in Thousands of Canadian Dollars												
Group Number	Deposits	Group Life Capital	NAAR for contract	NAAR for all Group	Capital for Contract	Credit for Stop Loss Arrangements	Adjusted Capital for Contract after Stop Loss Credits	Risk Reduction Features Present ? (Y or N)	Credit for Risk Reduction Features (85%)	Adjusted Capital for Contract after Risk Reduction Credits	Credit for Policyholder Deposits	Remaining Policyholder Deposits
		0		0	0		0	N	0	0	0	0
		0		0	0		0	N	0	0	0	0
		0		0	0		0	N	0	0	0	0
		0		0	0		0	N	0	0	0	0
		0		0	0		0	N	0	0	0	0
		0		0	0		0	N	0	0	0	0
Total Adjustments (Enter into Life Insurance worksheet)									0		0	
[Insert additional rows as required.]												
Notes: Stop Loss Credits for each contract are determined using the Stop Loss worksheet. They only need to be input into this worksheet for groups with Risk Reduction Features and/or Policyholder Deposits so that the credits for these components can be determined properly.												
If a Stop Loss arrangement applies to more than one group contract, the associated credit should be allocated on this sheet based on the NAAR.												
Risk Reduction Features include Guaranteed No Risk, Deficit Repayment, and Hold Harmless Agreements as per MCCSR 4-1-3												
Policyholder Deposits include Claim Fluctuation Reserves, Premium Stabilization Reserves, and Accrued Provision for Experience Refunds as per MCCSR 4-1-3												
Remaining Policyholder Deposits may be used to offset any Morbidity Risks on health coverages under the same contract.												

- A :** The Standard Deviation of the next year's Projected Value of the net death claim for the Group of products.
- B :** The natural log (ln) of the Macaulay Duration of the Projected Value of the net death claim for the Group of products. The interest rate used in this calculation is an annual rate of 5%. B is halved for adjustable products. Note that B has a minimum value of 1.
- C :** The Projected Value of next year net death claim for the Group of products.
- # of lives :** The number of lives covered in the Group of products.
- NAAR :** The NAAR for the Group of products. It is equal to net death benefit less net statutory policy liabilities.
- Net DB :** The death benefit for the Group of products, net of reinsurance.

Definitions

Projected Value : Expected values based on valuation assumptions (i.e. best estimate plus MfAD). Note that projections should include all valuation decrements.

Standard Deviation (A) defined as :

$$A = \sqrt{\sum_{i=1}^n q_i (1 - q_i) b_i^2}$$

Where b_i is the death benefit for policy i (net of reinsurance); and q_i is the valuation mortality including MfAD.

Group of products : Products with similar mortality guarantee duration. There can be more than one Group of products by line. If so :

- calculate A and B then Volatility by Group of products;
- calculate A and Volatility for the line = $\sqrt{\text{sum}(A^2)}$ and $= \sqrt{\text{sum}(\text{Volatility}^2)}$
- calculate B for the line = $\text{Volatility} / (2.5 \times A \times (G / H))$
- provide all the information in an attachment

Adjustable Products : Products where mortality experience can be passed on to policyholder values in terms of dividends, premium adjustment or other mechanisms.

Explanations

Volatility and Catastrophe calculations are done independently for the following types of products :

- Individual basic death
- Individual AD&D
- Group basic death
- Group AD&D

Gross capital for life insurance =

$$\begin{aligned} & \sqrt{(\text{Individual basic death Volatility}^2 + \text{Group basic death Volatility}^2)} \\ & + \sqrt{(\text{Individual AD\&D Volatility}^2 + \text{Group AD\&D Volatility}^2)} \\ & + \text{Individual basic death Catastrophe} + \text{Group basic death Catastrophe} \\ & + \text{Individual AD\&D Catastrophe} + \text{Group AD\&D Catastrophe} \end{aligned}$$

Volatility = $\sqrt{\text{sum}((2.5 \times A \times B \times \text{NAAR} / \text{Net DB})^2)}$

Basic death : For individual life, it is assumed that all the data are available. For group life when all the data are not available, the following approximations are used:

$$\begin{aligned} A &= C \times 39 / \sqrt{\text{\# of lives}} \\ B &= 1 \text{ for all adjustable products and for products with mortality guarantee} = 2 \text{ years} \\ &= 2 \text{ for all other products} \end{aligned}$$

AD&D : When all the data are not available, the following approximation is used for each Group of products :

$$\text{Volatility AD\&D} = 30\% \times \text{Volatility Basic death} \times \text{NAAR AD\&D} / \text{NAAR Basic death}$$

If this approach is employed, the basic death products used should be reasonably comparable to the AD&D with respect to duration, extent of reinsurance, etc. It would not necessarily be appropriate to simply use the entire individual or group basic as the basis. The form requires the basis to be shown.

For Group AD&D, where seriatim data are not available, and there is no corresponding basic death product to be used in the approximation, the formula for A should be modified to:

$$A = 2 \times C \times 39 / \text{sqrt}(\# \text{ of lives})$$

The multiple of 2 in the formula is based on the estimate that AD&D volatility is 30% of basic death volatility for the same volume, combined with the estimate that AD&D expected mortality is 15% of basic mortality.

Catastrophe = $\text{sum}(0.1 \times C)$ for each of the four types of products.

Adjustable products : For Adjustable products, 0.1 is replaced by 0.05.

AD&D : When all the data are not available, the following approximation is used for each Group of products :

$$\text{Catastrophe AD\&D} = 15\% \times \text{Catastrophe Basic death} \times \text{NAAR AD\&D} / \text{NAAR Basic death}$$

If this approach is employed, the basic death products used should be reasonably comparable to the AD&D with respect to duration, extent of reinsurance, etc. It would not necessarily be appropriate to simply use the entire individual or group basic as the basis. The form requires the basis to be shown.

Net capital for life insurance = Gross capital for life insurance
 - Credit for stop loss arrangements
 - Credit for claims fluctuation reserves

Credit for stop loss arrangements :

- Credit on qualified stop-loss arrangements can only be taken if regulatory approval is obtained in advance.
- For each stop loss arrangement, the calculation is :

$$X\% \times \text{Capital for type of products} \times \text{NAAR products covered} / \text{NAAR for type of products}$$

where X% is the level derived based on modeling approved by the regulator.

- A different Excel sheet should be used for each stop loss arrangement.

Credits for Risk Reduction Features and Policyholder Deposits (MCCSR 4-1-3) can be calculated using the Group Credits worksheet :

The total credits are entered on the Life Insurance worksheet, but the details do not have to be submitted.

Notes :

- If the direct/assumed contract is not adjustable but the reinsurance contract is, A, B and C should be calculated for the Group of products affected by this situation both with reinsurance (as if not adjustable) and without reinsurance. The average of both calculations should then be used.
- No additional credit is given for catastrophe coverage.