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Educational Note

Guidance for the 2007 Valuation of Policy Liabilities of Life Insurers

Document 207088

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Committee on Life Insurance Financial Reporting

October 2007

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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 Faulds, Chairperson
Committee on Life Insurance Financial Reporting

Jacques Tremblay, Chairperson
Practice Council

Date: October 24, 2007

Subject: **Educational Note: Guidance for the 2007 Valuation of Policy Liabilities of Life Insurers**

The purpose of this educational note is to provide guidance to actuaries in several areas affecting the valuation of the 2007 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 CIA Standards of Practice (SOP). This educational note has met the requirements of the Policy on Due Process for the Approval of Practice-Related Material Other than Standards of Practice and has received final approval for distribution by the Practice Council on October 10, 2007. In accordance with that paper, this educational note is "not binding".

CLIFR expects to publish the following two educational notes before the end of the year:

1. Currency Risk in the Valuation; and
2. Considerations in the Valuation of Segregated Fund Products.

The sections that covered these topics in last year's fall guidance have been removed. If the publication of these notes is delayed, actuaries would refer to last year's guidance.

As of the writing of this educational note, the Department of Finance has identified its plans to introduce legislation consistent with their backgrounder ("Finance Proposal") published on December 28, 2006 regarding changes in the taxation of financial institutions. The backgrounder dealt with the effect of accounting changes under CICA Handbook Section 3855 but the new legislation has not yet been introduced. Section 8 of this educational note provides guidance in this respect.

In addition, the Expected Experience Committee intends to publish updates to the studies on lapse experience under Universal Life Level COI and Term to 100 policies before the end of this year. For additional guidance refer to Section 4.

Other recent CLIFR guidance includes:

- Implications of CICA Handbook Section 3855 – Financial Instruments on Future Income and Alternative Taxes: Update to Fall Letter (207029), April 2007;
- Best Estimate Assumption for Expenses (206134), November 2006;
- Approximations to Canadian Asset Liability Method (CALM) (206133), November 2006;
- Valuation of Universal Life Policy Liabilities (206148), November 2006;
- Margins for Adverse Deviations (206132), November 2006;
- Use of Actuarial Judgment in Setting Assumptions and Margins for Adverse Deviations (206147), November 2006;
- Standards of Practice – Practice-Specific Standards for Insurers, Subsections 2320 and 2330 (206120) October 2006;
- CALM Implications of AcSB 3855 Financial Instruments – Recognition and Measurement (206077), June 2006;
- Standards of Practice – Practice-Specific Standards for Insurers, Section 2100 (206075) June 2006; and
- Technical Amendments – Standards of Practice – Practice-Specific Standards for Insurers, Sections 2200 Through 2500 (206070), May 2006.

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

As outlined in paragraph 1220.02 of the Standards of Practice, the "*actuary should be familiar with relevant educational notes and other designated educational material*." considering that a practice described "for a situation is not necessarily the only accepted practice for that situation and is not necessarily accepted actuarial practice for a different situation."

Some guidance provided last year is still appropriate, and has been duplicated in this educational note. Other guidance has been modified slightly either to reflect recent developments, or to improve clarity.

The topics covered are as follows:

TF, JT

1. Insurance Mortality *(unchanged)*

Currently no guidance is provided with respect to levels of future mortality improvement. CLIFR intends to publish such guidance in the near future and commissioned a research study in concert with the Society of Actuaries (SOA) 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 (can be accessed at http://www.actuaries.ca/members/resources/meetings/pdf/aa/2005/PD-8-Hardy.pdf).

Please note that the current wording of paragraph 2350.06 of the Standards of Practice (SOP) states that any reduction in policy liabilities related to insurance mortality improvement be offset by a corresponding adjustment to the insurance mortality margin for adverse deviations (MfAD).

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

2. 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 a research study in concert with the Society of Actuaries (SOA) 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 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.

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 an 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.

3. Scenario Assumptions – Interest Rates *(modified slightly)*

Revisions to subsections 2320 and 2330 were released in 2006. Modifications were made to the base scenario and seven prescribed scenarios. Two additional prescribed scenarios were also added.

Derivation of risk-free lower and upper bounds is based on moving averages of Canadian risk-free bonds. An example showing the derivation of bounds, and the resultant rates by scenario for a 20-year rate is provided in Appendix B.

Paragraph 2330.09.1 states that in the base scenario the "risk-free interest rates effective after the balance sheet date are 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, CLIFR recommends that the actuary 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 is concerned that the guidance on the selection of interest rate models for stochastic testing is limited[1] and that no calibration criteria have been established. This may result in an inappropriately wide range of practice. CLIFR is working on developing calibration criteria that are expected to be published by Fall 2008. Preliminary results of this work have been presented at the June CIA Meeting and the September Appointed Actuaries Seminar (http://www.actuaries.ca/meetings/AA2007/pd_ppt/PD-11%20Bridel.ppt). CLIFR would encourage actuaries to review these presentations. Comments and feedback would be welcome.

In the context of stochastic testing, the Conditional Tail Expectation, CTE (60) to CTE (80) defines the range of policy liabilities (paragraph 2320.[illegible]). Pending completion and adoption of calibration criteria, CLIFR recommends that the actuary perform scenario testing using the nine prescribed scenarios in addition to the testing performed on a stochastic basis and consider holding actuarial liabilities at least equal to the result under the worst prescribed scenario.

The decision to establish a policy liability that is less than required under the worst prescribed scenario would be supported by a clearly documented rationale. In this context, CLIFR recommends that the actuary ensure the following:

> 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.

[1] CLIFR recommends that the actuary be familiar with the educational note on the *Selection of Interest Rate Models* that was published in December 2003.

4. Lapse Studies - Universal Life Level COI and Term to 100 *(modified slightly)*

The CIA published a study on the Lapse Experience under Universal Life Level COI Policies in June of 2003. The scope of the study was limited to guaranteed Level COI coverages. The study has significant amounts of experience for the first five policy durations. An update to this study is expected to be released before the end of this year and contains experience through the first ten policy durations. Multi-dimension tables are included in this updated study. The studies do not include analysis by UL-specific drivers (e.g., fund values, credited rates, interest environment). It is suggested that the actuary consider the applicability of both of these studies to the business being valued.

Universal Life lapse-supported policies frequently exhibit some of the following characteristics:

minimum funded policies;

policies purchased for tax considerations;

joint last-to-die;

presence of persistency bonuses;

and may experience ultimate lapse rates similar to stand alone Term to 100 products.

A Term to 100 lapse study (update to 1999 study) is also expected to be released before the end of this year reflecting experience through the first 25 policy durations. Multi-dimension tables are introduced in this study as well.

CLIFR suggests that the actuary review the degree of lapse support within its Universal Life and Term to 100 portfolios and assess the applicability of the CIA lapse studies on lapse-supported products.

5. Long-Term Equity Returns *(unchanged)*

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.

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.

When using stochastic scenarios, the historical benchmark return is the arithmetic average of historical returns over a sufficiently long period, as the stochastic process captures the asymmetric distribution directly. 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/2002/202012e.pdf.

6. 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 appropriately captured in the deterministic base and prescribed scenarios within the standards, as these scenarios may continue to ascribe zero value to these features when in reality near to or in the money guarantees or options 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.

7. Considerations for Amounts on Deposit and Claims Provisions under CICA Section 3855 Financial Instruments (*unchanged*)

With the implementation of CICA Section 3855, concerns were raised with respect to the effect on liabilities for amounts on deposit and claims provisions, particularly if a company had been approximating the CALM liability by holding the amount expected to be paid without interest adjustment.

Paragraph 2320.01 of the Standards of Practice states that "*The actuary should calculate policy liabilities by the Canadian asset liability method.*"

Paragraph 2320.02 states that "*The amount of policy liabilities by that method for a particular scenario is equal to the amount of supporting assets at the balance sheet date which are forecasted to reduce to zero at the last liability cash flow in that scenario.*"

Feedback suggested that further guidance was needed with regard to the term over which liability cash flows would be projected for amounts on deposit and claims provisions. This would include

considerations on determining when an element of a policy would be treated separately from the other elements (i.e., bifurcated).

Paragraph 2320.16 states:

"If an element of a policy operates independently of the other elements, then it would be treated as a separate policy with its own term of liabilities. Examples are

> a flexible premium deferred annuity where the interest guarantee and cash value attached to each premium are independent of those for the other premiums, and
>
> a certificate of voluntary non-contributory association or creditor group insurance."

Paragraphs 2320.17 to 2320.27 then follow with guidance on determining the term of the liability.

In CLIFR's view, important considerations in determining if an element of a policy operates independently of another include the following:

> When risks on these elements are passed through to policyholders as part of the dividend policy they would not be considered as independent.
>
> Approximation techniques (e.g., estimating the impact of the claims lag as the value of incurred but not reported claims at a point in time) do not drive the treatment of the cash flow.
>
> Treatment for accounting purposes does not drive the treatment of the cash flow.
>
> When the provision for a claim is the recognition of a lag on a claim payment normally valued within the base liability it would not generally be considered independent.

Specific examples are as follows:

> Dividends on deposit included in a closed par fund where any gain/loss is reflected in future dividends would not be considered independent. The term of the liability for these amounts would be the same as that of the related participating policies and the actuary would value the dividends on deposit as a component of the cash flows in the CALM valuation.
>
> The term of the liability for medical and dental IBNRs would be close to zero, consistent with the term of the underlying contracts.
>
> The term of the liability for Group Long-Term Disability claims and their associated IBNRs would be longer, consistent with the expected timing of the claims terminations.

Because of the linkage under CALM between the value of the policy liabilities and the accounting value of the supporting assets, much of the period to period change in the accounting value of the assets under Section 3855 would be expected to be balanced by a corresponding change in the value of the liabilities, provided asset and liability cash flows are well matched and the held for trading designation is used.

Specific concerns have been raised with regard to situations where policy liabilities are determined to have a very short term, but management has chosen to invest longer. Under CALM valuation, this mismatch would be expected appropriately to result in a sensitivity of the surplus to changes in the interest rate environment and this result would be expected to continue under Section 3855 (i.e. the value of the policy liabilities would not respond completely to changes in the value of the underlying assets).

A final consideration relates to the balance sheet presentation of certain liabilities that have a mandated presentation on a separate line. Under these circumstances the actuary would determine the appropriate CALM liability using the considerations outlined above. This liability would be presented by showing the mandated separate provision on the balance sheet with the balance of the CALM liability shown as part of the provisions for future policy benefits line in the balance sheet.

The following example is taken from Section 4.4 of the educational note CALM Implications of AcSB Section 3855.

"… suppose that the actuary has determined that the term of the liabilities for certain dividends on deposit is the same as the term of the liabilities for the related participating whole life insurance policies. The actuary would then value the dividends on deposit as a component of the cash flows of the participating policies making appropriate assumptions for credited interest, accumulated dividend withdrawals, and so forth. The end result following CALM testing would be the appropriate policy liability for the participating policies including provision for the dividends on deposit. The mandated presentation requirement would then result in the accumulated value of the dividends on deposit being reported as a separate line item with the balance of the policy liability determined as above being reported as part of the provisions for future policy benefits line in the Balance Sheet."

8. Implications of CICA Section 3855 Financial Instruments on Future Income and Alternative Taxes *(modified slightly)*

The introduction of accounting changes under CICA Section 3855 may have created additional tax timing differences for many insurers. In response to these accounting changes, the Department of Finance had issued a press release and background notes ("Finance proposal") on December 28, 2006 regarding changes in the taxation of financial institutions to deal with the effect of accounting changes under CICA Section 3855. This proposal is not yet considered substantively enacted, although the Department of Finance has indicated its intention to implement the proposal as drafted during 2007. The actuary is referred to the Educational Note "Implications of *CICA Handbook* Section 3855 – Financial Instruments on Future Income and Alternative Taxes: Update to Fall Letter" issued in April 2007, for further guidance on the appropriate treatment.

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

Calculation as of June 30th, 2007

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
1997							6.32	6.63	6.26	6.05	5.96	5.95
1998	5.81	5.78	5.70	5.66	5.61	5.52	5.61	5.83	5.32	5.45	5.47	5.23
1999	5.23	5.43	5.36	5.[illegible]	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.[illegible]	5.61	5.55	5.51	5.67	5.61	5.51	5.56
2001	5.72	5.66	5.79	5.97	6.03	5.89	5.94	5.67	5.86	5.31	5.59	5.69
2002	5.68	5.69	5.[illegible]	5.92	5.78	5.74	5.73	5.58	5.43	5.63	5.58	5.42
2003	5.49	5.4[illegible]	5.58	5.41	5.12	5.03	5.40	5.44	5.23	5.38	5.29	5.20
2004	5.23	5.0[illegible]	[illegible]4	5.31	5.32	5.33	5.29	5.15	5.04	5.00	4.90	4.92
2005	4.74	4.76	4.77	4.59	4.46	4.29	4.31	4.12	4.21	4.37	4.18	4.02
2006	4.20	4.15	4.23	4.57	4.50	4.67	4.45	4.20	4.07	4.24	4.02	4.10
2007	4.22	4.09	4.21	4.20	4.39	4.56						

120 Month Average - Effective Annual*	5.36	* *Averages taken from annualized form of above rates.*
60 Month Average - Effective Annual*	4.87	*e.g. Jun 2007 rate = (1+0.0456/2)^2 = 4.61%.*
Average of 2 Averages	5.12	
Rounded To Nearest 0.10	5.10	<= Base Scenario 40+ Rate
90% and Rounded To Nearest 0.10	4.60	<= Prescribed Scenario Long Term Minimum

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

Generation of Forward Rates, given a set of spot rates

The theoretical spot-rate curve is constructed from the yield curve based on the observed yields of Treasury bills and Government of Canada Bonds. The spot rates are solved, such that the value of the Government of Canada coupon security is equal to the value of the package of zero-coupon Government of Canada securities that replicates the bond's cash flow.

Spot rates can be obtained from various sources, such as Bloomberg or JP Morgan, as well as the Bank of Canada website. Given a spot curve as of the valuation date, the implied forwards can be determined. A forward rate ${}_m f_n$ is the yield on a Government of Canada Bond purchased "n" months from now and maturing in "n+m" months.

Define s_m as the yield (as of the valuation date) on a zero-coupon Treasury bill maturing in "m" months. The forward rate is defined by the formula:

$$ {}_m f_n = \sqrt[m]{\frac{(1 + s_{m+n})^{m+n}}{(1 + s_n)^n}} - 1 $$

Please refer to the columns at right which illustrate the sample calculation of 1 and 20 year forward rates, from the current spot curve. The calculation is done in five steps:

Illustration: 1-yr and 20-yr Forwards

Step 1: Obtain current spot curve from various data sources

Step 2: Interpolate the spot curve where spot rates are not directly available.

Step 3: Determine the yield curve horizon as the duration, 20 or later, where the spot rate has reached a maximum level.

Step 4: Extrapolate for durations past the horizon, setting the spot rate equal to the spot rate at the horizon.

Step 5: Determine the implied forwards using the formula above.

Notes

1. Observed 30-yr Rate: 4.537% ; since this is lower than the 20-yr observed, ignore.
2. For each term, the time-0 forward equals the observed spot for that term.
3. For each term, only the first 20 forwards are used in the Base Scenario.

Example: Rates as of June 30, 2007

Year	Bloomberg Spots (annualized)	Implied Forwards 1-yr	Implied Forwards 20-yr
0		4.699%	4.599% [2]
1	4.699%	4.568%	4.594%
2	4.633%	4.670%	4.595%
3	4.646%	4.588%	4.592%
4	4.631%	4.509%	4.592%
5	4.607%	4.628%	4.597%
6	4.610%	4.636%	4.595%
7	4.614%	4.584%	4.593%
8	4.610%	4.577%	4.594%
9	4.607%	4.569%	4.595%
10	4.603%	4.598%	4.597%
11	4.602%	4.597%	4.597%
12	4.602%	4.597%	4.597%
13	4.602%	4.596%	4.597%
14	4.601%	4.595%	4.597%
15	4.601%	4.594%	4.597%
16	4.600%	4.593%	4.597%
17	4.600%	4.593%	4.598%
18	4.600%	4.592%	4.598%
19	4.599%	4.591%	4.598% [3]
20	4.599%		
21	4.599%		
22	4.599%		
23	4.599%		
24	4.599%		
25	4.599%		
26	4.599%		
27	4.599%		
28	4.599%		
29	4.599%		
30	4.599% [1]		
31	4.599%		
32	4.599%		
33	4.599%		
34	4.599%		
35	4.599%		
36	4.599%		
37	4.599%		
38	4.599%		
39	4.599%		

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

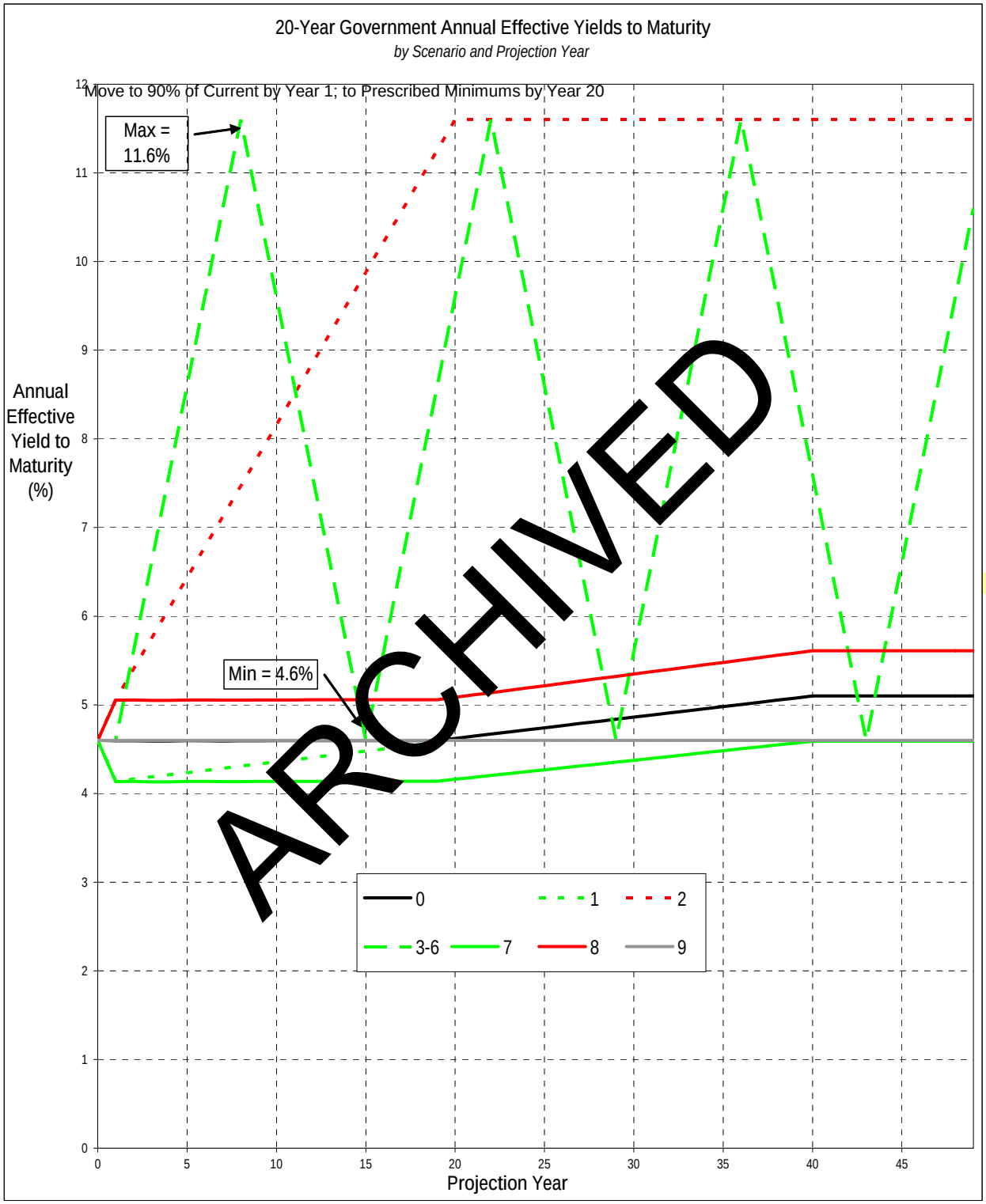
20-year Annual Effective Yields to Maturity
by Scenario and Projection Year

Colour	Meaning
Green	= Observed 20-yr rate @ valuation date
Orange	= 20-yr forwards implied by observed spots
Light blue	= Smoothly interpolated rates
Yellow	= Ultimate or nodal rate/spread

Assumptions	s.a.	a.e.
Observed 20-yr rate @ valn date:	4.547	4.599
Ultimate 20 Year Yield Rate:		5.10
Initial Spread:		0.50

Projection Yr (eoy)	Government Bond Yield Curves							Gross Spread over Governments					Gross Portfolio Bond Yields						
	0	1	2	3-6	7	8	9	0	1-6	7	8	9	0	1	2	3-6	7	8	9
0	4.599	4.599	4.599	4.599	4.599	4.599	4.599	0.50	0.50	0.45	0.55	0.50	5.10	5.10	5.10	5.10	5.05	5.15	5.10
1	4.59	4.14	5.06	4.60	4.13	5.05	4.60	0.50	0.48	0.45	0.55	0.50	5.09	4.61	5.53	5.08	4.58	5.60	5.10
2	4.60	4.16	5.40	5.60	4.14	5.05	4.60	0.50	0.45	0.45	0.55	0.50	5.10	4.61	5.85	6.05	4.59	5.60	5.10
3	4.59	4.19	5.75	6.60	4.13	5.05	4.60	0.50	0.43	0.45	0.55	0.50	5.09	4.61	6.17	7.03	4.58	5.60	5.10
4	4.59	4.21	6.09	7.60	4.13	5.05	4.60	0.50	0.40	0.45	0.55	0.50	5.09	4.61	6.49	8.00	4.58	5.60	5.10
5	4.60	4.24	6.44	8.60	4.14	5.06	4.60	0.50	0.38	0.45	0.55	0.50	5.10	4.61	6.81	8.98	4.59	5.61	5.10
6	4.60	4.26	6.78	9.60	4.14	5.05	4.60	0.50	0.35	0.45	0.55	0.50	5.10	4.61	7.13	9.95	4.59	5.60	5.10
7	4.59	4.28	7.12	10.60	4.13	5.05	4.60	0.50	0.33	0.45	0.55	0.50	[illegible]	4.61	7.45	10.93	4.58	5.60	5.10
8	4.59	4.31	7.47	11.60	4.13	5.05	4.60	0.50	0.30	0.45	0.55	0.50	5.09	[illegible]	7.77	11.90	4.58	5.60	5.10
9	4.60	4.33	7.81	10.60	4.14	5.05	4.60	0.50	0.28	0.45	0.55	0.50	5.10	4.61	8.09	10.88	4.59	5.60	5.10
10	4.60	4.36	8.16	9.60	4.14	5.06	4.60	0.50	0.25	0.45	0.55	0.50	5.10	4.61	8.41	9.85	4.59	5.61	5.10
11	4.60	4.38	8.50	8.60	4.14	5.06	4.60	0.50	0.23	0.45	0.55	0.50	[illegible]	4.61	8.73	8.83	4.59	5.61	5.10
12	4.60	4.41	8.85	7.60	4.14	5.06	4.60	0.50	0.20	0.45	0.55	0.50	5.10	4.61	9.05	7.80	4.59	5.61	5.10
13	4.60	4.43	9.19	6.60	4.14	5.06	4.60	0.50	0.18	0.45	0.55	0.50	5.10	4.61	9.36	6.78	4.59	5.61	5.10
14	4.60	4.45	9.53	5.60	4.14	5.06	4.60	0.50	0.15	0.45	0.55	[illegible]	5.10	4.60	9.68	5.75	4.59	5.61	5.10
15	4.60	4.48	9.88	4.60	4.14	5.06	4.60	0.50	0.13	0.45	[illegible]	0.50	5.10	4.60	10.00	4.73	4.59	5.61	5.10
16	4.60	4.50	10.22	5.60	4.14	5.06	4.60	0.50	0.10	[illegible]	0.55	0.50	5.10	4.60	10.32	5.70	4.59	5.61	5.10
17	4.60	4.53	10.57	6.60	4.14	5.06	4.60	0.50	[illegible]	0.45	[illegible]	0.50	5.10	4.60	10.64	6.68	4.59	5.61	5.10
18	4.60	4.55	10.91	7.60	4.14	5.06	4.60	0.50	0.05	0.45	0.55	0.50	5.10	4.60	10.96	7.65	4.59	5.61	5.10
19	4.60	4.58	11.26	8.60	4.14	5.06	4.60	0.50	0.03	[illegible]	0.55	0.50	5.10	4.60	11.28	8.63	4.59	5.61	5.10
20	4.62	4.60	11.60	9.60	4.16	5.08	4.60	0.50	0.00	0.45	0.55	0.50	5.12	4.60	11.60	9.60	4.61	5.63	5.10
21	4.65	4.60	11.60	10.60	4.18	5.11	4.60	0.50	0.00	0.45	0.55	0.50	5.15	4.60	11.60	10.60	4.63	5.66	5.10
22	4.67	4.60	11.60	11.60	4.20	5.14	[illegible]	[illegible]	0.00	0.45	0.55	0.50	5.17	4.60	11.60	11.60	4.65	5.69	5.10
23	4.69	4.60	11.60	10.60	4.22	5.16	4.60	0.50	0.00	0.45	0.55	0.50	5.19	4.60	11.60	10.60	4.67	5.71	5.10
24	4.72	4.60	11.60	9.60	4.25	5.19	4.60	0.50	0.00	0.45	0.55	0.50	5.22	4.60	11.60	9.60	4.70	5.74	5.10
25	4.74	4.60	11.60	8.60	4.27	5.22	4.60	0.50	0.00	0.45	0.55	0.50	5.24	4.60	11.60	8.60	4.72	5.77	5.10
26	4.77	4.60	11.60	7.60	[illegible]	[illegible]	[illegible]	0.50	0.00	0.45	0.55	0.50	5.27	4.60	11.60	7.60	4.74	5.79	5.10
27	4.79	4.60	11.60	6.60	4.31	[illegible]	4.60	0.50	0.00	0.45	0.55	0.50	5.29	4.60	11.60	6.60	4.76	5.82	5.10
28	4.81	4.60	11.60	5.60	4.33	[illegible]	[illegible]	0.50	0.00	0.45	0.55	0.50	5.31	4.60	11.60	5.60	4.78	5.84	5.10
29	4.84	4.60	11.60	4.60	[illegible]	5.32	4.60	0.50	0.00	0.45	0.55	0.50	5.34	4.60	11.60	4.60	4.80	5.87	5.10
30	4.86	4.60	11.60	[illegible]	4.37	5.35	4.60	0.50	0.00	0.45	0.55	0.50	5.36	4.60	11.60	5.60	4.82	5.90	5.10
31	4.88	4.60	11.60	6.60	[illegible]	5.37	4.60	0.50	0.00	0.45	0.55	0.50	5.38	4.60	11.60	6.60	4.85	5.92	5.10
32	4.91	4.60	11.60	[illegible]	4.42	5.40	4.60	0.50	0.00	0.45	0.55	0.50	5.41	4.60	11.60	7.60	4.87	5.95	5.10
33	4.93	4.60	11.60	8.60	4.44	5.43	4.60	0.50	0.00	0.45	0.55	0.50	5.43	4.60	11.60	8.60	4.89	5.98	5.10
34	4.96	4.60	11.60	9.60	4.46	5.45	4.60	0.50	0.00	0.45	0.55	0.50	5.46	4.60	11.60	9.60	4.91	6.00	5.10
35	4.98	4.60	11.60	10.60	4.48	5.48	4.60	0.50	0.00	0.45	0.55	0.50	5.48	4.60	11.60	10.60	4.93	6.03	5.10
36	5.00	4.60	11.60	11.60	4.50	5.50	4.60	0.50	0.00	0.45	0.55	0.50	5.50	4.60	11.60	11.60	4.95	6.05	5.10
37	5.03	4.60	11.60	10.60	4.53	5.53	4.60	0.50	0.00	0.45	0.55	0.50	5.53	4.60	11.60	10.60	4.98	6.08	5.10
38	5.05	4.60	11.60	9.60	4.55	5.56	4.60	0.50	0.00	0.45	0.55	0.50	5.55	4.60	11.60	9.60	5.00	6.11	5.10
39	5.08	4.60	11.60	8.60	4.57	5.58	4.60	0.50	0.00	0.45	0.55	0.50	5.58	4.60	11.60	8.60	5.02	6.13	5.10
40	5.10	4.60	11.60	7.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	7.60	5.04	6.16	5.10
41	5.10	4.60	11.60	6.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	6.60	5.04	6.16	5.10
42	5.10	4.60	11.60	5.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	5.60	5.04	6.16	5.10
43	5.10	4.60	11.60	4.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	4.60	5.04	6.16	5.10
44	5.10	4.60	11.60	5.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	5.60	5.04	6.16	5.10
45	5.10	4.60	11.60	6.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	6.60	5.04	6.16	5.10
46	5.10	4.60	11.60	7.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	7.60	5.04	6.16	5.10
47	5.10	4.60	11.60	8.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	8.60	5.04	6.16	5.10
48	5.10	4.60	11.60	9.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	9.60	5.04	6.16	5.10
49	5.10	4.60	11.60	10.60	4.59	5.61	4.60	0.50	0.00	0.45	0.55	0.50	5.60	4.60	11.60	10.60	5.04	6.16	5.10

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 may be inappropriate given the uncertainty around the data, he then reduces the best estimate capital growth assumption from 17.00% 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	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%
Dividends		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%
Shock		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%
Dividends		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%
Shock		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%
Dividends		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%
Shock		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%									