Canadian Institute of Actuaries | Institut canadien des actuaires

Educational Note

Guidance for the 2009 Valuation of Policy Liabilities of Life Insurers

Document 209111

Seeing Beyond Risk Canadian Institute of Actuaries Institut canadien des actuaires Voir au-delà du risque

Educational Note

Guidance for the 2009 Valuation of Policy Liabilities of Life Insurers

Committee on Life Insurance Financial Reporting

November 2009

Document 209111

Ce document est disponible en français

Members should be familiar with Educational Notes. Educational Notes describe but do not recommend practice in illustrative situations. They do not constitute Standards of Practice and are, therefore, not binding. They are, however, intended to illustrate the application (but not necessarily the only application) of the Standards of Practice, so there should be no conflict between them. They are intended to assist actuaries in applying Standards of Practice in respect of specific matters. Responsibility for the manner of application of Standards of Practice in specific circumstances remains that of the member in the life insurance practice area.

Memorandum

To: Members in the Life Insurance Practice Area

From: Tyrone G. Faulds, Chairperson
Practice Council

B. Dale Mathews, Chairperson
Committee on Life Insurance Financial Reporting

Date: November 10, 2009

Subject: **Educational Note: Guidance for the 2009 Valuation of Policy Liabilities of Life Insurers**

Introduction

The purpose of this educational note is to provide guidance to actuaries in several areas affecting the valuation of the 2009 year-end policy liabilities of life insurers for Canadian Generally Accepted Accounting Principles (GAAP) purposes. The guidance in this educational note represents a majority view of the members of the Committee on Life Insurance Financial Reporting (hereinafter referred to as CLIFR) of appropriate practice consistent with the Standards of Practice. This educational note has met the requirements of the *Policy on Due Process for the Approval of Guidance Material Other than Standards of Practice*. However, in accordance with that paper, this educational note is "not binding".

In accordance with the Institute's *Policy on Due Process for the Approval of Guidance Material other than Standards of Practice*, this educational note has been prepared by CLIFR, and has received final approval for distribution by the Practice Council on November 3, 2009. As outlined in subsection 1220 of the Standards of Practice, "*The actuary should be familiar with relevant Educational Notes and other designated educational material*." That subsection explains further that a practice which the Educational Notes describe for a situation is not necessarily the only accepted practice for that situation and is not necessarily accepted actuarial practice for a different situation." As well, "Educational Notes are intended to illustrate the application (but not necessarily the only application) of the Standards, so there should be no conflict between them."

Guidance to Members on Specific Situations

From time to time, CIA members seek advice or guidance from CLIFR. CLIFR strongly encourages such dialogue. CIA members would be assured that it is proper and appropriate for them to consult with the chairperson or vice-chairperson of CLIFR.

CIA members are reminded that responses provided by CLIFR are intended to assist them in interpreting CIA Standards of Practice, educational notes, Rules of Professional Conduct, and in assessing the appropriateness of certain techniques or assumptions. A response from CLIFR does not constitute a formal opinion as to whether the work in question is in compliance with the CIA Standards of Practice. Guidance provided by CLIFR is not binding upon the member.

Recent Guidance

In June 2008, the following Notice of Intent was published,

> Notice of Intent Regarding a Change to the Treatment of Secular Trends for Insurance and Annuitant Mortality in the Standards of Practice – Practice-Specific Standards for Insurers, Subsection 2350 Life and Health Insurance (http://www.actuaries.ca/members/publications/2008/208049e.pdf)

Any resultant changes to the Standards of Practice are not intended to be effective until October 15, 2010.

The following revisions to the Standards of Practice have been approved in the last 12 months.

> Standards of Practice – Practice-Specific Standards for Insurers, Subsection 2320 – Term of the Liability (http://www.actuaries.ca/members/publications/2009/209070e.pdf, July 2009). These changes clarify the determination of the term of the liability for segregated fund annuity contracts with and without material constraints. They also incorporate a reference to hedging of segregated fund guarantees and allow for an adjustment to the policy liability to reflect the change in fair value of the hedge assets as a result of market movement.
>
> Standards of Practice – Practice-Specific Standards for Insurers, Subsection 2340 – Foreign Exchange (http://www.actuaries.ca/members/publications/2009/209090e.pdf, September 2009). These changes relate to the development of a base scenario for foreign exchange rates and the development of a provision for adverse deviation (PfAD).

CLIFR expects to publish an Educational Note, Currency Risk in the Valuation, in the near future, consistent with the above changes to the Standards of Practice.

The Educational Note, Calibration of Stochastic Interest Rate Models Phase I, was published in 2009. For more information please refer to Section 4 of this note.

In addition, CLIFR expects to publish the following educational notes in the near future:

> Revision of the (draft) note on Valuation of Universal Life Policy Liabilities,
>
> Revision of the note on Future Income and Alternative Taxes,
>
> Valuation of Group Life and Health Policy Liabilities,
>
> Long-Term Equity Returns, and
>
> Calibration of Stochastic Interest Rate Models Phase II.

Other recent CLIFR guidance includes the following:

> Educational Note: Implications of Proposed Revisions to Income Tax Legislation (November 7, 2007 Department of Finance Proposal), January 2008 (http://www.actuaries.ca/members/publications/2008/208004e.pdf),

Educational Note: Considerations in the Valuation of Segregated Fund Products, November 2007 (http://www.actuaries.ca/members/publications/2007/207109e.pdf), and

Educational Note: Implications of *CICA Handbook* Section 3855 – Financial Instruments on Future Income and Alternative Taxes: Update to Fall Letter, April 2007 (http://www.actuaries.ca/members/publications/2007/207029e.pdf).

For your convenience all of these publications can be found on the CLIFR website in the Members Section (Organization/Practice Council/Committees and Task Forces/Committee on Life Insurance Financial Reporting).

Some guidance provided last year is still appropriate, and has been duplicated in this educational note. Other guidance has been modified, either to reflect recent developments or to improve clarity. Section 7, Equity Returns, was reintroduced, in light of the recent economic environment, because the educational note has not yet been published.

The topics covered herein are,

TGF, BDM

1. Experience Studies *(new)*

The Research Committee published the following studies during 2009:

2001-2004 Canadian Individual Annuitant Mortality Experience (March 2009)

http://www.actuaries.ca/members/publications/2009/209024e.pdf

The study reflects the experience of Canadian individual annuities. The policies included in the study are primarily policies in payout status, but in some cases experience during the deferred period has been included provided that the policy has no cash value and the policy cannot be changed.

2005-2006 Mortality Study – Canadian Standard Ordinary Life Experience (September 2009)

http://www.actuaries.ca/members/publications/2009/209083e.pdf

This annual report submitted by the Individual Life Subcommittee of the Research Committee details the intercompany mortality experience for Canadian standard ordinary life insurance policies.

In addition, the following study is expected to be published before the end of 2009:

1988-1997 Group LTD Termination Study.

2. Insurance Mortality *(modified)*

In the Appointed Actuary's Report, the actuary is encouraged to document the best estimate mortality assumption (including any mortality improvement) and the level of MfAD, including the justification and support for such assumptions.

The actuary is encouraged to consider reflecting mortality improvement for the period between the mid-point of the experience studies and the valuation date. The current wording of paragraph 2350.06 of the Standards of Practice states that any reduction in policy liabilities related to insurance mortality improvement after the valuation date would be offset by a corresponding adjustment to the insurance mortality margin for adverse deviations (MfAD) after the valuation date.

Currently no guidance is provided with respect to levels of future mortality improvement. The notice of intent released on June 25, 2008 indicates that CLIFR intends to publish such guidance in late 2009, with a proposed effective date of October 15, 2010.

CLIFR had also, in concert with the Society of Actuaries (SOA), commissioned a research study to help in this regard. Preliminary results of the SOA research were presented at the 2005 Seminar for the Appointed Actuary and are available on the CIA website at the link, http://www.actuaries.ca/members/resources/meetings/pdf/aa/2005/PD-8-Hardy.pdf.

The final report has been completed and is also available on the CIA website under CLIFR/Documents/Other Documents or at the link, http://www.soa.org/files/pdf/cia-mortality-rpt.pdf.

3. Annuity Mortality (*modified slightly*)

Paragraph 2350.11 of the Standards of Practice states, "It is prescribed that the actuary's best estimate includes a secular trend toward lower mortality rates as promulgated from time to time".

Recent annuity mortality improvement studies have yielded significantly different and sometimes contradictory results. As such, the uncertainty around the mortality improvement assumption could be significant, particularly as the time period from the valuation date increases.

CLIFR has appointed a subcommittee to review the appropriateness of the mortality improvement scale AA. This scale is applicable to both individual and group annuitants. CLIFR has commissioned, in concert with the SOA, a research study to review mortality improvement rates. Results of the SOA research, to date, indicate that the future mortality improvement rates from the AA Scale are more than likely to be insufficient in Canada and, therefore, for 2009, CLIFR continues to recommend using at least the AA Scale with a minimum improvement of 1.5% for attained ages up to 50, and 1% for attained ages between 51 and 80 as illustrated in Appendix A.

Note that, as stated in the notice of intent released on June 25, 2008, CLIFR intends to publish updated guidance in late 2009, but this guidance will not be applicable until October 15, 2010.

Paragraph 1740.05 of the Standards of Practice states: "*The margin for adverse deviations in each assumption should reflect the uncertainty of that assumption and of any related data.*" The common practice in the industry is to apply annuity mortality MfAD to the best estimate assumption, including the application of the improvement factors to the mortality table. The actuary is reminded that although the MfAD is only applied to the best estimate assumption, it is intended to cover the uncertainty associated with both misestimation risk and mortality improvement risk. In light of the recent annuity mortality improvement studies, the actuary is encouraged to review the appropriateness of the MfAD for annuity mortality.

For markets other than Canada, the improvement scale to be used in conjunction with annuitant mortality would be at least as conservative as the scale used in Canada unless experience indicates otherwise. For all jurisdictions, the use of higher rates of mortality improvement is appropriate if the experience indicates that higher rates are required.

4. Scenario Assumptions – Interest Rates (*modified*)

As in previous guidance, the actuary is reminded that, in addition to the nine prescribed scenarios, the actuary would select other scenarios including those in which the premiums for default risk, or spreads, range from 50% to 200% of the actual premiums at the balance sheet date. When spreads are wider than historical averages, the actuary would review the implications of higher spreads and consider 1) increasing asset depreciation assumptions, used for both the current asset return and reinvestment assumptions and/or 2) introducing a grading down of spreads to a level more consistent with long term averages in prescribed scenarios 1 to 6 or in alternate scenario(s). Further testing could also be done that would examine a cyclical approach to setting assumptions and margins.

In applying premiums for default risk in prescribed scenarios 7 and 8, the actuary may choose to adjust only the underlying risk-free rates, while maintaining the premium for default risk unchanged across these scenarios, as the scenarios examine shock movements to the underlying risk-free rates, without also shocking the spreads.

Derivation of risk-free lower and upper bounds used in the prescribed scenarios is based on moving averages of Canadian risk-free bonds. In the current environment, this approach generates declining lower and upper bounds from one reporting period to the next. For example, the 2008 Fall Letter (based on rates through June 2007) produced a lower bound of 4.6%.

Updating through December 2008 produces a lower bound of 4.3%. If rates stay at current levels for a period of time, the lower bound will continue to decrease.

Paragraph 2330.09.1 of the Standards of Practice states that in the base scenario the "risk-free interest rates effective after the balance sheet date would be equal to the forward interest rates implied by the equilibrium risk free market curve at that date, for the first 20 years after the balance sheet date." In order to determine the 20-year forward rates out to year 20, 40 years of spot rates are required. Risk-free interest rates are generally not observable in the market for very long terms (i.e., beyond 30 years) and are highly influenced by supply and demand toward the end of the observable horizon. It is, therefore, acceptable to retain the risk-free yield curve up to the point, in the long end (typically after 20 years), where the spot rate is at its peak ('the yield curve horizon'). Beyond the yield curve horizon, the actuary would assume a continuation of the last observed spot rate and calculate forward rates consistent with that assumption. An example of the process used to derive forward rates is presented in Appendix B.

CLIFR recently published Calibration of Stochastic Interest Rate Models Phase I which covers long-term risk-free rates. Preliminary results of this work have been presented at the June 2007 CIA Annual Meeting, the September 2007 Seminar for the Appointed Actuary, the June 2008 CIA Annual Meeting, and the September 2008 Seminar for the Appointed Actuary (http://meetings.actuaries.ca/meetings/aa/2008/Presentations/PE-11%20-%20Bridel.ppt).

CLIFR encourages actuaries to review the paper as well as these presentations. Phase I of the calibration criteria provides full calibration of long-term, risk-free interest rates. Work on Phase II, calibration of short- and medium-term, risk-free rates, is underway but not expected to be completed for year-end 2009 valuation. Premiums for default risk and asset depreciation assumptions were not examined in the Phase I report.

In the context of stochastic testing, the Conditional Tail Expectation (CTE), CTE (60) to CTE (80) defines the range of policy liabilities (paragraph 2320.51 of the Standards of Practice). For products that are supported by investments in long-term risk-free assets, and therefore fit within the Phase I framework, it would be possible to utilize risk-free interest rate models in the valuation that satisfy the calibration criteria, and in that case, CTE (60) to CTE (80) of the stochastic results may be used as long as the resulting liability is greater than that obtained under the base scenario (per paragraph 2330.09.2 of the Standards of Practice).

For a product with policy liabilities that are sensitive to short- and medium-term interest rates, and any other situations that do not fit within the Phase I framework, and for interest rate models that do not satisfy the calibration criteria or that incorporate premiums for default risk, the actuary would perform scenario testing using the nine prescribed scenarios in addition to the testing performed on a stochastic basis and consider holding policy liabilities at least equal to the result under the worst prescribed scenario. The decision to establish a policy liability that is less than that required under the worst prescribed scenario would be supported by a clearly documented rationale (for example, by being able to demonstrate that the stochastic model satisfies the calibration criteria). In this context, the actuary would ensure that,

> the stochastic interest rate model, including any parameters required, is appropriately selected for use in determining policy liabilities for Canadian life insurance financial reporting purposes,
>
> the range of stochastic scenarios encompasses the nine prescribed scenarios,

the model parameters are reviewed to confirm their appropriateness if the policy liabilities required under the worst prescribed scenario are greater than the policy liabilities at CTE (80), and

the policy liability is at least equal to the result under both the base scenario and prescribed scenario 9.

5. Value of Minimum Interest Guarantees and Embedded Options *(unchanged)*

With continuing low interest rates, it is suggested that actuaries assess and make appropriate provision for the potential cost of any minimum interest guarantees or other embedded economic options (e.g., guaranteed purchase options). These costs may not be captured appropriately in the deterministic base and prescribed scenarios within the Standards of Practice since these scenarios may continue to ascribe zero value to these features when, in reality, guarantees or options near to or in the money can have a substantial value. Stochastic modeling or option pricing techniques (stochastic or mathematical) could, therefore, ascribe material value to these features in the current interest environment. While the actuary is not required to model these features stochastically, he or she would review the exposure to minimum interest guarantees and other embedded options in the business being valued and determine whether an increase in the policy liabilities is warranted.

6. Taxes: Implications of CICA Section 3855 Financial Instruments on Future Income and Alternative Taxes and Harmonization of Sales Taxes *(modified)*

The introduction of accounting changes under the Canadian Institute of Chartered Accountants (CICA) section 3855 may have created additional tax timing differences for many insurers. On December 28, 2006, the Department of Finance published its backgrounder ("Finance Proposal") regarding changes in the taxation of financial institutions relating to the effects of the accounting changes. On November 7, 2007, the Department of Finance followed up on this proposal by issuing draft revisions to the income tax legislation.

On July 14, 2008, the Minister of Finance released for consultation, draft legislative proposals to implement the remaining tax measures from Budget 2008 along with several previously announced tax initiatives. The proposed changes to the taxation of financial institutions relating to the effects of the accounting changes under CICA Handbook Section 3855 are essentially unchanged from those issued in November 2007.

The legislation, Bill C-10, received Royal Assent on March 12, 2009 and is now effective.

CLIFR reminds the actuary that the effect of changes in accounting standards would be determined as at the start of the first taxation year that begins after October 1, 2006 and that this change would be spread evenly over a five-year period starting at that point.

For more information on the implications of the revisions to Income Tax Legislation, the actuary is referred to

Educational Note: Implications of Proposed Revisions to Income Tax Legislation (November 7, 2007 Department of Finance Proposal), January 2008 (http://www.actuaries.ca/members/publications/2008/208004e.pdf), and

Educational Note: Implications of CICA Handbook Section 3855 – Financial Instruments on Future Income and Alternative Taxes: Update to Fall Letter, April 2007 (http://www.actuaries.ca/members/publications/2007/207029e.pdf).

The guidance contained in "Educational Note: Guidance for the 2007 Valuation of Policy Liabilities of Life Insurers October 2007" is withdrawn.
http://www.actuaries.ca/members/publications/2007/207088e.pdf

As of the writing of this educational note, proposals have been set out in Ontario and British Columbia to harmonize provincial sales taxes with the federal Goods and Services Tax (GST). The actuary would discuss these proposals with the organization's accountant and auditor to determine whether or not it would be appropriate to reflect the proposals in the 2009 year-end valuation.

7. Equity Returns (*reintroduced*)

Paragraph 2340.11 of the Standards of Practice bounds the upper limit of the best estimate of investment return on a non-fixed income asset to a benchmark based on historical performance of assets of its class and characteristics.

CLIFR has investigated how to define the most appropriate historical period to determine the best estimate of investment return and has concluded that the longest possible period would be the most appropriate because the projection period for valuations is often very long and possibly even longer than the longest reliable historical period. This approach provides for a more stable projection. It runs over multiple shock periods and shocks will no doubt recur although in an unexpected fashion. An ideal historical period would also cover both increasing and decreasing interest rate periods.

In the Canadian market, data prior to 1956 are limited and do not provide the same market coverage as more recent data. So, as a practical consideration, and for the reasons cited above, CLIFR recommends using January 1956 to current year data as the historical period to establish the upper limit on the best estimate return for Canadian equities.

For other jurisdictions, the actuary would consider the quality and credibility of the historical return data, the relative sophistication of the economy during the period under study, and the correlation of the market in question with other global markets. For mature markets such as the United States, United Kingdom, Japan, and many countries in Western Europe, CLIFR recommends using a consistent historical period as that recommended above for Canadian equities.

For less stable or emerging markets, the availability of reliable historical data spanning a sufficiently long period is unlikely. In that case, the actuary would be cautioned against assuming that a significant risk premium over the risk-free interest rates in the base scenario can be earned on equity instruments. However, it would be reasonable to assume risk premiums higher than those observed in North American markets where the market in question has exhibited higher volatility and where a higher MfAD is assumed. In any event, the implied risk premium assumed by the actuary, reduced by the chosen MfAD, would not exceed the equivalent result assumed for Canadian equities (see Appendix C).

The historical benchmark would be routinely updated at least annually, ideally at the end of the same month each year, to provide consistency in the determination of the historical benchmark return. The lag between the valuation date and calculation date would ideally be short and would not exceed 12 months in any event. A lag exceeding 12 months would not adequately recognize recent changes in market values, particularly during periods of economic downturns. Although the historical benchmark is based on returns for historical periods that typically exceed 50 years,

the actuary should consider that the benchmark may change by over 100 bps during periods of sustained economic downturns such as experienced in the last 12 months.

When using deterministic scenarios, the historical benchmark return is the geometric average of historical returns over a sufficiently long period. It is appropriate to use the geometric mean rather than the arithmetic mean due to the asymmetric distribution of long-term returns.

Paragraph 2340.13 of the Standards of Practice sets the assumption that the change in value of non-fixed income assets as a percentage of market value of a diversified portfolio of North American common shares is 30%, and of any other portfolio is in the range of 25% to 40% depending on the relative volatility of the two portfolios. The economic downturn of the last 12 months has generally increased the volatility of the historical returns for most indexes. While the volatilities of historical returns generally remain comparable to those determined for previous years, the actuary would consider whether the relative volatilities are still appropriately reflected in the 25% to 40% range for the assumed change in value of non-fixed income assets for the valuation.

The actuary is reminded, however, that if the stochastic process is used to value segregated fund guarantees, then the actuary would ensure that the stochastic model returns meet the calibration criteria as specified in the March 2002 Report of the CIA Task Force on Segregated Fund Investment Guarantees that can be found on the CIA Members Site at http://www.actuaries.ca/members/publications/2002/202072e.pdf.

Appendix A: AA Scale Modification

Attained Age	AA Scale		AA Scale modified as per section 2		Attained Age	AA Scale		AA Scale modified as per section 2	
	Male	Female	Male	Female		Male	Female	Male	Female
1	0.020	0.020	0.020	0.020	51	0.019	0.016	0.019	0.016
2	0.020	0.020	0.020	0.020	52	0.020	0.014	0.020	0.014
3	0.020	0.020	0.020	0.020	53	0.020	0.012	0.020	0.012
4	0.020	0.020	0.020	0.020	54	0.020	0.010	0.020	0.010
5	0.020	0.020	0.020	0.020	55	0.019	0.008	0.019	**0.010**
6	0.020	0.020	0.020	0.020	56	0.018	0.006	0.018	**0.010**
7	0.020	0.020	0.020	0.020	57	0.017	0.005	0.017	**0.010**
8	0.020	0.020	0.020	0.020	58	0.016	0.005	0.016	**0.010**
9	0.020	0.020	0.020	0.020	59	0.016	0.005	0.016	**0.010**
10	0.020	0.020	0.020	0.020	60	0.016	0.005	0.016	**0.010**
11	0.020	0.020	0.020	0.020	61	0.015	0.005	0.015	**0.010**
12	0.020	0.020	0.020	0.020	62	0.015	0.005	0.015	**0.010**
13	0.020	0.020	0.020	0.020	63	0.014	0.005	0.014	**0.010**
14	0.019	0.018	0.019	0.018	64	0.014	0.005	0.014	**0.010**
15	0.019	0.016	0.019	0.016	65	0.014	0.005	0.014	**0.010**
16	0.019	0.015	0.019	0.015	66	0.013	0.005	0.013	**0.010**
17	0.019	0.014	0.019	**0.015**	67	0.013	0.005	0.013	**0.010**
18	0.019	0.014	0.019	**0.015**	68	0.014	0.005	0.014	**0.010**
19	0.019	0.015	0.019	0.015	69	0.014	0.005	0.014	**0.010**
20	0.019	0.016	0.019	0.016	70	0.015	0.005	0.015	**0.010**
21	0.018	0.017	0.018	0.017	71	0.015	0.006	0.015	**0.010**
22	0.017	0.017	0.017	0.017	72	0.015	0.006	0.015	**0.010**
23	0.015	0.016	0.015	0.016	73	0.015	0.007	0.015	**0.010**
24	0.013	0.015	**0.015**	0.015	74	0.015	0.007	0.015	**0.010**
25	0.010	0.014	**0.015**	**0.015**	75	0.014	0.008	0.014	**0.010**
26	0.006	0.012	**0.015**	**0.015**	76	0.014	0.008	0.014	**0.010**
27	0.005	0.012	**0.015**	**0.015**	77	0.013	0.007	0.013	**0.010**
28	0.005	0.012	**0.015**	**0.015**	78	0.012	0.007	0.012	**0.010**
29	0.005	0.012	**0.015**	**0.015**	79	0.011	0.007	0.011	**0.010**
30	0.005	0.010	**0.015**	**0.015**	80	0.010	0.007	0.010	**0.010**
31	0.005	0.008	**0.015**	**0.015**	81	0.009	0.007	0.009	0.007
32	0.005	0.008	**0.015**	**0.015**	82	0.008	0.007	0.008	0.007
33	0.005	0.009	**0.015**	**0.015**	83	0.008	0.007	0.008	0.007
34	0.005	0.010	**0.015**	**0.015**	84	0.007	0.007	0.007	0.007
35	0.005	0.011	**0.015**	**0.015**	85	0.007	0.006	0.007	0.006
36	0.005	0.012	**0.015**	**0.015**	86	0.007	0.005	0.007	0.005
37	0.005	0.013	**0.015**	**0.015**	87	0.006	0.004	0.006	0.004
38	0.006	0.014	**0.015**	**0.015**	88	0.005	0.004	0.005	0.004
39	0.007	0.015	**0.015**	0.015	89	0.005	0.003	0.005	0.003
40	0.008	0.015	**0.015**	0.015	90	0.004	0.003	0.004	0.003
41	0.009	0.015	**0.015**	0.015	91	0.004	0.003	0.004	0.003
42	0.010	0.015	**0.015**	0.015	92	0.003	0.003	0.003	0.003
43	0.011	0.015	**0.015**	0.015	93	0.003	0.002	0.003	0.002
44	0.012	0.015	**0.015**	0.015	94	0.003	0.002	0.003	0.002
45	0.013	0.016	**0.015**	0.016	95	0.002	0.002	0.002	0.002
46	0.014	0.017	**0.015**	0.017	96	0.002	0.002	0.002	0.002
47	0.015	0.018	0.015	0.018	97	0.002	0.001	0.002	0.001
48	0.016	0.018	0.016	0.018	98	0.001	0.001	0.001	0.001
49	0.017	0.018	0.017	0.018	99	0.001	0.001	0.001	0.001
50	0.018	0.017	0.018	0.017	100	0.001	0.001	0.001	0.001
					Over 100	0.000	0.000	0.000	0.000

Appendix B: Example of Scenario Assumptions – Interest Rates

Prescribed Interest Rate Scenarios

Scenario	Description
0	Base Interest Rate Scenario (forward rates based on the current yield curve grading to long term average)
1	Move to 90% of Current by Year 1; to Prescribed Minimums by Year 20
2	Move to 110% of Current by Year 1; to Prescribed Maximums by Year 20
3	Yield Curve Movements In Full Cycles (Up/Down/Up/Down/Up/Down)
4	Yield Curve Movements In Full Cycles (Down/Up/Down/Up/Down/Up)
5	Inversions and Yield Curve Movements In Full Cycles (Up/Down/Up/Down/Up/Down)
6	Inversions and Yield Curve Movements In Full Cycles (Down/Up/Down/Up/Down/Up)
7	Move to 90% of Scenario 0 by Year 1; 90% of Scenario 0 thereafter
8	Move to 110% of Scenario 0 by year 1; 110% of Scenario 0 thereafter
9	Current yield curve persists

Prescribed Ultimate and Minimum Long Rate - Sample Calculation

Dec 31th, 2008

SELECTED GOVERNMENT OF CANADA BENCHMARK LONG-TERM (V122544) SEMI-ANNUAL BOND YIELDS - PERCENT

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	5.23	5.43	5.36	5.41	5.58	5.63	5.74	5.68	5.91	6.36	6.10	6.23
2000	6.27	5.83	5.84	5.92	5.63	5.[illegible]	5.55	5.51	5.67	5.61	5.51	5.56
2001	5.72	5.66	5.79	5.97	6.[illegible]	5.89	5.94	5.67	5.86	5.31	5.59	5.69
2002	5.68	5.69	5.98	5.92	5.78	5.74	5.73	5.58	5.43	5.63	5.58	5.42
2003	5.49	5.46	5.58	5.[illegible]	5.12	5.03	5.40	5.44	5.23	5.38	5.29	5.20
2004	5.23	5.09	5.04	5.[illegible]	5.32	5.33	5.29	5.15	5.04	5.00	4.90	4.92
2005	4.74	4.76	4.77	4.5[illegible]	4.4[illegible]	4.29	4.31	4.12	4.21	4.37	4.18	4.02
2006	4.20	4.15	4.[illegible]	4.57	4.50	4.67	4.45	4.20	4.07	4.24	4.02	4.10
2007	4.22	4.09	4.[illegible]	4.[illegible]	4.39	4.56	4.49	4.44	4.50	4.38	4.23	4.18
2008	4.19	4.18	3.96	4.08	4.12	4.05	4.16	4.01	4.13	4.27	3.94	3.45

120 Month Average - Effective Annual*	5.10	* *Averages taken from annualized form of above rates.*
60 Month Average - Effective Annual*	4.49	*e.g. Dec 2008 rate = (1+0.0345/2)^2 = 3.48%.*
Average of 2 Averages	4.80	
Rounded To Nearest 0.10	4.80	<= Base Scenario 40+ Rate
90% and Rounded To Nearest 0.10	4.30	<= Prescribed Scenario Long Term Minimum

Appendix B: Example of Scenario Assumptions – Interest Rates (cont'd)

Par Yields, Spot Rates, Forward Spots, and Forward Par Yields

Define a spot rate z_n as the yield on a zero-coupon bond maturing in n periods.
Given an observed par yield curve p_n, the spot curve z_n is derived recursively:

Formula 1:

$$z_n = \left[\frac{(1+p_n)}{(1-p_n \sum_{k=1}^{n-1} (1+z_k)^{-k})} \right]^{1/n} - 1$$

Define a forward spot F(n,m) as the z_n on a zero purchased m periods from now.
Given a spot curve z_n, the implied Forward spots F(n,m) are derived via the relation:

Formula 2:

$$F(n,m) = \left[\frac{(1+z_{m+n})^{m+n}}{(1+z_m)^m} \right]^{1/n} - 1$$

The corresponding forward par yields FP(n,m) are then derived via the formula

Formula 3:

$$FP(n,m) = \frac{1-(1+F(n,m))^{-n}}{\sum_{k=1}^{n} (1+F(k,m))^{-k}}$$

A sample process is outlined below; sample 1- and 20-year rates are illustrated at right.

Construction of Implied Forward Par Yield Curves - Steps

Step 1: Obtain current par yield curve from various data sources.

Step 2: Interpolate the par yield curve where yields are not directly available.

Step 3: Derive the equivalent spot rate curve using Formula 1.

Step 4: Determine the year between 20 and 30 at which the spot curve reaches its maximum. Extend this rate out infinitely.

Step 5: Derive the implied forward spot using Formula 2.

Step 6: Determine the equivalent implied forward par yields using Formula 3.

Notes

1. Maximum spot = 4.265% at term = 20. Extend from this point out.
2. For each term, the time-0 forward spot equals the observed spot for that term.
3. For each term, the ultimate forward spot equals the observed "horizon" spot.
4. For each term, only the first 20 forwards are used in the Base Scenario.

Illustration: 1- and 20-yr Terms

all rates annualized

	Dec 31th, 2008 Observed Rates by Term			Implied Forwards by Year Spots		Par Yields	
	Par	Spots	Adj Spot	1-yr	20-yr	1-yr	20-yr
0				1.136%	4.265% [2]	1.136%	3.975%
1	1.136%	1.136%	1.136%	1.750%	4.424%	1.750%	4.189%
2	1.440%	1.442%	1.442%	1.832%	4.552%	1.832%	4.372%
3	1.569%	1.572%	1.572%	2.852%	4.675%	2.852%	4.562%
4	1.879%	1.891%	1.891%	3.254%	4.747%	3.254%	4.686%
5	2.139%	2.162%	2.162%	4.068%	4.798%	4.068%	4.785%
6	2.436%	2.477%	2.477%	4.754%	4.808%	4.754%	4.826%
7	2.734%	2.799%	2.799%	4.517%	4.783%	4.517%	4.814%
8	2.928%	3.013%	3.013%	4.996%	4.770%	4.996%	4.821%
9	3.123%	3.231%	3.231%	5.499%	4.734%	5.499%	4.789%
10	3.318%	3.456%	3.456%	4.218%	4.672%	4.218%	4.717%
11	3.384%	3.52[illegible]	3.525%	4.389%	4.675%	4.389%	4.742%
12	3.449%	3.596%	3.596%	4.566%	4.668%	4.566%	4.755%
13	3.515%	3.671%	3.671%	4.750%	4.653%	4.750%	4.754%
14	3.[illegible]1%	3.7[illegible]%	3.747%	4.943%	4.629%	4.943%	4.739%
15	3.64[illegible]%	3.827%	3.827%	5.144%	4.595%	5.144%	4.707%
16	3.712%	3.909%	3.909%	5.356%	4.551%	5.356%	4.658%
17	3.778%	3.[illegible]%	3.993%	5.579%	4.497%	5.579%	4.591%
18	3.8[illegible]%	4.081%	4.081%	5.815%	4.431%	5.815%	4.503%
19	3.9[illegible]%	4.171%	4.171%	6.066%	4.354%	6.066%	4.395%
20	3.975%	4.265%	4.265%	4.265%	4.265% [3]	4.265%	4.265%
21	3.954%	4.216%	4.265% [1]	4.265%	4.265% [4]	4.265%	4.265% [4]
22	3.932%	4.168%	4.265%	4.265%	4.265%	4.265%	4.265%
23	3.911%	4.122%	4.265%	4.265%	4.265%	4.265%	4.265%
24	3.890%	4.076%	4.265%	4.265%	4.265%	4.265%	4.265%
25	3.869%	4.031%	4.265%	4.265%	4.265%	4.265%	4.265%
26	3.848%	3.988%	4.265%	4.265%	4.265%	4.265%	4.265%
27	3.826%	3.944%	4.265%	4.265%	4.265%	4.265%	4.265%
28	3.805%	3.902%	4.265%	4.265%	4.265%	4.265%	4.265%
29	3.784%	3.860%	4.265%	4.265%	4.265%	4.265%	4.265%
30	3.763%	3.818%	4.265%	4.265%	4.265%	4.265%	4.265%
31	3.763%	3.816%	4.265%	4.265%	4.265%	4.265%	4.265%
32	3.763%	3.814%	4.265%				
33	3.763%	3.813%	4.265%				
34	3.763%	3.811%	4.265%				
35	3.763%	3.810%	4.265%				
36	3.763%	3.809%	4.265%				
37	3.763%	3.808%	4.265%				
38	3.763%	3.806%	4.265%				
39	3.763%	3.805%	4.265%				
40	3.763%	3.804%	4.265%				
41	3.763%	3.803%	4.265%				
42	3.763%	3.802%	4.265%				
43	3.763%	3.801%	4.265%				
44	3.763%	3.800%	4.265%				
45	3.763%	3.800%	4.265%				

Appendix B: Example of Scenario Assumptions – Interest Rates (cont'd)

20-year Annual Effective Yields to Maturity
by Scenario and Projection Year

= Observed 20-yr rate @ valuation date
= Implied 20-yr forward par rates
= Smoothly interpolated rates
= Ultimate or nodal rate/spread

Assumptions	a.e.
Observed 20-yr rate @ valn date:	3.975
Ultimate 20 Year Yield Rate:	4.80
Initial Spread:	0.50

Projection	Government Par Yield Curves (annualized)							Gross Spread over Governments					Gross Portfolio Par Yields (annualized)						
Yr (eoy)	0	1	2	4 & 6[1]	7	8	9	0	1-6	7	8	9	0	1	2	3-6	7	8	9
0	3.97	3.97	3.97	3.97	3.97	3.97	3.97	0.50	0.50	0.45	0.55	0.50	4.47	4.47	4.47	4.47	4.42	4.52	4.47
1	4.19	3.58	4.37	4.30	3.77	4.61	3.97	0.50	0.48	0.45	0.55	0.50	4.69	4.05	4.85	5.78	4.22	5.16	4.47
2	4.37	3.62	4.74	5.30	3.93	4.81	3.97	0.50	0.45	0.45	0.55	0.50	4.87	4.07	5.19	6.75	4.38	5.36	4.47
3	4.56	3.65	5.10	6.30	4.11	5.02	3.97	0.50	0.43	0.45	0.55	0.50	5.06	4.08	5.53	7.73	4.56	5.57	4.47
4	4.69	3.69	5.47	7.30	4.22	5.15	3.97	0.50	0.40	0.45	0.55	0.50	5.19	4.09	5.87	8.70	4.67	5.70	4.47
5	4.79	3.73	5.83	8.30	4.31	5.26	3.97	0.50	0.38	0.45	0.55	0.50	5.29	4.10	6.21	9.68	4.76	5.81	4.47
6	4.83	3.77	6.20	9.30	4.34	5.31	3.97	0.50	0.35	0.45	0.55	0.50	5.33	4.12	6.55	10.65	4.79	5.86	4.47
7	4.81	3.81	6.56	10.30	4.33	5.30	3.97	0.50	0.33	0.45	0.55	0.50	5.31	4.13	6.88	11.63	4.78	5.85	4.47
8	4.82	3.84	6.92	11.30	4.34	5.30	3.97	0.50	0.30	0.45	0.55	0.50	5.32	4.14	7.22	10.60	4.79	5.85	4.47
9	4.79	3.88	7.29	10.30	4.31	5.27	3.97	0.50	0.28	0.45	0.55	0.50	5.[illegible]	4.16	7.56	9.58	4.76	5.82	4.47
10	4.72	3.92	7.65	9.30	4.25	5.19	3.97	0.50	0.25	0.45	0.55	0.50	5.22	4.[illegible]	7.90	8.55	4.70	5.74	4.47
11	4.74	3.96	8.02	8.30	4.27	5.22	3.97	0.50	0.23	0.45	0.55	0.50	5.24	4.1[illegible]	8.24	7.53	4.72	5.77	4.47
12	4.75	4.00	8.38	7.30	4.28	5.23	3.97	0.50	0.20	0.45	0.55	0.[illegible]	5.25	4.2[illegible]	8.58	6.50	4.73	5.78	4.47
13	4.75	4.03	8.75	6.30	4.28	5.23	3.97	0.50	0.18	0.45	0.55	.50	5.[illegible]	[illegible]	8.92	5.48	4.73	5.78	4.47
14	4.74	4.07	9.11	5.30	4.26	5.21	3.97	0.50	0.15	0.45	0.[illegible]	0.50	5.24	4.22	9.26	4.45	4.71	5.76	4.47
15	4.71	4.11	9.48	4.30	4.24	5.18	3.97	0.50	0.13	0.45	0.55	0.[illegible]	5.[illegible]	4.23	9.60	5.43	4.69	5.73	4.47
16	4.66	4.15	9.84	5.30	4.19	5.12	3.97	0.50	0.10	0.45	0.[illegible]	0.[illegible]	5.16	4.25	9.94	6.40	4.64	5.67	4.47
17	4.59	4.19	10.21	6.30	4.13	5.05	3.97	0.50	0.08	0.45	0.[illegible]	0.50	5.09	4.26	10.28	7.38	4.58	5.60	4.47
18	4.50	4.22	10.57	7.30	4.05	4.95	3.97	0.50	0.05	.45	0.[illegible]	0.50	5.00	4.27	10.62	8.35	4.50	5.50	4.47
19	4.40	4.26	10.94	8.30	3.96	4.83	3.97	0.50	0.[illegible]	0.45	.55	0.50	4.90	4.29	10.96	9.33	4.41	5.38	4.47
20	4.41	4.30	11.30	9.30	3.84	4.69	3.97	0.50	0.00	0.45	0.55	0.50	4.77	4.30	11.30	10.30	4.29	5.24	4.47
21	4.43	4.30	11.30	10.30	3.86	4.72	3.97	0.50	.00	.45	0.55	0.50	4.79	4.30	11.30	11.30	4.31	5.27	4.47
22	4.45	4.30	11.30	11.30	3.89	4.75	3.97	0.50	[illegible]	0.45	0.55	0.50	4.82	4.30	11.30	10.30	4.34	5.30	4.47
23	4.47	4.30	11.30	10.30	3.91	4.78	3.97	0.50	0.00	.45	0.55	0.50	4.85	4.30	11.30	9.30	4.36	5.33	4.47
24	4.49	4.30	11.30	9.30	3.93	4.81	3.[illegible]	[illegible]	0.00	0.45	0.55	0.50	4.87	4.30	11.30	8.30	4.38	5.36	4.47
25	4.51	4.30	11.30	8.30	3.96	4.84	.97	0.50	.00	0.45	0.55	0.50	4.90	4.30	11.30	7.30	4.41	5.39	4.47
26	4.53	4.30	11.30	7.30	3.98	4.87	3.97	.50	0.00	0.45	0.55	0.50	4.93	4.30	11.30	6.30	4.43	5.42	4.47
27	4.55	4.30	11.30	6.30	4.01	4.90	3.97	.50	0.00	0.45	0.55	0.50	4.95	4.30	11.30	5.30	4.46	5.45	4.47
28	4.57	4.30	11.30	5.30	4.0[illegible]	.03	.97	.50	0.00	0.45	0.55	0.50	4.98	4.30	11.30	4.30	4.48	5.48	4.47
29	4.59	4.30	11.30	4.30	.06	4.[illegible]	3.97	0.50	0.00	0.45	0.55	0.50	5.01	4.30	11.30	5.30	4.51	5.51	4.47
30	4.61	4.30	11.30	5.30	.08	[illegible]	[illegible]	0.50	0.00	0.45	0.55	0.50	5.03	4.30	11.30	6.30	4.53	5.54	4.47
31	4.63	4.30	11.30	6.30	4.[illegible]	5.02	3.97	0.50	0.00	0.45	0.55	0.50	5.06	4.30	11.30	7.30	4.55	5.57	4.47
32	4.65	4.30	11.30	7.30	4.13	.04	3.97	0.50	0.00	0.45	0.55	0.50	5.09	4.30	11.30	8.30	4.58	5.59	4.47
33	4.67	4.30	11.30	8.30	.15	5.07	3.97	0.50	0.00	0.45	0.55	0.50	5.11	4.30	11.30	9.30	4.60	5.62	4.47
34	4.68	4.30	11.30	.30	4.18	5.10	3.97	0.50	0.00	0.45	0.55	0.50	5.14	4.30	11.30	10.30	4.63	5.65	4.47
35	4.70	4.30	11.30	10.[illegible]	4.20	5.13	3.97	0.50	0.00	0.45	0.55	0.50	5.17	4.30	11.30	11.30	4.65	5.68	4.47
36	4.72	4.30	11.30	11.[illegible]	4.22	5.16	3.97	0.50	0.00	0.45	0.55	0.50	5.19	4.30	11.30	10.30	4.67	5.71	4.47
37	4.74	4.30	11.30	10.30	4.25	5.19	3.97	0.50	0.00	0.45	0.55	0.50	5.22	4.30	11.30	9.30	4.70	5.74	4.47
38	4.76	4.30	11.30	9.30	4.27	5.22	3.97	0.50	0.00	0.45	0.55	0.50	5.25	4.30	11.30	8.30	4.72	5.77	4.47
39	4.78	4.30	11.30	8.30	4.30	5.25	3.97	0.50	0.00	0.45	0.55	0.50	5.27	4.30	11.30	7.30	4.75	5.80	4.47
40	4.80	4.30	11.30	7.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	6.30	4.77	5.83	4.47
41	4.80	4.30	11.30	6.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	5.30	4.77	5.83	4.47
42	4.80	4.30	11.30	5.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	4.30	4.77	5.83	4.47
43	4.80	4.30	11.30	4.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	5.30	4.77	5.83	4.47
44	4.80	4.30	11.30	5.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	6.30	4.77	5.83	4.47
45	4.80	4.30	11.30	6.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	7.30	4.77	5.83	4.47
46	4.80	4.30	11.30	7.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	8.30	4.77	5.83	4.47
47	4.80	4.30	11.30	8.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	9.30	4.77	5.83	4.47
48	4.80	4.30	11.30	9.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	10.30	4.77	5.83	4.47
49	4.80	4.30	11.30	10.30	4.32	5.28	3.97	0.50	0.00	0.45	0.55	0.50	5.30	4.30	11.30	11.30	4.77	5.83	4.47

1. Scenarios 3 & 5 are derived similarly - though the initial direction would be toward the maximum. In the above example, the year-1 rate would be 5.30%.

Appendix B: Example of Scenario Assumptions – Interest Rates (cont'd)

Appendix C: Example of Equity Returns for Emerging Markets

Data, Assumptions and Comments

	Canada (50 yrs)	XYZ (20 yrs)
Historical return		
- capital growth (given)	9.50%	17.00%
- dividends (given)	2.50%	3.00%
Total	12.00%	20.00%
Risk-free rate (given)	4.00%	6.00%
Implied Spread:	8.00%	14.00%
Volatility (given - information only):	22%	37%
MfADs (given):		
- on dividends	10%	20%
- on capital growth	20%	20%
- shock (applied in year 5):	30%	40%

This exhibit illustrates how the actuary might test to ensure the best estimate assumption for equity returns for a geography with unreliable historical experience. Here, the actuary initially uses what data he has and chooses appropriate MfADs for dividend income and capital growth (including the shock at worst time per SOP 2340.13).

However, the resulting 'net' risk premium over risk-free rates is 4.22% compared to 2% for Canada. Recognizing this result to be inappropriate given the uncertainty around the data, he then reduces the best estimate capital growth assumption from 17% to 14.08%, which reduces the resulting net risk premium to 2%. Therefore, he would not use a capital growth assumption in excess of 14.08% for this market.

Test Projection

	0	1	2	3	4	5	6	7	8	9	10
Canada											
Capital Growth		7.60%	7.60%	7.60%	7.60%	7.60%	7.60%	7.60%	7.60%	7.60%	7.60%
Dividends		2.25%	2.25%	2.25%	2.25%	2.25%	2.25%	2.25%	2.25%	2.25%	2.25%
Net Return (before shock)		9.85%	9.85%	9.85%	9.85%	9.85%	9.85%	9.85%	9.85%	9.85%	9.85%
Shock		0.00%	0.00%	0.00%	0.00%	-30.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cumulative (after shock)	1,000.00	1,098.50	1,206.70	1,325.56	1,456.13	1,119.69	1,229.98	1,351.13	1,484.22	1,630.42	1,791.01
Net Spread over Risk Free (incl. dividends)	2.00%										
XYZ (Initial, using unmodified empirical estimate of capital growth)											
Capital Growth		13.60%	13.60%	13.60%	13.60%	13.60%	13.60%	13.60%	13.60%	13.60%	13.60%
Dividends		2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%
Net Return (before shock)		16.00%	16.00%	16.00%	16.00%	16.00%	16.00%	16.00%	16.00%	16.00%	16.00%
Shock		0.00%	0.00%	0.00%	0.00%	-40.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cumulative (after shock)	1,000.00	1,160.00	1,345.60	1,560.90	1,810.64	1,260.20	1,461.84	1,695.73	1,967.05	2,281.78	2,646.86
Net Spread over Risk Free (incl. dividends)	4.22%										
XYZ (Revised)											
Revised b.e. capital growth assumption	14.08%										
Capital Growth		11.26%	11.26%	11.26%	11.26%	11.26%	11.26%	11.26%	11.26%	11.26%	11.26%
Dividends		2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%
Net Return (before shock)		13.66%	13.66%	13.66%	13.66%	13.66%	13.66%	13.66%	13.66%	13.66%	13.66%
Shock		0.00%	0.00%	0.00%	0.00%	-40.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cumulative (after shock)	1,000.00	1,136.60	1,291.87	1,468.34	1,668.92	1,138.14	1,293.61	1,470.32	1,671.17	1,899.45	2,158.92
Revised Net Spread over Risk Free (incl. dividends)	2.00%										