CSP-IU Illustrative Solutions
Spring 2008

1.

Solution:

(a)

First Premise:
Real economic value of the firm is PV(asset cash flows) – PV(liability cash flows)

Second Premise:
Central objective of asset liability management (ALM) is to manage the sensitivity of the real economic value of the firm to changes in interest rates

- ALM measures should be based on economics
- Firm should use ALM to control the degree to which its value is affected by interest rate changes

(b)

(i)

STAT and GAAP accounting measures have economic value

- Attention is on assets and liabilities as defined by current accounting principles
- Balance sheet as defined by accounting conventions can be seriously flawed as a basis for estimating economic value
- Accounting measures have economic significance
  - Low value can be costly
  - High value can be beneficial
- These values must be incorporated into a complete ALM analysis

(ii)

Risk is costly

- ALM implicitly assumes risks can be fully hedged or that market participants are risk neutral and only concerned with expected values
- Adjust cash flows downward to recognize risk, some cash flows exhibit greater uncertainty
- Cash flow uncertainty is different overall when measured as a portfolio than as a sum of individual risks or for individual assets or liabilities
- Risk may be decreased by diversification

1. **(b) continued**

(iii)

Managing interest rate exposure is not enough

- Managing the value of the firm goes far beyond effects of interest rate changes
- Must take into account all sources of risk

(iv)

Asset liability management is not just asset management

- Managing the value of the firm includes managing liabilities
- Manage liabilities:
  - Over time by changing mix of business
  - Over time by offering or discontinuing product features in new sales
  - Through reinsurance transactions

(c)

(i)

Describe the key considerations when examining the economic value of any insurance company as it pertains to 'Asset-Liability Management for a Going Concern'.

- Measures must take into account future cash flows from:
  - Existing balance sheet items
  - Business the firm reasonably expects to retain
  - New business (non-renewal) it reasonably expects to issue or acquire

- Retained and new business reflect the value of a going concern
  - Current accounting rule only count these if the firm is purchased for an amount over the book value
  - Excess over book value is goodwill on acquirer's books
  - Market price in an acquisition reflects these values

- Shareholder value is economic value plus franchise value
  - Economic value reflects cash flows from business already on the books
  - Franchise value reflects cash flows from future business (future retentions plus future new sales)

1. **(c)(i) continued**

- Franchise value is a hidden asset with a real duration
  - Critical to determine its duration
  - Recognize that future premiums may depend on interest rates
  - Understand extent that the firms own pricing strategy will be affected by interest rates and also competitive and regulatory constraints
  - Premiums charged by different firms may respond differently to changes in interest rates

- Include competitor effects and implications for investment and pricing strategy

(ii)

Propose ways to protect the insurer's shareholder value from interest rate risk.

- Managing shareholder value involves minimizing risk of duration mismatch
  - Asset duration depends in part on its pricing strategy
  - When future premiums vary inversely with interest changes, then future retentions are an asset with positive duration
  - Duration of assets must be lower than if future retentions are ignored
  - The greater the value of future retentions, the lower must be the duration of assets

- The firm's investment and pricing strategies cannot be determined independently
  - Marked contrast to usual practice of focusing on the current balance sheet and computing an asset duration and a liability duration

- Impact of competition
  - Consider competitor pricing strategy also
  - Interest effects can affect shareholder value indirectly by altering relative prices charged by firm and competitors
  - Interest effects may raise or lower the firms growth rate

- To minimize the interest rate risk to shareholder value, two additional factors must be taken into account:
  - Investment strategy must reflect pricing strategy of the firm and competitors
  - Investment strategy must reflect the sensitivity of existing and potential customers to price differentials between the firm and competitors

2.

Solution:

(a)

Capital Budgeting Techniques

- capital budgeting techniques can tell a company whether a given capital investment is likely to cover the cost of capital
- capital budgeting is a simple ranking capital investment based on their expected rate of return
- it determines which investments will return at least the company's cost of capital
- then the company can allocate funds to as many of these investments as possible

Limitations:

- the capital budgeting technique generate a universe of feasible investments but does not set out selection criteria
- it results in a random group of projects with no clear strategic focus
- the company's long term objectives are not incorporated in the technique
- sometimes it may be necessary to fund projects which return less than the company's cost of capital in order to support long term strategic planning

(b)

(i)

Actuarial appraisal value = PV of distributable cash flow
Distributable cash flow = After tax earnings - increase in required capital + investment income on required capital
After tax earnings = premiums - commissions - benefits - increase in statutory reserves + investment income on reserves and cashflows

12/31/2008

Earnings before inv inc = 2000 - 600 - 300 - (1500 - 0) = -400
Inv income on stat reserves = 1500 x 0.08 = 120
After tax Earnings = -400 +120 = -280
Required capital = 1500 x 0.10 = 150
Inv income on req capital = 150 x 0.08 = 12
Distributable cash flow = -280 -(150-0) + 12 = -418
PV = -418

2. (b)(i) continued

12/31/2009

Earnings before inv inc = 1200 - 350 - 700 - (900 - 1500) = 750
Inv income on stat reserves = 900 x 0.08 = 72
After tax earnings = 750 + 72 = 822
Required capital = 900 x 0.10 = 90
Inv income on req capital = 90 x 0.08 = 7
Distributable cash flow = 822 - (90-150) + 7 = 889
PV = 889 x 1.12 ^ -1 = 794

12/31/2010

Earnings before inv inc = 900 - 200 - 1100 - (0 - 900) = 500
Inv income on stat reserves = 0
After tax earnings = 500
Required capital = 0
Inv income on req capital = 0
Distributable cash flow = 500 - (0 -90) = 590
PV = 590 x 1.12 ^ -2 = 470

AAV = sum of PV = -418 + 794 + 470 = 846

(ii)

GAAP ROE = GAAP earnings / GAAP required surplus
GAAP required surplus = Statutory required surplus + unamortized GAAP deferred acquisition costs + (statutory reserve - GAAP benefit reserves)

12/31/2008

GAAP Equity = 150 + 1200 + (1500 - 600) = 2250
GAAP net income = 170
GAAP ROE = 170/2250 = 7.6%

12/31/2009

GAAP Equity = 90 + 550 + (900 - 200) = 1340
GAAP net income = 220
GAAP ROE = 220/1340 = 16.4%

12/31/2010

GAAP Equity = 0 + 400 + (0 - 0) = 400
GAAP net income = 70
GAAP ROE = 70/400 = 17.5%

2. (b)(ii) continued

Three year ROE geometric average = [(1.076)(1.164)(1.175)]^ (1/3) -1
= 13.7%

Recommendation : As the ROE > cost of capital (13.7% > 12%), ABC should invest in this product

(c)

At 1/1/2008, t=0 :
Without YRT, cash flow strain equals to after tax earnings at year end 2008 discount for one period

After tax earnings = premiums - commissions - benefits - increase in statutory reserves + investment income on reserves and cashflows
After tax earnings before inv inc = 2000 - 600 - 300 - (1500 - 0) = -400
Inv income on stat reserves = 1500 x 0.08 = 120
After tax Earnings = -400 +120 = -280
Discounted after tax earning to beginning of year:
BOY after tax earnings = -280 * 1.12 ^ -1 = -250

With YRT:
Strain with YRT = premium - ceded premium - commission + reinsurance allowance - benefits + ceded benefits - chg in reserves + reserve credit - investment return on reserve credit
= before reinsurance statutory earnings - ceded premium + reinsurance allowance + ceded benefits + reserve credit - investment return on reserve credit

Ceded amount = NAAR x (1 - retention rate)
= (face amount - terminal reserve) x (1 - retention rate)
= (8000 - 0) x (1 -0.2)
= 6400

ceded premium = ceded amount x YRT rate
= 6400 x 0.1 = 640

reinsurance allowance = ceded premium x 15%
= 640 x 0.15 = 96

reserve credit = YRT premium x 60%
= 640 x 0.6 = 384

2. (c) continued

Strain with YRT = -250 - 640 + 96 + 384 x (1.12 ^ -1) + (300 x 0.8) x (1.12 ^ -1)
- 384 * .08
= -267.72

If YRT arrangement were to be used, first year statutory earning was decreased marginally by 17.72

3.

Solution:

(a)

Determination of the risk profile of a product or company
Capital budgeting and planning
Evaluation of Merger and Acquisition
Insurance product pricing
Risk tolerance and constraints
Asset and liability management
Risk adjusted return of capital calculation
Performance Measurement
Incentive compensation
Regulator and rating agency discussions

(b)

VAR

- assess the probability of ruin at a given quantile of the probability vs Tail-VAR
- arithmetic average of losses exceeding a given quantile

Stochastic Analysis

- uses multiple scenarios. Results can be analyzed statistically vs Stress Testing
- gives results of highly adverse scenario. Results can not be analyzed statistically

Risk Neutral

- discounting risk-adjusted future cash flow with risk free rates vs Real World
- discounting projected cash flows with risk discount rates

Diversification Effect
Time horizon to consider

- One-year horizon: covariance model
- Multi-year time horizon: economic balance sheet projected for a long period until liabilities run-off

Whether to allow negative cumulative surplus
Whether to account for new business

3. continued

(c)

Ten-year term life

- Underwriting risk
  - Should consider mortality
- Operational risk
  - Failed internal process
- Liquidity risk
  - Insufficient liquid asset

Equity Indexed Annuity

- Underwriting risk
  - Policyholder behavior risk
- Credit risk
  - Risk of default of fixed income instruments
- Market risk
  - Interest rate risk
  - Equity risk
- Operational risk
  - Hedging operational failure risk

(d)

(i)

Ranking of the scenario results:

1600, 1400, 1350, 1300, 1250, 1200, 120, -45, -500, -600
Values below the 20th percentile 20%: -500 and -600
Average of values below the 20th percentile = (-500-600)/2 = -550
Economic capital 550

(ii)

using the ranking in (i)

The observation we need is the .01*10th observation
VAR(10) = -600
Economic capital = 600

4.

Solution:

(a)

Net cash payments = Premiums less claims less expenses

Year 1: 2000 - 500 - 550 = 950
Year 2: 2250 - 650 - 600 = 1000
Year 3: 0 - 800 - 550 = -1350

* Risk Capital Cost = Risk capital x Risk capital cost rate

Year 1: 1200 x 2.5% = 30 or 0 x 2.5% = 0
Year 2: 1125 x 2.5% = 28.13 or 1200 x 2.5% = 30
Year 3: 0 x 2.5% = 0 or 1125 x 2.5% = 28.13

Net cash flow after frictional costs

Year 1: 950 - 30 = 920 or 950 - 0 = 950
Year 2: 1000 - 28.13 = 971.87 or 1000 - 30 = 970
Year 3: -1350 - 0 = -1350 or -1350 - 28.13 = -1378.13

Economic liabilities = Present value of net cash flows less risk capital cost at risk-free rate plus spread

Year 1: -(-1350/(1 + 5% + 0.5%)^2 + 971.87/(1 + 5% + 0.5%)) = 291.70
or = 318.75
Year 2: -(-1350/(1 + 5% + 0.5%) = 1279.62 or = 1306.28
Year 3: 0

Change in economic liabilities

Year 1: 291.70 or 318.75
Year 2: 1279.62 - 291.70 = 987.92 or = 987.53
Year 3: 0 - 1279.62 = -1279.62 or = -1306.28

Economic profit before tax = Net cash payments - Risk Charge - Change in economic liabs

Year 1: 950 - 30 - 291.70 = 628.30 or 950 - 0 - 318.75 = 631.25
Year 2: 1000 - 28.13 - 987.92 = -16.04 or 1000 - 30 - 987.53 = -17.53
Year 3: -1350 - 0 + 1279.62 = -70.38 or -1350 - 28.13 + 1306.28 = -71.85

Taxable Income = Premiums - Claims - Expenses - Change in Tax Reserves
= net cash payment - change in Tax Reserves

Year 1: 950 - (1400 - 0) = -450
Year 2: 1000 - (1525 - 1400) = 875
Year 3: -1350 - (0 - 1525) = 175

4. **(a) continued**

Tax payable = Taxable income * tax rate
Year 1: -450 x 40% = -180
Year 2: 875 x 40% = 350
Year 3: 175 x 40% = 70

Economic profit after tax = Pre-tax profit less tax
Year 1: 628.30 - (-180) = 808.30 or = 811.25
Year 2: -16.04 - 350 = -366.04 or = -367.53
Year 3: -70.38 - 70 = -140.38 or = -141.85

(b)

EV defined as PV of free cash flow FCF discounted at company's weighted cost of capital (CoC)
FCF = change in stat surplus - change in required surplus (RS) (distributable earnings)
Therefore, GAAP FCF ~ GAAP earnings - change in required GAAP surplus

Approximation: GAAP earnings = Net Cash Payments - tax payable - incr in reserves + incr in DAC; where Net Cash Payments = Prem -claims/db - expenses

Net Cash Payments = 2250 - 650 - 600 = 1000

Taxable Income = Premiums - Claims - Expenses - Change in Tax Reserves = net cash payment - change in Tax Reserves

Taxable income = 1000 - (1525 - 1400) = 875

Tax payable = Taxable income * tax rate
Tax payable = 875 x 40% = 350

Increase in res = 1600 - 1500 = 100

GAAP earnings = 1000 - 350 - 100 + 50 = 600

Change in required GAAP surplus = 750 - 600 = 150

GAAP FCF = 600 - 150 = 450

5.

Solution:

(a)

Credited rate is a function of four interest rates

- Average net interest being earned net of investment expense and defaults
- Average net interest available on new investments
- Any interest rate guaranteed by the product
- Market rate

Guarantee could be – long-term minimum interest guarantee

- Short-term current interest rate guarantee
- Bailout rate
- Cannot credit less than a long-term or short-term guarantee

Most companies will use a targeted spread

- Credited rate = earned rate – targeted spread
- But company may not always achieve targeted spread

Credited rate will affect lapse experience

- Crediting less than competitor increases lapses
- Crediting more than competitor decreases lapses
- Always compared to base lapse rates

(b)

i90day (Time 0) = 4.50%
i15year (Time 0) = 6.00%
Volatility Factor (Vol) = 20%
Degree of Correlation (Corr) = 60%

Z1(1) = 0.482
Z2(1) = 1.829
Z1(2) = (0.709)
Z2(2) = 0.902

$$\text{i90day}(t+1) = \text{i90day}(t) \times \exp(Z1 \times \text{Vol})$$

$$Z15\text{year} = Z1 \times \text{Corr} + Z2 \times \left(1 - \text{Corr}^2\right)^{0.5}$$

$$\text{i15year}(T=1) = \text{i15year}(t) \times \exp(Z15\text{year} \times \text{Vol})$$

5. (b) continued

Year 1

$$\begin{aligned}
\text{i90day}(1) &= \text{i90day}(0)\times\exp(Z1\times\text{vol}) \\
&= 0.045\times\exp(0.482\times 0.2) \\
&= 4.96\%
\end{aligned}$$

$$\begin{aligned}
Z15\text{year} &= 0.482\times 0.6 + 1.829\times\left(1-0.6^2\right)^{0.5} \\
&= 1.7524
\end{aligned}$$

$$\begin{aligned}
\text{i15year}(1) &= \text{i15year}(0)\times\exp(Z15\text{year}\times\text{vol}) \\
&= 0.06\times\exp(1.7524\times 0.2) \\
&= 8.52\%
\end{aligned}$$

Year 2

$$\begin{aligned}
\text{i90day}(2) &= \text{i90day}(1)\times\exp(Z1\times\text{vol}) \\
&= 4.96\%\times\exp(-0.709\times 0.2) \\
&= 4.30\%
\end{aligned}$$

$$\begin{aligned}
Z15\text{year} &= -0.709\times 0.6 + 0.902\times\left(1-0.6^2\right)^{0.5} \\
&= 0.2962
\end{aligned}$$

$$\begin{aligned}
\text{i15year}(2) &= \text{i15year}(1)\times\exp(Z15\text{year}\times\text{vol}) \\
&= 8.52\%\times\exp(0.2962\times 0.2) \\
&= 9.04\%
\end{aligned}$$

6.

Solution:

(a)

(i)

Loss ratio test

- usually for health, P&C
- 1 year assessment only

(ii)

Gross premium valuation

- compare stat reserves to gross premium reserve
- if GPV > stat reserves, then adequate reserves held.

(iii)

Claim run off test

- Looks at claims by incurral year
- Looks at sum of cash paid and claim reserve
- The sum of the two should remain constant throughout all subsequent years
- If last table showed reserves + paid claims constant through the year, then the reserves are sufficient
- If the table showed reserves + paid claims declined by duration, the reserves are conservative
- If the table showed reserves + paid claims increased by duration, the reserves are inadequate
- This test is conservative since it ignores interest earned on reserves.

(b)

Using the claim run off test

Cash paid by incurral year

Cal year	2003	2004	2005	2006	2007
2003	10				
2004	12	7			
2005	6	10	5		
2006	3	5	10	6	
2007	2	4	6	10	5

6. (b) continued

Cum Cash paid by incurral year

Cal year	2003	2004	2005	2006	2007
2003	10				
2004	22	7			
2005	28	17	5		
2006	31	22	15	6	
2007	32	26	21	16	5

Min level of claim reserves (back solve so that all years are smooth)

Cal year	2004	2005	2006	2007
2004	19			
2005	9	16		
2006	4	6	10	
2007	0	0	0	0

Check

Cal year	2004	2005	2006	2007
2004	26			
2005	26	21		
2006	26	21	16	
2007	26	21	16	5

7.

Solution:

(a)

(i)

YRT

Advantages

- Simple to administer
- Lower ongoing cost because only mortality/morbidity risk is ceded

Disadvantages

- Ceding commission is limited
- Low cost limits the amount of future profits; therefore, limited surplus relief

(ii)

Mod-co

Advantages

- Ceding company does not need to transfer asset backing the reserves
- Ceding company controls investment policy
- No reserve credit problem even if the reinsurer is not licensed
- Can be applied to all types of insurance product

Disadvantages

- Complex to administer due to mod-co adjustment
- Capital losses due to asset transfer during treaty termination

(b)

Income Statement as of Dec 31, 2010

	ABC Life	**XYZ Re**
Gross Premium	$\frac{500000\times 10}{1000}=5000$	3000
Ceded Premium	$5000\times 60\%=3000$	0
Investment Income	$(3000+500)\times 10\%=350$	$1000\times 10\%=100$
Reinsurance Allowance	$3000\times 10\%=300$	0
Mod-Co Adjustment	$60\%\times\left[3400-3000(1+10\%)\right]=60$	0
Total Revenue	2710	3100
Increase in Reserve	$3400-3000=400$	0
Expense	50	25
Commissions	$5000\times 20\%=1000$	0
Mod-co Adjustment	0	60
Reinsurance Allowance	0	300
Total Benefit & Expenses	1450	385
Net Income	1260	2715

7. (b) continued

Balance Sheet as of December 31, 2010

	ABC Life	**XYZ Re**
Asset	$1760 + 3400 = 5160$	3715+0=3715
Reserve	3400	0
Surplus	$500 + 1260 = 1760$	$1000 + 2715 = 3715$
Liabilities & Capital	5160	3715

8.

Solution :

(a)

Method of restoring surplus to adequate levels once depleted

- Establish and use internal target surplus formulas
- Emphasize products with low RBC requirements
- Move away from products with high RBC requirements
- Redesign existing products to lower RBC requirements
- Increase profits by lowering expenses
- Increase profits by increasing premiums
- Increase profits by exiting unprofitable lines of business
- Buying assets with low RBC requirements and selling high RBC assets
- Using reinsurance or M&A transactions to lower liability exposures
- Reorganize legal structure of company using subsidiaries or holding company structuring options
- Increase capital by issuing surplus notes or issuing new equity
- Stop selling new business

(b)

LeveragedSelect is high risk
Choose high risk because Leveraged Select has no surrender charge and allows withdrawal at book value

C3 component 3.08%*4800000 = 30184

CorpSelect is medium risk

Choose medium risk because surrender charge greater than 5% and allows withdrawal at book value

C3 component 1.54%*9800000 = 150920

(c)

C3 Phase I and Phase II Approach Similarities and Differences

Similarities

Scenario-based approach is used for both
Both methods try to capture the 'tail of the distribution' of scenarios

8. **(c) continued**

Weighted average subsets of results are used to get results for both methods

- The C3-I method is tabular factor weights
- The C3-II method is Conditional Tail Expectation (CTE) method

Scenarios are sampled from a large, predetermined set of scenarios to reduce runtime

Scenario sampling is designed to maintain a floor of that value produced by the larger scenario set

Quantify interest rate risk in a more product specific manner than the original C3 method allowed for

Differences

Interest Sensitive Products (C3-I) vs. Variable Products with Guarantees

C3-I uses same models as CFT exercise while C3-II uses standalone models

C3-I uses calculated statutory surplus as the final result while C3-II uses assets as the run result and then subtracts reserves to get RBC

The C3-I method allows choice of 12 or 50 scenario subset to be used

C3-I method uses year by year values of key run metric for each scenario

C3-I allows exemption if:

- Significance Test Passed: If original C3 component is less than 40% of total RBC then interest rate risk is deemed not to be significant for that company
- Stress Test Passed: If Total Capital divided by RBC recalculated with annuity interest rate requirement 7.5 times higher is greater than 100%...

Where C3-II has no such exemption tests

- C3-II offers an Alternative Methodology
- C3-II uses equity returns and interest scenarios where C3-I uses only interest rate scenarios
- C3-II uses Prudent Best Estimate Assumptions vs. Conservative Statutory Assumptions for C3-I

9.

Solution:

(a)

Key valuation assumptions of guaranteed benefits related to policyholder behavior:

- Assumptions are dependent on the policyholder's understanding of complicated benefits.
- Are influenced by the media or their broker.
- Policyholders may not make decisions in their best financial interest.
- Can be different from history
- Industry experience may not exist

Lapse Rates:

Traditionally, low during surrender charge period (4-6%), then spike at end of period (20-50%), and are stable afterward (10-15%)

Rates will vary by company & by distribution channel

Lapse rates are affected by:

- Length of the surrender charge period
- Whether it's a qualified(401, 403(b), 408(b) or 408(a)) or non-qualified contract
- Tax rules
- Distributor incentives – the broker may be influenced by commission structure (trailing commissions vs. new sale)
- Are the guarantees 'in the money'?
- Policy performance relative to other variable annuities

Annuitization Rate

- Assumption tends to be vary low (<3%)
- On each anniversary after GMIB waiting period, policyholder must choose to annuitize or wait. Poor health or a large guarantee makes annuitization more likely.
- Age (assume no annuitizations prior to 60 or 65)
- Volatile markets – volatility means policyholders may flock to the safety of a guaranteed annuity
- Other assets – if policyholder has other assets, annuitization is less likely
- Taxes
- Commissions

9. (a) continued

Mortality pre-annuitization

Mortality has the biggest impact on the valuation of GMDB

Presence of GMDB may lead to anti-selection, as a policyholder in poor health is less likely to lapse a policy in the money

Lapse & mortality affected inversely when a policy is 'in the money'

Availability of viatical settlements: If the death benefit becomes large enough relative to the account value, viatical settlements companies may buy the policy from policyholders with marginal health issues

Partial withdrawals and contributions

10-15% of variable annuity policyholders withdraw money on a regular basis

May have a specific assumption for partial withdrawals, or partial withdrawals & contributions could be built in to the lapse rate

If there is free partial withdrawal feature, a separate assumption is preferred so that projected surrender charges are not overstated

Three situations can cause partial withdrawals & contributions to have a material impact on valuation.

- If a policy is part of qualified retirement plan, IRS requires withdrawals starting at age 70.5. This rule is usually met with partial withdrawals.
- Benefits that are no longer offered in the marketplace may get additional contributions, and fewer partial withdrawals
- Anti-selection occurs when the policy adjusts guarantees on a dollar for dollar basis for withdrawals instead of proportionality. Occurs to both GMDB & GMIB guarantees. Provides 'free' insurance to the policyholder. Taxes may be a disincentive.

9. **continued**

(b)

Higher expected bankruptcy costs

- Direct costs (administration and reorganization) include, lawyer fees and court costs;
- Indirect costs include interference from bankruptcy court (impact on operating decisions, investment decisions, and causes reductions in ongoing operating value of the firm)
- Expected present value of costs reflected in current market value
- Eliminating risk of bankruptcy will eliminate this cost, and increases the value of the firm
- As a company becomes weaker financially, it is more difficult to raise funds
- Must pass up profitable investments because cost of capital is too great

Higher payments to stakeholders

- For closely held firms – required rate of return must account for increased risk, higher returns needed
- For public firms – stakeholders such as managers, employees, customers, suppliers will all require greater compensation if there is a risk their 'investment' in the firm could be impacted by financial distress
- Employees will want higher wages; and reduced loyalty or work effort from employees
- Suppliers will be reluctant to enter into long term contracts
- Creditors will charge more and be less flexible
- Customers concerned about company's obligations and may be reluctant to buy

Higher Taxes

- Most of the world has a 'convex' tax code
- Effective Tax-rate increases with increase in pre-tax income
- Limits on use of tax carry forwards
- Create benefits to managing tax within 'optimal range'
- Reducing variance in taxable income will produce lower tax payments by keeping income within optimal range

10.

Solution :

(a)

(i)

Need benefit ratio

= (PV(benefits)+AV(benefits))/(PV(Revenue)+AV(Revenue))

=(9750+3800)/(60000+30000) = .15056

Liability at BOY = 60000x.15056 – 3800 = 5234

AV(benefits) at EOY = 3800x1.06 + 950= 4978

AV(revenue) at EOY = 60000x1.06 + 8000 = 71600

Liability at EOY = 71600x.15056 – 4978 = 5802

EGP = revenue – benefits – expenses – Δliability

=8000 – 950 – 250 – (5802 – 5234) = 6232

(ii)

New ratio = (9750+(1800-950)/1.06 + 3800)/90000

= .1595

New liability EOY = 71600x.1595 – 4978-(1800-950) = 5590

Actual EGP = 8000 – 1800 – 250 – (5590 – 5234) = 5594

(b)

Fair value is the price received in selling an asset or paid in transferring a liability in an orderly transaction between independent, knowledgeable, willing market participants.

Approaches

- Market approach: uses market trade data for same or similar instruments
- Income approach: finds present value of projected cash flows
- Cost approach: cost required to replace an asset or produce a substitute

Inputs

Level 1

- Current price in an active market for the identical asset or liability

Level 2

- price in an active market for similar instrument
- price for same instrument in market that is not active
- both level 1 and level 2 inputs are observable

Level 3

- asset or liability has unobservable inputs
- entity will need to use own assumptions

Recommend: for GMIB use Level 2 inputs

- GMIB's are not actively traded
- similar items like puts are actively traded

11.

Solution:

(a)

(i)

Accounting Standards

UL is SFAS 97

Term is SFAS 60

(ii)

Assumptions Used

UL

- assumptions are best-estimate without provision for adverse deviation
- assumptions are not locked-in

Term

- similar to UL except assumptions include provisions for adverse deviation
- assumptions are locked-in at issue

(iii)

Revenue and Expense Recognition

UL

- premium is not revenue on the income statement
- revenue includes amounts assessed against policyholders (COI, surrender charge, fees, other)
- expense includes benefit claims excess of account balance, admin costs, interest credited, DAC amort.

Term

- premium is revenue on the income statement
- benefits are expenses on the income statement

(iv)

Deferred Acquisition Costs (DAC) Calculation

UL uses a series of EGPs to amortize the DAC balance

UL looks at assumptions at each unlocking period, may revise at that time

Term uses a lock-in of assumptions, used as long as reserves are adequate

(b)

(i)

Qualifications and Procedure

- appointed or retained by the board of directors
- must be a member in good standing of AAA
- qualified by AAA to sign statements of actuarial opinion

11. (b) continued

(ii)

Statement of Actuarial Opinion

- must be submitted annually
- whether reserves are commuted appropriately
- consistent with prior reported amounts
- comply with state regulations
- assumptions must take account of contractual provisions

Opinion consists of

- paragraph identifying the appointed actuary and qualifications
- scope of the opinion, including tabulation of the reserves that have been analyzed for asset adequacy
- tabulation of the reserves that have been analyzed for asset adequacy
- method of analysis and reserves covered by the opinion that have not been so analyzed
- extent to which the appointed actuary has relied upon other individuals
- one or more additional paragraphs if needed to qualify the opinion
- disclose any inconsistencies
- disclose if additional reserves established in a prior opinion have been released
- briefly describe any assumptions on which the opinion is based

(iii)

Liability section must include the following information about the liabilities:

- a description of each product including:
  - marketing
  - underwriting
- the sources for the liabilities in force
- the policy reserve valuation methods and assumptions
- investment reserves
- reinsurance agreements
- identification of any explicit or implicit guarantees made by the general account in support of benefits provided through a separate account
- documentation of assumptions used in the asset adequacy analysis

12.

Solution:

(a)

SFAS 97 applies to all UL-type contracts.
UL contracts are characterized by at least one of the following features:

- Contractual assessments are made against the policyholder that are not fixed and guaranteed.
  - This contract would not qualify as COIs, loads and fees are fixed and guaranteed.
- Amounts that accrue to the benefit of policyholders are not fixed and guaranteed by the terms of the contract.
  - Because interest is fixed and guaranteed this is not true
- Premiums may be varied by the policyholder within contract limits and without consent of insurer.
  - This is true because premiums are flexible

(b)

Under SFAS 97, DAC is amortized using Estimated Gross Profits (EGPs)
q_x= DB/ (No. of Pols x face amt per pol)
q_x = 30000/(750000*750) = .00053
Benefit Reserve(t) = Account Value(t)
EGPt = {COI(t) - (Face(t) - Account Value(t))*q_x/[(1-q_x)*(1-w_x)])} + (Expense Load(t) - Expenses(t)) + (Invest Income(t) - Credited Interest(t)) + Surrender Charges +/- other assessments and credits such as Dividends

EGP(1) = {45,000 - (75000*750 - 40,312)*(.00053)/[(1-.00053)*(1-.04)]} + (3500 - 3200) + (2625 - 2500) + 2500- 0 = 16,681

DAC(t) = DAC(t-1)*(1+i) - k*EGP(t)
DAC(1) = 50,000*1.05 - 0.50*16681 = 44,160

SFAS 97 Income Statement Format:
Total Revenue = Investment Income + Policy Charges
2,625+51,000 = 53,625

Total Benefits & Expenses = Excess DB + Interest Credited + Commissions + Fixed Expenses - Change in DAC
31,244+2,500+50,000+3,200-44,160 = 42,785

Net Income = Total Revenue - Total Benefits & Expenses
53,625 - 42,785 = 10,840

Policy Charges = COI(t) + Expense Load(t) + Surrender Charges(t) =
45,000 +3,500 + 2,500 = 51,000

12. (b) continued

DB in Excess of AV = (Face(t) - Account Value(t))*q_x/[(1-q_x)*(1-w_x)] =
(75000*750 - 40,312)*.00053/[(1-.00053)*(1-.04) =31,244
chg in DAC(t)=DAC(t)-DAC(t-1)
44,160 - 0 = 44,160

13.

Solution:

(a)

(i)

Products taxed include –

- Ordinary, Industrial Group Life and Health products
- Reinsurance ceded premiums
- Some states tax annuity considerations
- Premiums paid in advance
- AD and disability waiver premiums

Products not taxed include

- Assumed premiums
- Dividends used to purchase PUAs
- Premiums returned on 'not-taken' policies or refunded under retroactive rate adjustments under group plans

(ii)

Concerns with taxing annuity considerations

- similar to taxing savings deposits
- would place annuity contracts at a competitive disadvantage
- higher tax amounts not priced for would lead to lower profits

(b)

The revised taxable income for 2006 should be computed in 3 steps ;

(i)

Calculate the Initial Taxable Income for all years
(Premiums – Expenses -Benefits – Dividends –Increase in Tax Reserves)

(ii)

Adjust for any Carry-Back losses (= min((i) and any available carry-back)

13. (b) continued

(iii)
Adjust for Small Company amount (= 60% of the result of (ii))

	2005	2006	2007
Premiums	500	550	400
Operating Expenses	125	137	250
Death Benefits	84	53	167
Policyholder Dividends	12	15	17
Increase in Tax Reserves	129	145	166
Intitial Taxable Income	150	200	-200

2007 losses can be carried back up to 3 yrs but no income in 2004.

Carry Back	150	50	0
Tentative Taxable Income	0	150	0
Small Insurance Company Deduction	0	90	0
Final Taxable Income	0	60	0

14.

Solution:

(a)

- A contract exchange
- Amendment, attachment of an endorsement or rider
- Election of a benefit feature present in the existing contract

(b)

The two most important criteria are:

- No change in the kind and degree of insurance risk:
  - The degree of insurance risk needs to be assessed.
- No change in the nature of investment return:
  - Changes between different types of interest crediting would make the test to fail.

(c)

(i)

Not considered 'substantially unchanged'

Why: Kind and degree of insurance risk criteria failed. WB for life is long term, which increased the mortality risk. This is different from GMWB that is short term. The Change in nature of investment return passed because the interest crediting method is the same.

(ii)

Not considered 'substantially unchanged'

Why: Kind and degree of insurance risk criteria failed. WB and EIA have different kind of mortality risk. The Change in nature of investment return failed as well. The interest crediting method changed.

(iii)

Considered 'substantially unchanged'

Why: Kind and degree of insurance risk criteria passed. The Change in nature of investment return criteria passed. The interest crediting method is very similar.

15.

Solution:

(a)

(i)

Inforce valued using embedded value

- Economic Value = PV (distributable earnings) @ hurdle rate
- hurdle rate = WACC

Reasons Economic value (ECV) better than embedded value (EV)

- EV only considers regulatory frictional costs. When distributing frictional costs, some of the less risky segments will receive too much
- EV tends to favor high yield investments

(ii)

CAPM doesn't consider frictional costs in determining a discount rate

- Base cost of capital, this is what shareholders could get investing on their own
- to create value need to earn higher than planned on investments
- frictional costs include:
  - double taxation, costs of frictional distress, agency costs, regulatory costs
- hurdle rate used should be the weighted average cost of capital

(b)

(i)

Basic shortcoming of DCF or NPV is that they cannot properly capture management's flexibility to adapt when uncertainty is resolved

Doesn't reflect options

CCA must be used when dealing with options.

CCA uses risk neutral decision tree discounting expected future values at the riskless rate

15. (b) continued

(ii)

The flexibility to defer the decision to launch the product is a real option. Options to delay, contract, expand etc can be valued.

Allows management to value different options to know how it can react if the market acceptance is good or bad

Allows uncertainly to be resolved before committing to launch the product

CCA captures the fact there are options and allows for their proper valuation

(iii)

S=20
S+ = 36
S- =12

V+ = 180
V- = 60
I = 112

20 = p * (36) + (1-p) * 12 / 1.08; p=.4

p = ((1+r) * S - S-)/(S+ - S-)

E+ = max (V+-I,0) = max (180-112,0) = 68

E- = max (V- - I,0) = max (60-112,0) = 0

Value to PH @ t=0 is ((p * E+) + ((1-p) * E-))/(1+r)

= (.4 * 68 + .6 * 0)/1.08 = 25

16.

Solution:

(a)

Step 1

calculated from the "issue date"
use "guaranteed" assumptions

Step 2

calculate as of "issue date"
using "guaranteed assumptions"
assuming that "GMP" are paid

Step 3

project max(GMF, AV)
using "guaranteed assumptions"
assuming that "GMP" are paid

Step 4

using "guaranteed assumptions"
assuming that "GMP" are paid

Step 5

${}_tV_{NL} = r * (PVFB_t - P_{NL} * a_{x+t})$
r = min (1,current fund value/GMFt)

Step 6

using "guaranteed assumptions"
assuming that "GMP" are paid

Step 7

Final CRVM Reserve should be:
${}_tV_{CRM} = {}_tV_{NL} - r * \text{unamortized } EA_{CRVM}$

(b)

Dynamic valuation is performed

- First, need to find the reference rate which is the min of 12 month and 36 month of Moody Moving average corporate bond index or the 12 month rate
- product classification
- guarantee period
- cash settlement option
- interest guarantees
- plan type:
- issue year versus change in fund

16. continued

(c)

$i_{cy} = 0.03 + w_1 * (r^1_{cy} - .03) + 0.50 * w_2 * (r^2_{cy} - 0.09)$
r_{cy} = reference rate

Reference rate is min of 12 month and 36 month of Moody Moving average corporate bond index or the 12 month rate

Min (.08, .07) = .07 or .07 = 0.07
$r^1_{cy} = \min (r_{cy}, 0.09) = 0.07$
$r^2_{cy} = \max (r_{cy}, 0.09) = 0.09$
$i_{cy} = .03 + .5 * (.07 - .03) + .5 * .5 * (.09 - .09) = 0.05$