1. (6 points) LifeCo’s CEO has asked you to analyze the profitability of the Institutional Pensions – GIC line of business and the drivers of its profitability.

   Asset yields are effective annual, earned, net of investment expenses.
   The average industry required return on capital: 12.0%
   The Lehman aggregate bond index, 1999: 6.7%
   The Lehman aggregate bond index, 1999, adjusted to duration of 3.3: 6.4%
   The Lehman aggregate bond index, 1999, adjusted to duration of 3.1: 6.3%

   (a) List the benefits of an integrated asset/liability performance attribution process.

   (b) Explain the two benchmarks you will use to construct a performance attribution system using the above indices.

   (c) Define each of your performance attribution components and explain their function.

   (d) Calculate the return of each performance attribution component using the summary information from the balance sheet for this line of business.
Questions 1-5 pertain to the Case Study.

2. (11 points) LifeCo is considering purchasing a P&C company. You are a consulting actuary that has been retained by LifeCo to help analyze the implications of such an acquisition on LifeCo’s ALM process.

(a) Explain how ALM can improve decision-making and enhance the ability to view LifeCo’s businesses from multiple perspectives.

(b) Describe the main components of a DFA as typically used by a P&C insurer.

(c) Compare LifeCo’s ALM process to DFA.

(d) Detail the tasks that LifeCo management must perform in implementing a new ALM process.

(e) Recommend the best practices that LifeCo should consider adopting in its new ALM process.
3. **(5 points)** You are in charge of setting an investment strategy for the surplus account of LifeCo. The primary investment objective of the surplus account is to safeguard principal while seeking to maximize the total rate of return over time. One of the tasks is to determine the asset allocation among various asset classes.

As a member of LifeCo’s Portfolio Rebalance Subcommittee you have just completed a full evaluation of capital market information in terms of expected returns, standard deviations and correlations among asset classes. Next, you want to decide on a risk measure to be used to construct an efficient portfolio.

One of the Subcommittee members has suggested selecting portfolio standard deviation (as used by Harry Markowitz in his quadratic optimization) as the risk measure.

(a) Evaluate the appropriateness of using standard deviation as the risk measure for the surplus portfolio.

(b) Describe and compare two other alternatives to using standard deviation as the risk measure, and evaluate how the use of each would impact the financial objectives of LifeCo.

(c) Propose the most suitable risk measure for LifeCo and justify your choice.

(d) Formulate a mathematical optimization program to construct an efficient portfolio using the risk measure chosen in (c).
4.  

(10 points) The management of LifeCo is concerned about the duration mismatch reported in the December 31, 1999 ALM report for its traditional and non-traditional life products segments. It has directed the Corporate Actuarial Department and the Investment Department to investigate the mismatch and to evaluate the possibility of using Z-bonds to reduce it.

(a) Criticize the use of modified duration as a measure of interest rate sensitivity for the two liability segments and the underlying invested assets.

(b) Compare the following interest rate sensitivity measures with modified duration:
   (i) effective duration
   (ii) effective key-rate duration

(c) For equities:
   (i) interpret the reported modified duration
   (ii) describe how the Franchise Factor Model can be used to model the interest rate sensitivity of equities

(d) Compare the payment profile of the following types of accrual bonds:
   (i) Z-bonds
   (ii) Z-PAC
   (iii) Tricky Z
   (iv) Jump-Z with cumulative sticky trigger

(e) Rank the accrual bonds presented in (d) according to their suitability to help reduce the duration mismatch of the traditional life product segment. Justify your answer.
5.  (5 points) You are a research analyst supporting the corporate bond desk at LifeCo and have been asked to consider investing in synthetic convertible notes (SCN) as a new asset class for the Equity Linked GIC portfolio.

You are given the following information for an SCN:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face amount</td>
<td>$100 million</td>
</tr>
<tr>
<td>Maturity</td>
<td>7 years</td>
</tr>
<tr>
<td>Coupon</td>
<td>4% paid annually</td>
</tr>
<tr>
<td>Strike</td>
<td>$1.3 \times \text{ purchase price}</td>
</tr>
<tr>
<td>Purchase price</td>
<td>par</td>
</tr>
<tr>
<td>Index</td>
<td>S&amp;P 500</td>
</tr>
<tr>
<td>At-the-market swap rate on LIBOR</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

(a) List and briefly describe the 3 factors that impact price volatility and performance sensitivity of structured notes.

(b) Calculate the up-front payment the swap dealer receives on the hedge.

(c) Calculate the annual internal rate of return (IRR) over the term of the SCN for the following 2 scenarios of annual returns of the S&P 500 index:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-5%</td>
<td>-7%</td>
<td>12%</td>
<td>0%</td>
<td>16%</td>
<td>8%</td>
<td>-1%</td>
</tr>
<tr>
<td>2</td>
<td>8%</td>
<td>15%</td>
<td>3%</td>
<td>9%</td>
<td>-6%</td>
<td>20%</td>
<td>-10%</td>
</tr>
</tbody>
</table>

(d) Analyze the suitability of this SCN for the asset portfolio backing LifeCo’s Equity Linked GICs.
6. (7 points) A risk-free investment, R, and investments S and T have the following Itô processes:

\[
dR = 0.05Rdt + 0.10Rdz_1
\]

\[
dS = 0.10Sdt + 0.20Sdz_2
\]

\[
dT = 0.03Tdt + 0.20Tdz_3
\]

The correlation matrix for R, S and T is known.

The payoff of a European derivative, F, is determined from the values of R, S and T on F’s exercise date.

(a) Formulate an expression for the process followed by F using constants where possible.

(b) Describe the steps required to value F using a Monte Carlo simulation.
7. (11 points) A regulatory proposal would require companies to disclose the value of options granted to their employees. Your CFO is concerned that under this proposed regulation, changes in your firm’s stock price will create earnings volatility, and has identified two options programs which would impact earnings under this proposal.

<table>
<thead>
<tr>
<th>Options Program</th>
<th>Price at purchase</th>
<th>Purchasing rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock Option Plan (SOP)</td>
<td>market price that prevailed when the option was granted</td>
<td>employees are given the right to purchase shares of the firm’s stock at the end of two years</td>
</tr>
<tr>
<td>Employee Stock Purchase Plan (ESPP)</td>
<td>80% of the market price at the beginning of the year</td>
<td>stock is delivered to employees at the end of the year if the stock price is above the discounted level at that time, however, if the price is below this level, the employee’s money is returned and no stock is delivered</td>
</tr>
</tbody>
</table>

- The options granted under the SOP from year-end 1999 have expired.
- At year-end 2000, options on 10,000 shares were granted under the SOP when the stock price was $24.
- At year-end 2001, options on 15,000 shares were granted under the SOP when the stock price was $30.
- Under the ESPP, employees have subscribed to purchase $360,000 worth of stock in 2002.

It is January 1, 2002. The firm pays a continuous annual dividend of 3.0%, the stock’s annual volatility is 40%, and the risk free rate is 5.0%. There are no exchange-traded options available on this stock.

(a) List the options embedded in these two programs.

(b) Propose alternatives to hedge against changes in the stock price.

(c) Determine the probability that the options granted under the ESPP will finish in-the-money.

(d) Calculate the delta of the portfolio of options under the SOP and ESPP programs and interpret the sign of the delta.

(e) Determine the total value of the options granted under these two programs.

(f) Select a second order measure that can be used to hedge variations in value and describe how it would be applied.
8. (5 points) You have been asked to evaluate the interest rate generator that your company uses for scenario testing. The current model is the CIR model and you are considering building the HJM model. The model would be used to simulate results for a new portfolio that includes both callable and non-callable corporate bonds, and mortgage-backed securities on the asset side and interest-sensitive annuities on the liability side. The actuaries need to test the adequacy of your asset-liability matching. They will do so by generating stochastic interest rates to ensure that assets are sufficient to cover liabilities under each stochastic interest rate scenario.

(a) Evaluate which interest rate generator would be most appropriate.

(b) Assess the key aspects of the assets and liabilities needed to be modeled, given an interest rate generator.

(c) Highlight the points where you should pay more attention to avoid model risk, given the scope of the work.

**END OF EXAMINATION**

MORNING SESSION
9. (3 points) As a research analyst, you have been asked to investigate the political risk factors that arise when investing in international equities.

Using only the model developed by Marvin Zonis:

(a) Describe how the following factors affect political stability and the capacity for economic success:
   (i) rental income
   (ii) trauma
   (iii) Gross Domestic Product (GDP) per capita.

(b) Rank the following countries in terms of political stability and the capacity for economic success from highest to lowest. Justify your answer.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Infant Mortality (per 1000)</th>
<th>GDP (per capita)</th>
<th>Oil Revenues (billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country A</td>
<td>1.0</td>
<td>750</td>
<td>70</td>
</tr>
<tr>
<td>Country B</td>
<td>1.1</td>
<td>800</td>
<td>100</td>
</tr>
<tr>
<td>Country C</td>
<td>1.2</td>
<td>1200</td>
<td>80</td>
</tr>
</tbody>
</table>

(c) Describe the other factors identified in the model developed by Marvin Zonis.
10. (3 points) You are given the following information for a bond portfolio with a current market value of $5 billion.

Change in Market Value for a 1 Basis Point Rate Increase

<table>
<thead>
<tr>
<th>1-Year Rate</th>
<th>2-Year Rate</th>
<th>3-Year Rate</th>
<th>4-Year Rate</th>
<th>5-Year Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>-$3.5 million</td>
<td>-$1.4 million</td>
<td>-$2.8 million</td>
<td>-$2.5 million</td>
<td>-$0.7 million</td>
</tr>
</tbody>
</table>

Factor Loadings for U.S. Treasury Principal Components (PC)

<table>
<thead>
<tr>
<th>PC 1</th>
<th>1-Year</th>
<th>2-Year</th>
<th>3-Year</th>
<th>4-Year</th>
<th>5-Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.44</td>
<td>0.44</td>
<td>0.44</td>
<td>0.44</td>
<td>0.44</td>
<td>0.44</td>
</tr>
<tr>
<td>PC 2</td>
<td>-0.80</td>
<td>-0.25</td>
<td>0.05</td>
<td>0.35</td>
<td>0.42</td>
</tr>
<tr>
<td>PC 3</td>
<td>0.43</td>
<td>-0.69</td>
<td>-0.22</td>
<td>0.08</td>
<td>0.52</td>
</tr>
</tbody>
</table>

1-Month Standard Deviation of Factor Scores

<table>
<thead>
<tr>
<th>PC 1</th>
<th>PC 2</th>
<th>PC 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 basis points</td>
<td>6 basis points</td>
<td>3 basis points</td>
</tr>
</tbody>
</table>

Historical data has shown that factor scores for each principal component are independent from each other.

Calculate the 1-month 99% VaR using “Principal Components Analysis” and the above data.
11. **(5 points)** Your life insurance company client currently uses passthrough mortgage securities to back its GIC portfolio. There are two main types of mortgage securities available:
   (i) recently issued premium coupon mortgages
   (ii) seasoned discount coupon mortgages

You have been asked to evaluate the use of PACs as an alternative investment strategy.

Your client has been offered:
- 10 year PACs issued in 1997 based on 8% mortgages with 85% to 300% PSA collars
- 5 year PACs issued in 2002 based on 6% mortgages with 85% to 300% PSA collars

(a) Assess the likely impact of a decrease in short term interest rates of 100 basis points on prepayment rates for each of the two types of passthrough mortgage securities.

(b) Predict the likely impact of the prepayment rate change described in (a) on your client’s cash flows and net income.

(c) List and explain the items you would consider in evaluating the suitability of any given PAC.

(d) Recommend the PAC that will provide the better match for a 5 year GIC issued in 2002.
12. (7 points) A multinational non-financial company is exposed to foreign currency and commodity price risks. You have been asked by the company to help them understand and manage these risks.

(a) Describe the different kinds of exposure faced by a non-financial company using an example of a negative impact for each one.

(b) Recommend whether or not the company should manage these strategic risks.

(c) Describe the following risks associated with the use of derivatives and propose ways to mitigate them:
   (i) operational risk
   (ii) legal risk

13. (8 points) You are buying an over-the-counter one year American call option on a zero-coupon, default risk-free, bond with a one year maturity.

You are given:

- the risk free interest rate is 0% at every duration
- the default risk premium on a one year zero-coupon bond issued by the option writer that ranks equal to the option in the event of default is 1.5%
- the strike price and the forward value are $1000
- the volatility is 20%

(a) (2 points) Calculate the price of this option in the no-default world using Black’s model.

(b) (4 points) Demonstrate how the answer in (a), appropriately adjusted for the presence of risk of default by the option writer, can be used as the lower bound for the price of this option. Calculate this lower bound.

(c) (2 points) Explain how the over-the-counter dealer can create a replicating portfolio to delta-hedge a similar European call option on this bond against movements in interest rates and credit rating.
14. (13 points) You are an investment actuary in charge of the derivatives trading and research department for an investment banking firm. A Wall Street venture capitalist has approached you regarding a potential acquisition of an industrial company.

You have been asked to study the following acquisition project and explain the use of contingent-claims analysis in capital budgeting:

- After one year the project is assumed to generate expected values of subsequent cash flows which follow a multiplicative binomial process.
- For each annual period, the value either increases to $u = 1.7$ or decreases to $d = 0.8$ of its earlier value.
- The gross value of the project’s expected cash flows is currently valued at $50$ million.
- The probability that governs state transitions is equal to 0.5.
- The buyer is considering the opportunity to invest a required immediate outlay of $52$ million (all equity).

Use the following assumptions:

- A twin security for this transaction exists in the financial markets, and its payoffs are 10% of the gross project values.
- The expected rate of return (or risk-adjusted discount rate) is 25% per annum.
- The risk-free rate is 10% per annum.

(a) Explain how real options on projects and call options on stocks are analogous and record the major areas where this analogy is deficient.

(b) Describe the key strategic questions that the management of the acquiring company must address when evaluating an investment.

(c) Review the possible option classifications and the different components of the option value to help management recognize and understand the potential combinations of real options available in an investment opportunity.

(d) Compare and contrast the use of the traditional (passive) discounted cash flow / decision-tree analysis (DCF/DTA) approach versus the options-based approach of contingent-claims analysis to valuing real investments when operating and financial flexibility options are present.
14. Continued

(e) Assume the firm has a one-year deferral agreement granting it the exclusive right, but not the obligation, to make the investment by next year if the project value next year turns out to exceed the necessary investment at that time.

Determine the value of the option to wait provided by the agreement using both the contingent-analysis and traditional DCF/DTA approaches.

(f) Select the approach in (e) that produces the correct value for this investment opportunity. Justify your choice by describing how the firm would arrange for the least amount of funds needed to purchase the project.

(g) Assume that the firm has the option to finance $25 million out of the required investment outlay of $52 million by borrowing it against the project’s expected future cash flows. The amount is to be repaid with interest in two years at an annual interest rate of 14%. The balance of $27 million is to be supplied today by the firm’s equity holders.

Determine the value of the financial flexibility provided in this debt financing arrangement.
15. (4 points) A pension fund has an asset allocation target of 40% bonds and 60% equities. You are given the following assumptions:

<table>
<thead>
<tr>
<th></th>
<th>Expected return</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonds</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Equities</td>
<td>7%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Return correlation = 0.80
Risk tolerance = 0.75
Tracking-error tolerance = 0.02

(a) Explain why the optimal asset allocation based on the mean-variance (MV) optimizer is often different from the real world asset allocation.

(b) Calculate the optimal asset allocation using the mean-variance/tracking-error (MVTE) utility function.

(c) Predict the results if the tracking-error tolerance goes to:
   (i) infinity
   (ii) zero
16. **(7 points)** You are given the following information for a GIC-type product issued by a life insurance company.

- The corporate tax rate is 35%.
- The current estimate of the company’s credit risk premium is 1.5%.

**Liability information:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial deposit</td>
<td>$1000</td>
</tr>
<tr>
<td>Maturity date</td>
<td>3 years</td>
</tr>
<tr>
<td>Credited rate</td>
<td>4.2%</td>
</tr>
<tr>
<td>Interest payments</td>
<td>paid annually</td>
</tr>
<tr>
<td>Valuation interest rate</td>
<td>equal to credited rate</td>
</tr>
</tbody>
</table>

**Asset information:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated capital</td>
<td>8.0% of statutory reserves</td>
</tr>
<tr>
<td>Risk-free rate</td>
<td>3.0%</td>
</tr>
<tr>
<td>Expected asset portfolio yield, before expected defaults</td>
<td>6.3%</td>
</tr>
</tbody>
</table>

Assume no expenses and that the tax adjustment is calculated without risk premiums.

(a) **(2 points)** Describe the steps used in determining the company’s credit risk premium to be used with the direct method of performing a fair valuation of liabilities. For each step, indicate the basis for determining appropriate assumptions.

(b) **(5 points)** Determine the fair value of the liability at time 0. Use the direct method.
17. *(6 points)* Gedda Life’s SPDA product has a surrender charge that starts at 6% and declines 1% per year for 6 years. The minimum guaranteed credited rate is 4%. The SPDA block is currently supported by the following portfolio of assets, with maturities ranging from 2 to 10 years:

- 10% government bonds
- 50% corporate bonds and private placements
- 15% mortgage-backed securities
- 25% commercial mortgages

Explain how each of the following derivatives can be used as part of the ALM strategy for this line and describe the risks being hedged.

(a) Interest Rate Cap

(b) Spread Lock

(c) Yield Curve Swap

(d) Interest Rate Floor

(e) Prepayment Cap
18. (4 points) Your company’s CFO is considering pricing interest-sensitive insurance liabilities using the required spread on assets (RSA) generated by simulating interest rate paths from an arbitrage-free stochastic interest rate model.

(a) Compare the key characteristics of MBS securities and insurance company SPDA contracts that support the use of similar pricing and valuation methodologies.

(b) Explain under what circumstances the option adjusted duration (OAD) must equal the mean term of liabilities (MTL) for an SPDA product.

(c) Predict the impact of each of the following changes taken separately on the RSA, OAD and MTL of a typical SPDA product.
   (i) Increasing the credited rate at issue and reset by 50 basis points.
   (ii) Increasing the base level of surrenders that are not related to the level of interest rates.
   (iii) Increasing the level of surrenders that are related to the level of interest rates.
   (iv) Increasing the rate credited by all competing insurance companies by 50 basis points.

**END OF EXAMINATION**
Answer #1

a)

- Disaggregate performance using multiple pricing benchmarks
  - Liability performance
    - Product design, pricing improvements
  - Asset performance
    - Asset selection
    - Return due to taking on interest rate and credit risk
    - View assets and liabs. together in order to reduce risk and maximize return

b)

- An asset portfolio with the same interest rate risk as the liability (credit and other risks ignored)
  - Lehman index adjusted to duration 3.1

- An asset portfolio with the same interest rate risk as the actual assets
  - Lehman index adjusted to duration 3.3

c)

- Liability performance would be (in terms of yield)
  - Benchmark (1) — actual liability
    - Return due to the assumption of interest rate risk
      - Benchmark (2) — Benchmark (1)
  - Asset performance would be (in terms of yield)
    - Actual assets — Benchmark (2)

d)

- Liability performance
  \[ 6.30\% - 6.60\% = -0.30\% \]
- Return due to the assumption of interest rate risk
  \[ 6.40\% - 6.30\% = 0.10\% \]
- Asset performance would be (in terms of yield)
  \[ 6.38\% - 6.40\% = -0.02\% \]
Answer #2

a)

- ALM will summarize the needs of diverse areas of the company and try to come up with a clear view of the more important aspects of the company regarding risk
- ALM can help make decisions like:
  - Entering a new line of business
  - Exiting a product market
  - Pricing, hedging
  - Allocation of capital
  - Amount and type of reinsurance
  - Investment considerations
- ALM can provide due diligence to help justify decisions that are controversial
- ALM can help to fulfill the requirements/needs of the different constituents of the company and outside parties: shareholders, regulators, rating agencies, employees, etc.
- ALM can help managers and other employees to see the firm from different perspectives, e.g.:
  - Time horizon: measure the results on a short and long-term basis (can have conflicting goals)
  - Accounting standards: statutory, GAAP, tax and economic basis
  - Future business: can incorporate the future business of the firm

b)

Initial Conditions:
- Assess the initial conditions of the firm and economy
- Should be in line with recent experience

Scenario Generator:
- Set of plausible scenarios for economic conditions, assets and liabilities
- Can be deterministic or randomly generated scenarios

Financial Calculator:
- Convert the scenarios into financial results using different measurement basis, e.g., economic, tax, regulatory and GAAP

Optimizer:
- If an objective function can be specified then optimal strategies can be proposed

Results:
- Give conclusions on the simulation performed: graphical output, distributions and output of the key variables
c)

- LifeCo is more concerned with interest rate risk
- DFA is concerned with all types of risk (interest rate, inflation, spread risk, etc.)
- LifeCo is on a product line level
- DFA is on a total company level (holistic view)
- LifeCo uses measures of interest rate risk such as duration, key rate duration, etc.
- DAF uses results of simulation to determine risk levels
- LifeCo chooses asset portfolio to optimize risk/reward profile
- DFA uses optimizer to evaluate a set of strategies to maximize financial reward (doesn't just focus on assets)

d)

- Clarify the goals/objectives of the insurance company and the questions of most importance to them
- Assemble reliable data on the company's risks
- Determine technology platform
- Decide whether to perform the modeling tasks in the company or outside the company
- Confirm choice of methodology and risk measures

e)

- Secure senior management commitment by explaining the benefits of ALM, such as:
  - Risk reduction
  - Manage earnings volatility
  - Increased stock price
- Clarify the roles and responsibilities of each department in the company
- Leverage the cash-flow testing platform
- Choose appropriate metrics/methods: have metrics that are related to the real profitability of the firm
- Ensure an efficient and responsive mitigation process — once risks have been identified, they must be mitigated or managed
Answer #3

a)

Using standard deviation assumes returns are normally distributed, and this is not always true, especially in the short run.

- It is a symmetric distribution, doesn't match investor's notion of loss aversion and utility
- Assumes a quadratic utility curve, which doesn't match most investor's notion of risk as well as LifeCo's.
  - LifeCo's objective is to minimize potential for significant loss while standard deviation is a measure of deviations from the mean

b)

An alternative is the lower partial moment framework

\[ LPM_n = \sum_{Rp=0}^{\tau} \rho(\tau - Rp)^n \]

1) Setting \( n = 2 \) gives the target semi-variance, this looks at the deviations below a target rate of return

This measure will allow LifeCo to meet the objectives of minimizing significant loss by selecting appropriate \( \tau \), as well as, maximizing economic value

2) Setting \( n = 1 \) gives the target shortfall. It gives the expected loss. It will not meet LifeCo's objective of minimizing loss.

c)

Using the target semi-variance \( (n = 2) \) is the most appropriate

It meets the main objectives of LifeCo, which is to minimize the chance of significant loss and maximize economic value.

d)

Minimize \( LPM_2 = \sum_{Rp=0}^{\tau} Pp(\tau - Rp)^n \)

Such that \( \sum x_0 E(R_0) = Rp^* \)

and, \( \sum x_0 = 1, x_0 > 0 \)

Where \( \tau \) is the worst case return and \( Rp^* \) is the return of the portfolio.
Answer #4

a)

Modified duration:
- Only considers small parallel shift: convexity and non-parallel shift not considered
- Sensitivity of cash flows to interest rate is not taken into account. Like embedded options in Universal Life and policy loans in Traditional life
- Generally speaking, not a good measure

b)

Effective duration:
   i)
   - Interest rate sensitivity of cash flows is considered
   - Convexity and changing of yield curve shape are still not considered
   - Better than modified duration

Effective key-rate duration:
   ii)
   - Measure sensitivity of price change to all the representative points on the yield curve
   - Interest rate sensitive cash flows and yield curve shape change are considered
   - Better measure than other two

c)

   i)
   - Constant growth model produces the modified duration
     \[ MV = \frac{d}{k - g} \]
   - Where \( d = \) dividend, \( g = \) growth, \( k = \) cost of capital

Usually this model produces a much higher duration (28 years) than observed in practice

ii)

\[ MV = TV + FV \]
- Tangible value (TV): value from existing business, with limited ability for inflation pass through as it might not be possible to reset prices. In the extreme case assume 0. Duration is medium-long
- Franchise value (FV): value from future business or growth. Assuming 100% inflation flow through as future prices can be reset, we get a duration of 0
- Duration is weighted average of two components described above. Final result is more reasonable
d)

i)  ➢ Accrual of interest on principal until all bonds ahead are paid up

ii) ➢ When prepayments are within collar, interest accrues on Z for a fixed period

iii) ➢ May change to regular interest paying status under certain event
     ➢ May change back to accrual status

iv) ➢ If triggered by a certain cumulative event, such as prepayment, then may jump to receive principal ahead of other classes. Duration is volatile and can be very short
     ➢ Sticky means that the bond does not revert back to accrual status

e)

From the best to the worst:
1. Z-PAC: long duration and higher stability of cash flow
2. Z-bond: long duration with more prepayment risk
3. Tricky Z: volatility of cash flow
4. Jump Z: high volatility of duration (bond duration can shorten dramatically)

Because in this case we want to increase the asset duration to match the liability duration, assets with long duration and less volatility are preferred
Answer #5

a)

- Stated Maturity — longer maturities are more price and volatility sensitive just like traditional bonds underlying index
- Leverage — amount the underlying index affects the calculation of coupon or principal amounts

b)

- Difference between the at-the-market swap rate of 7.5% and the fixed coupon of 4% = 3.5%
- Present value of 3.5% over 7 years at 7.5% = 18.5% of $100 million = $18.5 million

c)

i) Scenario 1

- Cumulative return of S&P = \[ \prod_{i=1}^{7}(1 + r_i) - 1 \]
  \[ = 22.73\% \]
- S&P is at a 1.227 X purchase price at the end of 7 years. This less than the strike of 1.3 X purchase
  - Principal received = face amount of $100 million
  - IRR = coupon yield because it was purchased at par, so IRR = 4%

ii) Scenario 2

Cumulative 7-year S&P return = 41.56%. Additional amount received at maturity
= \((1.4156 - 1.3)\times$100million\)
= $11.56million
So IRR > 4%
- In addition to $100 million face amount
  - 1.4156 = cumulative return
  - 1.3 = strike price
  - $100 million = face
d)

- SCN maturity = 7 years remaining term to maturity on equity linked GICs = 4.5 years
- This makes the SCN inappropriate. Also the GICs are currently in the money. The SCN starts out of the money until it returns 30% — not appropriate
- Also the size is inappropriate, the GIC has $55 million in assets at 75% participation rate. The SCN has $100 million at 100% — not appropriate!!
Answer #6

a)

The answer will have the form \( \frac{dF}{F} = u dt + \sum_{i=1}^{3} \sigma_i dZ_i \)

Where \( u = R + \sum_{i=1}^{3} \lambda_i \sigma_i \) and \( \lambda_i = \frac{u - r}{R_i} \)

\( \lambda_R = \frac{(0.05 - 0.05)}{1} = 0 \)
\( \lambda_s = \frac{(1.05 - 0.05)}{2} = 0.25 \)
\( \lambda_T = \frac{(0.03 - 0.05)}{2} = -0.1 \)
So, \( \mu = 0.05 + 0.25 \sigma_s - 0.1 \sigma_T \)

and, \( dz_1, dz_2, dz_3 \) have the same correlation as \( R, S \) and \( T \)

b)

1) Break the time to maturity, say \( H \), into \( N \) times steps of \( \Delta t = \frac{H}{N} \)
2) Use the discrete formulas for \( R, S \) and \( T \) or the formula for \( F \) to model changes over time. For example: \( R(t + \Delta t) - R(t) = R(t)(0.05 \Delta t + \Lambda \Delta t^{1/2}) \)
3) Need to draw a random sample \( (z_1, z_2, z_3) \) from a multivariate normal distribution and use Cholesky decomposition to get the correct correlation. Variance reduction techniques could be used in the process
4) Repeat steps 1 to 3 for the \( N \) time steps to determine the payoff of \( F \) at maturity
5) Discount the payoff at the risk free rates generated. This is one scenario
6) Repeat for a large number of scenarios and average the results
7) You can use standard error of estimates to determine a confidence interval for the results or to determine the number of scenarios
Answer #7

a)

The SOP plan has a two-year at-the-money call option embedded in it, since employees can buy the stock in two years for the price at issue. This option is European. The ESPP contains an embedded put option. If the price is below 80% of initial value, the employees get their money back (i.e., sell the stock for what they bought it for). This option is also European. Strike is 80% of purchase price.

b)

Alternative hedges:
   i) Naked and covered position: it's the worst strategy and the largest risk exposure
   ii) Stop-loss hedges:
       ▪ Buy shares when stock price rises higher than strike price
       ▪ And sell share when stock price less than strike price. The cost is very high due to frequency trading
   iii) Delta hedging:
       ▪ Calculate $\Delta = \frac{dc}{dS}$, for short a call and long $\Delta$ shares
       rebalance when Delta changes to maintain hedge.

c)

Current stock price is 30. Therefore, ESPP options are in the money if price finishes below $80\%(30) = $24

Probability of exercise in risk-neutral would $= 1 - N(d_2) = N(-d_2)$

$= 1 - N(4.08) = [1 - (6554 + 8(6591 - 6554))]$

$= 1 - 65796 = 34204$

$$d_1 = \frac{\ln\left( \frac{S_0}{X} \right) + \left( r - q + \frac{\sigma^2}{2} \right)(T)}{\sigma\sqrt{T}}$$

$$d_1 = \frac{\ln\left( \frac{30}{24} \right) + \left( 0.03 + \frac{.402}{2} \right)(1)}{.40\sqrt{1}} = .80786$$
\[ d_2 = d_1 - \sigma \sqrt{T} = 80786 - 40 = 80746 \]

d)

At-the-money call option (SOP) delta 1 options for year-end 2000 options

\[ \Delta = e^{-\eta T} N(d_1) \]

\[ d_1 = \frac{\ln \left( \frac{S_0}{X} \right) + \left( r - q + \frac{\sigma^2}{2} \right) T}{\sigma \sqrt{T}} \]

\[ r = 0.05, q = 0.03, \sigma = 0.40, T = 1, x = 24, S_0 = 30 \]

\[ \Delta = e^{-0.05(1)} N\left( \frac{\ln \left( \frac{30}{24} \right) + (0.05 - 0.03 + 0.40^2 / 2)(1)}{0.40 \sqrt{1}} \right) = 0.808 \]

\[ \Delta = e^{-0.05(1)} N(0.808) = e^{-0.05(0.79042)} = 0.767 \]

Total delta for these options = -10,000(0.767) = -7,670.60 since the company is short the options

Year-end 2001 options (SOP)

\[ \Delta = e^{-\eta T} N(d_1) \]

\[ S_0 = 30, \ X = 30, \ r = 0.05, \ q = 0.03, \ T = 2, \ \sigma = 0.40 \]

\[ d_1 = \frac{\ln(1) + (0.05 - 0.03 + 0.40^2 / 2)(2)}{0.40 \sqrt{2}} = 0.35 \]

\[ \Delta = e^{-0.05(2)} N(0.35) = e^{-0.05(0.6368)} = 0.5997 \]

Total delta for the options = -15,000(0.5997) = -8995.73 since the company is short the options
ESPP options: one option = 
\[ \Delta = e^{\theta t}[N(d_1) - 1] \]

\[ d_1 = \frac{\ln\left(\frac{30}{24}\right) + \left(0.03 - 0.03 + \frac{0.40^2}{2}\right)(1)}{0.40\sqrt{1}} = 0.808 \]

\[ N(d_1) = 0.79042 \]

\[ \Delta = e^{-0.03(1)}[0.79042 - 1] = -0.203386 \]

\[ \Delta \text{ of these options is } \# \text{ options } \frac{360,000}{24} = 15,000 \]

\[ \Delta = -15,000(-0.203386) = 3,050.79 \]

Since the company is short the options

Delta of whole portfolio:

\[ = -7,670.60 - 8,995.73 + 3,050.79 \]
\[ = -13,615.54 \]

e)

Year-end 2000 SOP options:

\[ N(d_1) = N(0.808) = 0.79042 \]
\[ N(d_2) = 0.65796 \]

\[ d_1 = \frac{\ln\left(\frac{S_0}{X}\right) + \left(r - q + \frac{\sigma^2}{2}\right)(T)}{\sigma\sqrt{T}} \]
\[ d_2 = d_1 - \sigma\sqrt{T} \]
\[ = 0.808 - 0.40 = 0.408 \]
\[ c = S_0 e^{-rT} N(d_1) - X e^{-rT} N(d_2) \]
\[ = 30e^{-0.03(1)}(79042) - 24e^{-0.05(1)}(65796) \]
\[ = 799 \]

Total value of these options = 10,000(799) = 79,909

Year-end 2001 SOP options 
\[ d_1 = \frac{\ln\left(\frac{S_0}{X}\right) + \left(r - q + \frac{\sigma^2}{2}\right)T}{\sigma \sqrt{T}} \]
\[ d_1 = 35 \quad N(d_1) = 6368 \]
\[ d_2 = d_1 - \sigma \sqrt{T} = 35 - 40\sqrt{2} = -22 \]
\[ N(d_2) = 4129 \]

\[ c = S_0 e^{-rT} N(d_1) - X e^{-rT} N(d_2) \]
\[ = 30e^{-0.03(2)}(6368) - 30e^{-0.05(2)}(4129) \]
\[ = 6.78 \]

Total value of these options = 15,000(6.78) = 101,749

For ESPP options:
\[ S = 30 \]
\[ X = 80(30) = 24 \]
\[ r = 0.05 \quad \sigma = 0.40 \]
\[ q = 0.03 \quad T = 1 \]
\[ d_1 = \frac{\ln\left(\frac{S_0}{X}\right) + \left(r - q + \frac{\sigma^2}{2}\right)T}{\sigma \sqrt{T}} \]
\[ d_1 = \frac{\ln\left(\frac{30}{24}\right) + \left(0.05 - 0.03 + \frac{0.40^2}{2}\right)}{0.40\sqrt{1}} = 0.808 \]
\[ N(d_1) = N(0.808) = 79042 \quad N(-d_1) = 1 - 79042 = 20958 \]
\[ N(d_2) = N(0.408) = 65796 \quad N(-d_2) = 1 - 65796 = 34204 \]
\[ P = Xe^{-\delta T} N(-d_2) - S_0 e^{-\rho T} N(-d_1) \]
\[ = 24 e^{-0.05 T}(34204) - 30 e^{-0.05 T}(20958) \]
\[ = 1.707 \]

Total value of this group of options:
\[ \# \ options = \frac{360,000}{24} = 15,000 \]
\[ Value = 15,000(1.707) = $25,605 \]

Total Value of options
\[ = 79,909 + 101,749 + 25,605 \]
\[ = 207,263 \]

f)

- Gamma is a second-order measure that can be used to hedge large variations in value. It is the second derivative of portfolio value with respect to the asset price. It is also the rate of change of \( \Delta \) with respect to the asset price:

\[ \Gamma = \frac{d^2 \pi}{dS^2} = \frac{d\Delta}{dS} \]

- Matching gammas corrects the error introduced by delta hedging, i.e., that changes are linear. Gamma is analogous to convexity in immunization.

- It can be applied by matching gammas (i.e., making the portfolio gamma neutral) by maintaining a position of

\[ \frac{\Gamma}{\Gamma_1} \]

in the traded option

\[ \Gamma = \text{portfolio gamma} \]
\[ \Gamma_1 = \text{gamma of traded option} \]

After adjusting for gamma neutrality, must rebalance to make delta neutral.
Answer #8

a)

- Need to use realistic, equilibrium model for asset adequacy testing
- Not practical if realistic and arb.-free
  - Term premium cannot be est. (confounding)
- HJM model is arb.-free
- HJM can not be realistic
- CIR model — equilibrium Model
- CIR can be a realistic model
- CIR is the only choice for realistic-equilibrium model
- Not pricing ⇒ arb.-free not needed ⇒ no need to calibrate exactly to current price
- Ease for application is a main criteria

b)

- Need to model assets and liability CFs, and
  - Payment function for MBS
  - Lapse and withdrawal for interest-sensitive annuities
  - Call behavior for callables
  - Default rates for bonds
  - All of the above are dependant on interest rate
- Parameters for pre-payments, defaults, policyholder behavior are usually estimated using regression on historical data

c)

- Interest rate model may be incorrect
  - Not have enough factors
  - Inappropriate for what is priced or current environment
- Model correct but data not good
- Model correct but solution is not
- Bugs in programming of model
- Data unstable
Answer #9

a)

i Rental income — if this is a high percentage of GDP this is a negative factor w.r.t. political stability — inhabitants don’t need to be industrious or productive, just learn how to benefit from natural resources (as in the case of oil-rich countries)

ii Trauma — after sufficient time has passed, trauma leads to infrastructure investment and is a positive factor for political stability

iii GDP per capita is the most important factor — high per capita GDP leads to political stability and is of course an indicator of economic success already achieved — so GDP growth is an important measure for capacity

b)

➢ Highest: Country C has the strongest per capita GDP and the second lowest proportion of GDP from natural resources (rental income) Infant mortality is not far behind other countries (higher is negative as it implies inferior distribution of wealth) [proxy for distribution of income]

➢ Lowest: Country B has slightly better GDP than Country A but most of the difference comes from rental income (at least if oil reserves is only indicator) and inferior infant mortality rate

➢ Middle: Country A is ahead of B and behind C with best infant mortality rate and second lowest rental income/per capita GDP

c)

➢ Inflation — stability of inflation rate is positive factor

➢ Democracy — is a legitimator of power as it represents choice of people. Other forms of government have potential to give rise to political unrest

➢ Competitiveness in international markets — ability to be economically viable if external growth in GDP (wealth)

➢ Human Capital — power if deployed in nation’s economy

➢ Agriculture — like rental income, some agriculture is good, but too much is bad

➢ Distribution of Income — Wealth less effective if in the hands of few. Population should share benefits of GDP to be positive factor.

➢ Quality of life — similar to above, high quality for all = political stability
The exposure subject to first factor:
\[-3.5 \times 0.44 - 1.4 \times 0.44 - 2.8 \times 0.44 - 2.5 \times 0.44 - 0.7 \times 0.44\]
\[= -4.796\]

The exposure subject to second factor:
\[-3.5 \times (-0.8) - 1.4 \times (-0.25) - 2.8 \times 0.05 - 2.5 \times 0.35 - 0.7 \times 0.42\]
\[= 1.841\]

The exposure subject to third factor:
\[-3.5 \times 0.43 - 1.4 \times (-0.69) - 2.8 \times (-0.22) - 2.5 \times 0.08 - 0.7 \times 0.52\]
\[= -0.487\]

Let $f_1$, $f_2$, $f_3$ stand for principal components factor score
\[f = -4.796 f_1 + 1.841 f_2 - 0.487 f_3\]

As they are independent from each other:
\[
\sigma_f^2 = \left((-4.796)^2 \times 17^2 + (1.841)^2 \times 6^2 + (-0.487)^2 \times 3^2\right)
\]
\[= 6771.62\]
\[\sigma_f = 82.29\]
\[VAR = 2.33 \times 82.3 = 191.74\]

So 1 month 99% VAR is 191.74
Answer #11

a)

i)  
- Increased refinancing
- Premium leads to higher
- Recent leads to higher

ii)  
- Increased refinancing
- Discount leads to lower
- Seasoned leads to lower
- Difference depends on size of premium / discount
- Mortgages priced off shorter portion of yield curve often used to refinance longer priced mortgages

b)  
- Prepayment increases cash inflows from mortgage investments
- Reinvestment only available at lower interest rates
- Gic's presumably based on interest at higher than current rates
- No incentive for Gic holders to surrender - so no increased cash outflows to liabilities
- Liabilities may grow longer
- Negative impact on income (asset returns - Gic interest)
- Less prepayment from vintaged discount pool
- More prepayment from recent premium pool
- Prepayments from discount pool at par = gains greater than expected
- Prepayments from premium pool at par = losses, greater than expected

c)  
- Collateral
- Effective Collars
- Priorities
- Effective Duration
- Interest rate sensitivity
d) Cannot judge by collars on issue - need to calculate effective collars premiums more likely to refinance than discount. but given past interest rate history, burnt out. discounted more likely to constitute sophisticated borrowers, so likely to refinance at first occasion both have 5 years to run PAC offer better security against call and extension risk than pass through older PAC has greater security than younger, all things being equal.
Answer #12

a) Accounting Exposure:
- Transaction Exposure: the exposure arising from the changes in foreign currency and commodity prices that adversely impact the expenses and the revenue to which the firm has already committed
- Translation: change in foreign currency that will adversely impact the assets and liabilities in the local currency of the parent
- Future Exposure/Contingent Exposure: exposure due to changes of foreign currency, commodity prices (and interest rates) that will adversely impact the expenses and revenues to project that the firm is expected to do, but not yet booked
- Competitive Exposure: exposure due to change in the risk factors that will adversely impact the firm regarding its market share of sales and ultimately its earnings (net income)
- Strategic Exposure: is the sum of these exposures

b) Yes, the company should manage because risk management policies will have an impact on the cash flow of the firm. Main reasons:
- Non-linearity of taxes
- Taxes are non-linear because:
  - AMT
  - Losses that cannot be deducted because of lack of taxable income
- Taxes normally have a convex structure
- Taxes will affect the more the tax schedule is convex and the more the earnings are volatile
- Taxes are not proportional to income
- Cost of financial distress: there are many cost associated with financial distress
  - Lack of confidence of the employees and other parties
  - Management diverts their attention from action that positively impacts the value of the firm
  - Cost associated with bankruptcy
  - Doubling the losses can more than double the cost of financial distress (because of non-explicit cost of financial distress)
- Improved financial and investment decisions
  - Can help to use more debt (may be beneficial)
  - Decrease the conflict of interest between the bondholder and the stockholder
  - Do not reject project with positive NPV (under-investment problem)
- Actions that ↑ cash flow volatility will transfer wealth from bondholder to stockholder

- Managerial Self-Interest: the managers are assumed to have a large part of their wealth associated to the success of the firm:
  - May have stock options
  - If company fails may lose job
  - Market perception of the ability of the managers to manage a company
  - Managers are assumed to have a concave objective function
  - The managers cannot diversify as the investors can do

- Capital Market Imperfections: must minimize earnings volatility

c)

- Losses due to human errors, management failure and system inadequacy
- Can be hedged or mitigated by:
  - Having an independent risk management unit that reports to the senior management
  - Independent audit to verify adherence to policies
  - Policies, standards, control and check
  - Good system

d)

- Risk that the contract cannot be enforced with given counter parties
- May be due to: lack of documentation, lack of regulation, insolvency, other party cannot contract, series of contract are considered illegal
- Netting and insolvency: netting is very good way to reduce risk with counter party, must verify when it applies
- Unenforceability and illegality
  - Parties may not be able to contract (ultra vires)
Answer #13

a)

No income means that in the no-default world this is a European call

\[ c = P(0, T)[F_0N(d_1) - XN(d_2)] \]

\[
P(0, T) \quad \text{Value at time 0 of the zero-coupon maturing at time } T \quad = 1
\]
\[
F_0 \quad \text{Value of the forward price at time } 0 \quad = 1000
\]
\[
X \quad \text{Strike price} \quad = 1000
\]
\[
T \quad \text{Time to option Maturity} \quad = 1
\]

\[
d_1 = \frac{\ln\left(\frac{F_0}{X}\right) + \frac{\sigma^2 T}{2}}{\sigma \sqrt{T}} = \frac{\sigma \sqrt{T}}{2} = 0.1
\]

\[
d_2 = d_1 - \sigma \sqrt{T} = -0.1
\]

\[ c = 1000(N(0.1) - N(-0.1)) = 1000(0.5398 - 0.4602) = 79.6 \]

b)

- American calls are worth more than European calls in the world with defaults because if the writer shows distress signs call may be exercised, hence

\[ C_{\text{American}} \geq C_{\text{European}} \]

- This is an asset on your balance sheet, so let
  - \( f \) is the European call value with default
  - \( f^* \) is the default free European call value
  - \( y(T) \) is the yield on the zero coupon bond \( P(T) \) issued by the option writer
  - \( y^*(T) \) is the yield on the risk-free zero coupon bond \( P^*(T) \). We get:

\[
h(0, T) = \frac{f^* - f}{f^*} = \frac{P^*(T) - P(T)}{P^*(T)} = \frac{e^{-\gamma^*(T)t} - e^{-\gamma(T)t}}{e^{-\gamma^*(T)t}}
\]

- Because the proportional loss is the same for the bond and the derivative given the independence of default occurrence from other variables. Hence.
\[ f = f \times e^{[y^*(T) - y(T)]T} \]

- Is the required lower bound, and:

\[ C_{\text{American}} \geq f = f \times e^{[y^*(T) - y(T)]T} = 79.6 \times e^{-0.015} = 78.4 \]

c)

- We need to hedge interest rate risk and the risk of default. Hence use
  Risk free zero-coupons
- Replicate option payoffs
- Solve for the necessary positions in each of zero-coupons
**Answer #14**

a)

Analogy between the call option and real option:

<table>
<thead>
<tr>
<th>Call Option On Stock:</th>
<th>Real Option on Project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Current stock price</td>
<td>- Expected future cash flow</td>
</tr>
<tr>
<td>- Time to maturity</td>
<td>- Time until opportunity</td>
</tr>
<tr>
<td>- Exercise price</td>
<td>- Investment cost</td>
</tr>
<tr>
<td>- Stock price volatility</td>
<td>- Expected cash flow volatility</td>
</tr>
<tr>
<td>- Risk-free rate</td>
<td>- Risk-free rate</td>
</tr>
</tbody>
</table>

But this analogy is deficient as:

1. Unexclusiveness of the ownership and competitive interaction  
   a. Traditional option exercise the option, have the exclusiveness of the option  
   b. Real option exercise non-proprietary option will invoke competition respond by reducing the value of the underlying asset  
2. Tradability and preemption  
   a. Generally most real options are not tradable or are at high prices  
   b. Early exercise motivated for the intent of preemption  
3. Across time interaction and compoundness  
   a. Generally real options are compound (option on an option)

b)

Exclusiveness of ownership and competition

1. Most real options can be replicated by competitors if it is a lower barrier to entry. Under these circumstances, the option is shared with the market and may lead to a competitive loss. Exclusiveness of the ownership can be characterized as proprietary or shared  
2. Inter/Intra Project: most projects are compound options; stand alone investments are simple options  
3. Urgency of Decision: Investment can be made now or deferrable

c)

- Proprietary — simple — expiring  
- Shared — simple — expiring  
- Proprietary — simple — deferrable  
- Shared — simple — deferrable
d)  
- DCF/DTA: Ignores or cannot properly capture management's flexibility to adopt decisions. Unable to capture the value of operating options properly.
- CCA: Can quantify the flexibility of an option. Combines the best features of DTA and NPV without the drawbacks.

e)  
\[ V_0 = 50 \quad V_1^+ = 50 \times 1.7 = 85 \]
\[ I_0 = 52 \quad V_1^- = 50 \times 8 = 40 \]
\[ Z^+ = \max(V_1^+ - I_1, 0) \]
\[ = \max(85 - 52 \times 11, 0) = 27.8 \]
\[ Z^- = \max(V_1^- - I_1, 0) \]
\[ = \max(40 - 52 \times 11, 0) = 0 \]
\[ Z = \frac{5 \times 27.8 + 5 \times 0}{1825} = 0.1112 \]

DCF/DTA option = 1112 - (50 - 52) = 1312

CCA - \( p = \frac{1 + r - d}{u - d} = \frac{1}{3} \)
\[ = \frac{27.8}{1} + \frac{0}{2} \times \frac{3}{1 + 0.1} = 8.42 \]

Option = 8.42 - (50 - 52) = 10.42

f)  
\[ S_0 = 1 \times 50 = 5 \]
\[ N = \frac{27.8 - 0}{5 \times 17 - 5 \times 8} = 118 \text{ million shares with } S_0 = 5 \]

Total Cost is 30.8

Borrowing remainder at risk free rate \( B = 22.48 \)
\[ E^+ = 618 \times 5 \times 17 - B \times 11 = 278 \]
\[ E^- = 618 \times 5 \times 8 - B \times 11 = 0 \]
So if the holder can pay 8.42 to get it why pay 11.12

So the CCA gives the correct value

g)

\[ V_1^+ = 85 \quad V_1^- = 40 \]
\[ V_2^{+-} = 68 \quad V_2^{--} = 32 \]
\[ V_2^{*1} = 164.5 \]

\[ D_2 = -25 \times (1.14)^2 = 32.69 \]
\[ I.D. = 25 \quad I.K. = 27 \]

\[ Z_{2}^{++} = \max(V_2^{++} - D_2, 0) = 112.01 \]
\[ Z_{2}^{+-} = \max(V_2^{+-} - D_2, 0) = 35.51 \]
\[ Z_{2}^{--} = \max(V_2^{--} - D_2, 0) = 0 \]

\[ Z_1^+ = \frac{PZ_{2}^{++} + (1-p)Z_{2}^{*+}}{1+r} = \frac{112.1 \times \frac{1}{3} + 35.51 \times \frac{2}{3}}{1.1} = 55.66 \]
\[ Z_1^- = \frac{PZ_{2}^{+-} + (1-p)Z_{2}^{*-}}{1+r} = \frac{35.51 \times \frac{1}{3} + 0 \times \frac{2}{3}}{11} = 10.76 \]
\[ Z_e = \frac{PZ_1^+ + (1-p)Z_1^-}{1+r} - Z_e = \frac{55.46 \times \frac{1}{3} + 10.76 \times \frac{2}{3}}{1.1} - 27 = -3.67 \]

\(-3.67 - (50 - 52) = -1.67\) as the flexible value of the option
Answer #15

a) 

- An investor's utility is not based on expected return/expected variance
- An investor may compare performance against a benchmark and may feel uncomfortable with large deviation
- An investor may lack of confidence in the assumptions, thus doubt on the results
- MV optimizer tends to give extreme allocation results
- Results are very sensitive to the assumptions; small change in assumptions could lead to large change in allocation

b) 

MVT utility fraction for portfolio $P$

$$U(P) = \text{Exp Ret}(P) - \frac{(\text{Exp Risk } (P))^2}{rt} - \frac{(\text{Exp Te } (P))^2}{tet}$$

Let $w$ be the weight allocated to bonds

\[ \text{Exp Ret}(P) = wx0.06 + (1-w) x 0.07 \]

\[ = 0.07 - 0.01 w \]

\[ (\text{Exp Risk } (P))^2 = (0.05w)^2 + 2w(1-w)(0.8)(0.05)(0.1) + (0.1(1-w))^2 \]

\[ = \frac{45w^2 - 120w + 100}{10,000} \]

\[ (\text{Exp Te } (P))^2 = (0.07 - 0.01w - 0.4 x 0.06 - 0.6 x 0.07)^2 \]

\[ = \frac{(0.4 - w)^2}{10,000} \]

Hence

\[ u(P) = 0.07 - 0.01w - \frac{45w^2 - 120w + 100}{10,000 \times rt} - \frac{(0.4 - w)^2}{10,000 \times tet} \]

Take derivative, and set to zero
\[
\frac{du(P)}{dw} = -0.01 - \frac{90w-120}{10,000 \times rt} - \frac{2(0.04 - w)(-1)}{10,000 \times tet}
\]

\[
= \frac{1}{10,000} \left[ \left( \frac{90}{rt} + \frac{2}{tet} \right)w - 100 \frac{120}{rt} + \frac{0.8}{tet} \right]
\]

\[
\frac{du^2(P)}{dw^2} < 0 \rightarrow \text{maximum value when} \quad \frac{du(P)}{dw} = 0
\]

\[
\frac{du(P)}{dw} = 0 \rightarrow w = \frac{\left( \frac{120}{rt} + \frac{0.8}{tet} - 100 \right)}{\left( \frac{90}{rt} + \frac{2}{tet} \right)}
\]

Substitute \( rt = 0.75 \), \( tet = 0.02 \) to get

\[
w = \frac{100}{220} = 0.4545
\]

c)

i) As \( tet = \infty \), \( w \rightarrow \frac{60}{120} = 0.5 \)
   Mean-Variance optimizer: 50% bonds, 50% equities

ii) As \( tet \rightarrow 0 \), no tracking error is tolerated. We obtain the target portfolio

\[
w = 0.4 \quad 40\% \text{ bonds, } 60\% \text{ equities}
\]
Answer #16

a)

Five Steps:

1. Estimate the firm's cost of capital
   a. Weighted average cost of debt and cost of equity capital
   b. Assumptions from marketplace
2. Estimate the return on firm's asset portfolio
   a. Need to consider defaults
   b. Expressed as premium over risk-free rate
3. Assess degree of financial leverage
   \[ DDE / \left( 1 - T \times F_r \right) \times FVL^* \]
   a. DDE = discounted distributable earnings
   b. FVL^* = fair value of liability without tax
   c. F_r = proposition of liability that's taxable
4. Assess impact of non-investment-related risks
   a. Estimate using RBL on invested and non-invested assets
5. Estimate policyholders risk-sharing burden
   a. Transfer of risk through experience rating, dividends, etc.

(b)

<table>
<thead>
<tr>
<th>t</th>
<th>Assets</th>
<th>Liability</th>
<th>Liability Cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1080</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1080</td>
<td>1000</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>1080</td>
<td>1000</td>
<td>42</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1042</td>
</tr>
</tbody>
</table>

\[ FVL^*_t = \frac{FVL^*_{t-1} + L(t) + I(t)}{1 + r - \theta^P} \]

\[ FVL^*_3 = 0 \]

\[ FVL^*_2 = \frac{0 + 1042}{1 + 0.03 + 0.015} = 997.13 \]

\[ FVL^*_1 = \frac{997.13 + 42}{1045} = 0.9438 \]

\[ FVL^*_0 = \frac{994.38 + 42}{1045} = 0.9175 \]
Fair Value of Taxes = \( (PVI_{t}^{MVA} - PVI_{t}^{FVL*}) \frac{1}{1 - T} \)

\[ FVL = FVL* + (FV \text{ taxes}) \]

\[ PVI_{t}^{MVA} = \frac{PVI_{t}^{MVA} + (r + \theta^D) TVA_{t-1}}{1 + r + \theta^D} \] since no risk premium, \( \theta^D = 0 \)

\[ PVI_{2}^{MVA} = \frac{0 + 0.03(1080)}{103} = 31.46 \]
\[ PVI_{1}^{MVA} = \frac{31.46 + 0.03(1080)}{103} = 62.00 \]
\[ PVI_{0}^{MVA} = \frac{62.00 + 0.03(1080)}{103} = 91.65 \]

\[ PVI_{t}^{FVL*} = \frac{PVI_{t}^{FVL*} + (r + \theta^D) TVA_{t-1}}{1 + r + \theta^D} \]

\[ PVI_{2}^{FVL*} = \frac{0 + 0.03(1000)}{103} = 29.13 \]
\[ PVI_{1}^{FVL*} = \frac{29.13 + 0.03(1000)}{103} = 57.41 \]
\[ PVI_{0}^{FVL*} = \frac{57.41 + 0.03(1000)}{103} = 84.86 \]

<table>
<thead>
<tr>
<th>( t )</th>
<th>( FVL^* )</th>
<th>( PVI_{t}^{MVA} )</th>
<th>( PVI_{t}^{FVL*} )</th>
<th>FV Taxes</th>
<th>FVL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>991.75</td>
<td>91.65</td>
<td>84.86</td>
<td>3.66</td>
<td>$995.41</td>
</tr>
<tr>
<td>1</td>
<td>994.38</td>
<td>62.00</td>
<td>57.41</td>
<td>2.47</td>
<td>$996.85</td>
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<tr>
<td>2</td>
<td>997.13</td>
<td>31.46</td>
<td>29.13</td>
<td>1.25</td>
<td>$998.38</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$0</td>
</tr>
</tbody>
</table>
Question #17

a) ➢ As interest rate increases the market value of the portfolio will decrease. The insurer needs to set competitive rates but also cover their expenses. Interest rate cap hedge interest rate increases and generates cash flows for adverse situation. Caps are based on CMT and CMS rates, they are cheaper, and track the new-money rates offered on competing annuities.

b) ➢ Used if the primary concern is that flattening of the yield curve will cause corporate and swaps spreads to widen. The insurer select the desired term (tenor) of the swap, and the dealer sets the lock at the end of the term at a certain spread. If the spread is wider than the lock, the dealer pays the insurer, if the spread is narrower the insurer pays to the dealer. The amount owed is Nominal Amount* (spread-lock)* duration of the swap. As the portfolio has a large percentage of bonds a spread lock would be an appropriate strategy.

c) ➢ If the interest rate increases a yield curve swap will help by shortening the duration. The insurer pays fixed and receives floating. The fixed rate is based on CMT or CMS rates of maturities of 5, 7, or 10 years. It allows the insurer to track the new money rates.

d) ➢ Interest rate floors hedge the risk of falling interest rates. As there is MBS in the portfolio we also need to hedge the risk of prepayment in extreme rally of interest rate. It also hedges the risk of falling below the minimum guarantee rate of 4%. The floor pays if the yield is less than the strike. Long assets can be replaced with short assets + floors.

e) ➢ A prepayment cap hedges the risk of falling rates. It pays an amount designed to meet the hedging need at each level of prepayment. It is like synthetically selling the MBS to the dealer. The investor can choose products driven by interest rate or driven by experience in the MBS market. The decision depends on the investor's view whether the option is overvalued or undervalued compare to pure interest rate option.
Answer #17

a)  
➢ Cash flows are dependent on the interest rate path that is experienced  
➢ Book value redemption/surrender, i.e., prepayment/surrender options where the cost of prepayment or surrender is not impacted by the current level of interest rates  
➢ Interest rate options next exercised with full economic efficiency

b)  
➢ No interest rate sensitive surrenders, i.e., no policyholder options  
➢ Fixed credited rated, i.e., no insurance company options

c)  
  i  Increase RSA with little or no impact on OAD and MTL  
  ii  Little or no impact on RSA and OAD and reduce MTL  
  iii Increase RSA and reduce OAD and MTL  
   iv Increase RSA and reduce OAD and MTL

**END OF EXAMINATION**
The Education and Examination Committee provides study notes to persons preparing for the examinations of the Society of Actuaries. They are intended to acquaint candidates with some of the theoretical and practical considerations involved in the various subjects. While varying opinions are presented where appropriate, limits on the length of the material and other considerations sometimes prevent the inclusion of all possible opinions. These study notes do not, however, represent any official opinion, interpretations or endorsement of the Society of Actuaries or its Education and Examination Committee. The Society is grateful to the authors for their contributions in preparing the study notes.
COURSE 8 - INVESTMENTS
CASE STUDY

LifeCo

Charles Gilbert
Joe Koltisko
Jean-Francois Lemay
Chris Macklem
Peter Tilley
Keith Drzal
BACKGROUND AND HISTORY

LifeCo is a multinational stock life insurance company and has general account assets totaling $5 billion supporting three main lines of business: Individual Life and Annuity, Institutional Pensions and Group Benefits. Its assets are internally segmented in eleven major portfolios defined below. Each portfolio is fully integrated in the accounting databases with full income statements and balance sheets produced monthly. LifeCo has recently implemented guidelines for Asset Liability Management and is in the process of identifying strategies for mitigating its exposure to interest rate and other risks.

LINES OF BUSINESS

*Individual Life and Annuity*
- Traditional Life
- Non Traditional Life
- Accumulation Annuity
- Equity-Linked GIC
- Separate Account for Variable Annuity and Variable UL

*Institutional Pensions*
- Payout Annuity
- GIC
- Separate Account for Institutional GICs

*Group Benefits*
- Long Term Disability
- Medical, Dental, Group Term

*Surplus Account*
- Surplus Capital

DESCRIPTION OF LIABILITIES

*Individual Life and Annuity*

*Traditional Life* includes all non-interest-sensitive individual life products and is predominantly comprised of non-par term and whole life. Guaranteed interest on whole life policies ranges from 3% to 6%. Policyholders can take out policy loans against any cash surrender value. A maximum loan rate of 7% exists on older policies. The duration of the traditional life liability cash flows tends to be fairly long. It has been difficult to find assets with suitable characteristics to effectively match these liabilities. The liabilities in the traditional life segment are supported by $300 million of assets.

*Non Traditional Life* consists entirely of universal life. Universal life policyholders can direct their investments into a number of interest bearing or equity-linked accounts.
Interest accounts generally credit a portfolio average rate and have a minimum credited interest guarantee of 4% across the board. Because LifeCo incurs significant costs associated with the acquisition of this business, even though the present value of future fund profits exceeds the present value of all future benefits and expenses, it will not have the hard assets to invest at issue in order to match the interest rate exposure of the liabilities. This situation creates significant reinvestment rate risk. To further complicate matters, the embedded options present in universal life mean that the liability cash flows will not be fixed and will vary with interest rates. The liabilities in the non traditional life segment are supported by $400 million of assets.

**Accumulation Annuity** contains all individual flexible and single premium deferred annuities. Assets total $1.5 billion. Most funds are available for withdrawal at a book value basis. Surrender charges decline to 0% over a 5-7 year period. Minimum guarantees are generally in the 3-4% range but there is a $500 million block of annuities that have a 5% minimum guarantee. This latter block was sold with a 6% cliff surrender charge and will be reaching the end of the surrender charge period in the next year (i.e. the surrender charge will go from 6% to 0). There is also a $250 million block of MVA (market value adjusted) annuities included in this segment. The Accumulation Annuity portfolio has been the subject of much modeling scrutiny over the years to better understand the product profitability and risk profile. Actuaries at LifeCo have internally flagged each asset purchase in the portfolio to a particular product in order to support a more detailed level of analysis.

**Equity Linked GICs** offer the return of principal after five years, plus 75% of the percentage increase of the S&P 500 total return index over that five year period (if positive). As at December 31st, 2000:

- assets total $55 million
- remaining term to maturity of GICs is 4.5 years
- current percentage increase of the S&P 500 total return index since issue is 6%
- volatility of the S&P 500 index equals 18%
- S&P 500 total return index is expected to grow at 15% / year

**Variable Annuities** include a guaranteed minimum death benefit, which, upon death of the policyholder, will pay the maximum of the current account value and the deposits accumulated at 5%. Upon surrender, the market value less surrender charges is paid.

**Separate Accounts for Variable Annuity and Variable** are invested in various, externally managed, mutual funds. Policyholders may transfer between the funds offered, make new deposits, and withdraw money, subject to a surrender charge.

**Institutional Pensions**

**Payout Annuity** contains pension buyout annuities in both immediate and deferred status, supplementary contracts arising from life or annuity contracts and structured settlement annuities. This segment was established to hold intermediate to long term income payment streams that may or may not include life contingencies. Structured settlement
annuities contain standard and substandard annuities, non life contingent streams and some COLA (cost of living adjustment) escalators. Assets total $700 million.

**Guaranteed Investment Contract (GIC)** include both single deposit and window GICs. This segment holds $1.5 billion of assets. $200 million of the portfolio consists of funding agreements that are putable with 60 days notice. The remainder are benefit-sensitive contracts with institutional pension plans, which mature over the next 5 years.

**Separate Account Institutional GIC** offers single deposit and window GICs to larger institutional clients. For accounts larger than $150 million, the company will offer to set up a separate portfolio for one client, with its own asset allocation targets. Administrative fees are reduced for the commingled accounts, which are available to clients with at least $25 million. While the institutional client owns the market value of its share in the separate account, the individual participants receive interest credited to the book value of their individual accounts. LifeCo annually resets the crediting rates, so that the market value gains and losses in the commingled account are shared with participants. The general formula used to set the credited rate is as follows.

*Credited rate*

\[ = \text{Market yield of separate account} - \text{Administration fees} + (\text{MV separate account} - \text{BV individual accounts}) / (\text{Duration of separate account}) \]

In addition, LifeCo guarantees that the market value of each separate account will never be less than 80% of the book value of the individual accounts associated with it. LifeCo does not offer synthetic GICs.

**Group Benefits**

**Group Long-Term Disability** pays up to 70% of an employee’s salary prior to the disability claim. Premiums are paid through payroll deduction. Premium rates are guaranteed for 2 years. Claims incurred stay with LifeCo even if the employer changes insurance carrier for new business. The current product provides “own occupation” benefits generally for two years from the date of incurral, after which payments continue only if the claimant is unable to work at all. LifeCo offers rehabilitative services and counseling where it may be effective, usually through the first four years of a claim. Claim runoff is such that reserves at claim duration 10 are expected to be about 10% of the reserve at date of incurral. There is no cash surrender benefit to either individual claimants or group policyholders. The claim liabilities and unearned premium in respect of the group LTD segment are backed by $500 million of assets.

**Other A&H** includes short term group medical, dental, and term life products. These products are sold through the same group benefits general agents who distribute the company’s LTD product. The company competes on strong underwriting and customer service. The products are repriced at least annually to meet profitability targets. While investment margins are material, they are seen as independent of underwriting margins.
Earned premium to surplus leverage is low, at about 4/1. The claim reserves and unearned premium in respect of the other A&H segment are backed by million of assets.

*Surplus Account* contains the surplus capital. The Surplus Account is managed to maximize total rate of return growth over time subject to a series of constraints related to liquidity, bond ratings and operating income versus surplus income concerns. Company guidelines require an asset mix of 10-70% in equities, 0-50% in real estate, and 5-90% in bonds. The target asset mix is 50% equities, 35% real estate, and 15% public and private bonds.

**RATINGS OF COMPANY**

Mud & Poor's (M&P) Rating Agency uses the following rating categories:

AAA, AA, A, BBB, BB, B, etc

LifeCo is currently rated "AA-". One year ago, M&P raised concerns about LifeCo and placed the company under ratings review. LifeCo was not downgraded at that time.

M&P's report at that time included the following rationale for the review:

**Capital:** LifeCo's capital position of 3.6% of assets is weak relative to the other insurers rated "AA-".

**Liquidity:** LifeCo's liquidity position appears weak. Given that the GIC's will mature over the next few years and that a significant portion of the new sales are directed to separate account products, the company would appear to have a higher than usual liquidity risk.

**Credit Risk:** LifeCo is exposed to C1 risk because of its investments in: below investment grade bonds, commercial mortgages, equity, and real estate. LifeCo also has a high percentage of total assets invested in CMO's which exhibit cashflow volatility.

**Growth/Profitability:** LifeCo's business mix is shifting to less capital intensive lower margin products.

**PERFORMANCE HISTORY**

LifeCo was established in 1945; however most of LifeCo's growth has taken place in the last ten years.

Although LifeCo has been profitable on both a Statutory and GAAP basis for the past 6 years, profits have fluctuated. Return on Equity (ROE) has averaged 8% over the past 5
years compared to an ROE of 12% for the industry. LifeCo’s Stock, on a total return basis, has returned 10%, on average, over the past 3 years.

ENVIRONMENT

In surveys, the company has generally received positive reviews from its customers for service and for value. One weakness of the company has been its public relations department. Early in 1999, LifeCo took steps to deal with this weakness by hiring one of the top public relations specialists in the country.

The insurance industry in general has received some bad press of late due to perceived market conduct problems. As a result, financial service companies that are not perceived as insurers have taken business away from companies perceived as insurers. LifeCo is definitely viewed as an insurer.

Because of the rapid changes in product design, LifeCo has 16 products running on 6 different administrative systems. With the strong stock market and declining interest rates, money has been moving from the fixed account to the variable accounts for both the variable annuity and the variable life products. The variable life market has been growing in recent years. The variable annuity market has also been growing, but it has been adversely affected by recent tax law changes. Additionally, recent changes in regulation have allowed banks to underwrite variable annuities, and several large banks are offering low load versions of this product. These changes have resulted in a dramatic slowing of variable annuity sales for LifeCo. At the same time, many reinsurers have taken a second look at offering reinsurance for the risk associated with the investment guarantees offered on these products and are now either not willing to provide reinsurance on this business at all or, if they do, at a much higher cost than was previously assumed in pricing.

DESCRIPTION OF ASSETS

General Fund Assets Backing Individual Life & Annuity and Institutional Pensions
LifeCo invests in private placement bonds, public bonds (including CMO’s), commercial mortgages, equities and real estate. For private placement bonds, LifeCo tries to maintain a 75% investment grade, 25% below investment grade mix. The current mix is worse than these percentages because of downgrades in the portfolio. 30% of the private placement bonds are callable.

For public bonds LifeCo tries to maintain an 80% investment grade, 20% below investment grade mix. Currently, LifeCo maintains a higher credit quality for the bonds to offset the current mix for the private placement bonds. 75% of the public bonds are callable.

General account assets are segmented into portfolios supporting the liability lines. LifeCo’s asset mix backing its pension business is: 83% bonds, 13% commercial
mortgages, 2% equities and 2% cash & short term. LifeCo's asset mix backing its individual life and annuity business, including the liability arising from the guaranteed minimum death benefit, is: 74% bonds, 10% commercial mortgages, 5% equities, 7% real estate, 2% policy loans and 2% cash & short term. LifeCo's asset mix backing its Group Life and Health business is: 85% bonds, 8% commercial mortgages, 5% equities and real estate, and 2% cash and other.

**Separate Accounts Variable Annuities and Variable UL Policies**
The overall distribution is 70% US equity, 15% US bonds, 5% money market, and 10% international bonds/equity for the variable annuity block. Assets total 1 billion of variable annuities, and 1 billion for variable.

<table>
<thead>
<tr>
<th>Fund Type</th>
<th>Volatility</th>
<th>Equity</th>
<th>Bond</th>
<th>Mortgage</th>
<th>Asian</th>
<th>Global</th>
<th>Money Market</th>
<th>Balanced</th>
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</thead>
<tbody>
<tr>
<td>Equity</td>
<td>18%</td>
<td>1</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>70.00%</td>
<td>0.00%</td>
<td>95.00%</td>
</tr>
<tr>
<td>Bond</td>
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<td>1</td>
<td>80.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
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<tr>
<td>Mortgage</td>
<td>3%</td>
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<td>80.00%</td>
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<td>0.00%</td>
<td>0.00%</td>
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<tr>
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<td>21%</td>
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<td>1</td>
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</tr>
<tr>
<td>Global</td>
<td>19%</td>
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<td>0.00%</td>
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<td>45.00%</td>
<td>1</td>
<td>0.00%</td>
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</tr>
<tr>
<td>Money Market</td>
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<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>1</td>
<td>0.00%</td>
</tr>
<tr>
<td>Balanced</td>
<td>9%</td>
<td>95.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>70.00%</td>
<td>0.00%</td>
<td>1</td>
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<table>
<thead>
<tr>
<th>Unit Value</th>
<th>Variable Annuities</th>
<th>Variable UL</th>
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<tbody>
<tr>
<td></td>
<td>Fund Value</td>
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</tr>
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<td>Bond</td>
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<tr>
<td>Mortgage</td>
<td>11.1</td>
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<tr>
<td>Asian</td>
<td>9.5</td>
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<tr>
<td>Global Equity</td>
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<tr>
<td>Money Market</td>
<td>10</td>
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<tr>
<td>Balanced</td>
<td>15.2</td>
<td>564</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,452</strong></td>
<td></td>
</tr>
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</table>

Note: The Delta and Gamma applies to the minimum guaranteed death benefit included in the variable annuity product.

<table>
<thead>
<tr>
<th>Reported Book Value</th>
<th>DAC</th>
<th>Net Book Value</th>
<th>PV of Cash-Flows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Annuities</td>
<td>2459</td>
<td>(74)</td>
<td>2,385</td>
</tr>
<tr>
<td>Variable UL</td>
<td>1122</td>
<td>(28)</td>
<td>1,094</td>
</tr>
</tbody>
</table>

**Separate Account Institutional GIC**
In total this line of business holds $1.2 billion in market value of assets. Each commingled account offers a different target asset allocation.
### Account 1

<table>
<thead>
<tr>
<th>Investment</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Treasuries</td>
<td>5%</td>
</tr>
<tr>
<td>AA/AAA public corporates</td>
<td>35%</td>
</tr>
<tr>
<td>A public corporates</td>
<td>15%</td>
</tr>
<tr>
<td>BBB public corporates</td>
<td>10%</td>
</tr>
<tr>
<td>Federal/Agency MBS passthroughs</td>
<td>25%</td>
</tr>
<tr>
<td>High grade private corporate debt</td>
<td>10%</td>
</tr>
</tbody>
</table>

### Account 2

<table>
<thead>
<tr>
<th>Investment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treasuries</td>
<td>5%</td>
</tr>
<tr>
<td>AA/AAA public corporates</td>
<td>10%</td>
</tr>
<tr>
<td>A public corporates</td>
<td>15%</td>
</tr>
<tr>
<td>BBB public corporates</td>
<td>15%</td>
</tr>
<tr>
<td>High yield public corporates</td>
<td>15%</td>
</tr>
<tr>
<td>Convertible securities</td>
<td>10%</td>
</tr>
<tr>
<td>Federal/Agency MBS passthroughs</td>
<td>15%</td>
</tr>
<tr>
<td>High grade private corporate debt</td>
<td>10%</td>
</tr>
<tr>
<td>Other private debt</td>
<td>5%</td>
</tr>
</tbody>
</table>

### Group Long-Term Disability

The asset portfolio is designed to have relatively low liquidity and high total return, with a duration target of 7 years. The target asset allocation is as follows:

<table>
<thead>
<tr>
<th>Investment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treasuries</td>
<td>5%</td>
</tr>
<tr>
<td>Inv Grade public corporates</td>
<td>35%</td>
</tr>
<tr>
<td>Federal/Agency MBS passthroughs</td>
<td>20%</td>
</tr>
<tr>
<td>High yield public corporates</td>
<td>10%</td>
</tr>
<tr>
<td>Commercial mortgages</td>
<td>10%</td>
</tr>
<tr>
<td>High grade private corporate debt</td>
<td>10%</td>
</tr>
<tr>
<td>Other private debt</td>
<td>5%</td>
</tr>
<tr>
<td>Real estate partnerships</td>
<td>5%</td>
</tr>
</tbody>
</table>

### Other A&H

Invested assets are managed for high liquidity and high total return.

<table>
<thead>
<tr>
<th>Investment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treasuries</td>
<td>10%</td>
</tr>
<tr>
<td>Inv Grade public corporates</td>
<td>50%</td>
</tr>
<tr>
<td>Federal/Agency MBS passthroughs</td>
<td>25%</td>
</tr>
<tr>
<td>High yield public corporates</td>
<td>10%</td>
</tr>
<tr>
<td>Public equities</td>
<td>5%</td>
</tr>
</tbody>
</table>
## Total Company (excluding Separate Accounts)

<table>
<thead>
<tr>
<th>Assets</th>
<th>Reported Book Value</th>
<th>Book Yield</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonds (total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1a Gov't</td>
<td>202.4</td>
<td>5.97%</td>
<td>202.8</td>
<td>6.1</td>
<td>1.0</td>
</tr>
<tr>
<td>A1b Public Corporate (Inv. Grade)</td>
<td>1573.7</td>
<td>6.76%</td>
<td>1621.0</td>
<td>9.2</td>
<td>23.6</td>
</tr>
<tr>
<td>A1c Public Corporate (below Inv Grade)</td>
<td>399.8</td>
<td>7.21%</td>
<td>419.0</td>
<td>5.8</td>
<td>20.0</td>
</tr>
<tr>
<td>A1d Private Corporate (Inv Grade)</td>
<td>790.3</td>
<td>6.99%</td>
<td>829.1</td>
<td>7.0</td>
<td>15.8</td>
</tr>
<tr>
<td>A1e Private Corporate (below Inv Grade)</td>
<td>437.7</td>
<td>7.54%</td>
<td>470.1</td>
<td>5.4</td>
<td>30.6</td>
</tr>
<tr>
<td>A1f Pass-throughs</td>
<td>274.2</td>
<td>6.88%</td>
<td>288.0</td>
<td>4.7</td>
<td>8.2</td>
</tr>
<tr>
<td>A1g CMO's</td>
<td>219.2</td>
<td>6.60%</td>
<td>227.5</td>
<td>4.3</td>
<td>6.6</td>
</tr>
<tr>
<td>A1 Bonds Subtotal</td>
<td>3897.2</td>
<td>6.90%</td>
<td>4057.5</td>
<td>7.5</td>
<td>105.8</td>
</tr>
<tr>
<td>A2 Cash &amp; short term</td>
<td>103.0</td>
<td>4.75%</td>
<td>103.0</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>A3 Commercial Mortgages</td>
<td>554.0</td>
<td>8.39%</td>
<td>595.0</td>
<td>5.4</td>
<td>27.7</td>
</tr>
<tr>
<td>A4 Derivative securities</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.0</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>A5 Equities</td>
<td>249.3</td>
<td>1.66%</td>
<td>249.3</td>
<td>19.9</td>
<td>49.9</td>
</tr>
<tr>
<td>A6 Real Estate (unleveraged)</td>
<td>237.0</td>
<td>9.70%</td>
<td>274.1</td>
<td>10.0</td>
<td>35.6</td>
</tr>
<tr>
<td>Invested Assets Subtotal</td>
<td>5040.5</td>
<td>6.89%</td>
<td>5278.8</td>
<td>8.0</td>
<td>219.3</td>
</tr>
<tr>
<td>A7 Accrued investment income</td>
<td>50.3</td>
<td>0.00%</td>
<td>50.3</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>A8 Policyholder Loans</td>
<td>52.5</td>
<td>7.17%</td>
<td>52.5</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>A9 Provision for asset default</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.0</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>A10 Other</td>
<td>75.5</td>
<td>0.00%</td>
<td>75.5</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>A11 Total Assets</td>
<td>5218.8</td>
<td>6.73%</td>
<td>5457.1</td>
<td>7.7</td>
<td>219.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Reported Book Value</th>
<th>Req Interest</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 Benefit liabilities</td>
<td>5030.8</td>
<td>6.27%</td>
<td>5220.0</td>
<td>9.8</td>
<td>155.5</td>
</tr>
<tr>
<td>B Total Liabilities</td>
<td>5030.8</td>
<td>6.27%</td>
<td>5220.0</td>
<td>9.8</td>
<td>155.5</td>
</tr>
<tr>
<td>C PreTax Equity</td>
<td>188.0</td>
<td>-</td>
<td>237.1</td>
<td>(38.62)</td>
<td></td>
</tr>
</tbody>
</table>

### Tax and Other Adjustments

| D1 Future tax payments | 65.8 | 83.0 |
| D2 Other adjustments |  | |

| D Subtotal, tax and other adjustments | 65.8 | 83.0 |

| Net Value (C-D) | 122.2 | 154.1 |
## Surplus Account

### Assets

<table>
<thead>
<tr>
<th></th>
<th>Reported Book Value</th>
<th>Book Yield</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonds (total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1a Gov't</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>A1b Public Corporate (Inv. Grade)</td>
<td>9.2</td>
<td>7.53%</td>
<td>4.3</td>
<td>2.20</td>
<td>0.14</td>
</tr>
<tr>
<td>A1c Public Corporate (below Inv Grade)</td>
<td>4.9</td>
<td>9.17%</td>
<td>8.8</td>
<td>3.90</td>
<td>0.25</td>
</tr>
<tr>
<td>A1d Private Corporate (Inv Grade)</td>
<td>3.5</td>
<td>8.01%</td>
<td>5.9</td>
<td>3.80</td>
<td>0.07</td>
</tr>
<tr>
<td>A1e Private Corporate (below Inv Grade)</td>
<td>10.8</td>
<td>9.82%</td>
<td>18.4</td>
<td>5.30</td>
<td>0.76</td>
</tr>
<tr>
<td>A1f Pass-throughs</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>A1g CMO's</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A1 Bonds Subtotal</strong></td>
<td><strong>28.4</strong></td>
<td><strong>8.74%</strong></td>
<td><strong>37.4</strong></td>
<td><strong>3.87</strong></td>
<td><strong>1.21</strong></td>
</tr>
</tbody>
</table>

|                |                     |            |               |                   |             |
| A2 Cash & short term | 0.0 |            |               |                   | 0.00        |
| A3 Commercial Mortgages | 0.0 |            |               |                   | 0.00        |
| A4 Derivative securities | 0.0 |            |               |                   | 0.00        |
| A5 Equities     | 101.5               | 2.61%      | 101.5         | 9.50              | 20.30       |
| A6 Real Estate (unleveraged) | 58.0 | 7.23% | 95.1 | 12.10 | 8.71 |
| **A6 Invested Assets Subtotal** | **188.0** | **4.96%** | **196.6** | **9.45** | **30.2** |
| A7 Accrued investment income | 0.0 |            |               |                   | 0.00        |
| A8 Policyholder Loans | 0.0 |            |               |                   | 0.00        |
| A9 Provision for asset default | 0.0 |            |               |                   | 0.00        |
| A10 Other       | 0.0                 |            |               |                   | 0.00        |
| **A11 Total Assets** | **188.0** | **4.96%** | **234.0** | **9.45** | **38.9** |

### Liabilities

<table>
<thead>
<tr>
<th></th>
<th>Reported Book Value</th>
<th>Req Interest</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 Benefit liabilities</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td><strong>B Total Liabilities</strong></td>
<td><strong>0.0</strong></td>
<td><strong>0.0</strong></td>
<td><strong>0.0</strong></td>
<td><strong>0.0</strong></td>
<td><strong>0.00</strong></td>
</tr>
</tbody>
</table>

### C PreTax Equity

- 188.0

### Tax and Other Adjustments

|                |                     |            |               |                   |             |
| D1 Future tax payments | 0.0 |            |               |                   |             |
| D2 Other adjustments | 0.0 |            |               |                   |             |
| **D Subtotal, tax and other adjustments** | **0.0** |            |               |                   |             |

### Net Value (C-D)

- 188.0
### Individual Life & Annuity - Traditional Life

<table>
<thead>
<tr>
<th>Assets</th>
<th>Reported Book Value</th>
<th>Book Yield</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonds (total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1a  Gov't</td>
<td>6.5</td>
<td>6.10%</td>
<td>6.45</td>
<td>13.9</td>
<td>0.03</td>
</tr>
<tr>
<td>A1b  Public Corporate (Inv. Grade)</td>
<td>51.6</td>
<td>6.90%</td>
<td>54.44</td>
<td>26.8</td>
<td>0.77</td>
</tr>
<tr>
<td>A1c  Public Corporate (below Inv Grade)</td>
<td>12.9</td>
<td>7.30%</td>
<td>13.61</td>
<td>12.0</td>
<td>0.65</td>
</tr>
<tr>
<td>A1d  Private Corporate (Inv Grade)</td>
<td>28.4</td>
<td>7.00%</td>
<td>29.94</td>
<td>17.2</td>
<td>0.57</td>
</tr>
<tr>
<td>A1e  Private Corporate (below Inv Grade)</td>
<td>15.5</td>
<td>7.50%</td>
<td>16.33</td>
<td>8.5</td>
<td>1.08</td>
</tr>
<tr>
<td>A1f  Pass-throughs</td>
<td>7.1</td>
<td>7.00%</td>
<td>7.45</td>
<td>5.5</td>
<td>0.21</td>
</tr>
<tr>
<td>A1g  CMO's</td>
<td>7.1</td>
<td>7.10%</td>
<td>7.52</td>
<td>6.5</td>
<td>0.21</td>
</tr>
<tr>
<td><strong>Bonds Subtotal</strong></td>
<td><strong>129.0</strong></td>
<td><strong>7.01%</strong></td>
<td><strong>135.74</strong></td>
<td><strong>19.0</strong></td>
<td><strong>3.53</strong></td>
</tr>
<tr>
<td>A2   Cash &amp; short term</td>
<td>6.0</td>
<td>4.75%</td>
<td>6.00</td>
<td>0.1</td>
<td>0.02</td>
</tr>
<tr>
<td>A3   Commercial Mortgages</td>
<td>39.0</td>
<td>8.00%</td>
<td>41.93</td>
<td>5.0</td>
<td>1.95</td>
</tr>
<tr>
<td>A4   Derivative securities</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A5   Equities</td>
<td>75.0</td>
<td>1.00%</td>
<td>75.00</td>
<td>28.0</td>
<td>15.00</td>
</tr>
<tr>
<td>A6   Real Estate (unleveraged)</td>
<td>21.0</td>
<td>10.50%</td>
<td>21.00</td>
<td>10.0</td>
<td>3.15</td>
</tr>
<tr>
<td><strong>Invested Assets Subtotal</strong></td>
<td><strong>270.0</strong></td>
<td><strong>5.71%</strong></td>
<td><strong>279.7</strong></td>
<td><strong>18.4</strong></td>
<td><strong>23.6</strong></td>
</tr>
<tr>
<td>A7   Accrued investment income</td>
<td>3.0</td>
<td>0.00%</td>
<td>3.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A8   Policyholder Loans</td>
<td>22.5</td>
<td>7.00%</td>
<td>22.50</td>
<td>0.1</td>
<td>0.00</td>
</tr>
<tr>
<td>A9   Provision for asset default</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A10  Other</td>
<td>4.5</td>
<td>0.00%</td>
<td>4.50</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A11 Total Assets</strong></td>
<td><strong>300.0</strong></td>
<td><strong>5.66%</strong></td>
<td><strong>309.7</strong></td>
<td><strong>16.6</strong></td>
<td><strong>26.8</strong></td>
</tr>
</tbody>
</table>

### Liabilities

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Reported Book Value</th>
<th>Req Interest</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 Benefit liabilities</td>
<td>300.0</td>
<td>6.10%</td>
<td>318.00</td>
<td>31.9</td>
<td>2.00</td>
</tr>
<tr>
<td><strong>B Total Liabilities</strong></td>
<td><strong>300.0</strong></td>
<td><strong>6.10%</strong></td>
<td><strong>318.0</strong></td>
<td><strong>31.9</strong></td>
<td><strong>2.0</strong></td>
</tr>
<tr>
<td>C PreTax Equity</td>
<td>0.0</td>
<td></td>
<td>-8.3</td>
<td>600.59</td>
<td></td>
</tr>
</tbody>
</table>

**Tax and Other Adjustments**

| D1 Future tax payments             | 0.0                 |              | -2.9          |                   |
| D2 Other adjustments               |                     |              |              |                   |
| **D Subtotal, tax and other adjustments** | **0.0**           |              | **-2.9**     |                   |

**Net Value (C-D)**                  | 0.0                 |              | -5.4          |                   |
### Individual Life & Annuity - Non Traditional Life

<table>
<thead>
<tr>
<th>Assets</th>
<th>Reported Book Value</th>
<th>Book Yield</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonds (total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1a Govt</td>
<td>13.8</td>
<td>6.20%</td>
<td>13.75</td>
<td>12.8</td>
<td>0.07</td>
</tr>
<tr>
<td>A1b Public Corporate (Inv. Grade)</td>
<td>110.0</td>
<td>7.00%</td>
<td>114.95</td>
<td>27.9</td>
<td>1.65</td>
</tr>
<tr>
<td>A1c Public Corporate (below Inv Grade)</td>
<td>27.5</td>
<td>7.50%</td>
<td>29.01</td>
<td>13.1</td>
<td>1.38</td>
</tr>
<tr>
<td>A1d Private Corporate (Inv Grade)</td>
<td>60.5</td>
<td>7.10%</td>
<td>63.83</td>
<td>18.2</td>
<td>1.21</td>
</tr>
<tr>
<td>A1e Private Corporate (below Inv Grade)</td>
<td>33.0</td>
<td>7.60%</td>
<td>34.82</td>
<td>9.1</td>
<td>2.31</td>
</tr>
<tr>
<td>A1f Pass-throughs</td>
<td>15.1</td>
<td>7.00%</td>
<td>15.88</td>
<td>5.6</td>
<td>0.45</td>
</tr>
<tr>
<td>A1g CMO's</td>
<td>15.1</td>
<td>7.30%</td>
<td>16.03</td>
<td>6.5</td>
<td>0.45</td>
</tr>
<tr>
<td>A1 Bonds Subtotal</td>
<td>275.0</td>
<td>7.12%</td>
<td>288.27</td>
<td>19.8</td>
<td>7.52</td>
</tr>
<tr>
<td>A2 Cash &amp; short term</td>
<td>8.0</td>
<td>4.75%</td>
<td>8.00</td>
<td>0.1</td>
<td>0.02</td>
</tr>
<tr>
<td>A3 Commercial Mortgages</td>
<td>44.0</td>
<td>8.00%</td>
<td>47.30</td>
<td>5.0</td>
<td>2.20</td>
</tr>
<tr>
<td>A4 Derivative securities</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A5 Equities</td>
<td>5.0</td>
<td>1.00%</td>
<td>5.00</td>
<td>28.0</td>
<td>1.00</td>
</tr>
<tr>
<td>A6 Real Estate (unleveraged)</td>
<td>28.0</td>
<td>10.50%</td>
<td>28.00</td>
<td>10.0</td>
<td>4.20</td>
</tr>
<tr>
<td>Invested Assets Subtotal</td>
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<td>7.35%</td>
<td>376.6</td>
<td>16.9</td>
<td>14.9</td>
</tr>
<tr>
<td>A7 Accrued investment income</td>
<td>4.0</td>
<td>0.00%</td>
<td>4.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A8 Policyholder Loans</td>
<td>30.0</td>
<td>7.30%</td>
<td>30.00</td>
<td>0.1</td>
<td>0.00</td>
</tr>
<tr>
<td>A9 Provision for asset default</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A10 Other</td>
<td>6.0</td>
<td>0.00%</td>
<td>6.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A11 Total Assets</td>
<td>400.0</td>
<td>7.17%</td>
<td>416.6</td>
<td>15.2</td>
<td>19.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Reported Book Value</th>
<th>Req Interest</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 Benefit liabilities</td>
<td></td>
<td>6.30%</td>
<td>406.0</td>
<td>40.2</td>
<td>4.00</td>
</tr>
<tr>
<td>B Total Liabilities</td>
<td>400.0</td>
<td>6.30%</td>
<td>406.0</td>
<td>40.2</td>
<td>4.0</td>
</tr>
<tr>
<td>C PreTax Equity</td>
<td>0.0</td>
<td></td>
<td>10.6</td>
<td></td>
<td>(943.69)</td>
</tr>
<tr>
<td>D Subtotal, tax and other adjustments</td>
<td>0.0</td>
<td></td>
<td>3.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Net Value (C-D) | 0.0 | 6.9
**Individual Life & Annuity - Accumulation Annuity**

<table>
<thead>
<tr>
<th>Assets</th>
<th>Reported Book Value</th>
<th>Book Yield</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonds (total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1a Gov't</td>
<td>58.7</td>
<td>6.20%</td>
<td>58.69</td>
<td>5.0</td>
<td>0.29</td>
</tr>
<tr>
<td>A1b Public Corporate (Inv. Grade)</td>
<td>469.5</td>
<td>7.00%</td>
<td>481.24</td>
<td>4.9</td>
<td>7.04</td>
</tr>
<tr>
<td>A1c Public Corporate (below Inv Grade)</td>
<td>117.4</td>
<td>7.50%</td>
<td>120.90</td>
<td>5.6</td>
<td>5.87</td>
</tr>
<tr>
<td>A1d Private Corporate (Inv Grade)</td>
<td>258.2</td>
<td>7.10%</td>
<td>267.26</td>
<td>5.3</td>
<td>5.16</td>
</tr>
<tr>
<td>A1e Private Corporate (below Inv Grade)</td>
<td>140.9</td>
<td>7.60%</td>
<td>148.60</td>
<td>5.0</td>
<td>9.86</td>
</tr>
<tr>
<td>A1f Pass-throughs</td>
<td>64.6</td>
<td>7.00%</td>
<td>67.14</td>
<td>4.6</td>
<td>1.94</td>
</tr>
<tr>
<td>A1g CMO's</td>
<td>64.6</td>
<td>7.10%</td>
<td>67.46</td>
<td>5.2</td>
<td>1.94</td>
</tr>
<tr>
<td><strong>A1 Bonds Subtotal</strong></td>
<td><strong>1173.8</strong></td>
<td><strong>7.11%</strong></td>
<td><strong>1211.28</strong></td>
<td><strong>5.2</strong></td>
<td><strong>32.10</strong></td>
</tr>
<tr>
<td>A2 Cash &amp; short term</td>
<td>30.0</td>
<td>4.75%</td>
<td>30.00</td>
<td>0.1</td>
<td>0.09</td>
</tr>
<tr>
<td>A3 Commercial Mortgages</td>
<td>135.0</td>
<td>8.00%</td>
<td>143.10</td>
<td>4.3</td>
<td>6.75</td>
</tr>
<tr>
<td>A4 Derivative securities</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A5 Equities</td>
<td>18.8</td>
<td>1.00%</td>
<td>18.75</td>
<td>20.0</td>
<td>3.75</td>
</tr>
<tr>
<td>A6 Real Estate (unleveraged)</td>
<td>105.0</td>
<td>10.50%</td>
<td>105.00</td>
<td>8.0</td>
<td>15.75</td>
</tr>
<tr>
<td><strong>A6 Invested Assets Subtotal</strong></td>
<td><strong>1462.5</strong></td>
<td><strong>7.31%</strong></td>
<td><strong>1508.1</strong></td>
<td><strong>5.5</strong></td>
<td><strong>58.4</strong></td>
</tr>
<tr>
<td>A7 Accrued investment income</td>
<td>15.0</td>
<td>0.00%</td>
<td>15.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A8 Policyholder Loans</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A9 Provision for asset default</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A10 Other</td>
<td>22.5</td>
<td>0.00%</td>
<td>22.50</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A11 Total Assets</strong></td>
<td><strong>1500.0</strong></td>
<td><strong>7.13%</strong></td>
<td><strong>1545.6</strong></td>
<td><strong>5.3</strong></td>
<td><strong>74.2</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Reported Book Value</th>
<th>Req Interest</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 Benefit liabilities</td>
<td>1500.0</td>
<td>5.90%</td>
<td>1575.00</td>
<td>5.3</td>
<td>15.00</td>
</tr>
<tr>
<td><strong>B Total Liabilities</strong></td>
<td><strong>1500.0</strong></td>
<td><strong>5.90%</strong></td>
<td><strong>1575.0</strong></td>
<td><strong>5.3</strong></td>
<td><strong>15.0</strong></td>
</tr>
</tbody>
</table>

| C PreTax Equity | | 0.0 | -29.4 | 4.21 |

**Tax and Other Adjustments**

| D1 Future tax payments | 0.0 | -10.3 |
| D2 Other adjustments | | |
| **D Subtotal, tax and other adjustments** | **0.0** | **-10.3** |

**Net Value (C-D)** | 0.0 | -19.1 |
### Institutional Pensions - Payout Annuity

#### Assets

<table>
<thead>
<tr>
<th>Bonds (total)</th>
<th>Book Value</th>
<th>Book Yield</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1a</td>
<td>16.9</td>
<td>6.40%</td>
<td>17.26</td>
<td>10.4</td>
<td>0.08</td>
</tr>
<tr>
<td>A1b</td>
<td>135.4</td>
<td>7.20%</td>
<td>144.20</td>
<td>9.2</td>
<td>2.03</td>
</tr>
<tr>
<td>A1c</td>
<td>33.9</td>
<td>7.60%</td>
<td>36.56</td>
<td>8.3</td>
<td>1.69</td>
</tr>
<tr>
<td>A1d</td>
<td>74.5</td>
<td>7.40%</td>
<td>80.06</td>
<td>8.0</td>
<td>1.49</td>
</tr>
<tr>
<td>A1e</td>
<td>40.6</td>
<td>7.90%</td>
<td>44.28</td>
<td>7.2</td>
<td>2.84</td>
</tr>
<tr>
<td>A1f</td>
<td>18.6</td>
<td>7.10%</td>
<td>19.55</td>
<td>6.5</td>
<td>0.56</td>
</tr>
<tr>
<td>A1g</td>
<td>18.6</td>
<td>7.30%</td>
<td>19.83</td>
<td>7.5</td>
<td>0.56</td>
</tr>
<tr>
<td><strong>Bonds Subtotal</strong></td>
<td><strong>338.5</strong></td>
<td><strong>7.33%</strong></td>
<td><strong>361.73</strong></td>
<td><strong>9.0</strong></td>
<td><strong>9.26</strong></td>
</tr>
</tbody>
</table>

| A2            | 14.0       | 4.75%      | 14.00         | 0.1               | 0.04        |
| A3            | 286.0      | 8.75%      | 308.88        | 6.0               | 14.30       |
| A4            | 0.0        | 0.00%      | 0.00          | 0.0               | 0.00        |
| A5            | 44.0       | 1.00%      | 44.00         | 28.0              | 8.80        |
| A6            | 0.0        | 10.50%     | 0.00          | 10.0              | 0.00        |
| **Invested Assets Subtotal** | **682.5** | **7.46%** | **728.6** | **9.0**           | **32.4**    |

| A7            | 7.0        | 0.00%      | 7.00          | 0.0               | 0.00        |
| A8            | 0.0        | 7.00%      | 0.00          | 0.1               | 0.00        |
| A9            | 0.0        | 0.00%      | 0.00          | 0.0               | 0.00        |
| A10           | 10.5       | 0.00%      | 10.50         | 0.0               | 0.00        |
| **A11 Total Assets** | **700.0** | **7.28%** | **746.1** | **8.8**           | **32.4**    |

#### Liabilities

| B1          | 700.0 | 6.75% | 759.50 | 9.5 | 2.00 |
| B           | **Total Liabilities** | **700.0** | **6.75%** | **759.5** | **9.5** | **2.0** |

### PreTax Equity

| C       | 0.0 |

### Tax and Other Adjustments

| D1      | 0.0 |
| D2      |     |
| D       | **Subtotal, tax and other adjustments** | **0.0** |

### Net Value (C-D)

| Net Value (C-D) | 0.0 |

| -8.7 |
### Institutional Pensions - GIC

<table>
<thead>
<tr>
<th>Assets</th>
<th>Reported Book Value</th>
<th>Book Yield</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bonds (total)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1a   Gov't</td>
<td>71.6</td>
<td>5.60%</td>
<td>71.63</td>
<td>2.5</td>
<td>0.36</td>
</tr>
<tr>
<td>A1b   Public Corporate (Inv. Grade)</td>
<td>573.0</td>
<td>6.40%</td>
<td>584.46</td>
<td>2.8</td>
<td>8.60</td>
</tr>
<tr>
<td>A1c   Public Corporate (below Inv Grade)</td>
<td>143.3</td>
<td>6.75%</td>
<td>146.83</td>
<td>3.0</td>
<td>7.16</td>
</tr>
<tr>
<td>A1d   Private Corporate (Inv Grade)</td>
<td>315.2</td>
<td>6.80%</td>
<td>329.33</td>
<td>4.3</td>
<td>6.30</td>
</tr>
<tr>
<td>A1e   Private Corporate (below Inv Grade)</td>
<td>171.9</td>
<td>7.30%</td>
<td>181.35</td>
<td>4.0</td>
<td>12.03</td>
</tr>
<tr>
<td>A1f   Pass-throughs</td>
<td>78.8</td>
<td>6.80%</td>
<td>83.51</td>
<td>5</td>
<td>2.36</td>
</tr>
<tr>
<td>A1g   CMO's</td>
<td>78.8</td>
<td>5.80%</td>
<td>79.58</td>
<td>1.3</td>
<td>2.36</td>
</tr>
<tr>
<td>A1    Bonds Subtotal</td>
<td>1432.5</td>
<td>6.58%</td>
<td>1476.69</td>
<td>3.4</td>
<td>39.18</td>
</tr>
<tr>
<td><strong>A2</strong>  Cash &amp; short term</td>
<td>30.0</td>
<td>4.75%</td>
<td>30.00</td>
<td>0.1</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>A3</strong>  Commercial Mortgages</td>
<td>0.0</td>
<td>8.00%</td>
<td>0.00</td>
<td>5.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A4</strong>  Derivative securities</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A5</strong>  Equities</td>
<td>0.0</td>
<td>1.00%</td>
<td>0.00</td>
<td>28.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A6</strong>  Real Estate (unleveraged)</td>
<td>0.0</td>
<td>10.50%</td>
<td>0.00</td>
<td>10.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Invested Assets Subtotal</strong></td>
<td>1462.5</td>
<td>6.54%</td>
<td>1506.7</td>
<td>3.4</td>
<td>39.3</td>
</tr>
<tr>
<td><strong>A7</strong>  Accrued investment income</td>
<td>15.0</td>
<td>0.00%</td>
<td>15.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A8</strong>  Policyholder Loans</td>
<td>0.0</td>
<td>7.00%</td>
<td>0.00</td>
<td>0.1</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A9</strong>  Provision for asset default</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A10</strong>  Other</td>
<td>22.5</td>
<td>0.00%</td>
<td>22.50</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A11</strong>  Total Assets</td>
<td>1500.0</td>
<td>6.38%</td>
<td>1544.2</td>
<td>3.3</td>
<td>39.3</td>
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</table>

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Reported Book Value</th>
<th>Req Interest</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B1</strong> Benefit liabilities</td>
<td>1500.0</td>
<td>6.60%</td>
<td>1537.50</td>
<td>3.1</td>
<td>7.50</td>
</tr>
<tr>
<td><strong>B</strong> Total Liabilities</td>
<td>1500.0</td>
<td>6.60%</td>
<td>1537.5</td>
<td>3.1</td>
<td>7.5</td>
</tr>
<tr>
<td><strong>C</strong> PreTax Equity</td>
<td>0.0</td>
<td></td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tax and Other Adjustments**

| D1               | Future tax payments | 0.0 | 2.3 |
| D2               | Other adjustments   |     |     |
| **D** Subtotal, tax and other adjustments | 0.0 | 2.3 |

**Net Value (C-D)**

| Net Value (C-D) | 0.0 | 4.4 |
### Group Business

#### Assets

<table>
<thead>
<tr>
<th>Assets</th>
<th>Reported Book Value</th>
<th>Book Yield</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonds (total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1a  Gov't</td>
<td>35.0</td>
<td>6.00%</td>
<td>35.00</td>
<td>8.9</td>
<td>0.18</td>
</tr>
<tr>
<td>A1b  Public Corporate (Inv. Grade)</td>
<td>225.0</td>
<td>6.70%</td>
<td>237.38</td>
<td>20.9</td>
<td>3.38</td>
</tr>
<tr>
<td>A1c  Public Corporate (below Inv Grade)</td>
<td>60.0</td>
<td>7.20%</td>
<td>63.30</td>
<td>7.0</td>
<td>3.00</td>
</tr>
<tr>
<td>A1d  Private Corporate (Inv Grade)</td>
<td>50.0</td>
<td>6.80%</td>
<td>52.75</td>
<td>11.9</td>
<td>1.00</td>
</tr>
<tr>
<td>A1e  Private Corporate (below Inv Grade)</td>
<td>25.0</td>
<td>7.30%</td>
<td>26.38</td>
<td>7.5</td>
<td>1.75</td>
</tr>
<tr>
<td>A1f  Pass-throughs</td>
<td>90.0</td>
<td>6.80%</td>
<td>94.50</td>
<td>3.9</td>
<td>2.70</td>
</tr>
<tr>
<td>A1g  CMO's</td>
<td>35.0</td>
<td>6.70%</td>
<td>37.10</td>
<td>5.8</td>
<td>1.05</td>
</tr>
<tr>
<td>A1   Bonds Subtotal</td>
<td>520.0</td>
<td>6.77%</td>
<td>546.40</td>
<td>13.7</td>
<td>13.05</td>
</tr>
<tr>
<td>A2   Cash &amp; short term</td>
<td>15.0</td>
<td>4.75%</td>
<td>15.00</td>
<td>0.1</td>
<td>0.05</td>
</tr>
<tr>
<td>A3   Commercial Mortgages</td>
<td>50.0</td>
<td>8.00%</td>
<td>53.75</td>
<td>5.0</td>
<td>2.50</td>
</tr>
<tr>
<td>A4   Derivative securities</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A5   Equities</td>
<td>5.0</td>
<td>1.00%</td>
<td>5.00</td>
<td>28.0</td>
<td>1.00</td>
</tr>
<tr>
<td>A6   Real Estate (unleveraged)</td>
<td>25.0</td>
<td>10.50%</td>
<td>25.00</td>
<td>10.0</td>
<td>3.75</td>
</tr>
<tr>
<td>Invested Assets Subtotal</td>
<td>615.0</td>
<td>6.92%</td>
<td>645.2</td>
<td>12.7</td>
<td>20.3</td>
</tr>
<tr>
<td>A7   Accrued investment income</td>
<td>6.3</td>
<td>0.00%</td>
<td>6.31</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A8   Policyholder Loans</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.1</td>
<td>0.00</td>
</tr>
<tr>
<td>A9   Provision for asset default</td>
<td>0.0</td>
<td>0.00%</td>
<td>0.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A10  Other</td>
<td>9.5</td>
<td>0.00%</td>
<td>9.46</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A11  Total Assets</td>
<td>630.8</td>
<td>6.75%</td>
<td>660.9</td>
<td>12.3</td>
<td>24.1</td>
</tr>
</tbody>
</table>

#### Liabilities

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Reported Book Value</th>
<th>Req Interest</th>
<th>PV Cash Flows</th>
<th>Modified Duration</th>
<th>Req Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1  Benefit liabilities</td>
<td>630.8</td>
<td>5.90%</td>
<td>624.00</td>
<td>7.0</td>
<td>125.00</td>
</tr>
<tr>
<td>B   Total Liabilities</td>
<td>630.8</td>
<td>5.90%</td>
<td>624.0</td>
<td>7.0</td>
<td>125.0</td>
</tr>
</tbody>
</table>

C   PreTax Equity                           | 30.8               |              | 36.9          |                   |             |

#### Tax and Other Adjustments

<table>
<thead>
<tr>
<th>Tax and Other Adjustments</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D1  Future tax payments</td>
<td>10.8</td>
<td></td>
<td>12.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2  Other adjustments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D   Subtotal, tax and other adjustments</td>
<td>10.8</td>
<td></td>
<td>12.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Net Value (C-D)                             | 20.0              |              | 24.0          |                   |             |
ASSET LIABILITY MANAGEMENT
POLICY STATEMENT

I. Overall Objective for the ALM Function
ALM is the ongoing process of formulating, implementing and monitoring strategies in respect of assets and liabilities to attain our financial objectives for a given set of risk tolerances and constraints.
As with all financial services companies, risk is an inherent part of doing business. Over the normal course of business LifeCo is exposed to credit risk, interest rate risk, foreign exchange rate risk, off-balance sheet risk, pricing risk, liquidity risk, as well as other various market risks. ALM is a vital ongoing process that requires the management of all these risks.
The principal risk management objectives are to eliminate excessive and unacceptable risk and optimize the risk/return profile of the total company. A key focus of the ALM function at LifeCo is interest rate risk.

As a result of timing differences in the repricing of assets and liabilities, fluctuations in market interest rates can affect both accounting earnings and the market value of assets, liabilities and off-balance sheet items and hence the economic value and net worth of LifeCo. The objectives in managing interest rate risk are to:

- Maximize the economic value of LifeCo subject to stated risk tolerances and constraints (see ALM Guidelines).
- Support the achievement of business strategies while protecting earnings and liquidity.
- Minimize the potential for significant loss as a result of changes in interest rates.
- Manage interest rate risk of current and future earnings to a level that is consistent with the mix of businesses and that limits such exposure to a percentage of the book value of assets.

Another key focus of the ALM function at LifeCo is market risk. Market risk arises whenever financial results can be adversely affected by changes in the equity markets. The most extreme exposure to market risk occurs when investment guarantees are offered. The risk exposure associated with these guarantees is managed by using dynamic hedging.

Liquidity risk is the risk that LifeCo will be unable to maintain cash flows that are adequate to fund its operations and meet all present and future financial obligations on a timely and cost effective basis.
A separate Liquidity Policy details the management of LifeCo’s liquidity risk.
Foreign exchange rate risk arises whenever future payments in a foreign currency are made or received. A loss occurs if there is an appreciation (in the case of foreign dollars owed) or depreciation (in the case of foreign dollars due) of the local currency relative to
the foreign currency. The objective is to eliminate any foreign exchange rate risk. This is accomplished through the use of currency swaps. Credit risk includes the risk of default on scheduled payments of either interest or principal. Credit quality guidelines are determined by the Investment Department of LifeCo, approved by the Board of Directors and are specified in the Investment Policy. The credit quality of the assets is monitored the Investment Department of LifeCo and reported to the Board of Directors.

Off-balance sheet risk refers to the risk associated with derivative instruments. The Operational Guidelines for Use of Derivatives provides control procedures and details the management of LifeCo’s exposure to derivatives risk.

II. ALM Process
The ALM process consists of four fundamental steps:

Identify the level of risk exposure
It is a requirement that at all times the exposure to all risks be known. This is accomplished by regular measurement and monitoring of the exposure to various risks.

Decide whether the risk exposure is appropriate
The purpose of ALM is not necessarily to eliminate or even minimize risk. The level of risk will vary with the return requirement and financial objectives. Return objectives and risk tolerances are determined by LifeCo and reviewed from time to time.

Modify the existing risk
This is accomplished by rebalancing the portfolio or through the use of interest rate swaps, currency swaps or other hedging techniques to assume offsetting risk.

Optimize the risk/return profile of the business
For a given level of risk financial objectives are maximized. Optimization ensures that portfolios lie on the risk/return efficient frontier for LifeCo’s stated return objectives, risk tolerances and constraints.

III. ALM Committee Purpose
Risk tolerances are determined by the ALM Committee and approved by the Board of Directors. Asset-Liability strategies as well as the policies and guidelines for the management of the aforementioned risks are established by the ALM committee. The ALM committee sets limits on potential earnings fluctuations that could arise from interest rate risk as well as on- and off- balance sheet accrual positions. The ALM committee monitors exposures in view of market developments and LifeCo’s financial condition, sets guidance for interest rate risk management decisions and monitors liquidity and capital adequacy. ALM policy is established by the ALM Committee, reviewed by the Board of Directors at least annually and is implemented by Corporate
Actuarial in conjunction with the Investment Department of LifeCo and the Finance division of LifeCo.

IV. ALM Committee Composition/Frequency of Meetings
The ALM committee meets monthly and consists of the CEO, CFO, Chief Actuary, CIO, VP Risk Management and includes representation from functional areas as appropriate. Committee proceedings are chaired and recorded by the VP Risk Management.

V. ALM Guidelines
LifeCo's exposure to interest rate risk is quantified by calculating price sensitivity statistics such as modified duration, dollar duration, convexity, and partial durations and by performing scenario testing and cash-flow analysis. A pure dedication strategy of matching asset and liability cash-flows is widely recognized as costly, unnecessary and would not be appropriate for LifeCo. Negative net cash flows are identified and assessed from a liquidity perspective only. Exposure to interest rate risk is monitored for each product line and for all major products. Although ALM is performed at both the product and product line level, specific guidelines are set for Accumulation Annuities in total, Traditional Life Products in total, Non-Traditional Life Products in total and total company surplus.

(a) Accumulation Annuities

Dollar Duration of Assets less Dollar Duration of Liabilities

Key Rate Sensitivity

Worst Case Scenario at 95% Confidence Level

< 30% x book value of assets

< 0.02% x book value of assets for any and all key rates

< 0.50% x book value of assets

(b) Variable Annuities

Delta of liability less delta of assets

Gamma

Vega

Rho

<10% of delta of liability

Unhedged

Unhedged

<5% of rho of liability

(c) Traditional Life Products
### (c) Non-Traditional Life Products

<table>
<thead>
<tr>
<th>Metric</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollar Duration of Assets less</td>
<td>$&lt; 100% \times \text{book value of assets}$</td>
</tr>
<tr>
<td>Dollar Duration of Liabilities</td>
<td></td>
</tr>
<tr>
<td>Key Rate Sensitivity</td>
<td>$&lt; 0.10% \times \text{book value of assets for any and all key rates}$</td>
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<tr>
<td>Worst Case Scenario at 95% Confidence Level</td>
<td>$&lt; 5.00% \times \text{book value of assets}$</td>
</tr>
</tbody>
</table>

### (d) Institutional Pension - Payout

<table>
<thead>
<tr>
<th>Metric</th>
<th>Criterion</th>
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</thead>
<tbody>
<tr>
<td>Dollar Duration of Assets less</td>
<td>$&lt; 100% \times \text{book value of assets}$</td>
</tr>
<tr>
<td>Dollar Duration of Liabilities</td>
<td></td>
</tr>
<tr>
<td>Key Rate Sensitivity</td>
<td>$&lt; 0.10% \times \text{book value of assets for any and all key rates}$</td>
</tr>
<tr>
<td>Worst Case Scenario at 95% Confidence Level</td>
<td>$&lt; 5.00% \times \text{book value of assets}$</td>
</tr>
</tbody>
</table>

### (e) Institutional Pension - GIC

<table>
<thead>
<tr>
<th>Metric</th>
<th>Criterion</th>
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<tbody>
<tr>
<td>Dollar Duration of Assets less</td>
<td>$&lt; 30% \times \text{book value of assets}$</td>
</tr>
<tr>
<td>Dollar Duration of Liabilities</td>
<td></td>
</tr>
<tr>
<td>Key Rate Sensitivity</td>
<td>$&lt; 0.02% \times \text{book value of assets for any and all key rates}$</td>
</tr>
<tr>
<td>Worst Case Scenario at 95% Confidence Level</td>
<td>$&lt; 2.00% \times \text{book value of assets}$</td>
</tr>
</tbody>
</table>
(f) Group Business

Dollar Duration of Assets less Dollar Duration of Liabilities < 100% x book value of assets

Key Rate Sensitivity < 0.1% x book value of assets for any and all key rates

Worst Case Scenario at 95% Confidence Level < 5.00% x book value of assets

(g) Total Company

Dollar Duration of Assets less Dollar Duration of Liabilities < 100% x book value of assets

Key Rate Sensitivity < 0.05% x book value of assets for any and all key rates

Worst Case Scenario at 95% Confidence Level < 2.00% x book value of assets

(h) Surplus

Dollar Duration of Actual Assets less Dollar Duration of Benchmark < 100% x book value of assets

Where the modified duration of benchmark is assumed to be 10 years and the present value of the benchmark is assumed equal to the present value of the assets.

In order to ensure that the above guidelines are met for each product line, it may be necessary to rebalance the portfolio by trading assets or through the use of financial engineering. Rebalancing is performed monthly for Accumulation Annuities and quarterly for Life Products. In addition to meeting the above guidelines, for rebalancing purposes, each asset segment shall have assets that do not exceed the liabilities by more than +/- $2,000,000.

The Investment Department has the discretion to position the exposure of the company to the worst case scenario that it deems least likely to occur within the above guidelines for mismatch provision.
ASSET LIABILITY MANAGEMENT
PROCEDURE MANUAL

I. Reporting
Corporate Actuarial reports on LifeCo’s ALM position to the Investment Department and the ALM Committee on a quarterly basis. For Accumulation Annuities the ALM position is monitored on a weekly basis and reflects all asset commitments from the time at which they are priced. Corporate Actuarial reports on LifeCo’s ALM position to the Board of Directors at each of its meetings. The quarterly reports include a discussion of our exposure to interest rate risk, changes in market interest rates during the period, the results of scenario testing and various technical notes. Attached to the report are the following:

- price sensitivity statistics including dollar duration, modified duration, convexity, and key rate sensitivity analysis
- cash flow analysis
- a comparison of the mismatch provision for the past 12 months
- book values and market values of assets and liabilities
- a comparison of the term structure of interest rates for the current and prior periods

Appendix contains a sample ALM report.

II. Allocation of Asset Commitments

Status of Commitments
Corporate Actuarial receives a weekly report on the status of asset commitments from the Investment Department which contains information on the following stages of commitment:

1. Under Review/Negotiation
2. Under Application/Recommended for Investment
3. Internal Approval - Not Yet Committed
4. Committed - Not Yet Priced
5. Priced
6. Funded

Allocation of Commitment to Product Lines
Once an asset reaches the committed stage, Corporate Actuarial reviews each of the product line portfolios in terms of the liability characteristics and ALM guidelines and recommends allocation of the commitment to the most suitable product line. Once an asset reaches the committed stage the Investment Department and Corporate Actuarial will determine whether a hedge transaction will be needed between the time the commitment is priced and the time it is funded.

Determination of Method of Funding
The committed asset is added to the portfolio for purposes of measuring exposure to interest rate risk. Corporate Actuarial examines the impact of various funding
alternatives and recommends the sale of asset(s) that optimizes the portfolio with respect to LifeCo’s financial objectives within the approved ALM guidelines.

**Priced Commitments**
Committed assets are not reflected for ALM purposes until they become priced. Until this point there is no exposure to interest rate risk. If a hedge transaction was previously deemed necessary, it will be effected once the asset becomes priced.

### III. Hedging

**Measurement**
A hedge is the assumption of an additional risk exposure that offsets an existing risk. The intended effect of a hedge is to reduce the overall portfolio risk (e.g. currency or interest rate risk). Thus the impact on the overall risk exposure of the portfolio is examined for all hedges. Although hedges are examined at the portfolio level, care must be taken to ensure that any derivatives transactions are appropriately arranged to qualify for hedge accounting treatment where intended.

### IV. Priced Commitments
A new priced commitment will add exposure to interest rate risk to a portfolio. Before a hedge is effected for this transaction the overall impact on the portfolio must be examined.

### V. Portfolio Rebalancing
From time to time, portfolio rebalancing will be required to keep the assets in balance with the liabilities and in order to ensure that all ALM guidelines specified in the ALM Policy Statement are adhered to. Formally, all portfolios are reviewed quarterly with the exception of the Accumulation Annuities portfolio which is reviewed monthly. Optimization is also performed in order to maximize LifeCo’s financial objectives subject to its risk tolerances and constraints. Portfolio rebalancing and optimization may involve asset trades and/or the use of financial engineering. Any asset between asset segments must be done at market value and requires the physical sale and purchase of assets. Transfers at book value are strictly prohibited.

### VI. Interest Rate Sensitivity
A number of tools are used to measure the interest rate sensitivity of the assets and liabilities. **Dollar duration** provides a measure of the interest rate sensitivity in dollar terms of the market value of the assets and liabilities for a parallel change in interest rates. For example, if the dollar duration of assets is $100,000,000 greater than the dollar duration of liabilities, then for a 100 basis point increase in interest rates for all terms to maturity across the yield curve, the market value of assets will decrease by approximately $1,000,000 more than the market value of liabilities. **Modified duration** provides a measure of the interest rate sensitivity in percentage terms of the market value of the assets and liabilities for a parallel change in interest rates. For
example, if the modified duration of an asset is 4, then for a 100 basis point increase in interest rates the market value of the asset will decline by approximately 4%.

**Convexity** measures the rate of change of duration. Duration only provides an approximation of the price sensitivity to changes in interest rates. The precision of the approximation deteriorates as the change in interest rates increases. Including convexity improves the approximation. In general, assets with greater convexity are more desirable than assets with less convexity. This is because as interest rates decrease the increase in the market value of the assets increases at a faster rate. Conversely, as interest rates increase the decrease in the market value of the assets decreases. It is therefore desirable to have assets which have higher convexity than the liabilities.

**Key rate sensitivity analysis** measures the impact on market value of changes in interest rates at each term to maturity along the yield curve. This is a valuable tool as interest rates seldom move in a parallel fashion.

**Cash flow analysis** assumes no renewal or reinvestment of cash flows and must be interpreted with care. It is not necessary or advisable to be perfectly cash flow matched; however, large net cash outflows must be considered in the context of liquidity available in the portfolio.

**Scenario testing** is performed on a deterministic basis and involves measuring the sensitivity of economic value to both parallel and non-parallel yield curve shifts.

**Asset Quality**
Credit quality guidelines are contained in the Investment Policy and specify maximum holdings of individual credits which decline as credit quality declines, as well as an average quality constraint on the total portfolio. It is the philosophy of LifeCo that the credit risk exposure of the Company’s assets should be highly diversified, actively managed, and under continuous review by the Investment Department. The ALM committee will be informed by the Investment Department of the credit risk exposure of the Company’s assets to ensure compliance with the credit quality guidelines.

**VII. Liquidity**
Cash flow analysis is performed which provides an indication of the potential liquidity requirements of the portfolio. In addition, asset mix is monitored with respect to renewal and surrender experience to ensure that sufficient liquid assets exist to meet anticipated cash outflow requirements.

**VIII. Capital Adequacy**
Target capital is 150% of regulatory capital required.

**IX. Profitability**
Profitability is measured in terms of return on total company surplus. Economic value is the central focus of ALM.
X. Specific Responsibilities

ALM Committee
The ALM Committee is responsible for overall policy formulation as detailed in the Policy Statement. The ALM Committee is also responsible for monitoring the ALM position of LifeCo and ensuring that all ALM guidelines are adhered to.

ALM Sub-Committees

Portfolio Rebalance Subcommittee
All asset trades affect the statutory reserve and mismatch provision under GAAP, the measurement of profitability, the economic value of surplus, key rate sensitivity, capital requirements and the return on capital. In addition to determining whether a trade increases the yield to maturity - or even the total rate of return - of a portfolio, the aforementioned considerations need to be taken into account whenever asset trades are contemplated. The function of this subcommittee is to examine portfolio changes, quantify the impact of derivatives and asset trades, monitor and measure the exposure to interest rate and other risks and perform optimization and rebalancing of all portfolios. This subcommittee meets a minimum of once per quarter and consists of a representative from the Investment Department of LifeCo, Corporate Actuarial and Finance.

Rate Setting Subcommittee
The function of this subcommittee is to determine crediting rates for both Life and Accumulation Annuities. This subcommittee meets weekly and consists of a representative from the Investment Department of LifeCo, Corporate Actuarial, Finance, Marketing Actuarial and Accumulation Annuities Marketing.

Product managers
The Life and Investment Product vice-presidents are responsible for the execution of business strategies decided at ALM Committee.

Corporate Actuarial
Corporate Actuarial is responsible for implementing ALM policy and ensuring that ALM guidelines are adhered to. Corporate Actuarial projects asset and liability cash flows, calculates all price sensitivity statistics, performs key rate sensitivity analysis and scenario testing, determines reserves and mismatch provision. Corporate Actuarial, together with the Investment Department of LifeCo, suggests assets trades or the use of financial engineering for the purposes of rebalancing the portfolio in order to ensure that LifeCo’s financial objectives are maximized and that all ALM guidelines are met.

Investment Department
The Investment Department is responsible, with input from Corporate Actuarial, for the determination and execution of all trades, financial engineering and hedging strategies in accordance with the guidelines specified in the ALM Policy Statement. The Investment Department communicates all transactions including forward
commitments to Finance and Corporate Actuarial and distributes a weekly report on the status of mortgage and private placement commitments and related hedging arrangements.

**Finance**
Finance is responsible for recording all transactions and keeping the asset accounting system up to date. Finance provides electronic files of bond and private placements on a quarterly basis.
OPERATIONAL GUIDELINES FOR USE OF DERIVATIVES

I. Overview
LifeCo, by the nature of its business activities and products, is routinely exposed to risks such as those described in sections V through VIII.

LifeCo purchases derivatives to manage these risks that are identified by the liability product managers and/or Corporate Actuarial. Derivatives may not be purchased for speculative purposes.

The guiding principle in the use of derivatives is that LifeCo is a limited end-user acting primarily to reduce risk. Strategies that involve the writing of options by LifeCo are specifically excluded, with the exception of options embedded in LifeCo’s products.

II. Definition of Derivatives
For purposes of these guidelines, derivatives are defined as contracts that the company enters into with a counterparty, where the contract value derives from the value of an underlying asset or underlying reference rate or index. Such indices include, but are not limited to, LIBOR, U.S. Treasury instruments, and the S&P 500 index. This definition of derivatives includes instruments as described in section IX. This definition does not include asset classes such as mortgage-backed securities, collateralized mortgage obligations, asset-backed securities, and other structured assets that are treated as bonds for accounting and regulatory purposes.

III. Responsibilities
The ALM Committee is responsible for recommending the type and amount of each derivative purchase. The Investment Department is responsible for the purchase of derivatives. The Finance Department is responsible for derivatives accounting and reporting. The ALM Committee is responsible for all board reports relating to derivatives activity.

IV. Objectives
The objective of derivatives use at LifeCo is to reduce potential volatility in the future operating earnings of the lines of business. Depending on the source of the volatility and the type of derivative purchased, the derivative may reduce both upside and downside earnings volatility, or may reduce only downside earnings volatility.
V. Business Exposures Managed
LifeCo’s life insurance and accumulation annuity products have minimum interest guarantees. In an extended period of low interest rates, profit margins would be reduced, and possibly even be negative.
The life insurance and accumulation products allow surrenders at book value, possibly with a book value surrender charge. In periods of rapidly rising interest rates, the assets backing these products would not support a credited rate that is competitive with new money rates. If the company chose to maintain competitive credited rates, then profit margins would be reduced or even be negative. If the company chose to maintain profit margins with an uncompetitive credited rate, then policy surrenders could increase, leading to a loss of future profit margins and market value losses on asset sales to pay the surrender benefits.
LifeCo’s equity-linked GIC credits an interest rate that is linked to the performance of the S&P 500 equity index. This product also guarantees the return of principal. LifeCo’s investments must meet both of these guarantees.

VI. Mismatch risk
The company’s assets and liabilities are not cash flow matched.
In time periods where the company’s asset cash flows exceed the liability cash flows, there is reinvestment risk. For example, the assets allocated to the payout annuity business are shorter than the liability cash flows. Since the payout annuity benefits cannot be changed, reinvestment risk would be realized if interest rates were low at the time of the asset reinvestment.
In time periods where the company’s liability cash flows exceed the asset cash flows, there is funding risk. For example, if assets have to be sold to pay excess benefits at a time when interest rates are high, market value losses will be realized on the asset sales. There is also potential mismatch risk in LifeCo’s equity-linked GIC. If the assets allocated to this business do not match the performance guaranteed relative to the S&P 500 index, then the profits may vary substantially from the product’s pricing assumption.

VII. Mortgage commitment risk
LifeCo’s Investment Department commits to funding commercial mortgage loans weeks in advance of disbursing funds for the loan. These commitments require a loan rate to be locked in at that time for the mortgage. If interest rates rise between this commitment date and the disbursement date, then the earned rate on these assets acquired on the disbursement date will be lower than the earned rates that the liability pricing areas would expect the Investment Department to be able to achieve in the current interest rate environment.

VIII. Foreign exchange risk
The Investment Department may invest in assets denominated in foreign currencies. In addition, the multinational nature of the operations of LifeCo produces operating earnings denominated in more than one currency. As currency exchange rates fluctuate, the value
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of LifeCo’s investment income and operating earnings will also fluctuate unless the currency risk is hedged.

IX. Approved Derivative Classes
The Board of Directors has currently approved the purchase, subject to the guidelines detailed below, of interest rate swaps, currency swaps, interest rate caps, interest rate floors, and equity options indexed to the S&P 500. Derivatives not in these categories may be purchased only with the prior approval of both the Chief Investment Officer and Chief Executive Officer of LifeCo.

Interest rate swaps: interest rate swaps are bilateral agreements between LifeCo and the counterparty to exchange a series of cash flows at specified intervals. The cash flows may be fixed or floating. Floating cash flows would be calculated based on a set formula and reference index. Swap terms and conditions such as a reference index, frequency of payments, expiry date of the contract, and notional amount of the contract are set at the time of the swap purchase.

Government bond futures: a futures contract obligates its owner to buy a specified amount of a specified government bond at a specified price on a specified date. These contracts are used by LifeCo in either “long” positions (an agreement to buy a government bond) or “short” positions (an agreement to sell a government bond). Futures contracts are entered into directly with an exchange clearinghouse.

Purchased options on government bond futures: these options give LifeCo the right, but not the obligation, to buy (or sell, depending on the type of option) government bond futures at a set price on a set future date. These options allow LifeCo to benefit from favorable price movements in government bond futures. LifeCo’s loss on unfavorable price movements is limited to the premium paid to purchase the option.

Forward rate agreements: these agreements are similar to the futures described above, but they are negotiated with other financial institutions rather than an exchange clearinghouse. They are agreements that a certain interest rate will apply to a certain principal amount for a certain time period in the future.

Foreign currency swaps: these are bilateral agreements between LifeCo and the counterparty whereby interest and principal in one currency are exchanged for interest and principal in another currency.

Foreign currency forward rate agreements: forwards are transacted over-the-counter, typically with a domestic Schedule I bank. LifeCo agrees to buy or sell a specific amount of foreign currency at a specified rate of exchange on a specified date.

Foreign currency futures: LifeCo agrees to buy or sell a specific amount of foreign currency at a specified rate of exchange on a specified date. The actual currency transaction being hedged seldom coincides with the maturity of the futures contract. The futures are usually sold prior to maturity and the gain or loss on the contract is used to offset the increase or decrease in the value of the currency transaction being hedged.

Purchased interest rate caps and floors: interest rate caps protect LifeCo in rising interest rate environments by paying the excess, if any, of a prevailing reference rate at a future date over the strike rate in the contract. The contract has a set notional amount, maturity date, payment dates, and reference rate. Since only positive differences are paid to LifeCo, LifeCo’s only outlay is the premium paid for the cap. Interest rate floors are
similar to caps, but protect LifeCo in falling rate environments by paying the excess, if any, of the contract’s strike rate over the prevailing reference rate at a future date. **Equity index options**: European call options on the S&P 500 index give LifeCo a payment at maturity equal to the excess, if any, of the value of the index over the option’s strike price. Each call option contract is for $100 times the value of the index. LifeCo’s only outlay is the premium paid for the call option.

**X. Acquisition of Derivatives**
Interest rate swaps may be purchased in combination with a floating rate asset to achieve a fixed rate of return. The procedures and policies are then the same as the procedures and policies for acquiring fixed rate assets. If an interest rate swap is purchased for other ALM purposes, the ALM Committee must submit a written request for the purchase to the Investment Department. Interest rate caps and floors purchases and equity option purchases must be in the form of a written request from the ALM Committee to the Investment Department. The Investment Department must obtain a minimum of two quotes from approved counterparties.

**XI. Transaction Approval**
Each derivative purchase will result in a written sheet with the terms and conditions (the “confirmation sheet”) of that derivative. This sheet must be signed by the Investment Department employee responsible for that purchase.

**XII. Exposure Limits**
The net market value exposure of all interest rate and currency swaps with any one counterparty will not exceed $250 million. The market value of all equity call options with any one counterparty will not exceed $100 million. The market value of all interest rate caps and floors with any one counterparty will not exceed $100 million.

**XIII. Transaction Documentation and Control Procedures**
Each derivative purchase results in a confirmation sheet (see section XI). A copy of this sheet is sent by the Investment Department to the Finance Department. The Finance Department maintains a file for all derivatives. The Finance Department documents all payments made and received under swap contracts and verifies the calculation of these payments. The Finance Department also verifies the amounts of payments, if any, due from the counterparty on all caps and floors each time a payment, if any, is due. The Vice President of Finance reviews and initials all of these payment calculations.

**XIV. Accounting and Disclosure**
LifeCo will follow all required accounting practices for derivatives and disclose the balance sheet effect of derivatives in all shareholder reports and other required reports for securities regulators.

**XV. Communication of Purchases**
The Board of Directors will be notified of each derivative purchase at the next scheduled board meeting following such purchase.
XVI. Approved Counterparties
Counterparties must have a credit rating of at least BBB from Moody’s or Poor’s Agency. LifeCo must have a master ISDA agreement signed with the counterparty prior to the derivative purchase. Each agreement is subject to the approval of LifeCo’s Secretary and General Counsel.

XVII. Market Valuation
Each December 31\textsuperscript{st}, the Investment Department will obtain market valuations for each derivative from the counterparty for that derivative. A report showing the market values and market values from the prior December 31\textsuperscript{st} will be provided to the ALM Committee.

XVIII. Administration
All derivatives will be maintained where possible on LifeCo’s Investment Administration System. If a derivative cannot be administered on this system, it will be identified in an exception report, which will be submitted by the Finance Department to the ALM Committee each December 31\textsuperscript{st}. This report will show, for each derivative not administered on the Investment Administration System, the type of derivative, the counterparty, the purchase date, the notional amount, and the current market value as provided by the Investment Department.
Asset Liability Management Report for

December 31,

This report details the ALM position for all of LifeCo’s products and focuses on the company’s exposure to interest rate risk. The ALM guidelines specified in the company’s ALM Policy Statement and Procedure Manual reflect the company’s tolerance to interest rate risk.

Interest Rates

![Risk Free (Government) Spot Rate Curve]

Summary of ALM Position
At December 31, significant mismatches existed in the Life and Group Benefit portfolios, all other portfolios were within the guidelines specified in the ALM Policy Statement and Procedure Manual. Various ways are being investigated to reduce asset liability mismatches. It is anticipated that extensive rebalancing of the affected asset portfolios will be required. A summary of the ALM position for LifeCo follows.
<table>
<thead>
<tr>
<th></th>
<th>Book Value ('000)</th>
<th>Present Value ('000)</th>
<th>Modified Duration</th>
<th>Dollar Duration ('000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRADITIONAL LIFE PRODUCTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>300,000</td>
<td>309,700</td>
<td>16.6</td>
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<td>Liabilities</td>
<td>300,000</td>
<td>318,000</td>
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</tr>
<tr>
<td>Difference</td>
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<td>-8,300</td>
<td>-15.3</td>
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</tr>
<tr>
<td>Guideline</td>
<td>&lt; 2,000</td>
<td>&lt; 1,000</td>
<td>&lt; 300,000</td>
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</tr>
<tr>
<td><strong>NON-TRADITIONAL LIFE PRODUCTS</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>400,000</td>
<td>416,600</td>
<td>15.2</td>
<td>6,348,000</td>
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<tr>
<td>Liabilities</td>
<td>400,000</td>
<td>406,000</td>
<td>40.2</td>
<td>16,321,000</td>
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<tr>
<td>Difference</td>
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<td>10,600</td>
<td>-25.0</td>
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<td>&lt; 400,000</td>
<td>&lt; 400,000</td>
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<tr>
<td><strong>ACCUMULATION ANNUITIES</strong></td>
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<td></td>
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</tr>
<tr>
<td>Assets</td>
<td>1,500,000</td>
<td>1,545,600</td>
<td>5.3</td>
<td>8,224,000</td>
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<tr>
<td>Liabilities</td>
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<td>1,575,000</td>
<td>5.3</td>
<td>8,348,000</td>
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<tr>
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<tr>
<td><strong>INSTITUTIONAL PENSION – PAYOUT</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Assets</td>
<td>700,000</td>
<td>746,100</td>
<td>8.8</td>
<td>6,535,000</td>
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<tr>
<td>Liabilities</td>
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<td>759,500</td>
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<td>7,215,000</td>
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<tr>
<td>Difference</td>
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<tr>
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<tr>
<td><strong>INSTITUTIONAL PENSION – GIC</strong></td>
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<tr>
<td>Assets</td>
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<td>1,544,200</td>
<td>3.3</td>
<td>5,067,000</td>
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<tr>
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<td>1,537,500</td>
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<td>4,766,000</td>
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<tr>
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<td>6,700</td>
<td>-0.2</td>
<td>300,000</td>
</tr>
<tr>
<td>Guideline</td>
<td>&lt; 2,000</td>
<td>&lt; 450,000</td>
<td>&lt; 450,000</td>
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</tr>
<tr>
<td><strong>GROUP BENEFITS</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>630,800</td>
<td>660,900</td>
<td>12.3</td>
<td>8,157,000</td>
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<tr>
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<td>624,000</td>
<td>7.0</td>
<td>4,388,000</td>
</tr>
<tr>
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<td>&lt; 630,000</td>
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<td><strong>SURPLUS ACCOUNT</strong></td>
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<tr>
<td>Assets</td>
<td>188,000</td>
<td>243,020</td>
<td>9.5</td>
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<tr>
<td>Target</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>188,000</td>
<td>243,020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guideline</td>
<td></td>
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<td></td>
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<tr>
<td><strong>TOTAL COMPANY</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>5,218,800</td>
<td>5,457,100</td>
<td>7.7</td>
<td>42,006,000</td>
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<tr>
<td>Liabilities</td>
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<td>5,220,000</td>
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<td>51,182,000</td>
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<tr>
<td>Difference</td>
<td>188,000</td>
<td>237,100</td>
<td></td>
<td>-9,157,000</td>
</tr>
<tr>
<td>Guideline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ACCUMULATION ANNUITIES

Dollar Duration (Price Sensitivity to Parallel Shifts in the Yield Curve)
The modified duration of assets is longer than the duration of liabilities by less than 0.01.
The difference between the dollar duration of assets and liabilities is (124,000,000).
This is within the approved guideline of +/- 450,000,000.

Key Rate Sensitivity Analysis (Price Sensitivity to Specific Rate Changes)
For all points along the curve key rate sensitivities are within the approved guideline.

Scenario Testing
Worst Case Scenario
The worst case scenario that was tested was a increase followed by a decrease in interest rates. If this scenario were realized, it would result in a loss of $7.6 million in economic surplus.

Cash Flow Analysis
The accompanying graph does not represent actual cash outflows but rather interest rate reset dates for the assets and liabilities. No renewals or new sales are projected and asset maturities are not reinvested. Thus the usefulness of this analysis is limited to studying interest rate risk exposure. This would represent an extreme adverse scenario for measuring liquidity risk exposure.
Portfolio Rebalance
Rebalancing is performed on a monthly basis for Accumulation Annuities. At the end of December, except for cash reallocation there was no rebalancing required for Accumulation Annuities.

Asset Mix
The target mix calls for more bonds and private placements and less mortgages. The C1 capital requirement for the Accumulation Annuities portfolio excluding additional requirements for troubled assets is approximately $11.7 million at the end of December. In comparison, the C1 requirement based on the target asset mix would be $11.2 million.
TRADITIONAL LIFE PRODUCTS

Dollar Duration (Price Sensitivity to Parallel Shifts in the Yield Curve)
The modified duration of assets is shorter than the duration of liabilities by 15.3 years. This reflects the difficulty in finding assets that matches the extremely long duration of liabilities. The difference between the dollar duration of assets and liabilities is (5,006,000,000) which exceeds our approved guideline of +/- 300,000,000.

Key Rate Sensitivity Analysis (Price Sensitivity to Specific Rate Changes)
We are exposed to rates falling at the 25 and 30 year terms and to rates increasing at the 10, 15 and 20 year terms. Exposure is large and exceeds guidelines.

Scenario Testing
The maximum decline in economic surplus at the 95% confidence was $89.7 million at the end of December. The scenario that gives rise to this exposure is a decrease in long term interest rates.

Cash Flow Analysis
The large positive spikes represent the maturity of the long zero coupon bonds that were purchased to extend the duration of the assets.
Portfolio Rebalance
At the end of December rebalancing was necessary as a result of the lengthening of the liabilities due to assumption changes.

Asset Mix
The target mix does not reflect policy loans, calls for more government bonds, and less private placements. The C1 capital requirement for the Traditional Life Products portfolio excluding additional requirements for troubled assets is approximately $0.5 million. In comparison, the C1 requirement based on the target asset mix would be $0.5 million. The asset mix does not reflect the assumed equity position.
NON-TRADITIONAL LIFE PRODUCTS

Projection of Cash Flows
Based on December 31, assets and liabilities, net cash flows are projected to be an average of $1.3 million per month going forward.

Margin Squeeze
Interest sensitive cash flows have been modeled to vary for given changes in interest rates (i.e. the margin squeeze will be reflected in the price sensitivity statistics). The impact of the margin squeeze for a 1% decrease in interest rates is a $10.3 million loss in economic value.

Dollar Duration (Price Sensitivity to Parallel Shifts in the Yield Curve)
The modified duration of assets is shorter than the duration of liabilities by 25.0 years. The difference between the dollar duration of assets and liabilities is (9,974,000,000). This significantly exceeds the guideline of 400,000,000.

Key Rate Sensitivity Analysis (Price Sensitivity to Specific Rate Changes)
Significant exposure exists to a decrease in interest rates at the long end of the curve, a result of the duration mismatch between the assets and liabilities. The company is exposed to increases in interest rates for the other points on the curve.

<table>
<thead>
<tr>
<th>Key Rate Sensitivity</th>
<th>Changes in Net Position ('000) per .01% Increase in Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>-32</td>
</tr>
<tr>
<td>-63</td>
<td>-63</td>
</tr>
<tr>
<td>-152</td>
<td>-172 (Term -Years)</td>
</tr>
<tr>
<td>-258</td>
<td>-344</td>
</tr>
<tr>
<td>-330</td>
<td>-292</td>
</tr>
<tr>
<td>716</td>
<td>974</td>
</tr>
</tbody>
</table>

Scenario Testing
The maximum decline in economic surplus at the 95% confidence level decreased from $129.3 million to $122.1 million at the end of December. The scenario that gives rise to this exposure is a graduated decrease in long-term interest rates.

<table>
<thead>
<tr>
<th>Maximum Decline in Economic Surplus ('000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar-00</td>
</tr>
<tr>
<td>Jun-00</td>
</tr>
<tr>
<td>Sep-00</td>
</tr>
<tr>
<td>Dec-00</td>
</tr>
</tbody>
</table>
Cash Flow Analysis
Note that both fixed and variable cash flows are shown together.

Asset/Liability Cash Flows by Month ('000)

Portfolio Rebalancing
At the end of December rebalancing was necessary to counteract the lengthening of the liabilities due to assumption changes. It was assumed that the majority of Surplus assets were sold to fund the purchase of long bonds in this portfolio.
INSTITUTIONAL PENSION - PAYOUT

Dollar Duration (Price Sensitivity to Parallel Shifts in the Yield Curve)
The modified duration of assets is shorter than the duration of liabilities by 0.70 years.
The difference between the dollar duration of assets and liabilities is (680,000,000) and is within the approved guideline of 700,000,000.

Key Rate Sensitivity Analysis (Price Sensitivity to Specific Rate Changes)
Due to the efficiency of the immunization strategy, no significant interest rate exposure exists on that line of business.

Scenario Testing
The maximum decline in economic surplus at the 95% confidence level decreased stands at $5.96 million, and is the result of a increasing interest rate for the first 20 years followed by a sharp increase.

Cash Flow Analysis
INSTITUTIONAL PENSION - GIC

Dollar Duration (Price Sensitivity to Parallel Shifts in the Yield Curve)
The modified duration of assets are longer than the duration of liabilities by 0.20 years.
The difference between the dollar duration of assets and liabilities is 300,000,000.

Key Rate Sensitivity Analysis (Price Sensitivity to Specific Rate Changes)
Due to the efficiency of the immunization strategy and the short duration of the liabilities,
no significant interest rate exposure exists on that line of business.

| Key Rate Sensitivity Changes in Net Position ('000) per .01% Increase in Rate |
|---------------------------------|---------------------------------|
| Term - Years                    | 0.25  1  2  3  4  5  7  10  15  20  25  30 |
| -5                              | 5     | 0     | -2.5  -2.1 -2.1 -1.3 -1.8 -0.7 -1.0 -1.0 -1.0 -1.0 |

Scenario Testing
The maximum decline in economic surplus at the 95% confidence level decreased stands
at $5.2 million, and is the result of an immediate, large increase in interest rates.

Maximum Decline in Economic Surplus ('000)

<table>
<thead>
<tr>
<th>Month</th>
<th>Surplus ('000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar-00</td>
<td>3,964</td>
</tr>
<tr>
<td>Jun-00</td>
<td>4,320</td>
</tr>
<tr>
<td>Sep-00</td>
<td>4,505</td>
</tr>
<tr>
<td>Dec-00</td>
<td>5,247</td>
</tr>
</tbody>
</table>

Cash Flow Analysis

Asset/Liability Cash Flows by Month ('000)

Cumulative Net Cash Flow

Dec-00 03 06 08 11 14 16 19 22 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 81 84 87 90 93 96 99 102
GROUP BENEFITS

Dollar Duration (Price Sensitivity to Parallel Shifts in the Yield Curve)
The modified duration of liabilities exceeds the duration of assets by 0.10 years. The
difference between the dollar duration of assets and liabilities is 3,789,000,000. This
greatly exceeds the guideline of 630,000,000.

Key Rate Sensitivity Analysis (Price Sensitivity to Specific Rate Changes)
The exposure tends to be at the longer durations, where a decrease in interest rates will
create a loss.

Scenario Testing
The maximum decline in economic surplus at the 95% confidence level decreased stands
at $1.1 million, and is the result of a slow decrease in interest rates.

Cash Flow Analysis