**Answer #1**

a). Required Capital

C-1

| | |
|---|---|
| Investment Grade | = 425 x 0.2% = 0.85 |
| Below Inv Grade | = 225 x 5.0% = 11.25 |
| Private Bonds | = 200 x 1.0% = 2.00 |
| Mortgage | = 125 x 3.0% = 3.75 |
| Real Estate | = 20 x 10% = 2.00 |
| Cash | = 5 x 0.3%= 0.015 |
| **Total C-1 Risk** | **= 19.865** |

C-2

| | |
|---|---|
| Long Term Dis Prem | = 350 x 25%= 87.5 |
| Long Term Dis Reserve | = 950 x 5%= 47.5 |
| **Total C-2 Risk** | **= 135.0** |

C-3

None

Capital Requirement = $\{C\text{-}2^2 + (C\text{-}1 + C\text{-}3)^2\} \wedge (1/2)$
= $\{135^2 + (19.866 + 0)^2\} \wedge (1/2)$
= 136.45

Year 2000 required capital will increase 136.45

b). Options to fund the purchase of Cling-to-Life

I. Issue Stock
- Will increase company surplus
- No impact on RBC ratio
- Negative impact on Zest's stock price due to potential info asymmetry
- Since Zest's stock price has already dropped due to the possible rating down grade, issuing stock will not be management's first choice

II. Issue Debt
- Will not increase company surplus position because there will have to be a liability set up for the bond
- With increase in liability, RBC will increase
- No impact on company's stock price
- Increases leverage of the company and very possibly affects Zest's rating (downgrade)
- Since Zest wants to maintain its AA rating and its required capital position is at the lower end of the AA range, issuing debt should not be Zest's first choice

III. Bank Loan

- Special type of debt and therefore it does not increase Zest's surplus position
- Zest's RBC will increase due to leverage increasing
- Banks will access the intended use of the loan and charge an appropriate rate for the loan
- If Zest needs to renegotiate the loan in the future, it will be easier with a single lender
- Bank is in good position to monitor Zest's operations
- Stock price reaction should be positive
- Other benefits
    - No prepayment penalty
    - Bank might provide other services
    - Keep strategic info private with the bank

So Zest should choose a bank loan as its first choice. If not available, perhaps reinsurance or securitization would be a reasonable alternative. Issuing debt or stock would just increase Zest's problems.

**Answer #2**

a)

Zest's current ALM policy

- Zest calculates McCaulay duration
- Currently using duration match for ALM
- Duration match is effective only for small and non-parallel rate changes
- Need frequency equilibrium, leads to costs
- Does not account for non-parallel interest rate shift
- Does not capture volatility of cash flow

For individual life insurance (term life)

- May be not appropriate for its long maturity nature
- Interest rate may change

For GIC line

- GIC's have interest-rate options
- GIC's supported by assets with long maturities

For Group LTD line

- Pays guaranteed disability benefits over long period of time
- Current ALM insufficient
    - Durations, difficult to calculate because of inflation
    - Approach does not measure if assets will support benefit guarantees
    - ALM does not address lapse, inflation risk

b)

- Secure senior manager commitment
- Clearly ensure assignment roles and responsibilities
- Select the important metrics
- Ensure responsive and effective mitigation process
- Refine duration measure
    - Effective duration
    - Key rate duration
    - Match convexities
        - Convexity measures sensitivities of durations
        - Tough to measure

c)

Holistic approach

- Focus on risk at the entire company level
- Look for synergies between lines of business
- Benefit from one business unit can offset loss from another one
- Zest can focus on the entire company risk
    - ALM for all businesses, not for each unit
- Issue a new product line with negative correlation with current product line
- Dynamic financial analysis allows company to assess a variety of risks
    - Allows review of business from multiple perspectives
    - Can justify otherwise controversial decisions

## Answer #3

## Risk Adjusted Liquidity of Liability:

| | | *Immediate Scenario* | | | *Ongoing Scenario* | | |
|---|---|---|---|---|---|---|---|
| | Reserve Base | Liability Risk Factor | Surrenderability Factor | Result | Liability Risk Factor | Surrenderability Factor | Result |
| GICs | 4,291.5 | 100% | 50% | 2,145.8 | 100% | 50% | 2,145.8 |
| Indiv. Var. Life | 401.4 | 0% | | — | 0% | | — |
| Indiv. Term Ins | 36.1 | 50% | 100% | 18.1 | 50% | 100% | 18.1 |
| Group- LTD | 1,162.5 | 50% | 100% | 581.3 | 50% | 100% | 581.3 |
| | | | TOTAL: | 2,745.1 | | TOTAL | 2,745.1 |

## Liquid Assets:

| | | *Immediate Scenario* | | | *Ongoing Scenario* | | |
|---|---|---|---|---|---|---|---|
| | Asset Value | AAF Desc. | Allowable Asset Factor | Result | AAF Desc. | Allowable Asset Factor | Result |
| Private Bonds-Invest. Grd. | 2,023.7 | (80%*.25+65%*.75) | 68.8% | 1,391.3 | (90%*.25+75%*.75) | 78.8% | 1,593.7 |
| Private Bonds- Below Invest. Grd. | 505.9 | (0%*.8+0%*.2) | 0.0% | — | (20%*.8+0%*.2) | 16.0% | 80.9 |
| Public Bonds- Invest. Grd. | 3,510.4 | (98%.25+96%.75) | 95.6% | 3,387.5 | (100%) | 100.0% | 3,510.4 |
| Public Bonds–Below Invest. Grd. | 802.4 | (0%*.8+0%*.2) | 0.0% | — | (25%.8+0%*.2) | 20.0% | 160.5 |
| Public Bonds-CMO | 794.6 | (90%) | 90.0% | 715.1 | (90%) | 90.0% | 715.1 |
| Cmm'l Mtgs- Invest. Grd | 792.5 | (90%*.25+75%*.75) | 78.8% | 624.1 | (90%) | 90.0% | 713.3 |
| Cmm'l Mtgs-Below Invest. Grd. | 1,132.0 | (0%) | 0.0% | — | (0%) | 0.0% | — |
| Equities | 580.6 | (100%*.1+70%*.9) | 73.0% | 423.8 | (100%*.1+85%*.9) | 86.5% | 502.2 |
| Real Estate | 340.3 | (90.0%) | 90.0% | 306.3 | (90.0%) | 90.0% | 306.3 |
| Cash and Short-Term | 24.0 | (100.0%) | 100.0% | 24.0 | (100.0%) | 100.0% | 24.0 |
| | | | TOTAL: | 6,872.2 | TOTAL: | | 7,606.4 |

S&P earnings model would be used; Ratio is derived by dividing actual earnings by target earnings at the BBB level where numerator is defined as earnings (GAAP) before interest and taxes.

Denominator is defined as sum of earnings targets for each line of business multiplied by reserves, GAAP assets or revenue for responsible lines of business.

**Answer #4**

a)

1. Slow or eliminate new business growth — internal action
    - Practical solution Zest pursuing LTD
    - GIC and LTD highly sensitive to rating agency views
    - Annuity business not profitable
2. Reduce expenditures — internal action
    - Salaries or other fixed costs
    - Watch for morale problems
3. Improve quality of investment portfolio
    - Decrease exposure to risky assets such as equity and real estate
    - Increase quality of bonds
    - Decrease long-term expected returns
    - Has immediate impact on surplus
4. Surplus Notes
    - Would be effective for Zest, however, rating agencies scrutinize
    - Advantages
        i. Zest is US company so applies
        ii. Subordinated debt
        iii. Debt based on level of surplus
        iv. Tax deductible interest
        v. No loss of governance
    - Disadvantages
        i. Low rated issue may not be accepted by market
        ii. Costly for small amounts
        iii. Unfamiliar to institutional investors
        iv. Requires state department approval (may not approve)
        v. Inflexible
        vi. Surplus notes principal must be repaid (up to 40 years)
5. Debt-external
    - Not a good idea for Zest as rating agencies will dislike and requires holding company structure to increase surplus
    - Types
        i. Public and private bond offerings
        ii. Commercial banks
        iii. Lines of credit
    - Advantages
        i. Tax relief
        ii. No loss of governance
        iii. Low cost for large amounts
    - Disadvantages
        i. Covenants
        ii. Rating agencies dislike

iii. Must pay interest and principal back

6. Securitize Assets — External
   - Existing assets or future revenues
   - Agents receivables
   - Policy loans
   - Advantages
     i. Eliminate junky asset risk
     ii. Lower cost than debt or equity
     iii. Rating agencies will like
     iv. Flexibility
   - Disadvantages
     i. Costly for small amounts
     ii. Requires regulatory permission
7. Issue new preferred or common stock
   - Public or private market
8. Indemnity Reinsurance
   - Advantages
     i. Strategic reasons — use u/w expertise of reinsurer
     ii. Reduces RBC requirements
     iii. Improves surplus
     iv. Surplus relief through ceding expense allowance and reserve credit
     v. Rating agencies like
     vi. Can transfer undesirable assets
     vii. Available to all forms of insurance
   - Disadvantages
     i. Not recognized for accounting purposes
     ii. Solvency risk
     iii. Administration costs
     iv. Regulatory barriers
     v. Rating agencies inconsistent
9. Assumption Reinsurance
   - Zest should exit out of it's unproductive business and eliminate cross subsidization
   - Like a sale of block of business
   - Type of reinsurance
     i. YRT
     ii. Coinsurance
     iii. Macco

**Answer #5**

a)

Utilize CAPM model to determine the appropriate discount rate

$$(4)+1.9*3.8=11.22\%$$

Value of Project = .5 * 60 million/1.1122+
.5 * 45 million/1.1122=
47.20374033 million

Rejected refunding because 47.203<52

Reject funding because $47.203 < 52$

b)

Payoff structure of "twin security" **S=100**

$S+ = S*(60/47.20374) = 127.10857$

$S- = S*(45/47.20374) = 95.33143$

Payoff structure for investment in project **E**

$E+ = (2*60mil) - 56mil = 64mil$

$E- = 45mil$

Key is to evaluate using risk-neutral probabilities and discount at risk-free rates

$$p = \frac{(1+r)*S-(S-)}{(S+)-(S-)} = \frac{(1.04)*100-95.33143}{127.10857-95.33143} = 0.272793$$

$$(1-p) = 0.727207$$

$$FV = ((.272793*64mil)+(.727207*45mil))/(1.04) = \$50.154million$$

Value of managerial option = 48.2529 million – 47.203 million = 1.05 million

c)

Invest in project

Sell short $N$ shares of "twin security"

$$N = \frac{(E+)-(E-)}{(S+)-(S-)} = \frac{64mil - 45mil}{127.108 - 95.3314} = 597.914 shares$$

Invest $B$ at risk–free rate

$$B = \frac{N*(S-)-(E-)}{(1+r)} = \frac{658807(95.33143) - 45mil}{(1+.04)} = \$11{,}538{,}462$$

Cash flows at time 0:

$$N*S - B - 52mil = 597914*100 - 11538462 - 48252938 = \$0$$

Value at time 1

Positive performance: $(E+) + B(l+r) - N*(S+) = 64mil + 11538462(1.04) - 597914*127.1086 = 0$

Negative performance $(E-) + B(l+r) - N*(S-) = 45mil + 11538462(1.04) - 597914*95.3314 = 0$

So there are no arbitrage opportunities.

| | |
|---|---|
| Maximum | 46 |
| Inside Limit | 38 |
| MAK | 20 |

**Answer #6**

a)

In the absence of observable market prices, there are at least three theoretically correct methods for estimating the value of a series of (potentially) risky future cash flows.

1. Discount the true probability-weighted future cash flows using discount rates that are the sum of a risk-free rate and a risk premium

2. Modify the probabilities of the risky future cash flows to account for risk and discount at risk-free rates

3. Modify the risky cash flows to account for risk and discount at risk-free rates

b)

i. If the payment of principal and interest is guaranteed by the parent company, the GIC becomes a risk free bond. So, in this case to determine the fair value of the GIC as of 12/31/2001, we need to determine the amount of cash flow that will be due on 12/31/2002, and discount it at the risk-free (one-year treasury) rate:

Principal and accumulated interest, on 12/31/2002:

$$= 100{,}000{,}000 \times (1 + 0.0375/2)^2 = \$103{,}785{,}156.25$$

Discounting this value at the risk free rate of 2.17% (one-year treasury rate, with biannual compounding), we get:

$$= \$103{,}785{,}156.25/[(1 + 0.0217/2)^2]$$

$$= \mathbf{\$101{,}569{,}148.75}$$

ii. In the absence of external (and parent company guarantees), we will use Black-Scholes option formula to derive the value of the GIC:

Step 1. Derive the *continuously compounded* risk-free rate, to be denoted by $\delta$:

$$e^{\delta} = (1 + \frac{.0217}{2})^2$$

From which we get: $\delta = 2.1583\%$

Step 2. Derive $d_1$ and $d_2$, of the Black-Scholes formula:

$$d_1 = \frac{\ln(\frac{A}{X}) + (\delta + \frac{\sigma^2}{2})/T}{\sigma\sqrt{T}}, \text{ and}$$

$d_2 = d_1 - \sigma\sqrt{T}$, where:

A = current value of portfolio, in our case, this is equal to = **$108,762,500** (market value *as of close of market on 12/31/2001)*

X = exercise price for the GIC contract, in our case, this is equal to projected value of GIC – principal and interest – as of 12/31/2002, that is, **$103,785,156.25**

T = 1 year

$\sigma$ = 0.20

$\delta$ = 2.1583%.

Using the above values we get:

**$d_1$ = 0.4421, and $d_2$, = 0.2421.**

Step 3. Derive $N(d_1)$, and $N(d_2)$, *the cumulative normal values, using the Standard Normal Table.*

$N(d_1)$ = N(0.4421) = 0.6708, and

$N(d_2)$ = N(0.2421) = 0.5957

Step 4. Derive the value C, the call option value, or the value of the company equity

$$C = AN(d_1) - X e^{-\delta T} N(d_2)$$

= 108,762,500.00 x 0.6708 - 103,785,156.25 x $e^{-0.021583}$ x 0.5957

= $12,457,443.73.

Step 5. Derive the value of GIC by subtracting the equity value of XYZ from the market value of the portfolio held by XYZ

The fair value of GIC = A – C = 108,762,500.00 - 12,457,443.73

= $96,305,056.27.

**Answer #7**

a)

1. Solvency standards should be the same for all classes to the insurance contract
2. Method should be objectively determined. Should be a mathematical formula. All insurance companies with the same risks should produce the same RBC
3. Method should discriminate between all observable risk elements

b)

| Assets | L | P | PD |
|---|---|---|---|
| 1500 | 260 | .7(.25) | 0 |
| 1500 | 290 | .7(.5) | 0 |
| 1500 | 500 | .7(.25) | 0 |
| 1500 | 1010 | .25(.25)=$\frac{1}{16}$ | 0 |
| 1500 | 1040 | .25(.5)=$\frac{1}{8}$ | 0 |
| 1500 | 1250 | .25(.25) =$\frac{1}{16}$ | 0 |
| 1500 | 2010 | .05(.25)=$\frac{1}{80}$ | 0 |
| 1500 | 2040 | .05(.5)=$\frac{1}{40}$ | 0 |
| 1500 | 2250 | .05(.25)=$\frac{1}{80}$ | 0 |

$$D_L = .05[510(.25) + 540(.5) + 750(.25)]$$
$$= 29.25$$

$$d_L = \frac{D_L}{L} \qquad LFE[6] = 610$$

$$dL = .0479 < .1 \qquad \frac{.0479}{.1}$$

$$61 = \frac{1}{80}(2010 - x) + \frac{1}{40}(2040 - x) + \frac{1}{80}(2250 - x) + \frac{1}{16}(1010 - x) + \frac{1}{8}(1040 - x) + \frac{1}{16}(1250 - x)$$

$$4880 = 2010 - x + 4080 - x + 2250 - x + 5050 - 5x + 10400 - 12x + 6250 - 5x$$
$$= 30040 - 24x$$
$$x = 1048$$

$$4880 = (30040 - 5050) - (24x - 5x)$$
$$= 24990 - 19x$$
$$x = 1058$$

$$4880 = (24990 - 10400) - (19x - 10x)$$
$$= 14590 - 9x$$
$$x = 1079$$

Capital reg = 1079 – 610 = 469
Capital held = 1500 – 610 = 890

Ratio = 1.90
Assigned Credit Rating = BBB

c)

Assuming no correlation reduces the required capital. Specifically, by reducing the likelihood that the both lines will simultaneously perform poorly, this limits the probability of a loss. This, in turn, lowers the Expected Policyholder Deficit and, thereby, capital.

d)

Expected policyholder deficit is similar to an option

- In this case (risky liabilities and risk less assets), the EPD is similar to a call option:
  - Exercise price = Value of Assets
  - Hedged position = Risky Liabilities
  - Option payoff = Max (L-A, O)
  - A limited liability position provided by a corporate structure allows stockholders to avoid some of policyholder obligations (i.e. EPD) with no recourse.
  - This is the option embedded in this situation.

**Answers #8**

a)

- The expected market value of the bond in a default scenario is $55. For the bond to be trading at $20 – this is approximately a one standard deviation event - or about a 66% chance of the market value of a defaulted senior secured bond to be trading at $20
- CreditMetrics' inputs are derived from historical observations. Each input has its own expectation and volatility distribution. Recoveries in the event of default are notoriously uncertain. Recoveries should be treated as random events. Rating agencies studies are based on observations from thousands of bonds. Application of transition studies more appropriate for a portfolio of bonds - not an individual bond
- Credit risk is different from other market risks. Credit risk will have a long-tailed distribution whereas other market risks will have a symmetric distribution. In such case, normal distribution will not be able to explain the risk profile of credit risk; and hence, percentile (rather than standard deviation) should be used to explain the credit risk
- Unlike market risk, credit risk does not have adequate open market data in order to determine a more appropriate correlation of credit quality across obligors. Therefore two alternative methods will be used to estimate the correlation figures: (1) assume they are uniform across the portfolio (2) assume a model to capture these correlations

(b)

- SPE Corp should have done the calculation on a portfolio basis not on a stand-alone basis and sensitivity tested the results to understand if any bond, issuer, or asset class has an outsized effect on the results
- A primary reason to have a quantitative approach to credit risk management is so that we can more systematically address concentration risk - like one security being 10% of the portfolio
- Not relying on the explicit rating agency rating - a time lag exists between when the market identifies a change in the quality of a company and when the rating agencies make a rating change. In reality, Huge Energy may not have been a Baa company.

c)

(i)

- VAR is an overall risk measure of a company. It is the maximum potential loss for a given time horizon and for a specified confidence interval.
- VAR = E(W) – W* = Wo*(u-R*) general formula.
- If distribution is normal, the formula simplifies to VAR=Wo*x*alpha*sigma*(delta t)^.5
- It summarizes in a single number the global exposure to market risk and the profitability of adverse financial variables. It measures risk using the same units as the bottom line
- SPE can use VAR to determine its overall risk to determine the max potential loss it is willing to risk regarding its equity and debt securities portfolio
- VAR can be used to set position limits for traders, measure returns on a risk adjusted basis, model evaluation, set capital adequacy for banks

(ii)

- In both approaches the results are themselves affected by sampling variation, or estimation risk - both measures are only an estimate of risk and are extremely dependent on parameters, data, assumptions and methodology
- RiskMetrics (VAR) assumes returns are normally distributed - CM does not make this assumption
- Unlike market risk where daily liquidity price observations allow a direct calculation of VAR, CM seeks to construct what it cannot directly observe; the volatility of value due to credit quality changes
- The time horizon for CM, generally 1 year, is much longer than that of VAR, which can be as short as 1 day

(iii)

- VAR is very dependent on all underlying assumptions, methodology parameters, data, time horizon
- VAR measures are only an estimate of risk and should be reported with confidence intervals
- Different methodologies lead to different results. The selection of inputs and methodology still feeds through human biases - which invariably impact the results
- Many risks like political, liquidity, personnel, regulatory risk and others cannot be captured through quantitative techniques

(iv)

- VAR = E(W) – W*
- E(W): the mean/expected return is $12.6 million (at 50% level)
- W*: the lowest portfolio value at the 5% confidence level is -$10 million
- VAR = $12.6 - $(10) = $22.6 million

d)

New approach to measure C3 risk (Asset Liability mismatch) for interest rate sensitive products

Procedure:

1. Model statutory cash flows among path specific scenarios
2. Calculate surplus
3. Calculate present value of deficit (PV (deficit))
4. Pick scenario which resulted in largest PV (deficit)
5. Put the other scenarios in order
6. C3a requirement is a weighted average of the results

- Companies with strong C3 protection will have C3a requirements decrease and visa versa. Eliminate incentives in taking on convexity risk / A-L Mismatch in order to reduce C1

- Encourages reserve strengthening
- Practice better in line with asset adequacy analysis and is more company specific since actuary has some freedom in select assumptions
- VAR has not traditionally been applied to complex and long duration liabilities (typical of an insurance company's portfolio)
- New c-3a standard will attempt to capture duration mismatches. VAR may not appropriately credit a company with tight asset-liability mgmt vs. a company taking duration and convexity bets

e)

- The four basic elements of a risk management system:
  1.) Firm wide risk measurement
  2.) Risk control at the business level
  3.) Measuring risk adjusted return
  4.) Capital-at-Risk allocation

Considerations:

1.) Centralized or decentralized ways of allocation
   a) Top-down: CaR and performance objectives are assigned by senior management to each risk taking unit.
   b) Internal market: Each unit effectively determines its own performance objectives.
   c) Negotiation: target levels are derived though an iterative process where senior management's judgments lead to initial proposals, which are then negotiated with the business units.

2.) Elements for SPE to consider:
   a) The types of risk being measured
   b) The architecture of the risk-taking centers and the degree of risk specialization
   c) The linkages between risk-adjusted performance measures and the reward/punishment system

3.) How specialized the risk mgmt units should be
   a) Specialized risks are dealt to those who are best at managing it and its easy auditing
   b) Must make sure synergies are kept in tact
   c) Risk must be isolatable

4.) Should unit be evaluated based on utilized or allocated capital
   a) Utilized – ex-post measure, does not punish units for caution for not using allocated capital, created incentive to bid for more capital
   b) Allocated – opposite

5.) Measure of performance
   a) RAROC
   b) Residual income

f)

- Issue is utilized capital at risk vs. allocated capital at risk
- A 100% AAA portfolio is less risky than the BBB portfolio and should require less actual capital than the originally allocated capital
- If SPE uses the allocated capital, then asset managers who decrease risk will be penalized in their performance measure. If SPE uses the utilized capital, then an asset manager's performance will be properly tracked, but there is no motivation for an asset manager to ask for the lowest amount of required capital. A potential solution is that the performance be based on actual capital plus a negotiated charge for unutilized capital
- A company may inefficiently allocate capital and postpone profitable ventures

**Answer # 9**

Under Canada, use scenarios to describe liabilities, make initial reserve equal to PV of most likely reserve. Then add PADs to reserve (must increase reserve). Both Canadian GAAP and Australian MOS use current best estimates, but Canadian GAAP fully reflects current estimate, while Australian MOS spreads effect of changes to current estimates (if they generate increased profitability over past estimates) through remaining years, since:

$$BEL_{old} + PV\ Profits_{old} = BEL_{new} + PV\ Profits_{New}$$

a)

- Reserve under Australian MOS is calculated with best estimate of benefits, including all expenses and lapses without PAD's (provision for adverse deviations)
- Best Estimate Liability = PV all future benefits and expenses minus future net premiums
- Does not include profits. MOS has PV of profits added to BEL, which are released as a percent of PV of the profit carrier. In this case, profit carrier would probably be investment income
- Thus, if experience is same as projected, profit is a constant percentage of investment income, while in Canada, profit emergence is more volatile
- Reserve under Canada is PPM (Policy Premium Method) which is calculated with best estimate of benefits, including all expenses and lapses with PADs
- Reserve = PV (all future benefits and expenses with PADs) – PV (all future gross premiums)

b)

Reserve assumptions under MOS are best estimates, while for Canada they are best estimates including PADs. These PADs have bounds prescribed but latitude within bounds:

| | |
|---|---|
| Mortality PAD: | (3.75 to 15) / (curtate expectation of life) |
| Expense PAD: | 2.5% to 10% of expenses |
| Lapses: | 5% to 20% of expected; PADs must increase liability |

c)

Acquisition costs for this product are not explicitly deferred as in the US. Both Canada's and MOS methods implicitly defer acquisition expenses since each is included in reserve.

d)

If experience proved less favorable under MOS to where PV(profits) is negative, would set profits to zero in each year until better experience, till PV profits is positive, then recalculate profit. Under Canada, do not release PADs, instead would reflect whole effect of revised assumptions.

**Answer #10**

a)

- Observed patterns in dividend policy indicate that dividends are smoothed: regulated firms pay more; industry and national patterns exist; a positive market reaction occurs when dividends are increased, a negative reaction occurs if they're decreased; dividend policy is sticky – reduction is bad news
- Under the Pecking Order Hypothesis, firms have a hierarchy of funding preferences: 1. Retained earnings 2. Secured debt 3. Unsecured Debt 4. Equity
- Dividends are viewed as permanent by the market (according to the Signaling Model), as a sign of company strength
- Dividends are info transmitters from well-informed managers to poorly informed shareholders due to asymmetric info of markets
- Cutting dividends may imply managers, who have more information, have a negative outlook on current and future earnings
- Signaling Theory suggests that dividend policy is a way for a strong company to attract investors and separate itself from weaker firms that cannot match increases
- The market is very responsive to changes in dividends and debt
- A reduction in dividends will most likely have a negative impact on the market; stock price will decrease
- Although, according to M&M proposition, the dividend scale has no impact on the market value of stock, the public likes the comfort of a steady flow of income (mental accounting according to behavioral finance) or see dividends as a plus to an already successful rise in value, or a silver lining in a cloud when stock values decline (framing according to behavioral finance theory)
- M&M assumptions of no taxes and perfect markets fail
- Agency Cost of Dividends show up as a tendency for managers to retain cash flow by over-investing in zero- or negative-NPV projects
- Managers who pursue a dividend policy that is in the shareholders' best interests will be rewarded by increasing share prices and greater professional tenure
- If the purpose of the dividend reduction is clearly stated to shareholders, this might mitigate some of the decline
- Outcome will most likely be negative to the current stock price, which is not what Maple Leaf would like to achieve

b)

- An increase in debt leads to a positive market reaction and an increase in share price, empirically
- Leverage increasing events are a positive signal, indicating managers confidence in future cash flows since they must support the interest payments
- Interest payments are tax-deductible
- Debt increases the cost of financial distress and risk of bankruptcy
- Debt financing can help overcome the Agency Costs of external equity by reducing the scope for excessive managerial perquisite consumption

- External debt serves as a bonding mechanism for managers as they are willing to risk losing control of the firm if they fail to perform
- Agency Cost of Debt: -Asset substitution; claim dilution; under-investment
- Restrictive bond covenants could constrain management flexibility
- A firm's optimal D/E ratio balances agency costs of debt against agency cost of equity
- Debt features such as maturity, issue costs, covenants, priority/seniority, private/public should be considered

c)

- Recommend that Maple Leaf issue debt. Adding debt will help control the agency costs of equity. Maintaining dividends will preclude the negative signal, share price-decreasing effect of reducing dividends. It will move Maple Leaf toward the optimal capital structure of 15% debt, 15% preferred, and 70% common equity.

**Answer #11**

a)

$$\beta_j = \frac{Cov}{Var} = \frac{14.97}{9.98} = 1.5$$

$$k = r_f + \beta_j * (r_m - r_f) = 3\% + 1.5 * (11\% - 3\%) = 15\%$$

$$NPVCF_1 = \sum_{t=1}^{5} \frac{C_t}{(1+k)^t} - I_0 = \frac{70{,}000}{(1.15)^1} + \frac{80{,}000}{(1.15)^2} + \frac{100{,}000}{(1.15)^3} + \frac{125{,}000}{(1.15)^4} + \frac{175{,}000}{(1.15)^5} - 300{,}000 = 45{,}587.77$$

$$NPVCF_2 = \sum_{t=1}^{5} \frac{C_t}{(1+k)^t} - I_0 = \frac{70{,}000}{(1.15)^1} + \frac{80{,}000}{(1.15)^2} + \frac{80{,}000}{(1.15)^3} + \frac{80{,}000}{(1.15)^4} + \frac{80{,}000}{(1.15)^5} - 300{,}000 = -40{,}523.24$$

$$WeightedNPV = NPVCF_1 * q + NPVCF_2 * (1-q) = 45{,}587.77 * .5 + (-40{,}523.24) * .5 = 2{,}532.26$$

Weighted NPV is >0 so, accept the project.

b)

$$V^+ = PVCF_1 \text{ at time 1} = \frac{63{,}000}{(1.15)^0} + \frac{72{,}000}{(1.15)^1} + \frac{90{,}000}{(1.15)^2} + \frac{112{,}500}{(1.15)^3} + \frac{157{,}500}{(1.15)^4} = 357{,}683.34$$

$$V^- = PVCF_2 \text{ at time 1} = \frac{56{,}000}{(1.15)^0} + \frac{64{,}000}{(1.15)^1} + \frac{64{,}000}{(1.15)^2} + \frac{64{,}000}{(1.15)^3} + \frac{64{,}000}{(1.15)^4} = 238{,}718.92$$

$$p = \left\{ [\frac{(q * V^+ + (1-q) * V^-)}{(1+k)}] * (1+r_f) - V^- \right\} / \{V^+ - V^-\} =$$

$$\left\{ [\frac{(.5 * 357{,}683.34 + .5 * 238{,}718.92)}{(1.15)}] * (1.03) - 238{,}718.92 \right\} / \{357{,}683.34 - 238{,}718.92\} \cong .24$$

$$NPVCF_1 = V^+ / (1+r_f) - I_0 = 357{,}683.34 / 1.03 - 300{,}000 = 47{,}265.38$$

$$NPVCF_2 = V^- / (1+r_f) - I_0 = 238{,}718.92 / 1.03 - 300{,}000 = -68{,}234.35$$

Since $NPVCF_2$ is <0, company will not invest in project if Bob's contract is not renewed.
Therefore, assume 0 for downside value.

Weighted NPV = $p * NPVCF_1 + (1-p) * NPVCF_2 = .24 * 47{,}265.38 + .76 * 0 = 11{,}269.87$

Weighted NPV at original time 0 = $11{,}269.87 / (1+r_f)^2 = 11{,}269.87 / (1.03)^2 = 10{,}622.94$

Since the NPV with the option (i.e. Expanded NPV) is greater than the NPV without the option (i.e. the Passive NPV), the company should defer the project.

c)

Option Premium = Expanded NPV – Passive NPV = 10,622.94 – 2,532.26 = 8,090.68

**Answer #12**

a)

Describe various calculation methodologies for the fair value of liabilities

**Direct Approach:**

Also known as Option Pricing Method
Valuation of liability cash flows directly
Uncertainty in cash flows modeled using stochastic scenarios
Path-wise present values are averaged to complete the valuation

$$FVL_{t-1} = \left[FVL_t + L_t E_t\right] / \left(1 + r_t + theta_t^L\right) \text{ and } FVL_N = 0$$

- L = is expected policy cash flows
- E = is expected expense cash flows
- r = is risk-free interest rate
- theta$^L$ is an additional spread

**Indirect Approach:**

Also known as Actuarial Appraisal Method
Based on valuing business on free cash flows generated
Calculated discounted distributable earnings (DDE)
Discounting at appropriate risk-adjusted cost of capital for each path

$$DDE_{t-1} = \left[DDE_t + DE_t\right] / \left(1 + r_t + theta_t^K\right) \text{ and } DDE_N = 0$$

$$DTL_t = T * \left[\left(MVA_t - TVA_t\right) - \left(FVL_t - TVL_t\right)\right]$$

$$FVL_t = MVA_t - DLT_t - DDE_t$$

DE: Distributable Earnings
(r + theta$^K$): Cost Of Capital
MVA: Market Value Of Assets
TVA, TVL: Tax Value Of Assets And Liabilities
T: Firm's Corporate Tax Rate

Direct and indirect method provide equivalent results with consistent assumptions

$$FVL = MVA - DDE / (1 - T) + [T / (1 - T)] / (TVA - TVL)$$

MV (Surplus) = MV (Assets) - MV (Liabilities)

Solve for FV of liabilities from MVA and MVS

Develop benchmark portfolios of assets for each liability segment that are so closely matched

MLV will be MV of benchmark portfolios of assets

b)

- Consider interconnection between liabilities and assets
- Consider discount rate/cost of capital
- Use best estimate assumptions (do not include margins for adverse deviations)
- Assumptions' inter-relationships or correlations
    - Stochastic vs. deterministic assumptions
- Since short-duration term products, most important exposure for dot life is mortality assumptions

c)

- Asset/liability mismatches will become apparent as solvency reserve does not reflect that liabilities are interest sensitive due to options included in various products.
- FVL allocates earnings to time generated whereas the solvency reserves does not fully capture changes in company value, given that solvency reserves:
    - Uses conservative assumptions
    - Valuation assumptions not change after issue
- Can determine the true economic value of a firm

d)

- What is the investor's definition of risk/risk tolerance
- There is no generally right or wrong answer to the question of how much should be hedged, depends upon:
    - Ability to forecast currency movements
    - Nature of the liabilities
    - Currency volatilities
    - Correlations across currencies
- Decision not to hedge if returns from currency exposure could be forecast with accuracy
- Consider the liquidity of the currencies and derivatives
- Selling only one and five year term:
    - Amount of reserves (and assets) should be immaterial
- Foreign currency expenses should not be material exposure for Dot Life's current product lines

**Answer #13**

a)

- Asset adequacy testing is a check to make sure current reserves/liabilities are not deficient
  - It only considers in force block of business, no projection or consideration to existing surplus or new business

- Method: Project cash flows from existing business and future premium from existing business ONLY. A criterion for testing is that the ending market value of surplus be POSITIVE
- Good for company since:
  - Meets regulatory requirements
  - Allows detection of early problems
  - Internal measure/control
    - Asset adequacy testing is appropriate to support the actuarial opinion

b)

(i.)

1. Should include all business unless immaterial
2. Time horizon should be set such that the business becomes immaterial in the end
3. OK to combine LOB, either combine cash flow or surplus
4. Assets can be allocated as long as they are not used twice
5. Should include policyholder dividend
6. Derivatives are not included, but other significant cash flows are included
7. Discount rate can be set equal to net portfolio rate
8. Ending surplus/deficit examined to see the scenarios passed. Intermediate deficit may be OK if eventually turn out to be surplus
9. Need judgment to decide if need additional reserve
10. Additional reserve may be charged to surplus or operating gain
11. Pre-year-end data is OK if there is no significant gap and the difference is reconciled
12. Need to consider IMR, AVR. Also need to consider other insurance obligations

c)

(ii)

1. Define objective
2. Review prior year models
3. Develop assumption
4. Determine the sensitivity testing that needed to be done
5. Model
6. Validate the result
7. Determine corrective action if needed
8. Write a report

****END OF EXAMINATION****