1. (4 points) LifeCo is reviewing its Operational Guidelines for the Use of Derivatives for consistency with The Group of Thirty recommendations.

   (a) Identify and describe the various derivatives risks as outlined in the Group of Thirty recommendations.

   (b) Assess LifeCo’s management of these risks associated with the derivatives used to hedge its liabilities.
2. **(10 points)** LifeCo’s ALM committee is concerned about the impact of the following capital market events on the company’s value:

(1) Low equity market return
(2) Higher than expected credit loss
(3) Low interest rate environment

(a) Describe the minimum guarantees offered in the Variable Annuity product and how the guarantees can be priced using the
(i) actuarial approach, and
(ii) capital market approach.

(b) Assess the potential impact of the capital market events described above on the Variable Annuity product.

(c) Recommend risk management strategies to mitigate the risks associated with the capital market events described above on the Variable Annuity product.

(d) Describe the characteristics of the Payout Annuity product cash out flows.

(e) Assess the potential impact of the capital market events described above on the Payout Annuity product.

(f) Recommend investment strategies to mitigate the impact of the capital market events described above on the Payout Annuity product through
(i) asset allocation, and
(ii) use of derivative products.

Justify your recommendations.
3.  (5 points) LifeCo’s ALM report for December 2000 indicates a significant mismatch in the Non-Traditional Life Products segment.

(a)  (1 Point) Compare the use of dollar duration to effective duration as a risk metric for this product line.

(b)  (4 Points) Describe various approaches to ALM as outlined by Glacy and Vilms and assess how each approach might be applied to the non-traditional life segment in order to mitigate the mismatch problem.
4. (8 points) LifeCo is considering how to evaluate the performance of a new GIC product. You are given the following pricing assumptions for LifeCo’s new GIC product:

- **Term:** 3 years
- **Maturity Value:** 123% of the initial deposit
- **Lapse:** None
- **Policyholder Options:** None
- **Premium Size:** $1,000
- **Required Return on Capital:** 8% per annum
- **Required Capital Factor for GICs:** 3.6% of liabilities
- **Asset Return:** 8.5%
- **Tax Rate:** 35%
- **Risk-Free Zero-Coupon Rate Curve:**
  - 1-year: 5.70%
  - 2-year: 6.08%
  - 3-year: 6.21%

**GIC Competitors:**
- **Required Return on Capital:** 12%
- **Required Capital Factor for GICs:** 5% of liabilities
- **Asset Return:** 8%

(a) Compare the “entity-specific” and “fair value” systems.

(b) Calculate the tax-adjusted liability value at issue for LifeCo’s new GIC product using the Cost of Capital method.

(c) Calculate the liability value at issue and the required spread of LifeCo’s new GIC product using the Total Return method as presented by Ho, Scheitlin and Tam.

(d) Describe the arguments for and against reflecting an entity’s credit standing in the fair value of its liabilities.

(e) Assess how the Cost of Capital method reflects credit standing and how this might impact the valuation of LifeCo’s liabilities.
5. (3 points) LifeCo is concerned about the mismatch of its assets and liabilities at the total company level.

(a) Calculate the modified duration of surplus excluding separate accounts.

(b) Estimate the change in interest rates that would reduce total company surplus to zero.

(c) Calculate the modified duration of liabilities needed to immunize surplus.

(d) Criticize the manner in which the interest rate risk exposure is quantified in (b) and (c).

6. (5 points) LifeCo’s ALM committee manages the investment needs and risk exposures of several business segments with very different characteristics.

(a) Explain how the target asset duration should be changed to address any imbalance between benefit duration and renewal premium duration for each of LifeCo’s product lines.

(b) Describe the constraints on asset sales that must be considered when rebalancing asset segments.

7. (3 points)

(a) Explain the two basic properties of utility functions as described by Gerber and Pafumi.

(b) Explain the principle of equivalent utility.
8.  (4 points) You are given the following information for zero-coupon bonds:

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Interest Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-year</td>
<td>4%</td>
</tr>
<tr>
<td>2-year</td>
<td>5%</td>
</tr>
<tr>
<td>3-year</td>
<td>6%</td>
</tr>
</tbody>
</table>

(a) Construct two sample portfolios of equal value, each using zero-coupon bonds at all three maturities, such that the portfolio durations are the same.

(b) Approximate the impact on the value of the two portfolios of a 1% increase in zero-coupon interest rates at every maturity using the portfolios’ modified duration.

(c) Approximate the impact on the value of the two portfolios of a 1% increase in the 1-year zero-coupon rate and no change in the 2 and 3-year zero-coupon rates using the portfolios’ modified duration.

(d) Evaluate the validity of the approximations in (b) and (c).

9.  (4 points) You maintain a model that determines the 1-month 95% confidence value at risk (VAR) of your company’s guaranteed minimum accumulation benefit (GMAB) portfolio.

(a) Describe the key limitations of the VAR methodology.

(b) Describe methods that can be used to test and address these limitations.
10. (5 points) A large Canadian life insurer, CanCo, is about to purchase a mid-sized U.S. insurer, TargetCo. Assume:

(1) TargetCo will continue all of its existing lines of business.
(2) TargetCo will reinvest profits in its U.S. operations.
(3) TargetCo’s Corporate functions will be performed in CanCo’s Canadian office.
(4) TargetCo’s Sales and Marketing and other lines of business functions will continue to operate in the U.S.

The post-acquisition strategic plan assumes:

**Pro forma Cash Flow Summary**

<table>
<thead>
<tr>
<th></th>
<th>CanCo</th>
<th>TargetCo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Expenses – Sales and Marketing</td>
<td>CAD 200</td>
<td>USD 50</td>
</tr>
<tr>
<td>Operational Expenses – Corporate and Other</td>
<td>CAD 300</td>
<td>CAD 75</td>
</tr>
<tr>
<td>Policy Benefits and Other Expenses</td>
<td>CAD 100</td>
<td>USD 20</td>
</tr>
<tr>
<td>Premium and Investment Income</td>
<td>CAD 700</td>
<td>USD 150</td>
</tr>
</tbody>
</table>

**Balance Sheet (at date of acquisition)**

<table>
<thead>
<tr>
<th></th>
<th>CanCo</th>
<th>TargetCo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>CAD 11,000</td>
<td>USD 2,500</td>
</tr>
<tr>
<td>Liabilities</td>
<td>CAD 9,000</td>
<td>USD 2,000</td>
</tr>
<tr>
<td>Surplus</td>
<td>CAD 2,000</td>
<td>USD 500</td>
</tr>
</tbody>
</table>

**Exchange Rate**

1 USD = 1.5 CAD    volatility = 4%

**Risk-Free Interest Rate**

Canada: 4%
US: 3%

(a) Describe the financial and economic impacts that foreign exchange rate risk could have

(i) in general, on a multinational company, and
(ii) specifically, on CanCo and TargetCo following this acquisition.
10. Continued

(b) Determine the impact of an immediate 10% depreciation in the U.S. dollar on
(i) the consolidated surplus of CanCo and TargetCo in Canadian dollars, and
(ii) the net cash flow of TargetCo itself.

(c) Describe the external concerns associated with the purchase that may affect
current and potential CanCo shareholders.

(d) Outline how options and other financial instruments could be used to manage the
foreign exchange exposure of TargetCo’s net cash flow position and compare
TargetCo’s risk exposure under each approach.

(e) Calculate the cost of a European style currency option that would protect
TargetCo’s net cash flow position in U.S. dollars for one year. Assume that the
currency value follows a geometric Brownian motion process and all cash flows
are end-of-year.
11. (6 points) You are given the following information.

Current index value = 800
Annual volatility of index = 20%
No dividends
Price of 1 month at-the-money European call index option = 25.025
One-month time steps for all calculations
Risk-free rate is the same for all periods

(a) Calculate the risk-free rate implied in the call price using a binomial tree.

(b) Estimate an upper and lower bound on the price of a 2-month American lookback call.

(c) Calculate the price of a 2-month American lookback call using a binomial tree.

12. (3 points) ABC Life has formulated an ALM strategy whereby the long-term liability cash flows of its non-participating life block are backed with equities. ABC Life does not feel that duration is an appropriate metric to measure the interest rate sensitivity of this asset class. Stochastic modeling techniques are used to measure the likelihood that the equities will be sufficient to meet the long-term cash flows beyond 20 years.

Critique the use of duration for equities in the ALM strategy for ABC Life.

**END OF EXAMINATION**

MORNING SESSION
13. (3 points) Describe the key features of derivatives risk management aimed at preventing derivatives mishaps in an insurance company setting.

14. (4 points) ABC Life is investigating hedging the currency exposure of its international operations.

(a) Describe the critical factors for identifying the optimal degree of currency exposure to be hedged.

(b) For each of the critical factors indicate whether the optimal hedge ratio of the currency exposure increases or decreases as the factor increases.

(c) Explain the two economic theories relating to exchange rates.

(d) Assess the impact on the hedging strategy for the currency risk assuming the economic theories are:
   (i) True
   (ii) False
15. (4 points) Given the following information.

<table>
<thead>
<tr>
<th></th>
<th>POOL A</th>
<th>POOL B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originator</td>
<td>GNMA</td>
<td>FNMA</td>
</tr>
<tr>
<td>Type</td>
<td>30-year fixed</td>
<td>50% 30-year fixed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% balloon</td>
</tr>
<tr>
<td>Weighted Average Coupon</td>
<td>8.0%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Weighted Average Maturity</td>
<td>25.6 years</td>
<td>19.2 years</td>
</tr>
<tr>
<td>Maturity Distribution</td>
<td>27 years 80%</td>
<td>25 years 20%</td>
</tr>
<tr>
<td></td>
<td>20 years 20%</td>
<td>22 years 20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19 years 20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 years 20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 years 20%</td>
</tr>
<tr>
<td>% Refinance Mortgagors</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>% Home Purchase Mortgagors</td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Economic Environment:** Strong housing market

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Yield Curve</strong></td>
<td></td>
</tr>
<tr>
<td>1-year Treasury</td>
<td>1.5%</td>
</tr>
<tr>
<td>10-year Treasury</td>
<td>3.5%</td>
</tr>
<tr>
<td>30-year Treasury</td>
<td>5.5%</td>
</tr>
</tbody>
</table>

**Rates for New Issues of 30-Year Fixed Mortgages for Calendar Year 2003 through November**

<table>
<thead>
<tr>
<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rates</td>
<td>8.6%</td>
<td>8.4%</td>
<td>8.2%</td>
<td>8.0%</td>
<td>7.9%</td>
<td>7.6%</td>
<td>7.5%</td>
<td>7.0%</td>
<td>6.5%</td>
<td>6.0%</td>
<td>6.5%</td>
</tr>
</tbody>
</table>

(a) Describe the four primary structural components of the Goldman Sachs mortgage backed securities prepayment model including
(i) primary variables that drive change in these components, and
(ii) expected impact of these variables on total prepayments.

(b) Compare and contrast the impact on prepayments in the two mortgage pools for each of the variables described in (a).
16. \((4\text{ points})\) You are building a model for forecasting equity real estate values in portfolio asset projections, given economic scenario inputs.

(a) List and justify the items you will need in order to build a robust model for equity real estate values.

(b) Describe a method for determining the optimal level of equity real estate in your company’s various portfolios.
17. **(8 points)** You are the Chief Risk Officer of Pusillanimous Re that provides annual catastrophe reinsurance to the marketplace. You invest the asset portfolio in cash and three zero-coupon bonds, each with 1-year time to maturity. You are given the following information:

Reinsurance exposure: Excess cost layer between 100 million and 350 million of 1 billion total earthquake exposure.

<table>
<thead>
<tr>
<th></th>
<th>Cash</th>
<th>Bond A</th>
<th>Bond B</th>
<th>Bond C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Value (millions)</td>
<td>2.0</td>
<td>2.2</td>
<td>2.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Face Value (millions)</td>
<td>2.0</td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Expected default loss (%)</td>
<td>0</td>
<td>5</td>
<td>not given</td>
<td>15</td>
</tr>
<tr>
<td>Expected recovery rate (%)</td>
<td>100</td>
<td>not given</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>Historical default rate (%)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

You are concerned about the default risk of your asset portfolio and the magnitude of your liability exposure.

(a) Describe how you would calculate the 1-year default probability of Bond B using
   (i) bond market prices, and
   (ii) equity prices of the bond issuer.

(b) Calculate the 1-year expected default loss of Bond B implied by bond market prices.

(c) Explain the reasons for the differences typically observed between the default probabilities derived using historical default data and those derived from the bond market prices.

(d) Compare and contrast the use of add-up credit default swaps (CDS) and first-to-default CDS for management of the default risk in the asset portfolio.

(e) Describe how a first-to-default basket CDS on the asset portfolio can be valued using a Gaussian copula approach.

(f) Explain how CAT bonds work and how they can be used to manage the option structure of your liability risk exposure.
18. (4 points) The financial results at your insurance company over the past year have been dismal. Your new CFO has asked you to determine the reasons behind this. She has recently read about transfer pricing for banks, and is interested in applying this concept to your company.

Total returns for your company:

<table>
<thead>
<tr>
<th></th>
<th>Duration</th>
<th>Credit Rating</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>10</td>
<td>A</td>
<td>5.70%</td>
</tr>
<tr>
<td>Liabilities</td>
<td>7</td>
<td>AAA (claims paying)</td>
<td>6.20%</td>
</tr>
</tbody>
</table>

Total return of generic assets over the past year:

<table>
<thead>
<tr>
<th>Duration</th>
<th>Credit Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A AA AAA</td>
</tr>
<tr>
<td>5</td>
<td>6.00% 6.50% 7.50%</td>
</tr>
<tr>
<td>6</td>
<td>5.90% 6.40% 7.40%</td>
</tr>
<tr>
<td>7</td>
<td>5.80% 6.30% 7.30%</td>
</tr>
<tr>
<td>8</td>
<td>5.70% 6.20% 7.20%</td>
</tr>
<tr>
<td>9</td>
<td>5.60% 6.10% 7.10%</td>
</tr>
<tr>
<td>10</td>
<td>5.50% 6.00% 7.00%</td>
</tr>
</tbody>
</table>

Your CFO wants to see the returns attributed to the following four sources:

1) Liability performance
2) Asset performance due to interest rate risk
3) Asset performance due to credit risk
4) Asset performance due to selection of individual securities

(a) Construct the appropriate benchmark portfolios from the generic assets provided.

(b) Attribute your company’s performance to the four sources described above, using the benchmarks constructed in (a).

(c) Describe the considerations in benchmark selection when applying transfer pricing to an insurance company.
19. (5 points) The current value of the assets and liabilities are respectively $A_0$ and $L_0$. The liability in five years is designated $L_5$. Senior management is concerned that the asset portfolio could drop in value below the liability value in five years.

One method to model the asset returns would be using a multivariate normal model and modified Cholesky decomposition with the following assumptions:

$$\begin{align*}
\mu &= [0.12, 0.06, 0.085] = [\text{equities, fixed income, real estate}] \\
\text{covariance matrix} &= \begin{bmatrix}
0.04 & 0.003 & 0.014 \\
0.003 & 0.0025 & -0.0015 \\
0.014 & -0.0015 & 0.01
\end{bmatrix}
\end{align*}$$

(a) Evaluate potential problems in using this method to model the asset returns.

(b) Explain and evaluate the use of an option-based portfolio hedging strategy for a portfolio of assets, $A_0$, and liabilities, $L_0$, where $A_0 > L_0$, using

(i) a put, and  
(ii) a call.

(c) Demonstrate that the strategies in (b) for the put and call options are equivalent, assuming that cash flows are reinvested.

(d) Explain and evaluate the use of dynamic hedging by replicating the put option using a risky portfolio and a duration-matched Treasury portfolio.
20. (6 points) A financial institution has sold short three European call options on a stock with the following characteristics:

- Stock price: 100
- Strike price: 110
- Volatility: 20%
- Expiry: 2 years
- Contract size: 1,000 shares
- Dividends: none
- Risk-free rate: 5%

(a) (4 Points) Describe and evaluate strategies the financial institution can use to manage the risk of this portfolio.

(b) (1 Point) Calculate delta, theta and gamma for the portfolio.

(c) (1 Point) Verify the calculations of delta, theta and gamma by showing that the results for the portfolio satisfy the Black-Scholes-Merton differential equation.
21. (6 points) A model of the type GARCH(1,1) is being used to set volatility for integer values of strike price for an option pricing model that is based on a lognormal distribution. You have the following information on the model for a specific underlying asset:

- A weight of 10% is given to a variance of 4% that is reached asymptotically as the strike price increases toward infinity.
- The model assumes returns are a constant 20%.
- A weight of 80% is given to the variance determined for the prior strike price.
- The variance is 9% for a strike price of 0.

(a) Calculate the change in volatility for each of strike prices of 1 and 2 assuming the variance for a strike price of 0 decreases from 9% to 8%.

(b) Assess whether the model with the given parameters is more appropriate for an equity option or a currency option. Support your answer by interpreting the resulting implications for the volatility smile.

(c) Describe how to determine a maximum likelihood estimate for the above model, assuming the distribution of returns conditioned on the variance is normal.
22. (7 points) You would like to calibrate a new Monte Carlo pricing model by comparing the model price to the Black-Scholes price of a European call option on a non-dividend paying stock. The European call option and the underlying stock have the following characteristics:

Current stock value = 100
Expected growth rate of the stock price = 10%
Volatility = 25%
Exercise price = 95
Time to maturity = 6 months
Risk-free interest rate = 6%
Black-Scholes price of the option = 11.37

Assume that the percentage change in the stock price is normally distributed.

(a) Calculate the control variate technique adjustment using stratified sampling on 3 intervals.

(b) Describe additional techniques that can be used to improve the efficiency of the Monte Carlo method.

(c) Describe how the Monte Carlo method can be adapted to calculate the price of American options.
23. *(6 points)* You are given the following information about an interest rate collar with quarterly resets. Assume quarterly compounding unless otherwise indicated.

- Notional amount = 100,000,000
- Strike interest rate for cap = 7.0%
- Strike interest rate for floor = 4.5%
- Time to expiration = 2 years

<table>
<thead>
<tr>
<th>Time t</th>
<th>Forward 3-month interest rate starting at time t</th>
<th>Zero-coupon interest rate to time t (continuous compounding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 months</td>
<td>5.0%</td>
<td>4.49%</td>
</tr>
<tr>
<td>12 months</td>
<td>5.2%</td>
<td>4.64%</td>
</tr>
<tr>
<td>15 months</td>
<td>5.3%</td>
<td>4.77%</td>
</tr>
</tbody>
</table>

(a) Compare the collar to a portfolio of bond options with equivalent payoffs.

(b) Calculate, using Black’s model, the price of the floorlet that prevents the interest rate from being lower than the strike price for 3 months starting in one year. Assume that the volatility of the underlying three-month rate is 20%.

(c) Assess the suitability of Black’s model for valuing options embedded in a mortgage backed security.
24. (3 points) You have been asked to review the trading costs of the following stock:

<table>
<thead>
<tr>
<th>Time</th>
<th>Price</th>
<th>Number of shares traded</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Previous close is 44 1/8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1:40 pm</td>
<td>44 1/8</td>
<td>1000</td>
</tr>
<tr>
<td>1:42</td>
<td>44 1/4</td>
<td>2000</td>
</tr>
<tr>
<td>1:45</td>
<td>44</td>
<td>500</td>
</tr>
<tr>
<td>1:46</td>
<td>43 7/8</td>
<td>5000</td>
</tr>
<tr>
<td>1:50</td>
<td>43 3/4</td>
<td>2000</td>
</tr>
<tr>
<td>1:51</td>
<td>43 7/8</td>
<td>400</td>
</tr>
<tr>
<td>1:54</td>
<td>44 1/4</td>
<td>6000</td>
</tr>
</tbody>
</table>

(a) Explain why the measurement of trading costs is important.

(b) Calculate the price impact of trading for the above stock using the “money flow” system as adapted by Birinyi.

***END OF EXAMINATION***
Solution 1

(a)

I. Market Risk – Risk to value of derivative due to change in market. Components include:
   a) Delta – Absolute Price
   b) Gamma – Convexity
   c) rho – Discount Rate
   d) Vega – Volatility
   e) Theta – Time Decay
   f) Basis Risk – Tracking Error
   g) Investing and Funding Risk

II. Liquidity Risk – Derivatives may not be able to be sold, unwound at need time or at needed price

III. Credit Risk – The risk of counter party default

IV. Operational Risk – Risk of human error, system error, or lack of documentation

V. Legal Risk – Risk that a contract is unenforceable. Possible ways:
   a) contract is illegal
   b) lack of documentation
   c) Risk that one party could not contract
   d) unenforceability of contract in insolvency

(b)

I. LifeCo has exposure limit to counter party to mitigate credit risk, and has crediting rating minimum

II. LifeCo has good documentation procedures to mitigate legal and operational risk, but they should also have internal audit to verify adherence to policies.

III. For market risk, LifeCo should calculate and measure things such as delta, sigma, vega, rho, etc.
Solution 1 (continued)

IV. LifeCo has an outline of responsibilities and committees.

V. LifeCo has set guidelines for approved derivatives and permitted uses.

VI. Board of Directors are notified of transactions

VII. Contract and counterparty requires chief counsel approval

VIII. LifeCo needs to consider credit enhancement clauses

IX. LifeCo has ALM committee

X. LifeCo requires master contract
Solution 2

(a) Offered GMDB, which is greater of acct value and accumulative value at 5%

(i) Actual approach = guarantee benefit = exposure × election rate × Pr of claim

Election rate = 1

Pr of claim based on mortality

Exposure = max (0, DB-acct value)

use historical data to estimate probability

(ii) Capital market approach

Use option approach, risk neutral

Pay off like a put option

LifeCo's GMDB is type II guarantee

(b) VA funds invested 70% in equity, 15% bond, and 5% money market

Lower equity return make guarantee more likely in the money

Lower equity return reduces M&E fee since it often based on asset under management

Probably means more surrender/lapse

High credit loss makes guarantee more likely in the money

Could be more default

Lower interest reduces money market return

Might be positive for equity and bonds

But could mean low return in long run

(c) Static hedge

Buy put options for equity

Buy CDs for bonds

Buy floors to hedging lower rate

Idea is to buy options or exchange risk of guarantee with counterparty risk

Dynamic hedging

Synthetic manufacture option payoff

Can be flexible process

Uses short-dated option

Can use integrated risk management approach

Need risk attitude, risk expertise, risk size and correlation

Market price dynamics

May just running the risk

Or reinsure

Or make market by develop products that offset GMDB risk
Solution 2 (continued)

(d) Payout annuity includes pension buyout annuities,
structured settlements
cashflow usually is very predictable
cashflow is usually interest rate insensitive other than some COLA benefit
usually long term

(e) PA portfolio has more than 6% equity, 10% in below investment, 5% in
MBS/CMO
low equity return may not support crediting rate
not enough current income
but long term may be good
6% may be too much
Could be large default from below investment grade
10% allocation is very large
down grade from investment grade make things worse
may need more capital
low interest rate means low reinvestment income
pre-payment from MBS/CMO
A&L duration match will get worse
right now already asset duration is shorter than liab duration

(f)

(i) reduce equity allocation
reduce below investment allocation
reduce MBS/CMO
could increase investment grade corporate
callable bonds not good, so reduce
diversify
consider real estate, CML, CMBS, ABS etc

(ii) use put option to hedge equity return
use CDS to hedge credit risk
use floor to hedge low interest rate
Solution 3

(a) Dollar duration gives an idea of how the assets MV will change relative to the liabilities PV for a parallel shift in the interest rate curve, assuming the cashflows will be the same as before the shift.

Effective duration will give an idea of how the assets MV and liabilities PV will change (in %) for a parallel shift, taking into account the presence of interest rate sensitive cashflows on both sides of the balance sheet.

The liabilities in the Non-traditional Life segment have embedded options:
- Guaranteed interest rate of 3-6%
- Max loan rate of 7% on older policies
A non-negligible % of the assets are callable

Effective duration will be a better metric due to the presence of interest rate sensitive cashflows. Dollar duration will not give a true picture.

(b)

Investment Strategy
- Allocation of assets to eliminate excessive and unacceptable risk
- Bulk of portfolio should be in high quality fixed income instruments. This would allow the company to meet the minimum credited rate guarantees. Should also increase the term of the bonds so the durations would increase and this would help mitigate the mismatch problem.
- Should also include equities and derivatives. These would help back the portfolio rates that are being credited. The derivatives if selected appropriately would help with the embedded options of the non-traditional life segment.

Product Development
- Should correspond to investment strategy
- Must balance competitiveness and risk assumption
- LifeCo should manage the risks better in this product, and make sure it is not guaranteeing minimums that are too high
Solution 3 (continued)

Reinsurance
- Help control liability cash flows
- Reinsurance usually takes advantage of diversification by pooling risks, but with respect to asset/investment risk, it might actually increase the risk.
- Securitization is the selling of liabilities at a discount – may help reduce risk, but not really appropriate.
- This is a good opportunity for LifeCo. They could use coinsurance to reduce risk... or if they wanted to be risk of risk entirely, could fully reinsure.

Holism
- Need to take advantage of the synergies of the different lines.
- Seeks to leverage diversification of business. Sell products with offsetting risk.
- Enterprise wide rather than at product level.
- Difficult to know that products in fact have offsetting risks.
- LifeCo doesn’t currently use this.
- This would work if there are other product lines with different duration requirements. You can then combine them with the UL line and then address the overall mismatch problem.
Solution 4

(a) differences:

<table>
<thead>
<tr>
<th></th>
<th>Rationale</th>
<th>Assumptions</th>
<th>Credit Standing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair Value</td>
<td>Exit value; Immediate Settlement</td>
<td>Market-based</td>
<td>Reflected</td>
</tr>
<tr>
<td>Entity-Specific Value</td>
<td>Orderly settlement over the life of the liability</td>
<td>Specific to Entity</td>
<td>Not reflected</td>
</tr>
</tbody>
</table>

Similarities:
- both use JWG hierarchy
- both use PV techniques
- both update assumptions on each valuation date

(b)

\[ r_i = r_A - e^{\left( \frac{r_e - r_A}{1-t} \right)} \]

assumptions from market participants holding similar assets and liabilities

\[ r_A = .08 \]
\[ e = .05 \]
\[ r_e = .12 \]
\[ t = 35 \]

\[ r_i = .08 - (.05) \left( \frac{.12}{1 - .35} - .08 \right) \]
\[ r_i = 7.48\% \]

Liability at time 0 \[ 0 = \frac{(1,000)(1.23)}{(1.0748)^3} = 990.65 \]
Solution 4 (continued)

(c) Under the Total Return Approach, the liability value at issue is the single premium = $1,000

The requires spread "s" is such that:

\[
\text{initial liability value} = \frac{\text{Maturity Value}}{(1+d_3 + s)^3}
\]

\[
d_3 = 3 \text{ year risk-free spot rate} = 6.21\%
\]

where \[
\frac{1,000}{\left(1+.0621+s\right)^3} = 93\text{bps}
\]

(d) Arguments for:
- Liability is someone else's asset
- Not reflecting it means a company can manipulate its earnings by trading in its own dept
- No compelling reason why insurance liabilities should be treated any differently than publicly issued debt
- FV of liabilities from owner’s perspective can never be greater than assets-requiring FV to reflect credit standing

Arguments against:
- if credit reflected, earnings can go up when credit rating goes down-counterintuitive
- Insurers can’t exit liabilities except through settlement with policyholders. Trying to do reflecting credit standing violates “unfair trade practices” laws
- The effect of credit standing is small because of the presence of guarantee funds, and the priority status of policyholders in insolvency cases
- Not reflecting it provides more useful information to financial statement users, including creditors and potential buyers.
- Insurance liabilities are not traded-no market value. Asset valuation models don’t necessarily apply to insurance liabilities
(e) The cost of capital approach incorporates credit standing by discounting at a rate other than the risk-free rate, which takes into account the riskiness of the cash flows. The impact of this on LifeCo would be to reduce the valuation of their liabilities because of their weakened capital position and potential for downgrade.
Solution 5

(a) \( D_s \cdot S = (D_A \cdot A - D_L \cdot L), \) where A, L and S are market values
\( D_s = (D_A \cdot A - D_L \cdot L)/S \)
\( D_s = (7.7 \cdot 5457.1 - 9.8 \cdot 5220)/237.1 \)
\( D_s = -38.53 \) years

(b) Surplus would be reduced to zero if:
\( \Delta S = S_0 \cdot D_s \leq (\Delta t) \)
\( (0 - 237.1) = -237.1 \cdot (-38.53) \cdot (\Delta t) \)
\( 1 = (-38.53) \cdot (\Delta t) \)
\( \Delta t = 1/(-38.53) \)
\( \Delta t = -0.02595\%, \) i.e. if rates decrease by 2.6%

(c) Surplus would be immunized if \( D_s = 0 \)
\( D_s \cdot S = (D_A \cdot A - D_L \cdot L), \) where A, L and S are market values
\( 0 = (D_A \cdot A - D_L \cdot L) \)
\( D_l = (D_A \cdot A)/L \)
\( D_l = (7.7 \cdot 5457.1)/5220 \)
\( D_l = 8.05 \) years

(d) Use of modified duration assumes fixed cash flows. Assets and liabilities have interest-sensitive cash flows (or embedded options). Should use effective duration.
Solution 6

(a)

\[ D(a) = \frac{V(t) D(a) (1+k)}{V(a)} - \frac{V(FR) D(FR)}{V(a)} \]

Where \( t \) = reserves, \( FR \) = future retentions, \( p \) = future prem - future benefits, \( a \) = assets, \( k \) = required capital, \( V() \) = value of

If prem's interest sensitive (\( v=1 \))
   Future premium will decrease as int rates rise \( \Rightarrow \) \( D(FR) > 0 \)
   This implies that the target duration must be reduced

But, if competitor is not interest sensitive
   Negative impact on \( D(FR) \), causes an increase in \( D(a) \)
   If competitor is interest sensitive, no further impact

If prem's not interest sensitive (\( v=0 \))
   \( D(FL) > D(FP) \) \( \Rightarrow \) \( D(FR) < 0 \)
   So \( D(a) \) must be increased

But, if competitor is interest sensitive
   Positive impact on \( D(FR) \), causes a decrease in \( D(a) \)
   If competitor not interest sensitive, no further impact

(b)

1. Accounting Constraint
   - Impact varies by accounting system
   - RBC impact
2. Tax Constraint
   - Sale will realize a capital gain or loss
   - Manage at company level
3. Value/EVA
   - Sale may decre. distributable earnings. Post-tax cash flows must be replaced, otherwise decre. EVA
4. ALM
   - Effect on selling segment's duration matching
   - Yield curve shape
5. Credited Rate
   - If sell asset with high yield, it may decre. credited rate
Solution 6 (continued)

6. Policyholder equity issues
   - Sale may create additional risks or mismatches (counterparty, issuer exposure)
   - May be contrary to company philosophy
Solution 7

(a) utility functions, \( u(x) \)
are increasing functions
\[ u'(x) > 0 \]
(utility increases as wealth, \( x \) increases)
and are concave
\[ u''(x) < 0 \]
(utility increases at a decreasing rate as wealth increases)

(b) two investments or decisions are the same to an investor if they have the same utility
Example: insurance coverage that costs a premium an investor will be indifferent to purchasing this insurance if the utility is the same with or without it.

\[ u(x) = E[u(W+P-S)] \]
where \( u(x) \) is utility
and \( E[u(W+P-S)] \) is utility with the insurance that give coverage of claims \( S \) for a premium \( P \)
Solution 8

(a) Let $\omega_{1i}$ and $\omega_{2i}$ be the weight in % of total portfolio of the $i^{th}$ bond in the first and second portfolio respectively.
The effective duration of portfolio 1 is then calculated by
$$D_1 = \omega_{11} + \omega_{12} + \omega_{13}$$
Similarly, the duration of the portfolio #2 is given by
$$D_2 = \omega_{21} + \omega_{22} + \omega_{23}$$
In order to match the durations, we must have
$$\omega_{11} + \omega_{12} + \omega_{13} = \omega_{21} + \omega_{22} + \omega_{23}$$
in addition, in order to have the same market valued, we must have
$$\omega_{11} (1.04)^{-1} + \omega_{12} (1.05)^{-2} + \omega_{13} (1.06)^{-3} = \omega_{21} (1.04)^{-1} + \omega_{22} (1.05)^{-2} + \omega_{23} (1.06)^{-3}$$

Many portfolio could be found that meet those equations, for example, let’s choose portfolio 1 such that weight are equals:
that is $\omega_{11} = \omega_{12} = \omega_{13} = \frac{1}{3}$
in addition let’s assume the market value of the portfolios is $300$, thus:
$$100 \cdot 1.04 = 104$$ of face value in 1-yr bond
$$100 \cdot 1.05^2 = 110.25$$ of face value in 2-yr bond
$$100 \cdot 1.06^3 = 119.10$$ of face value in 3-yr bond

To get portfolio 2, first note that market value of each bond must add to 300 and duration must be 2 thus,
$$\omega_{21} + \omega_{22} + \omega_{23} = 2$$ (duration)
$$300(\omega_{21} + \omega_{22} + \omega_{23}) = 300$$ (market value)

Choosing an arbitrary value for $\omega_{22}$ of $\frac{150}{300}$, we get
$$\omega_{21} = \frac{75}{300} \qquad 75 \cdot 1.04 = 78$$ of face in 1-yr
$$\omega_{22} = \frac{150}{300} \Rightarrow 150 \cdot 1.05^2 = 165.38$$ of face in 2-yr
$$\omega_{23} = \frac{75}{300} \qquad 75 \cdot 1.06^3 = 89.33$$ of face in 3-yr
Solution 8 (continued)

(b) Since duration = 2

a 1% increase will lead to a charge of $-1\% \cdot 2 \cdot 300 = -\$6$

or a decrease of $\$6$ in the portfolio value for both portfolios

(c) For portfolio 1 we have $\omega_{11} = \frac{1}{3}$

So

$\Delta$ in portfolio = $-\omega_{11} \cdot D \cdot 300 \cdot 0.01 = -\$2$

or a decrease in value of $\$2$

For portfolio 2: $\Delta$ in portfolio = $-\omega_{21} \cdot D \cdot 300 \cdot 0.01 = \frac{-75}{300} \cdot 2 \cdot 300 \cdot 0.01 = -\$1.50$

or a decrease in value of $\$1.50$

(d) Need key rate duration!

Portfolio #1

A shift of all curve by 1% gives a value of

$$P^* = \frac{104}{1.05} + \frac{110.25}{(1.06)^2} + \frac{119.10}{(1.07)^3} = 294.39 \text{ vs } -\$6 \text{ in answer b}$$

So effective duration of

$$D = \frac{P^* - P}{-P \cdot 0.01} = 1.86972$$

For 1-yr rate only

$$P^* = \frac{104}{1.05} + 100 + 100 = 299.04 \text{ vs } -\$2 \text{ in answer c}$$

So $D(1) = 0.31746$

For 2-yr rate:

$$D(2) = 0.62596$$

For 3-yr rate:

$$D(3) = 0.9263$$
Solution 8 (continued)

Portfolio #2

Similarly we get

all rate shift \( \Rightarrow P^* = 294.3856 \) vs $6 in answer b  \( D=1.8714 \)
1 yr shift \( \Rightarrow P^* = 299.2857 \)  \( D(1)=0.23809 \)
2 yr shift \( \Rightarrow P^* = 297.18316 \)  \( D(2)=0.938946 \)
3 yr shift \( \Rightarrow P^* = 297.9168 \)  \( D(3)=0.6944 \)
Solution 9

(a) In this context, value at risk can be defined as follows: “We are 95% certain that over the maximum increase value of our GMAB liability is $X where X is the Value at Risk”. The key limitations are as follows:
   Results vary widely with methodology
   May give false sense of security to senior management
   Does not reflect liquidity risk, operational risk, etc
   Assumes a normal distribution

(b) Stress Testing – use predefined deterministic scenarios that reflect some of the most extreme event observed historically.
   This addresses the fat tails issue
   Avoids the statistical distribution issues altogether.
   Back-testing – test the model against the past and addresses all of the model integrity issues – policyholder behaviour, and statistical distributions
Solution 10

(a)

(i) FX Risk
- Transactional Exposures
  - Transactions in foreign jurisdictions have to be translated over to base currency. Income risk
  - Commodities priced in other currencies could become expensive if rates move against you
  - Revenues of course have a major impact if they have to be consolidated.
- Translational Exposures
  - Asset values have to be converted over
  - Affects equity account
- Competitive exposure-change in relative competitive position
- Contingent Exposures
  - For transactions that may take place in the future

(ii) Problem is in Cash Flow Statement where TargetCo now has CAD as an expense for corporate. Other than that there isn’t a big problem other than:

Asset values would have to be converted to CAD and this could affect the balance sheet for CanCo.

(b)

(i) 10% depreciation
⇒ 1 USD = 1.35 CAD

<table>
<thead>
<tr>
<th></th>
<th>CanCo</th>
<th>TargetCo before devel</th>
<th>TargetCo after dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>CAD</td>
<td>11,000</td>
<td>USD 2,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAD 3,750</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAD 3,375</td>
</tr>
<tr>
<td>Liais</td>
<td>CAD</td>
<td>9,000</td>
<td>USD 2,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAD 3,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAD 2,700</td>
</tr>
<tr>
<td>Surplus</td>
<td>CAD</td>
<td>2,000</td>
<td>USD 500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAD 750</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CAD 675</td>
</tr>
</tbody>
</table>

Consolidated

<table>
<thead>
<tr>
<th></th>
<th>Before Combined</th>
<th>After Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>14,750</td>
<td>14,375</td>
</tr>
<tr>
<td>Liais</td>
<td>12,000</td>
<td>11,700</td>
</tr>
<tr>
<td>Surplus</td>
<td>2,750</td>
<td>2,675</td>
</tr>
</tbody>
</table>

So surplus goes down CAD 75
Solution 10 (continued)

(ii) \[ 1 \text{ USD} = 1.35 \]

<table>
<thead>
<tr>
<th>Premiums</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales&amp;Mktg &amp; Policy Ben</td>
<td>(USD 70)</td>
<td>(USD 70)</td>
</tr>
<tr>
<td>Corporate</td>
<td>(CAD75 = USD 50)</td>
<td>(CAD75 = USD 55.56)</td>
</tr>
<tr>
<td>USD 30</td>
<td></td>
<td>24.44</td>
</tr>
</tbody>
</table>

So a reduction of USD 5.56 – makes sense because expenses got a little bigger.

(c) External Concerns:

Analysts (Share Price)
FX is only a 2\textsuperscript{nd} order effect on operations acc to analysts so they may ignore

Investors
Will be concerned with vol of earnings. Still since investors can create own hedges by taking derivative/margin positions this may not be relevant.

Income Investors (Maintain Dividend Policy)
If CanCo pays a dividend is the volatility in earnings going to limit dividend flexibility by putting a strain on cash flow.

What about dividend growth? Problem if too much fluctuation in income/cash flow.

(d) Options
- Gives an option on the move in rates
- Exposed to positive benefits if guess right
- "Insurance" protection at a cost
Solution 10 (continued)

Futures
- Less flexible
- Partial or full hedge
- Could cause cash flow issues if obligation has to be fulfilled but there are cash flow problems operationally.

Forwards or swaps
- Similar to futures but credit risk may be an issue
- Futures/forwards/swaps effectively lock in the current exchange rate of 1.50, hedging against movements in f/x rate either way

(e) Need to hedge the 75 CAD in 1 year (protect against rising Canadian dollar)
Assume we want a put option on US$ (or call on CANS) – solution is done with put on US$

At the strike price of 1.50
Solution 10 (continued)

\[ S_o = 1.5 \]
\[ K = 1.5 \]
\[ \sigma = 0.04 \]
\[ r = 0.04 \]
\[ r_f = 0.03 \]
\[ T = 1.0 \]

\[ p = Ke^{-rT}N(-d_2) - S_o e^{-rT}N(-d_1) \]

\[ d_1 = \frac{\ln(S_o / K) + (r - r_f + \sigma^2 / 2)T}{\sigma \sqrt{T}} \]

\[ = \frac{0 + \left(0.04 - 0.03 + (0.04)^2 / 2 \right)(1)}{(0.04)\sqrt{1}} = +0.27 \]

\[ d_2 = d_1 - \sigma \sqrt{T} = +0.27 - (0.04)\sqrt{1} = 0.23 \]

\[ N(-d_1) = N(-0.27) = 0.3936 \]

\[ N(-d_2) = N(-0.23) = 0.4090 \]

\[ \Rightarrow p = (1.50)e^{-0.04}(0.4090) - 1.50e^{-0.03}(0.3936) \]

\[ \Rightarrow p = 1.50[3929631 - 3819691] \]

\[ p = 0.016491 \]

Since we have to protect 75M CAD or $50M USD we will need 50 contracts for a cost of:

\[ 50 \times 0.016491 = 825,000 \text{ CAD or } 550,000 \text{ US} \]
Solution 11

(a) Value of one-month call option implies following value for rf:

Using a one-period binomial tree, movement is either up or down

Call is in the money only for an upward movement, and payoff is the amount of this movement

\[ C = S \times p \times (u-1) \times \exp(-rf/12) \]

25 025 = 800 \times p \times (u-1) \times \exp(-rf/12)

d = \exp(-\sigma \times \sqrt{1/12}) = \exp(-.20 \times \sqrt{1/12}) = .9439

u = 1/.9439 = 1.059434

So \[ p = 25 025/800/(1.059434-1) \times \exp(rf/12) = .526319 \times \exp(rf/12) \]

Also, \[ p = (a-d)/(u-d) = (\exp(rf/12)-d)/(u-d) = (\exp(rf/12)-.9439)/(1.059434-.9439) = 8.65544 \times \exp(rf/12)-8.16987 \]

So \[ \exp(rf/12) \times 8.129121 = 8.16987 \]

Thus \[ rf = 6\% \]

(b) Upper and lower bounds

Upper bound:
Current value of index (800)

Lower bound:

Look at lower bound as for 2-month European call option since strike will be no more than strike on European call, of 800.

That is, \[ S_0 - K \times \exp(-rf \times T) = 800 \times (1 - \exp(-.06 \times 2/12)) = 796 \]

And of course, value is greater than one period call option in (a) worth 25.025

The upper bound is the value of the stock index, $800.
Solution 11 (continued)

(c) Price of lookback:

Construct binomial tree with 2 time-steps

Have all assumptions from (a) above.
u = 1.05943, d = 0.9439, p = 0.528956

Index value (scaled to start at 1)

<table>
<thead>
<tr>
<th></th>
<th>1.12239</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.05943</td>
</tr>
<tr>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>0.9439</td>
<td>0.8909</td>
</tr>
</tbody>
</table>

Path-dependent minimum index values (last col. shows lower path’s value first)

<table>
<thead>
<tr>
<th></th>
<th>1.0000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0000</td>
</tr>
<tr>
<td>1.0000</td>
<td>0.9439</td>
</tr>
<tr>
<td>0.9439</td>
<td>0.8909</td>
</tr>
</tbody>
</table>

Path-dependent payoff if exercised at given node

<table>
<thead>
<tr>
<th></th>
<th>0.12239</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05943</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0.0561, 0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Option values at each node, assuming no early exercise

<table>
<thead>
<tr>
<th></th>
<th>0.12239</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \exp(-0.05) \times 0.528956 \times 0.12239 + 0 = 0.064416 )</td>
<td>0.0561, 0</td>
</tr>
<tr>
<td>( \exp(-0.05) \times (0.528956 \times 0.064416 + 0.471044 \times 0.029526) )</td>
<td>0.0561, 0</td>
</tr>
<tr>
<td>( -0.047742 )</td>
<td></td>
</tr>
<tr>
<td>( \exp(-0.05) \times 0.528956 \times 0.0561 + 0 = 0.029526 )</td>
<td>0</td>
</tr>
</tbody>
</table>
Solution 11 (continued)

Option values at each node, reflecting early exercise right – early exercise not optimal at any node, so same values. So option value = 800*0.047742 = 38.19
Solution 12

- Duration is usually measured to account for interest rate sensitivity of a fixed income instrument.

- The assets are equities. The factors affecting the value of equities are much more than interest rates. Interest rate changes are a main factor affecting the performance of fixed-income instruments, but it is not so dominating in explaining the equity value change.

- According to the DDM motel, duration of equities can be much longer than what is observed in the market. Also, the Franchise Factor model solved the equity duration paradox, it is still an area requiring more research and empirical study.

- Using equity to back long-term liabilities without participation into investment returns is a bad idea, using a metric not even theoretically sound to measure the interest sensitivity of the assets will make things even worse by giving the unreliable indication of performance results.
Solution 13

- Define risk limits
  - to avoid catastrophic losses

- Monitor risk limits seriously
  - penalize when the risk limits are not satisfied otherwise, feeling that the risk limits are not to be taken seriously

- Do not underestimate the benefit of diversification
  - diversification can significantly reduce risk

- Do not think you can outguess the market
  - gain is only obtained by luck

- Carry out scenario analysis and stress testing
  - help to assign the risk present in derivatives

For financial entities
- Monitor traders carefully
  - position limits, concentration
- Separate the back, middle, and front office
  - to ensure that all functions are adequately performed
- Do not blindly trust model
- be conservative in the recognition on inception profits
- do not sell clients inappropriate products
  - dangerous for the LT life of the business
- do not ignore liquidity risk
  - important in period of stress liquidity (crisis)
- beware when everyone following the same trading strategy
  - could result in the future at market instability

For non-financial institutions
- Understand the trades that you are executing
  - large losses occur when a trade was made and the senior management does not understand it
- Be cautious by making the Treasury department, a profit center ⇒ manage liquidity (goal) not produce profit.
- Be cautious that a hedger does not become a speculator, hedge is dull ⇒ speculation is fun however, large risk involved
Solution 14

(a) Critical Factors
- size + composition of international allocation in portfolio
- cost of hedging
- risk tolerance of management
- potential purchase of foreign goods

(b) As size of international allocation ↑ ’s, hedge ratios ↑ ’s
As size of hedging ↑↑’s, optimal hedge ratio ↓ ’s
As risk tolerance ↑ ’s, optimal hedge ratio ↑ ’s

(c) Purchasing Power Parity
   Economic theory that predicts in long run equilibrium, the cost of goods in local and foreign markets will be equivalent. Exchange rates tend to offset inflation rates.

   Interest Rate Parity
   Economic theory stating that adjusted for foreign exchange rates, interest rates in foreign and local markets are equivalent.

(d) If true-preserving future purchasing power, not a consideration in deciding whether to hedge because cost of goods in local and foreign markets will be equivalent.

   If false – In light of preserving purchasing power of foreign products, consider hedging less to protect against local cost of imports due to exchange rate fluctuations. Also if false implies possible arbitrage opportunities.
Solution 15

(a) prepayments—relocations and re-financings—assumptions and curtailments

relocations—when an individual moves out of one house and into another. Relocations are high during strong housing markets. They tend to be higher in the spring and summer. Low current interest rates increase relocations since existing payment can buy more home. Higher relocations increase preps. Demographic reasons increase relocations. Higher tax deductibility with relocations.

Refinancings—when an individual prepays his mortgage by refinancing into a lower interest or shorter term mortgage. High after a fall in interest rates. However, burnout occurs after the same low is hit a few times. Also, when the yield curve steepens, there is incentive to refinance into a shorter term mortgage. The impact of refinancings are high, higher refinancings increase preps. Surge is refinancing when rates increase after steady decrease and homeowner thinks they missed the bottom.

assumptions—when the buyer of a house “assumes” the mortgage from the seller of the house. This occurs mostly when interest rates have gone up, so the current mortgage is a discount mortgage. Higher assumptions decreases preps. GNMA mortgage may be assumed rather than prepaid. Minimal transaction costs, little judgment or interest rate timing, and easier to qualify.

curtailments—partial extra principal payments above what is scheduled. While they do not have a large impact on new mortgage pools, their cumulative impact can be very high. They are higher when homeowners feel there are no better investment opportunities for their extra money. Increasing curtailments increase preps. WAM calculations ignore future curtailments and may be overstated.

(b) Pool A: relocations—Likely fairly low since 80% of pool has only 3 years on their current mortgage. However there is a strong housing market. Slower preps since not in summer anymore.

refinancings—High as interest rates fall below the weighted average coupon. Pool A on cusp of being economic to refinance. Due to steep curve would be good time to refinance to shorter term mortgage.
Solution 15 (continued)

Pool A younger with higher LTV and higher incentive to refinance which would increase prepay over b. Present increase in rates could cause surge in prepay.

assumptions: Very slow since interest rates are falling. However, they are allowed since it's a GNMA pool.

curtailments - Small effect since pool is not very seasoned.

Pool B: relocations Very high since high demographic seasoning. Strong housing market, relatively old mortgages, 50% balloon mortgages, which appeal to short-tenure homeowners, falling interest rates all contribute. Slower prepay since not in summer anymore.

refinancings Somewhat high. Although 80% of loans have already refinanced, the weighted average coupon is very high relative to end-of-2003 rates. Due to the steep yield curve, would be a good time to refinance into a shorter term mortgage. Recent increase in rates could cause surge in prepay.

assumptions Not allowed since it's not a GNMA pool.

curtailments Have likely had a large impact over time, especially on those mortgages that are very seasoned. Curtailments will likely continue to be strong as homeowners look to gain equity.

COURSE 8: Fall 2003
Investment

-49-
Solution 16

(a) Cap Rates = \( \frac{\text{Net operating Income}}{\text{MV property}} \)

Cap rates:
1) Provide yield similar to debt instruments adjusted for risk and uncertainty
   Can use fixed rate mortgages which are positively correlated with cap rates
2) Have similar characteristics to equities
   proxy with S&P index or E/P ratio
   E/P ratio is positively correlated with cap rates
3) Influenced by inflation
   proxy with T-note/T-Bill differential
   inflation negatively correlated with cap rates
4) Include expectation for tax sheltered returns
   tax effect not very significant
5) Include risk premium that varies with supply/demand cycle of Real estate market.
   proxy with national vacancy rate or \( \Delta \) in GNP

Also consider
Trends in operating income
Expectation for market rents

(b) 1) Need appropriate return & volatility measures
Consider:
a) Appraisal Based Index
   Drawbacks
   Volatility of appraisal data less than half true volatility due to
   Appraisal smoothing-use stale info
   Temporal Aggregation properties appraise annually but updated quarterly
Solution 16 (continued)

Seasonal Patterns properties reappraise in 4th Q (about 55%)

Can correct using

$$\text{Adjusted Index} = \frac{\text{Previous Annual Index Return} - \lambda \left(\text{Current Annual Index Return}\right)}{(1-\lambda)}$$

higher $\lambda$ means more smoothing
$\lambda$ should be between 0.5 and 0.7

b) Index of equity Real Estate stocks including:
   REITs, Real estate operating companies not in trust form,
   land subdividers and commercial developers and general contractors

2) Consider risk aversion of portfolio owner, diversification
   requirements, and any other constraints

3) Maximize return for each level of risk and construct efficient
   frontier. Use analysis to determine optimal level
Solution 17

(a)
Set up default payoff and probability - $QRFexp(-Y)$
Set up no-default payoff and probability - $(1-Q)Fexp(-Y)$
equate sum to riskless bond value - $Fexp(-r)$
solve for formula - $Q=(1-exp(-(Y-r)))/(1-R)$
Use Merton model to value company equity as an option on the company assets $E0=V0N(d1)-Dexp(-rT)N(d2)$
this imposes one condition on company value and asset volatility $\sigma_x E_0 = N(d_1)\sigma_\nu V_0$
Ito's lemma gives the other condition

Now solve 2 equations in 2 unknowns

(b)
use $Q=(1-exp(-(Y-r)))/(1-R)$
substitute the right numbers for each bond (r from C, then into B)
Produces illogical numbers (risky yields lower than risk free) - model is wrong

(c)
Higher default probabilities from bonds
1) Liquidity premium on corporates
2) Extreme scenario anticipation
3) Bond driven calculation is a risk neutral world estimate
4) Historical default probabilities are real world

(d)
First to default pays off only on the first default
- cheap if high correlations
- but bad if high correlation and low number of bonds
- bad if significant low quality concentration
Add-up CDS is equivalent to the
sum of simple CDS' on each bond
- expensive (risky bonds)
- no correlation reduction
(e) Use Monte Carlo simulation
At each trial calculate for each of A, B, C
(a) PV (Payoff)
(b) PV of payments until min(default, 1 year)
Swap spread = (average of all (a))/(average of all (b))
To incorporate correlation
assume their joint is multivariate normal
then joint distribution of times to default
can be described in terms of
cumulative probability distributions of default and
pairwise correlations of inverse normal transforms
this is the Gaussian copula assumption
it allows estimation of correlation separately from marginals

(f) [1] Excess of loss contract is a bull spread on total losses
long call with strike at lower limit of the layer and
short call with strike at higher limit of the layer
[2] Issue bonds that curtail principal or interest payments
based on the value of earthquake losses
(I) issue bond with principal of (350-100=250) million
and high bond holder interest
the principal is decreased by losses in the layer
(II) issue a much larger amount with interest rates
reduced by excess layer losses
[3] CAT bonds are attractive because of lack of
any significant correlation to market returns
Solution 18

(a) To split the performances between the four sources we need:
    Return of liabilities: 6.2% (AAA, duration=7)
    Return of assets: 5.7% (A, duration=10)

    Benchmark 1, must replicate credit of liabilities and duration of liabilities
    Benchmark 2, must replicate credit of liabilities but duration of asset
    Benchmark 3, must replicate the duration and credit quality of asset

    Benchmark 1 = 7.3%
    Benchmark 2 = 7%
    Benchmark 3 = 5.5%

(b) Company performance = \( r_A - r_L = -0.5\% \)
    Liability performance = benchmark 1 - \( r_L = 1.1\% \)
    Asset performance-interest rate risk = benchmark 2 - benchmark 1 = -0.3%
    Asset performance-credit risk = benchmark 3 - benchmark 2 = -1.5%
    Asset performance-selection = \( r_A \) - benchmark 3

(c) - Organizational issues
    - Short term vs long term measures
    - Handling interest rate sensitive cashflows
    - Take into account duration of asset and liabilities and convexity
    - Selecting the appropriate market curve for insurance co. Cash flows are long term
    - Take into account embedded options in the products
Solution 19

(a) Multivariate normal simulation is
- Inherently single period
- Does not allow dynamic asset allocation
- Asset return series are not assumed to be autocorrelated
  - Not good for fixed-interest assets (FI)
  - Common to assume mean reversion or some autocorrelation for FI
- Modeling interest rates as return on an asset class is problematic
  - Model term structure of interest rates more appropriate
- Variance is assumed to be constant
  - Empirical evidence of volatility clustering

(b)

(i) Use \( S_0 = A_0 - L_0 \) to buy a 5 year put on the risky asset portfolio with
strike value \( L_5 \)
\[ L_5 = \text{liability value in 5 years} \]
Invest \( L_0 \) in a risky portfolio
\[ i_c = \text{uncertain return of risky portfolio in 5 years} \]
\[ L_0 (1 + i_c) + \max [L_5 - L_0 (1 + i_c), 0] = L_0 (1 + i_c) \quad \text{if } L_0 (1 + i_c) > L_5 \]
\[ L_0 (1 + i_c) + L_5 - L_0 (1 + i_c) = 5 \quad \text{if } L_0 (1 + i_c) < L_5 \]

(ii) Buy a 5 year call on the risky asset portfolio with strike value \( L_5 \)
Invest \( L_5/(1 + i_f) \) in duration-matched Treasury fund
\( i_f = \text{risk-free return on Treasury in 5 years} \)
- Long dated option not viable
  - Market is illiquid
  - High cost (spread)
Solution 19 (continued)

(c) by put-call parity $P + L_0 = C + L_2 / (1 + i_f)$

(d) replicate put option using B-S formula

\[ P = L_5 / (1 + i) N(-d2) - L_0 N(-d1) \]

$L_5 / (1 + i) N(d-2)$ represent amount invested in risk-free Treasury fund

$- L_0 N(-d1)$ represent short holding of risky portfolio

The total portfolio is

Risky asset = $L_0 - L_0 N(-d1) = L_0 \left(1 - N(-d1)\right)$

Treasury fund = $L_5 / (1 + i) N(-d2)$

- Require sale and purchase of equity portfolio as the hedge ratio changes
- Can be expensive because of transaction cost and illiquidity
- Not possible to trade when prices jump as market “gaps”
- For long run investor fixed time horizon is unlikely to be appropriate
- Gamma of put is high and hedge ration, $N(-d1)$, changes significantly as time horizon moves close to expiry date and value of asset close to strike price
- Increased trading activities and transaction costs
Solution 20

(a) Common hedging strategies for derivatives
- Naked hedging: do nothing; exposure when the option in-the-money
- Covered position: short call while long the underlying asset; exposure when stock price decreases more than option price earned
- Stop-loss strategies: When stock price higher than strike price, then buying stock; when stock price lower than strike price, then selling the stock. May incur substantial transaction cost and suffered due to high bid-ask spread.

Above three methods are all inappropriate. We always using delta neutral may be with gamma-neutral, vega-neutral strategies to hedging the call. May hold underlying assets in an amount governed by calls delta, gamma and vega.

(b) Due to no dividends:
For European call: \( C = S_0 N(d_1) - ke^{-rT} N(d_2) \)
\[
S_0 \Delta = N(d_1) \text{ where } d_1 = \frac{\ln(S_0/K) + \left( r + \frac{\sigma^2}{2} \right) T}{\sigma \sqrt{T}} = \frac{\ln \left( \frac{100}{110} \right) + \left( 0.05 + \frac{0.2^2}{2} \right)}{0.2 \sqrt{2}} \approx 0.158
\]

\[\therefore N(d_1) = N(0.158) = N(0.15) + 0.8[N(0.16) - N(0.15)] = 0.5628\]

Because portfolio consist of three short call options, and each option's contract size is 1,000 shares
\[\Delta \text{ of portfolio} = -3 \times 1000 \times 0.5628 = -1688.4\]

\[
\Theta = -\frac{S_0 N'(d_1) \sigma}{2 \sqrt{T}} - rke^{-rT} N(d_2)
\]
\[d_1 = 0.158 \quad d_2 = d_1 - \sigma \sqrt{T} \approx -0.1248\]

\[N'(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} \quad N'(d_1) = 0.394 \quad N(d_2) = 0.4503\]
Solution 20 (continued)

\[ \Theta = -\frac{100 \times 0.394 \times 0.2}{2\sqrt{2}} - 0.05 \times 110 \times e^{-0.05 \times 2} \times 0.4503 \triangleq -5.027 \]

\[ \text{theta of portfolio} = -3 \times 1000 \times (-5.027) = 15,081 \]

\[ \Gamma = \frac{N(d_1)}{S_0 \sigma \sqrt{T}} = \frac{0.394}{100 \times 0.2 \times \sqrt{2}} \triangleq 0.01393 \]

\[ \text{gamma of portfolio} = -3 \times 1000 \times 0.01393 = -41.79 \]

(c) BSM differential equation: 
\[ \frac{\partial f}{\partial t} + rS \frac{\partial f}{\partial s} + \frac{1}{2} \sigma^2 s^2 \frac{\partial^2 f}{\partial s^2} = rf \]

then \[ \Theta + rs \Delta + \frac{1}{2} \sigma^2 s^2 \Gamma = r \Pi \]

from b)

\[ \Theta + rs \Delta + \frac{1}{2} \sigma^2 s^2 \Gamma = -5.027 + 0.05 \times 100 \times 0.5628 + \frac{1}{2} \times 0.2^2 \times 100^2 \times 0.01393 = 0.573 \]

and \[ c = \pi = S_0 N(d_1) - Ke^{-rt} N(d_2) = 100 \times 0.5628 - 110 e^{-0.05 \times 2} \times 0.4503 = 11.46 \]

\[ \therefore \pi = 0.05 \times 11.46 = 0.573 = \Theta + rs \Delta + \frac{1}{2} \sigma^2 s^2 \pi \]

This verify the BSM differential equation.
Solution 21

(a) Garch (1,1)
\[ \sigma_n^2 = \gamma V_L + \alpha \mu^2 (n-1) + B \sigma^2 (n-1) \]
\[ \sigma_0^2 = 9\% \quad V_L = 4\% \quad \mu = 20\% \]
\[ B = 80\% \quad \gamma = 10\% \]
\[ \gamma + \alpha + B = 1 \quad \alpha = 10\% \]

\[ \sigma_n^2 = .004 + .1 (2)^2 + 8 \sigma^2 (n-1) = .008 + 8 \sigma^2 (n-1) \]
\[ \sigma_0^2 = .09 \]
\[ \sigma_1^2 = .008 + 8 \times .09 = .08 \]
\[ \sigma_2^2 = .008 + 8 \times .08 = .072 \]
\[ \sigma_0^2 = .08 \]
\[ \sigma_1^2 = .072 \]
\[ \sigma_2^2 = .008 + 8 \times .072 = .0656 \]

so
\[ \Delta \sigma_1 = \sqrt{.072} - \sqrt{.08} = -1.45\% \]
\[ \Delta \sigma_2 = \sqrt{.0656} - \sqrt{.072} = -1.22\% \]

(b) Equity has the following volatility smile

![Volatility vs Strike](image)

For low prices the volatility is above constant volatility log normal, Black Scholes. For higher strike prices the volatility is below lognormal, lighter tail. If the option were valued by Black Scholes it would overestimate the price of an equity option at a high strike price and underestimate it at a low strike price.
Currency Options have the following volatility smile:

![Volatility smile diagram]

When the option is deep in or deep out of the money its volatility is higher than lognormal, heavier tails. While if it is around the strike price its volatility is below lognormal. If valued by Black Scholes with constant volatility, deep in or out of the money options would be underpriced while at the money options would be overpriced.

The given model has the following volatility smile:

![Volatility smile diagram with 9% and 4%]

This is more appropriate for an equity option.

(c) Find $\alpha$, $B$ and $\gamma$ to maximize the following function

$$\sum_{i=1}^{m} -\ln \sigma(i) - \frac{(u(i)-u)^2}{\partial \sigma^2(i)}$$

Where $\sigma(i)$ is the volatility estimate for period $i$ with observation $\mu(i)$.

This can be simplified by assuming $\gamma V\ell = .008$, then you only need to find $\alpha$ and $B$ that maximizes the sum.
Solution 22

(a) The best Monte Carlo simulation formula for the stock price is

$$S(T) = S(0)e^{\left(\mu - \frac{\sigma^2}{2}\right)T + \sigma \epsilon \sqrt{T}}$$

Set $T = 1/2$, $S(0) = 100$, $\sigma = 0.25$

Stratified sampling on 3 intervals: the Hull book suggests mid-points of the 3 intervals, i.e., $1/6$, $3/6$ and $5/6$, as random numbers to use.

$\epsilon_1 = N^{-1}\left(\frac{1}{6}\right) = -0.97, \, \epsilon_2 = N^{-1}\left(\frac{3}{6}\right) = 0, \, \epsilon_3 = N^{-1}\left(\frac{5}{6}\right) = 0.97$

For risk neutral valuation, set $\mu = r = 6\%$

$$S_3\left(\frac{1}{2}\right) = 100e^{\left(\left(6\% - \frac{25\%^2}{2}\right)\frac{1}{2}\right) + 25\% \epsilon_3 \sqrt{\frac{1}{2}}} = 100e^{0.44\% + 17.678\%} = 120.43 \text{, payoff of call = 120.43 - 95 = 25.43}$$

$$S_2\left(\frac{1}{2}\right) = 101.45 \text{, payoff of call = 101.45 - 95 = 6.45}$$

$$S_1\left(\frac{1}{2}\right) = 85.46 \text{, payoff of call = 0}$$

Hence, call price at time 0 is

$$\frac{1}{3} e^{-rT} \left[ \sum_{i=1}^{3} \text{Payoff in scenario } i \right] = \frac{1}{3} e^{-0\% \times 0.5 \times \left[25.43 + 6.45 + 0\right]} = 10.31$$

The control variate adjustment is $11.37 - 10.31 = 1.06$
Solution 22 (continued)

(b)

Antithetic variable
- Use -ε with ε

Importance sampling
- For out-of-money options, focus simulation on 'in-the-money' portion of results

Moment matching of random numbers

Low discrepancy sequence
- So random numbers spread out over region more evenly

Representative simulation through a tree
- Ensure number of paths through a node is consistent with probability implied in the tree used

(c)

**Method 1**: Least Square Approach

Price of American option known at time T.

At time (N-1)At, calculate exercise value and holding value V. With values from all simulation runs, relate value V to stock price S using formula
\[ V = aS^2 + bS + c. \]

**Method 2**: Exercise Boundary Parametrization approach

Determine \( S^*(t) \) so that exercise immediately for American put if \( S_t(t) < S^*(t) \), otherwise hold. Work iteratively to find \( S^*(t) \) that maximizes option value.
Solution 23

(a)
- A collar is a combination of a long cap and short floor
- A cap can be recognized as a put option maturing at time $\tau_k$ on a zero-coupon bond maturing at time $\tau_{k+1}$. The strike price is the notional amount $L$. The payoff is
  \[ \text{Max} \left[ L - \frac{L (1 + R_k \delta_k)}{1 + R_k \delta_k}, 0 \right] \]
- The same applies to a floor, it can be recognized as a call option on a zero-coupon bond maturing at time $\tau_{k+1}$
- Therefore, the collar will have the same payoffs with a portfolio of bond option contains a put and call option on zero-coupon bond

(b) $\delta = 0.2$, $\tau_k = 1$, $\tau_{k+1} = 1.25$, $\delta_k = 0.25$
$R_k = 0.045$, $F_k = 0.052$, $\gamma = 0.0477$

\[ d_1 = \frac{\ln(F_k / R_k) + \delta k^2 \tau_k / 2}{\delta_k \sqrt{\tau_k}} = \frac{\ln(0.052 / 0.045) + 0.02}{0.2} = 0.8229 \]
\[ d_2 = d_1 - \delta_k \sqrt{\tau_k} = 0.6229 \]

\[ N(-d_1) = N(-0.8229) \]
\[ = N(-0.82) - 0.29 \left[ N(-0.82) - N(-0.83) \right] \]
\[ = 0.2061 - 0.29 \left[ 0.2061 - 0.2033 \right] \]
\[ = 0.2053 \]

\[ N(-d_2) = N(-0.6229) \]
\[ = N(-0.62) - 0.29 \left[ N(-0.62) - N(-0.63) \right] \]
\[ = 0.2676 - 0.29 \left( 0.2676 - 0.2643 \right) \]
\[ = 0.2666 \]
Solution 23 (continued)

\[ L\delta_k \rho(\alpha \tau_{k\ell}) \left[ R_k N(-d_2) - F_k N(-d_1) \right] \]
\[ = 100,000,000 \times 0.25 \times e^{-0.0477 \times 1.25} \times (0.045 \times 0.2666 - 0.052 \times 0.2053) \]
\[ = 31122.86 \]

(c)

1) Black's model assumes a log normal distribution of a single variable
   - can elevate the risk in an analytical term. Like option pricing on cap or floor
   - ease to apply

2) Can't model path dependency of cashflows
   - simplified assumption may not measure accurately the prepayment risk
   - Assume interest rate is constant
   - Assume volatility is constant

3) In general Black’s model is not suitable to value prepayment option in MBS
   - may also be better to have a model that models the yield curve, not just the short rate.
Solution 24

(a) - Understanding and measuring trading costs is essential to a successful implementation of any international equity strategy.

- Trading cost measurement gives you an indication of how expensive a given stock is to physically trade
- Trading costs can eat into profits and gains if they are large for a given stock

<table>
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<th>Time</th>
<th>Price</th>
<th>Size</th>
<th>Price Differential</th>
<th>Change x Shares</th>
<th>Impact</th>
<th>Value of Trade</th>
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<td>44 1/8</td>
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<td>0</td>
<td>$</td>
<td>-</td>
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<td>3/8</td>
<td>$ 2,250.00</td>
<td>0.85%</td>
<td>$ 265,500.00</td>
</tr>
</tbody>
</table>

$ 3,550.00  0.48%  $ 744,550.00

(b) Total Dollar Value of the price impact of trading = $3,550 or 0.48% of the Total Value of the Trade
EDUCATION AND EXAMINATION COMMITTEE

OF THE

SOCIETY OF ACTUARIES

COURSE 8 INVESTMENTS STUDY NOTE

COURSE 8 INVESTMENT CASE STUDY

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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**

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

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 billion of variable annuities, and 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>
</tr>
</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>
<td>4%</td>
<td>0.00%</td>
<td>1</td>
<td>80.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Mortgage</td>
<td>3%</td>
<td>0.00%</td>
<td>80.00%</td>
<td>1</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Asian</td>
<td>21%</td>
<td>25.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>1</td>
<td>45.00%</td>
<td>0.00%</td>
<td>25.00%</td>
</tr>
<tr>
<td>Global</td>
<td>19%</td>
<td>70.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>45.00%</td>
<td>1</td>
<td>0.00%</td>
<td>70.00%</td>
</tr>
<tr>
<td>Money Market</td>
<td>0%</td>
<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>
</tr>
</tbody>
</table>

| Unit Value | | Variable Annuities | | Variable UL ($millions) |
|------------|-----------------------------------|-----------------------------------|------------------------|
|            | Fund Value | Delta | Gamma | Delta | Gamma | Delta | Gamma | Total | Delta | Gamma | Delta | Gamma | Delta | Gamma | Total | Delta | Gamma |
| Equity     | 18.2       | 1,042  | (189,993) | 5,287 | 258   | 2,452 | 1,122 |
| Bond       | 13.1       | 294    | (98,102) | 4,263 | 460   |        |        |
| Mortgage   | 11.1       | 37     | (6,467)  | 66    | 0     |        |        |
| Asian      | 9.5        | 49     | (10,105) | 130   | 0     |        |        |
| Global Equity | 14.8     | 343    | (11,559) | 6,992 | 56    |        |        |
| Money Market | 10       | 123    | (470,985) | 896   | 90    |        |        |
| Balanced   | 15.2       | 564    | (505,539) | 30,797| 258   |        |        |

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-Value 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>Asset Class</th>
<th>Allocation</th>
</tr>
</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>Asset Class</th>
<th>Allocation</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>Asset Class</th>
<th>Allocation</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>Asset Class</th>
<th>Allocation</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></td>
<td>5040.5</td>
<td>6.89%</td>
<td>5278.8</td>
<td>8.0</td>
<td>219.3</td>
</tr>
<tr>
<td>Invested Assets Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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>

### 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>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>
</tbody>
</table>

### C PreTax Equity

| PreTax Equity               | 188.0               | 237.1        | (38.62)       |

### Tax and Other Adjustments

<table>
<thead>
<tr>
<th>Tax and Other Adjustments</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D1  Future tax payments</td>
<td>65.8</td>
<td>83.0</td>
<td></td>
</tr>
<tr>
<td>D2  Other adjustments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D   Subtotal, tax and other adjustments</td>
<td>65.8</td>
<td>83.0</td>
<td></td>
</tr>
</tbody>
</table>

### Net Value (C-D)

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

### Assets

<table>
<thead>
<tr>
<th>Description</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>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>A1 <strong>Bonds Subtotal</strong></td>
<td>28.4</td>
<td>8.74%</td>
<td>37.4</td>
<td>3.87</td>
<td>1.21</td>
</tr>
<tr>
<td>A2 Cash &amp; short term</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>A3 Commercial Mortgages</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>A4 Derivative securities</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>A5 Equities</td>
<td>101.5</td>
<td>2.61%</td>
<td>101.5</td>
<td>9.50</td>
<td>20.30</td>
</tr>
<tr>
<td>A6 Real Estate (unleveraged)</td>
<td>58.0</td>
<td>7.23%</td>
<td>95.1</td>
<td>12.10</td>
<td>8.71</td>
</tr>
<tr>
<td><strong>Invested Assets Subtotal</strong></td>
<td>188.0</td>
<td>4.96%</td>
<td>196.6</td>
<td>9.45</td>
<td>30.2</td>
</tr>
<tr>
<td>A7 Accrued investment income</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>A8 Policyholder Loans</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>A9 Provision for asset default</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>A10 Other</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td><strong>A11 Total Assets</strong></td>
<td>188.0</td>
<td>4.96%</td>
<td>234.0</td>
<td>9.45</td>
<td>38.9</td>
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</table>

### Liabilities

<table>
<thead>
<tr>
<th>Description</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></td>
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<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></td>
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### PreTax Equity

- **PreTax Equity**: 188.0

### Tax and Other Adjustments

<table>
<thead>
<tr>
<th>Description</th>
<th>Reported Book Value</th>
</tr>
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<tbody>
<tr>
<td>D1 Future tax payments</td>
<td>0.0</td>
</tr>
<tr>
<td>D2 Other adjustments</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>D Subtotal, tax and other adjustments</strong></td>
<td><strong>0.0</strong></td>
</tr>
</tbody>
</table>

### Net Value (C-D)

- **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>A1   Bonds Subtotal</td>
<td>129.0</td>
<td>7.01%</td>
<td>135.74</td>
<td>19.0</td>
<td>3.53</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>Invested Assets Subtotal</td>
<td>270.0</td>
<td>5.71%</td>
<td>279.7</td>
<td>18.4</td>
<td>23.6</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>A11  Total Assets</td>
<td>300.0</td>
<td>5.66%</td>
<td>309.7</td>
<td>16.6</td>
<td>26.8</td>
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</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>B   Total Liabilities</td>
<td>300.0</td>
<td>6.10%</td>
<td>318.0</td>
<td>31.9</td>
<td>2.00</td>
</tr>
</tbody>
</table>

| C  PreTax Equity                         | 0.0                 |              | -8.3          | 600.59            |

<table>
<thead>
<tr>
<th>Tax and Other Adjustments</th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>D1  Future tax payments</td>
<td>0.0</td>
<td></td>
<td>-2.9</td>
<td></td>
</tr>
<tr>
<td>D2  Other adjustments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D   Subtotal, tax and other adjustments</td>
<td>0.0</td>
<td></td>
<td>-2.9</td>
<td></td>
</tr>
</tbody>
</table>

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

### 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>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>A6 Invested Assets Subtotal</td>
<td>360.0</td>
<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>
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</table>

### 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>400.0</td>
<td>6.30%</td>
<td>406.00</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>
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### Tax and Other Adjustments

<p>| | | | | | |</p>
<table>
<thead>
<tr>
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<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>D1 Future tax payments</td>
<td>0.0</td>
<td></td>
<td>3.7</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>0.0</td>
<td></td>
<td>3.7</td>
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<td></td>
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</tbody>
</table>

### Net Value (C-D)

<p>| | | | | | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
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<tbody>
<tr>
<td>Net Value (C-D)</td>
<td>0.0</td>
<td></td>
<td>6.9</td>
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### Individual Life & Annuity - Accumulation Annuity

#### 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><strong>Bonds (total)</strong></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>1173.8</td>
<td>7.11%</td>
<td>1211.28</td>
<td>5.2</td>
<td>32.10</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>Invested Assets Subtotal</strong></td>
<td>1462.5</td>
<td>7.31%</td>
<td>1508.1</td>
<td>5.5</td>
<td>58.4</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>1500.0</td>
<td>7.13%</td>
<td>1545.6</td>
<td>5.3</td>
<td>74.2</td>
</tr>
</tbody>
</table>

#### 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><strong>B1 Benefit liabilities</strong></td>
<td>1500.0</td>
<td>5.90%</td>
<td>1575.00</td>
<td>5.3</td>
<td>15.0</td>
</tr>
<tr>
<td><strong>B Total Liabilities</strong></td>
<td>1500.0</td>
<td>5.90%</td>
<td>1575.0</td>
<td>5.3</td>
<td>15.0</td>
</tr>
</tbody>
</table>

#### C PreTax Equity

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C PreTax Equity</strong></td>
<td>0.0</td>
<td></td>
<td>-29.4</td>
<td>4.21</td>
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#### Tax and Other Adjustments

<p>| | | | | | |</p>
<table>
<thead>
<tr>
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<th></th>
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<tbody>
<tr>
<td><strong>D Subtotal, tax and other adjustments</strong></td>
<td>0.0</td>
<td></td>
<td>-10.3</td>
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<td></td>
</tr>
</tbody>
</table>

#### Net Value (C-D)

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Net Value (C-D)</strong></td>
<td>0.0</td>
<td></td>
<td>-19.1</td>
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### Institutional Pensions - Payout 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>16.9</td>
<td>6.40%</td>
<td>17.26</td>
<td>10.4</td>
<td>0.08</td>
</tr>
<tr>
<td>A1b Public Corporate (Inv. Grade)</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 Public Corporate (below Inv Grade)</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 Private Corporate (Inv Grade)</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 Private Corporate (below Inv Grade)</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 Pass-throughs</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 CMO's</td>
<td>18.6</td>
<td>7.30%</td>
<td>19.83</td>
<td>7.5</td>
<td>0.56</td>
</tr>
<tr>
<td>A1 Bonds Subtotal</td>
<td>338.5</td>
<td>7.33%</td>
<td>361.73</td>
<td>9.0</td>
<td>9.26</td>
</tr>
<tr>
<td>A2 Cash &amp; short term</td>
<td>14.0</td>
<td>4.75%</td>
<td>14.00</td>
<td>0.1</td>
<td>0.04</td>
</tr>
<tr>
<td>A3 Commercial Mortgages</td>
<td>286.0</td>
<td>8.75%</td>
<td>308.88</td>
<td>6.0</td>
<td>14.30</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>44.0</td>
<td>1.00%</td>
<td>44.00</td>
<td>28.0</td>
<td>8.80</td>
</tr>
<tr>
<td>A6 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>Invested Assets Subtotal</td>
<td>682.5</td>
<td>7.46%</td>
<td>728.6</td>
<td>9.0</td>
<td>32.4</td>
</tr>
<tr>
<td>A7 Accrued investment income</td>
<td>7.0</td>
<td>0.00%</td>
<td>7.00</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A8 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>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>10.5</td>
<td>0.00%</td>
<td>10.50</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A11 Total Assets</td>
<td>700.0</td>
<td>7.28%</td>
<td>746.1</td>
<td>8.8</td>
<td>32.4</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>700.0</td>
<td>6.75%</td>
<td>759.50</td>
<td>9.5</td>
<td>2.00</td>
</tr>
<tr>
<td>B Total Liabilities</td>
<td>700.0</td>
<td>6.75%</td>
<td>759.5</td>
<td>9.5</td>
<td>2.00</td>
</tr>
<tr>
<td>C PreTax Equity</td>
<td>0.0</td>
<td></td>
<td>-13.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Tax and Other Adjustments

| D1 Future tax payments | 0.0 | -4.7 |
| D2 Other adjustments |    |     |
| D Subtotal, tax and other adjustments | 0.0 | -4.7 |

### 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>Bonds (total)</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>
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<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>0.0</td>
<td>8.00%</td>
<td>0.00</td>
<td>5.0</td>
<td>0.00</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>0.0</td>
<td>1.00%</td>
<td>0.00</td>
<td>28.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A6 Real Estate (unleveraged)</td>
<td>0.0</td>
<td>10.50%</td>
<td>0.00</td>
<td>10.0</td>
<td>0.00</td>
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<tr>
<td>Invested Assets Subtotal</td>
<td>1462.5</td>
<td>6.54%</td>
<td>1506.7</td>
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<td>39.3</td>
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<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>7.00%</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>22.5</td>
<td>0.00%</td>
<td>22.50</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>A11 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>B1 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>B Total Liabilities</td>
<td>1500.0</td>
<td>6.60%</td>
<td>1537.5</td>
<td>3.1</td>
<td>7.5</td>
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</table>

C PreTax Equity

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

Net Value (C-D)

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

<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>35.0</td>
<td>8.9</td>
<td>0.18</td>
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<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>
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<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>
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<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>
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<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>
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<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>
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<td>A2 Cash &amp; short term</td>
<td>15.0</td>
<td>4.75%</td>
<td>15.0</td>
<td>0.1</td>
<td>0.05</td>
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<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>A6 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>
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<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>
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</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>125.00</td>
</tr>
</tbody>
</table>

| C PreTax Equity          | 30.8                |              | 36.9          |                   |             |

## Tax and Other Adjustments

| D1 Future tax payments   | 10.8                |              | 12.9          |                   |             |

| D Other adjustments      |                     |              |               |                   |             |

| D Subtotal, tax and other adjustments | 10.8 | 12.9 |

| Net Value (C-D)       | 20.0 | 24.0 |
APPENDIX B

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

<table>
<thead>
<tr>
<th>Measure</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollar Duration of Assets less</td>
<td>&lt; 30% x 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% x book value of assets for any</td>
</tr>
<tr>
<td></td>
<td>and all key rates</td>
</tr>
<tr>
<td>Worst Case Scenario at 95% Confidence Level</td>
<td>&lt; 0.50% x book value of assets</td>
</tr>
</tbody>
</table>

(b) Variable Annuities

<table>
<thead>
<tr>
<th>Measure</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta of liability less delta of</td>
<td>&lt;10% of delta of liability</td>
</tr>
<tr>
<td>assets</td>
<td></td>
</tr>
<tr>
<td>Gamma</td>
<td>Unhedged</td>
</tr>
<tr>
<td>Vega</td>
<td>Unhedged</td>
</tr>
<tr>
<td>Rho (Rho of less rho of assets)</td>
<td>&lt;5% of rho of liability</td>
</tr>
</tbody>
</table>

(c) Traditional Life Products
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(c) Non-Traditional Life Products</td>
<td>Dollar Duration of Assets less Dollar Duration of Liabilities</td>
<td>$&lt; 100% \times \text{book value of assets}$</td>
</tr>
<tr>
<td></td>
<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></td>
<td>Worst Case Scenario at 95% Confidence Level</td>
<td>$&lt; 5.00% \times \text{book value of assets}$</td>
</tr>
<tr>
<td>(d) Institutional Pension - Payout</td>
<td>Dollar Duration of Assets less Dollar Duration of Liabilities</td>
<td>$&lt; 100% \times \text{book value of assets}$</td>
</tr>
<tr>
<td></td>
<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></td>
<td>Worst Case Scenario at 95% Confidence Level</td>
<td>$&lt; 5.00% \times \text{book value of assets}$</td>
</tr>
<tr>
<td>(e) Institutional Pension - GIC</td>
<td>Dollar Duration of Assets less Dollar Duration of Liabilities</td>
<td>$&lt; 30% \times \text{book value of assets}$</td>
</tr>
<tr>
<td></td>
<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></td>
<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 Mud & 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 31st, 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 31st 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 31st. 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

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>
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<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>
<td>5,138,000</td>
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<tr>
<td>Liabilities</td>
<td>300,000</td>
<td>318,000</td>
<td>31.9</td>
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<td>Difference</td>
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<td>-15.3</td>
<td>-5,006,000</td>
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<tr>
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<td>&lt; 2,000</td>
<td>&lt; 300,000</td>
<td></td>
<td></td>
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<tr>
<td><strong>NON-TRADITIONAL LIFE PRODUCTS</strong></td>
<td></td>
<td></td>
<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>
</tr>
<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>
<td>-9,974,000</td>
</tr>
<tr>
<td>Guideline</td>
<td>&lt; 2,000</td>
<td>&lt; 400,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ACCUMULATION ANNUITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>1,500,000</td>
<td>1,545,600</td>
<td>5.3</td>
<td>8,224,000</td>
</tr>
<tr>
<td>Liabilities</td>
<td>1,500,000</td>
<td>1,575,000</td>
<td>5.3</td>
<td>8,348,000</td>
</tr>
<tr>
<td>Difference</td>
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<td>-29,400</td>
<td>0.0</td>
<td>-124,000</td>
</tr>
<tr>
<td>Guideline</td>
<td>&lt; 2,000</td>
<td>&lt; 450,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>INSTITUTIONAL PENSION – PAYOUT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>700,000</td>
<td>746,100</td>
<td>8.8</td>
<td>6,535,000</td>
</tr>
<tr>
<td>Liabilities</td>
<td>700,000</td>
<td>759,500</td>
<td>9.5</td>
<td>7,215,000</td>
</tr>
<tr>
<td>Difference</td>
<td>0</td>
<td>-13,400</td>
<td>-0.7</td>
<td>-680,000</td>
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<tr>
<td>Guideline</td>
<td>&lt; 2,000</td>
<td>&lt; 700,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>INSTITUTIONAL PENSION – GIC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>1,500,000</td>
<td>1,544,200</td>
<td>3.3</td>
<td>5,067,000</td>
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<tr>
<td>Liabilities</td>
<td>1,500,000</td>
<td>1,537,500</td>
<td>3.1</td>
<td>4,766,000</td>
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<tr>
<td>Difference</td>
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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>
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<td></td>
</tr>
<tr>
<td><strong>GROUP BENEFITS</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Assets</td>
<td>630,800</td>
<td>660,900</td>
<td>12.3</td>
<td>8,157,000</td>
</tr>
<tr>
<td>Liabilities</td>
<td>630,800</td>
<td>624,000</td>
<td>7.0</td>
<td>4,388,000</td>
</tr>
<tr>
<td>Difference</td>
<td>0</td>
<td>6,900</td>
<td>-0.1</td>
<td>3,789,000</td>
</tr>
<tr>
<td>Guideline</td>
<td>&lt; 2,000</td>
<td>&lt; 630,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SURPLUS ACCOUNT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>188,000</td>
<td>243,020</td>
<td>9.5</td>
<td>2,211,000</td>
</tr>
<tr>
<td>Target</td>
<td></td>
<td></td>
<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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL COMPANY</strong></td>
<td></td>
<td></td>
<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>
</tr>
<tr>
<td>Liabilities</td>
<td>5,030,800</td>
<td>5,220,000</td>
<td>10.2</td>
<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></td>
<td>-4                                           -32          -55          -63          -152         -258         -172 Term -Years</td>
</tr>
<tr>
<td></td>
<td>5                                             7            10           15           20           25           30</td>
</tr>
<tr>
<td></td>
<td>0.25                                          1             2            3            4            5            7</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>

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Cash Flow Analysis
Note that both fixed and variable cash flows are shown together.

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.

Key Rate Sensitivity
Changes In Net Position ('000) per .01% Increase In Rate

<table>
<thead>
<tr>
<th>Term -Years</th>
<th>0.25</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>-0.9</td>
<td>-1.7</td>
<td>3.3</td>
<td>4.3</td>
<td>16.2</td>
<td>12.6</td>
<td>24.6</td>
<td>36.6</td>
<td>36.6</td>
<td>33.6</td>
<td>-29.4</td>
</tr>
</tbody>
</table>

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.

Maximum Decline in Economic Surplus ('000)

<table>
<thead>
<tr>
<th></th>
<th>5,549</th>
<th>5,766</th>
<th>5,491</th>
<th>5,963</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Mar-00</td>
<td>Jun-00</td>
<td>Sep-00</td>
<td>Dec-00</td>
</tr>
</tbody>
</table>

Cash Flow Analysis

Asset/Liability Cash Flows by Month ('000)
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

<table>
<thead>
<tr>
<th>Term - Years</th>
<th>0.25</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
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<tbody>
<tr>
<td>-1.5</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>-1.3</td>
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<td>-2.1</td>
<td>-2.1</td>
<td>-2.1</td>
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<td>-2.5</td>
<td>-2.5</td>
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<tr>
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<tr>
<td>-0.7</td>
<td>-1.0</td>
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<td>0.0</td>
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<td>-5.0</td>
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<td>-5.0</td>
<td>-5.0</td>
<td>-5.0</td>
<td>-5.0</td>
</tr>
</tbody>
</table>

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>Economic Surplus ('000)</th>
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</thead>
<tbody>
<tr>
<td>Mar-00</td>
<td>3,964</td>
</tr>
<tr>
<td>Jun-00</td>
<td>4,320</td>
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<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)
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.

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Cash Flow Analysis