Solution 1

(a) Rate components to determine a credited interest rate are:

(i) Earned Rate:
Rate earned on assets supporting the fixed annuity block
Net of investment expenses and default costs

(ii) New Money Rate
Rate available on new investments

(iii) Guaranteed Rate
Minimum rate guaranteed each contract year
Should also consider any bailout provision

(iv) Market Rate
Rate available for alternative (competitive) investments
Consider money market funds, CDs, other fixed annuity products

(b) Chief actuary's suggestion to use portfolio rate does not take market rates into account

(i) Increasing interest rate environment
Earned rate on existing block of assets will lag rates available on new assets
Will result in renewal credited rates less than the rates available for new sales
Lapses will be higher
May have to liquidate assets to support surrender cash flows (disintermediation)

(ii) Decreasing interest rate environment
Earned rate on existing block of assets will exceed rates available on new assets
Renewal credited rate will be higher than the rate available for new sales
Lapses will be lower
Product will credit more than is necessary to compete

Solution 1 (continued)

(c) A crediting strategy that depends on two or more of earned rate (portfolio rate), new money rate and market rate can be used.:
X%(earned rate – target spread) + Y%(new market rate – target spread) + (1 – X% - Y%) (market rate – target spread).

This reduces the impact of changes in lapse rates by taking into account the earned rate, new money rate and market rate.
Also, look at company experience and market experience in determining rate

Solution 2

Part A

Sex distinct rates

Unisex rates for some regulatory environments

margins for conservatism

modify industry tables to reflect markets such as mortality improvement or substandard mortality

Part B

Constant multiple mortality-constant %*q_x for all mortality rates

Has undesirable affect of maintaining the extra mortality at all durations making the mortality too high at the older ages

Rated Age Mortality-add r years to age and use existing mortality

Has undesirable affect of increasing extra mortality at all durations

Constant Extra Deaths-add k deaths per 1,000 to mortality rates

Produces the highest mortality initially but decreases and grades to std. @ end

Select constant extra death since mort pattern is closest to that needed for the labor union.

Part C

q = estimate mortality rate = deaths/policies=5/2000=.0025

Var = npq=2000*.9975*.0025=4.9875

95% confidence interval = [E +/- 1.96 * Var^(1/2)]/n=(5+/-1.96*(4.9875)^(.5))/2000=.0025+/-.00218

Manipulate the confidence interval formula to solve for n=((1.96*(pq)^.5)/.0005)^2=38,320

need 38,320 policies for 95% confident that mort rate will be between 2 and 3 per thousand

Solution 3

a) Death Benefit Calculation Formula
- Return of Premium
- Roll-up
- Ratchet
- Reset

Limits on Increase
- Caps on guarantees
- Attained age limits on increases

Variable Account Performance
Limits on Investment Options
Issue Age
Coverage
- Who's covered
- Can spouse continue
- Effective date of DB calculations

b) Black Scholes
- Model GMDB as a series of put options
- Exercise options at Death
- Disadvantage: can't model diversification
- Disadvantage: works best for short-term options

Monte Carlo Simulation
- Simulate GMDB path by path
- Advantage: fund correlation/diversification can be modeled

c) Lapses
- Lower if DB is 'in the money'

Annuitization
- No impact since tends to be very low anyway

Mortality
- Major impact to pricing
- Antiselection: presence of benefit valued more by the unhealthy

Partial Withdrawals and Contributions
- If benefit no longer available, encourages lower withdrawals/higher contributions
- Antiselection: if guarantees are adjusted dollar for dollar

Solution 4

a)

- Senior Management
  - Sets direction / goals
- Marketing
  - Gets information on what customers and producers want
  - Gets information on what competitors are doing and may do in response
- Actuarial
  - Responsible for the financial soundness of the product
  - Prices the product

b)

- Primary market – affluent families and affluent pre-retired people
- The product would not fit for affluent people.
- The low face amount could cause problems since Saturn has issue with expenses (it's one of their competitive weaknesses). This would make it very hard to compete in a low face amount market.
- Whole life products are unappealing to affluent customers and is not a core product for Saturn.

c)

i Potential Risk of Proposed Product

- Lapse Risk – higher first year lapses
  - High commission rate could be abused by unethical agents with rebating arrangement with customer
- Risk of Fraud
  - Agent could pay first year's premium to get the high first year commission and then lapse the policy
- Reserve adequacy
  - Pricing mortality is greater than valuation mortality
- Mortality Risk due to Guarantee issue
  - Risk of anti-selection by lives with poor mortality.
- Corporate Concerns
  - High mortality and commission rates will create strain

ii Recommended Changes

- Reduce first year commission rate to less than 100% and increase renewal commission rates.
- Pay reduced death benefit in first few years (i.e. return of premium)
- Saturn doesn't have experience to evaluate lapses, mortality,..
  - Talk to a consultant
  - Talk to a reinsurer

Solution 4 (continued)

d)

- Mean Reserve = .5 (${}_4V_{40}$ + NP_{40} + ${}_5V_{40}$) = .5 (270 + 80 +280) = 315
- Deferred Premiums = modal premiums due after the valuation date but before the next anniversary approximated as .25 x NP_{40} = .25 x 80 = 20
- Unearned Premium = 0 since not applicable under mean approach
    - Used with mid-terminal reserves

Solution 5

a)
Setting the risk discount rates (hurdle rates)
Desirable risk-adjusted rate of return on covered business
A single biggest impact on economic values
Reference to the weighted average cost of capital, because it is affected by finance structure
Two methods to set up risk discount rates (RDRs):

- Top-down method: Use CAPM to set up a single interest rate
  - Do not reflect the profile of each product
  - RDR = (I + Rf) + Bm (Rm – (I + Rf))
  - Where I = Inflation rate
  - Rm = Market rate of return
  - Rf = Risk-freee rate
  - Bm = Risk-adjusted factor
- Bottom-up method: Separately set up RDR for each product to reflect risk characteristics of each product

b)

European Embedded Value: measure of consolidated value of stockholders' interests on covered business
EV(0) = Free surplus + (Required Capital – Cost of Holding Required Capital)
+ Present Value of In-force Business (PVIF)
Free Surplus = Market value of capital and Surplus in excess of required capital
PVIF = Present Value of cash flows of all in-force business – PV of Guaranteed benefits and Options

EV(0)	=	Market Value of allocated Capital and Surplus	=	$800
	-	Cost of Holding Required Surplus	-	(200*16% + 300*6%)
	+	PVIF	+	850 - 50
	-	PV of New Business	-	0
	=		=	$1,550

Solution 5 (continued)

c)

Purchase Value = Solvency Reserve – Assets
= $1000 - $600
= $400

Purchase Value = EV (0) - Required Capital - Tax - Transaction Costs

Tax = Tax rate * (Solvency Res - Tax Reserve - Purchase Value – Trans. Costs)
= 40% * ($1,000 - $970 - $400 - $10)
= -$152

Embedded Value = $400 - $152 + $400 + $10 = $708

d)

Reasons for acquiring a block of business

- Increase in economies of scale
- Cutting expense / reduce unit costs
- Make the company grow
- Deploy idle capital

Prerequisites

- Have access to capital
- Could increase the profit of the company
- Could integrate the sources and capacities from two companies such as experience practices, admin systems, distribution system

Purchase price factors

- Purchase value = Solvency Reserve – Assets
- Factors determining a purchase price are required capital, tax costs, transaction costs, and goodwill
- Goodwill includes the value of new business, reputation, brand name and distribution system

Solution 6 – US Only

a) A two tiered annuity is a deferred annuity that keeps two different account values:

- One for people who annuitize
- One for people who withdraw their funds

People who annuitize will have higher rates credited to their funds and higher AV profitability is maintained with lower interest margins since the annuitization rates will incorporate two profit sources: interest and mortality.

b) **U.S. Two-Tier Reserving Requirements**

Two-tiered annuity reserving requirements for US Statutory purpose are based on deferred annuity methodology according to CARVM (Commissioners Annuity Reserve Valuation Method).

The present value (PV) of all future possible benefits over the PV of all future compulsory considerations (premiums minus loads required by the contract) are calculated and the minimum value is taken.

It is a worst case scenario, assuming contract holders will act in the most adverse way against the insurer.

For two tiered annuities, the max PV based on account value at annuitization or at surrender will be taken. Discounting is at the prescribed interest rate and a prescribed mortality table also needs to be used.

Project fund values forward on a guaranteed basis which includes annuity benefits, death benefits and nonforfeiture benefits.

US requirements prescribe the methodology and assumptions (interest and mortality only) by law and regulations. The assumptions are conservative since the emphasis is with solvency. Lapses and other assumptions (eg. Expenses) are not considered.

Valuation interest rate method is based on ‘issue year’ vs ‘change in fund’.

Solution 6 (continued) US Only

General Differences in Valuation Requirements

Canadian requirements are based on Canadian Asset Liability Method (CALM) and the valuation must adhere to the Consolidated Standards of Practice (CSOP) which makes specific recommendations concerning valuation date, development of appropriate assumptions and valuation method.

The actuary is responsible for setting best estimate assumptions for all relevant assumptions. The actuary will add in margins for adverse deviations to each assumption.

Policy liabilities are determined using one of seven prescribed interest rate scenarios whereas in the US the usage of prescribed interest rate scenarios is no longer regulated (except in NY state).

c)

i) Highest Liquidity: Government Bonds, Widely held Corporate Bonds, Widely held stocks
ii) Lowest Liquidity: Real Estate
iii) Highest Quality: Gov't Bonds, Gov't Guaranteed Mortgages (incl. CMOs), Highly Rated Corporate Bonds
iv) Lowest Quality: Junk Bonds
v) Longest Duration: Real Estate, Preferred Stocks, and Common Stocks
vi) Highest Yield (excl. Capital Gains): Junk Bonds
vii) Highest Yield (incl. Capital Gains): Common Stocks
viii) Most Predictable Cash Flows: Noncallable bonds and some CMO and ABS tranches, which are designed to generate predictable cash flows
ix) Most Volatile Cash Flows: Residual CMO and ABS tranches that are designed to absorb cash flow volatility in order to provide cash flow stability to other tranches.

(d)

(i)Two-tiered annuities have higher persistency than traditional deferred annuities
Traditional deferred annuities also have a considerable "shock" lapse at the end of the surrender charge period, which does not exist with a two-tier product
Therefore, need longer assets for a two-tiered annuity.

Solution 6 (continued) US Only

(ii) Due to higher persistency, an insurer may consider holding the following assets as part of their investment strategy:

- Government Bonds: Not callable
- Real Estate: Illiquid which may take months/years to sell for its full value
- Common Stocks: Makes sense when matched against very long-term liabilities
- Preferred Stocks: Non-callable preferred which makes it an excellent match for an insurer's longest term liabilities, especially those longer than the longest bond maturities available.

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b) **Canadian Two-tiered Reserving Requirements**

- CSOP applies to all kinds of insurance
- Uses Canadian Asset Liability Method (CALM)

Cash flows need consider:

1. Retrospective Premium and commission
2. Experience Rating Refunds
3. Reinsurance ceded
4. Subrogation and Salvage
5. Exercise of Policyholder Options
6. Deemed termination at the end of the term of liabilities of each policy then in force.
7. Time value of money

Liability = Amount of assets at balance sheet date which are forecasted to reduce to zero at the last liability cash flow date.

Must calculate liabilities using multiple scenarios and adopt the scenario whose liabilities make sufficient but not excessive provision for the insurer's obligagtions.

Scenario tested assumptions should include at least the interest rate assumptions

Interest Rate assumptions should comprise:

1. A Base scenario which assumes continuance of reinvestment and inflation rates
2. Each of the prescribed scenarios in a deterministic application
3. Ranges which comprehend each of the prescribed scenarios in a stochastic application
4. Other scenarios appropriate for the circumstances of the insurer

Solution 6 (continued) Canada Only

Must contain Margins for Adverse Deviations

Annuity Mortality considerations:

1. Assumption depends on annuitant's age, sex, smoking habit, health, lifestyle, size of premium, plan of annuity, whether registered or not, group versus individual contract.
2. Must include the effect of any anti-selection resulting from the annuitant's option to select the timing, form, or amount of annuity payment or to commute the payments.
3. Include a secular trend toward lower mortality rates.
4. Low and high margin are a subtraction of 5% and 15% of the best estimate.

General Differences in Valuation Requirements

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Solution 7

(a)
1) Charge the same policy fee for all amounts of insurance
-This method decreases the rate per $1,000 of coverage as policy size increases
2) Offer different premiums per $1,000 for various amount bands
-Widely used
-For example, use one set of premiums for policies below $100,000,
one set for greater than $100,000
3) Combine both policy fees and amount bands
4) Offer a continuous rate structure
5) One reason for discounts for larger size policies is that mortality experience is better for larger size policies

(b)
Dried Blood Spot testing provides info to assess mortality risk for cardiovascular disease, diabetes, liver disease, HIV testing, and alcohol abuse
-specimen of blood is collected by a finger stick onto filter paper
Oral Fluid Testing involves the collection of saliva
-can be used to test for HIV infection, cotinine, and cocaine
-fluid may be collected by an agent or paramed using a noninvasive oral collection device
Cotinine Testing is a form of nicotine
-indicator of recent tobacco use
-usually conducted on a specimen of blood, urine or oral fluid

(c)
Oral Fluid Testing is not used at the proposed age and amount.
-more common to use urine or a blood profile
-little use of DBS
Paramedical is used by vast majority
-non-meds and meds are infrequently used
Motor Vehicle Report is used by less than half the respondents
-generally used more for younger ages, and older than at 45
Prostate Specific Antigen is very uncommon at age 45
-generally used more for older males at larger face amounts
Lifestyle underwriting could include other tests
HIV is commonly tested
APS or ECG would be just as common as MVR

Solution 7 (continued)

(d)
elite preferred q=(1-discount)*aggregate q
=(1-.3)*.0029
=.00203
preferred q=(1-discount)* aggregate q
=(1-.2)*.0029
=.00232
residual standard q=[aggregate q-(preferred q* % preferred qualifying)-(elite q* % elite qualifying)]/(1-preferred % qualifying – elite % qualifying)
=(.0029-.3*.00232-.10*.00203)/(1-.3-.1)
=.003335

Solution 8 – Canada only

ABC Life would have to split the data by:
country that ABC Life operates in
product line
Participating and non-participating business
new business vs in-force
Product line definitions should be determined by the AA based on the circumstances of the company
lines should be reported separately in the AAR to the same extent they are separately reported to business unit mgmt
lines that are analyzed separately on at least an annual bases should be reported separately
lines that form a separate part of the basis of determining product line bonuses should be reported separately
products with essentially the same characteristics should not be shown separately
Small product lines:
lines whose liabilities are less than 0.25% of total actuarial liabilities need not be reported separately
lines whose liabilities are greater than $25 million should be reported separately
sum of liabilities of all product lines not reported separately should not exceed 5% of total actuarial liabilities
New business:
All material products that are currently being actively sold should be reported separately
New business products that are anticipated in the business plan to become material should be reported separately
Distinct new product lines introduced for sale during the year, which the company did not have for sale in the past, should be reported separately
Old existing products with only a few new sales need not be detailed
Exceptions to the guidelines may be made if, in the AA's opinion, they are warranted
Reasons for these exceptions must be disclosed in the product line section of the AAR

OSFI requires the AA to document the rationale, justification and validation of all expected experience assumptions used
Any use of implicit assumptions or approximations requires disclosure and discussion
For participating and adjustable products the AA should describe how the dividends are reflected in calculation of the actuarial liabilities
AA must use judgment on the level of detail included with respect to assumptions
Multi page listings of mortality or lapse tables are discouraged
Such detailed data must be kept available at the company if needed
If there are numerous tables, sample rates are sufficient for the AA report
AA should describe the source of the expected experience assumptions
State if industry tables used
If industry tables available but not used, AA should compare the assumptions to the industry tables
For assumptions where limited experience exists, AA should disclose the basis and rationale for determining assumptions
AA should disclose when the expected experience assumptions were last updated or reviewed
The AAR should report the key future investment rates and reinvestment strategies assumed
The AAR should disclose and discuss the results of the seven scenarios required by CALM
Additional scenario testing, or the exclusion of any scenario, should be disclosed
For the scenario used in the valuation, it is required that the resulting portfolio interest rates and reinvestment rates for each duration be disclosed

Solution 8 (continued) - Canada only

Any use of derivatives must be disclosed
If future cash flows from more than one asset segment are aggregated under the CALM methodology this must be discussed
For par accounts, the AAR should provide description of the policyholder dividend scale assumed in valuation
include any prospective changes in the dividend scale relative to the current dividend scale
The AA must disclose whether any ancillary sources of earnings margins are assumed to offset any assumptions in the valuation
For fraternal companies the AA should disclose any special fees, subsidies from the fraternal organization and any special income

Solution 8 – US only

Reserves:
Mortality
Same assumptions that are contractually specified for guaranteed cash surrender values
Which usually are consistent with assumptions for regulatory minimum policy reserves
Interest
Hierarchy of Rates
1st Dividend Fund interest rate
2nd Interest rate used to calculate guaranteed cash surrender values = guaranteed interest rate
3rd NAIC minimum nonforfeiture interest rate
Lapse
None
Dividends
None
Expenses
None

DAC/Gross Margins:
Mortality
Current best estimate assumptions - consider company's recent experience
consider pricing assumptions
consider dividend scale
in conjunction with lapse assumptions
effects of underwriting
Interest
Two rates needed:
Yield on Assets - to calculate the amount earned from the investment of policyholder reserves
Expected Investment Yield - to discount gross margins
Can either be fixed at contract issue or vary as rate changes over time
Lapse
Current best estimate
Dividends
Annual policyholder dividends only - no terminal dividends
Initial dividend scale at issue and subsequent change in the scale
Should make assumption of elected dividend option, now and future
Expenses
Deferrable Acquisition Cost - expense that varies and relates to acquisition of new business
Commissions
in excess of ultimate renewal levels
Non-Deferrable Acquisition Costs - all other acquisition expenses that don't vary or relate to securing new business

Solution 8 (continued) – US only

Ultimate renewal level commissions
Direct Maintenance Costs
costs associated with maintaining records and processing contract information - can include claim and surrender expenses
Investment Expenses
Future Utility Expenses
Overhead

Reserves:
Mortality
Expected at time contract is written - best estimate
Should include a Provision for Adverse Deviation (PAD) - 5 to 10% in excess of best estimate
Improvements in mortality must be proven
Interest
Investment Earnings Rate - best estimates net of investment expenses
Risk of not earning return anticipated at time of pricing - some use declining earning rate
Should include a PAD
Lapse
Best estimate assumptions
Assumptions can greatly effect profitability of certain product - test emergence of profits before finalizing
Some add a PAD to assumption, some don't
Dividends
None
Expenses
Same categories above as PARWL DAC/Gross Margins

DAC:
Mortality
Same assumptions as reserves
Interest
Same assumptions as reserves
Lapse
Same as reserves
Dividends
None
Expenses
Same as reserves

Solution 9

i)Last Survivor features
Flexible Premium, low amount needed for given benefit, or limited pay
Auto Death Benefit Increase – CPI based or fixed percent
Split Option – split into separate policies upon divorce, other events. Limit total face to existing face.
Estate Preservation rider – to pay extra estate tax within 3 years
First-to-die rider – some estate taxes or expenses at first death

First-To-Die features
Survivor Purchase – continue coverage on remaining insureds w/o new underwriting
Auto Death Benefit Increase – CPI based or percent
Add/Delete Insureds – Change of business partners w/o canceling the policy
Simultaneous death – extra benefit if 2 people die at the same time
Split Option – split into separate policies if arrangement terminates. Limit total face to existing face.

ii) Last Survivor
Estate planning, pay estate taxes for wealthy clients
Business – 2+ key men
Family business – taxes on transfer to children, or funds for children to acquire business

First-To-Die
Business – key person, buy-sell arrangement, funds to buy deceased partner's share
Family – first death for dual incomes, estate taxes, funeral expenses

Solution 10

Part A

Concentric Diversification-introduces into new markets some new products related to current products.
This is concentric since Direct Life is expanding into new markets with Acme & the Labor Union
Introducing the IVA a new but related (ie. insurance) product for Direct Life.
Forward Integration-occurs when a co acquires distributors in its distribution
Direct Life is preparing to purchase Acme Agents, a new distributor. This is Forward Integration.

Part B (i)

Employ a Compliance and legal staff
Check with customer about fee and risk disclosures
Check applications for completeness, accuracy and suitability
Periodic reviews of customer holdings
Audit procedures and results
Provide producers clear and regular compliance guidance
Discipline producers for deviating from company compliance
Review producers education and license before hiring and regularly afterwards
Maintain written procedures for processing apps, premiumss and benefit payments
Maintain a quality unit to oversee menial transaction processes

Part B (ii)

Misrepresentation - false or misleading statements about products, company or rep
Twisting – product misrepresentation to induce product replacement
Churning – inducing one replacement after another in order to earn higher compensation
Rebating – an inducement from the rep to buy typical a portion of the compensation
Misappropriation – misuse of client money
Co-mingling – mixing rep and client money

Part C

Tot Rev=80=5+20+1+4+50
Tot Exp=60=40+20
Net Inc=20=80-60
Acme Agent's Price = 7 * Net Inc = 7 * 20 = 140
Direct Life Tot Rev=97=80*1.2+1
Var Exp Ratio = $40 / Acme Agent Total Rev* Direct Life Rev = $40/$80 *97 = $48.5
Direct Life Fix Exp=30=20*1.25+5
Direct Life Net Inc=18.5=97-78.5
Present Value= Net Inc * Annuity Factor = 5.02 = 18.5 X 5.02 = 92.9
Acme is looking for more than the value Direct Life has determined.

Solution 11

(a) Minimum Nonforfeiture Amount (MNA) = Accumulation of net considerations less withdrawals/surrenders, less contract charge, less any premium tax, and less any indebtedness/loans with interest
Net considerations = 87.5% of gross considerations
Interest Rate based on 5 Year Constant Maturity Treatsury
As of a date or average of a period
Rounded to nearest 1/20th percent
No longer than 15 months prior to contract issue date
No greater than 3% and no less than 1%

Rate = 2.90% (4.14% - 1.25%, rounded to nearest 5bp)
MNA(1) = (10,000 * .875 - 50)*1.029 = 8,952.30
MNA (2) = (8952.30 - 50) * 1.029 = 9,160.47
MNA (3) = (9160.47 - 50) * 1.029 = 9,374.67
Annuity Value = 10000*.99*1.025 - 75 = 10,072.50
Surrender charge = .12 * 10000 = 1200
Cash surrender value = 10,072.50 - 1200 = 8,872.50
CSV < MNA
Recommend the following changes:
Decrease the contract charge to$50 or less
Increase the guaranteed interest rate to 2.90% or higher
MNA allows max charge of 12.5% so total of surrender charge plus the front end load must be less than 12.5%
- Remove 1% front end load OR Decrease the SC to 11.5% and keep the 1% load (or some combination of these)

(b) First Year Commissions
- % of first year premium, most common
- Other options: Amount per policy or % of cash value
- usually annualized and fully vested

Renewal Commissions
- Rate: usually % of premium
- Pattern : level or variable by policy year and whether graded by policy size or volume of new business

Asset Based Commissions/Fees/Trails
- Percent of account value
- provide income stability to agents although not a significant source of income for new agents

Solution 11 (continued)

Bonuses
- % of first year premium/commissions or renewal premium/commission
- based on agent performance: sales/comp, persistency, # of new clients

Expense Allowance
- % of sales measure (i.e. first year comp) or renewals or persistency
- used to pay office costs and other business expenses (e.g. advertising)

Security Benefits
- insurance: life, health, dental, vision
- disability, retirement, thrift, savings, 401K
- comp arrangements: e.g. defer commission income until after death, retirement, disability

Recommend a reduction in first year commission (e.g. 6-7% range)
Recommend adding an asset based commission (e.g. 50bp -100bp range)
Recommend renewal commissions be non-vested for renewal premiums; i.e. only pay if the agent still represents the company when the commission is due

Solution 12

a)
provide useful info to help make decisions
must be detailed enough so the manager can get their task done
frequent reporting for timely action
distribution only to managers who can act
accurate
linked to objectives of the co, by use of key measurable financial results
answers what is responsible for cost and revenue items
must answer who is responsible
costs allocated to lines of business
b)
i)
run-on-the-bank risk
dividend cut causes some policyholders to surrender policies
Company has to pay cash for cash values
ratings could go down
adverse publicity
rumors of financial problems leads to withdrawal spiral

ii)
keep more highly liquid assets
option to delay payment of CV in contract
avoid hot money products
obtain line of credit from bank/credit facility
issue additional stocks/bonds

c)
pegging
  for a short period of time
  look at future dividends on current scale
  if lower than what was paid last year
  eliminate part/all of reduction
Substitution
  substitute dividend from prior scale
  for the dividend to be paid under current scale
  used only recent issues where dividend small
pegging/substitution may improve persistency
experience premium
  stop dividend declining in dollar terms
  must be equitable between blocks

Solution 12 (continued)

d)
i)
Self-Support Test
policy form cannot be subsidized from any other source
at every illustrated point starting with 15th policy duration
(20th if second or later to die)
Accumulated value of policy cash flows
using disciplined current scale
should be at least the illustrated policy value
Lapse-support test
regulation prohibits illustration of non-guaranteed elements in policies that are lapse supported
uses same assumptions as self-support test
except modified persistency
0 lapse rate after year 5
includes persistency bonuses

(ii)
the illustration actuary to check if illustrated scale needs to be reduced
illustration actuary checks illustrated scale is not more favorable to policyholder than
lesser of the disciplined current scale and the currently payable scale
illustration actuary checks his disciplined current scale (DCS) assumptions
any changes to DCS means illustration actuary must redo self-support test
any changes to DCS means illustration actuary must redo lapse-support test
illustration actuary may have problems with making his annual certification on existing business
as the reduction in payable dividends may not be related to experience assumptions
disclose if payable scale reduces since last certification for reasons other than experience change

Solution 12 (continued)

iii)
be aware that illustration will create policyholder reasonable expectations
current experience by itself may not be appropriate basis for determining the range of scenarios
for par primary range should reflect dividend scales that are reasonable given historical significance
suitable scenarios based on policies of company
practice of company to adjust dividend
experience of company
process by which dividend scale changed
account for trends in investment returns
account for type of assets
account for term to maturity of assets
account for the investment policy of company
Company surplus policy
Historical results should be adjusted for current factors

Solution 13 – US only

a)
-EIA GMAV funded by bonds
  -low interest rates will make bond expensive
-index funded by call options
  -high stock market will make calls expensive
-consider lowering participation rate (% of index credited)
-increasing the margin
-allowing features to be reset annually
-lower cap on index rate credited
-change crediting strategy from point-to-point to averaging
-structure as a FPDA instead of an SPDA – lower percentage of premium
 in SNL formula
-credit lower rate if state allows
-all the above may make plan unattractive

b)

point to point =Min(((110/100)-1) * 70%, 6%) = 6%
↑ cap

averaging =Min(((105+108+95+98+110)/(5 * 100)-1) * 70%, 6%)
= min(2.24%, 6%) = 2.24%

c)
-using highest would mislead the customer
  -would create unrealistic expectations
-should be based on best estimate of future assumptions
  -based on past experience
  -and adjusted for current factors
-new indices have no historical experience
-need to show experience of indices that very similar
-should show alternate worse scenario
  -should not make p/h think this is worst case scenario
-range of scenarios should be narrow enough to be representative
  -wide enough to avoid revisions

Solution 13 (continued) – US only

d)
i/-EIAs contain embedded derivatives valued
-EDs are split off and valued separately under FAS 133
-then host contract without ED is valued separately under FAS 97
ii/-need to value all future options as well as current
-using Black-Scholes or other option pricing method
-may use stochastic method instead of deterministic
iii/-earnings will be volatile
-will be affected by option cost which is affected by index
-will be affected by hedging strategy
iv/-use risk free rate
-need to use current rate – not at issue

Solution 13 – Canada only

a)
-EIA GMAV funded by bonds
  -low interest rates will make bond expensive
-index funded by call options
  -high stock market will make calls expensive
-consider lowering participation rate (% of index credited)
-increasing the margin
-allowing features to be reset annually
-lower cap on index rate credited
-change crediting strategy from point-to-point to averaging
-structure as a FPDA instead of an SPDA – lower percentage of premium
 in SNL formula
-credit lower rate if state allows
-all the above may make plan unattractive

b)
participation rate ↓
point to point =Min(((110/100)-1) * 70%, 6%) = 6%
↑ cap
averaging =Min(((105+108+95+98+110)/(5 * 100)-1) * 70%, 6%)
= Min(2.24%, 6%) = 2.24%

c)
-using highest would mislead the customer
  -would create unrealistic expectations
-should be based on best estimate of future assumptions
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-new indices have no historical experience
-need to show experience of indices that very similar
-should show alternate worse scenario
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-range of scenarios should be narrow enough to be representative
  -wide enough to avoid revisions

Solution 13 (continued) – Canada only

d)
i/- term is extended if it ↑ policy liabilities
-needs to be extended to at least the end of the index period
-are there constraints on the company on renewals
-can be extended to offset acquisition expenses
-value of future cash flow cannot be greater than acq. expenses
-must be locked in
ii/- scenario tested assumptions need no MfAD
- MfADs needed for all assumptions not scenario tested

-MfAD needs to increase the liability – otherwise sign of MfAD should be reversed
-decrease in index would likely decrease the policy liability
iii/-stochastic scenarios ranges should encompass prescribed scenarios
- reserve should be in CTE(60) to CTE(80) range
-need to run prescribed to see that worst is not greater than CTE(80)
-would need to recalibrate model

Solution 14 – US only

Only need to apply test to base contract since product does not have any riders or no-lapse guarantees(AV is not allowed to be negative)
If insurance benefits have explicit fee, that fee should be used in the test.
If there is no explicit fee, or fee does not capture substance of agreement, another method of determining assessments can be used
In this case, use COI plus interest margin since pricing was on an integrated basis and COIs alone are insufficient to cover DBs

First determine assessments & Excess DBs
SOP 03-1 liability required if amounts are first positive and then negative
Total assessment(t) = COI(t) + interest margin (t)
Calculated assessments 799, 861, 994, 1096, 1170
Test gain/loss(t) = total assessment(t) - excess DB(t)
Calculated gain/loss(t) 280, 220, 109, 15, -65
Have gains in years 1-4, followed by a loss.

SOP Reserve = SOPReserve(t-1)*(1+i)+(BR*Assessments(t)- ExcessDB(t))* (1+i)^.5
Assessments = COI + interest margin + expense charges
i = valuation discount rate = 5%
Benefit Ratio = Total PV Excess DB/ Total PV Assessments
Total PV Excess DB = 3697 = 519*(1.05)^-1 + 641*(1.05)^-2 + 884*(1.05)^-3 + 1081*(1.05)^-4 + 1235*(1.05)^-5
Total PV Assessments = 4219 = 799*(1.05)^-1 + 861*(1.05)^-2 + 994 *(1.05)^-3 + 1096*(1.05)^-4 + 1170*(1.05)^-5
Benefit Ratio = **3697/4219** = 0.8763
SOP Reserve (1) = 0 + (.8763*799-519)*(1.05)^5 = 186
SOP Reserve(2) = 186*(1.05)+(.8763*861-641)*(1.05)^.5 = 311

Solution 14 (continued) – US only

Original DAC Schedule
Estimated Gross Profits(EGP) = Mortality Margin + Interest Margin + Expense Margin + Surrender Charges
Mortality Margin = COIs - Excess DBs
Interest Margin = Interest Earned - Interest Credited
Expense Margin = Loads - Expenses = 0
Surrender Charges = 0 for this product

DAC(t) = (DAC(t-1)+DeferredExpense(t))*(1+i) - kfactor*GrossProfit(t)
EGP(1) = 280
EGP(2) = 220
DAC(1) = (0+250)*1.05 - .4792*(-210+490) = 128
DAC(2) = (128+0)*1.05-.4792*(-257+477) = 29

Updated DAC Schedule
Gross Profits now = Old Gross Profits - Increase in SOP Reserve
DAC(1) = (0+250)*1.05 - .5219*(280-186) = 213
DAC(2) = (213+0)*1.05-.5219*(220-126) =175

Impact of SOP = New DAC - Original DAC = 175 - 29 = 146 increase

Solution 14 – Canada only

to identify plausible threats to satisfactory financial condition
the financial condition is satisfactory if:
- throughout forecast period insurer is able to meet all future obligations under the base scenario and all plausible adverse scenarios
- under the base scenario it meets the minimum capital requirement
to determine actions which lessen the likelihood of those threats
to determine actions which would mitigate a threat if it materialized
to reflect the current business plan in the projected financial results of the company
to prevent insolvency by arming the company with info
to strengthen monitoring systems where company is most susceptible

(i)
- OSFI minimum required MCCSR ratio is 120%
- OSFI expects companies to maintain ongoing capital of no less than 150% of MCCSR ratio at all time

Tested scenario 1:
- MCCSR ratio deteriating from 165% in 2006 to 103% in 2010
- the actuary needs to report this scenario as one of the adverse scenarios since the MCCSR ratio falls below the minimum regulatory capital requirement during the projection period
- financial condition ok, if throughout forecast period, able to meet all future obligations under base scenario and all plausible adverse scenarios, and under base scenario, meets the min reg capital requirements
- only given 2 tested scenarios and not complete DCAT results, cannot determine if Company A's financial position is ok.

- at 2008, the MCCSR ratio drops to 144%.
- OSFI will be closely monitoring Company A and will demand actions taken to improve capital positon or even take control of the Company
- at 2009, the MCCSR rato drops below 120%.
- OSFI would take over control of the company if management action from 2008 not effective
- net income is a lot lower than base scenario, with net loss in 2009 and 2010. With low lapse rate, profitability is greatly impacted due to large proportion of products are "lapse supported"
- total capital required are higher for all projection years as compare to base scenario due to:
- higher mortality and lapse risk component as a result of higher NAAR (from higher survivorship)
- possibly higher C3 risk due to higher policy liabilities

- lower net income results in lower surplus in later years

Solution 14 (continued) – Canada only

Tested scenario 2:
- MCCSR ratios ranged from 174% to 160%
- MCCSR ratios remain at satisfactory level through out the projection period

- net income are slightly lower for all projection years due to lower reinvestment return
- this scenario is not reported as an adverse scenario

- if lower interest rate leads to higher policy liabilities the C3 risk, which is calculated based on policy liabilities will increase

- total available capital are slightly lower, possible explanation:
- slightly lower net income decrease surplus

(ii)
- Tested scenario 1 is the only unsatisfactory scenario among the two tested scenarios presented
- possible actions taken to improve MCCSR ratio:
- expand company product line by introducing new products such as UL, annuities or health product, diversify from "lapse supported" products, reduce income sensitivity to lapse rate
- reprice existing new business portfolio to reduce sensitivity to lapse rate and increase profitability
- slow or stop new product sales until reprice
- put capital raising plans in place
- use reinsurance to mitigate lapse risk
- if the lapse risk has reached unacceptable level to management, could sell off the line of business to other company
- control over non-variable expense levels

Solution 15 – US only

a) Mortality Margin – COI charges less benefit claims > P/H balances
Expense Margin – Contract charges less costs for administration
Investment Margin – Earned less credited interest
Surrender Charges
Other Charges

- Best estimate assumptions without PAD

b) Pre-tax Profit = Net Cash Flow + Increase in DAC – Increase in URL – Increase in Reserve

DAC Amort % = DAC Expenses/PV EGP = 8000 / 12,250 = 65.3%
DAC Amort = 65.3% * 1775 = 1159
Interest on DAC = DAC(2) * Credited Interest = 6500 * 0.065 = 423
DAC(3) = DAC(2) + Int on DAC – DAC Amort = 6500 + 423 – 1159 = 5763
Increase in DAC = DAC(3) – DAC(2) = 5763 – 6500 = -737

URL Amort % = Front End Load / PV EGP = 3000 / 12,250 = 24.5%
URL Amort = 24.5% * 1775 = 435
Interest on URL = URL(2) * Credited Interest = 2300 * 0.065 = 150
URL(3) = URL(2) + Int on URL – URL Amort = 2300 + 150 – 435 = 2015
Increase in URL = URL(3) – URL(2) = 2015 – 2300 = -285

Increase in Reserve = Reserve(3) – Reserve(2) = 91,240 – 93,125 = -1885

Pre-tax Profit = -381 – 737 + 285 + 1885 = 1052

Solution 15 – **Canada only**

a) Investment return model considerations

- Random number generator
- Number of scenarios should be at least 1000, test for acceptable level of precision
- Annual frequency may not be enough
- Model should be p-measure = real world
- Should not generate negative stock prices or interest rates
- Should have at least 2 parameters – drift and volatility
- Should be based on historical market data
- Construct and appropriate proxy for specific funds
- Calibration of investment returns

Liability model

- Product features – management expense ratios, contract guarantees, ratchets and resets, fund transfers, partial withdrawals, investment options, surrender charges
- In Force – seriatim vs. grouped
- Policyholder behavior affecting surrender, partial withdrawals, ratchets, future deposits
- Modeling of hedges – static or dynamic – PfADs should be established on conservative basis
- Modeling or reinsurance

b) Company A should use stochastic modeling for reserves and capital

- Better method for measuring segregated fund guarantees
- Complicated product with guarantees
- If using hedging strategy approved by OSFI, may reduce capital required

Company B should use factor approach for reserves and capital

- Product features are simpler
- Risk exposure lower due to lower guarantees
- Reinsurance helps to mitigate risk

Solution 16

a) Debt as capital source

Advantages
- Viewed as low risk, so owners expect lower rate of return
- Interest paid on debt is tax-deductible
- Good for supporting low risk capital needs
- Bond debt and bank debt are common sources

Disadvantages
- Too much debt can increase weighted average cost of capital
- Only available at holding company level
- If company fails to make interest and principal payments on time, company faces bankruptcy

Equity as capital source

Advantages
- Usually largest component of capital
- Sum of owner contributions and retained earnings
- Common and preferred stock do not have to be repaid

Disadvantages
- Equity is risky, so owners expect a higher rate of return
- Most appropriate for supporting high risk capital needs
- Only available at holding company level
- Must be wiped out before debt capital can be hit

b)

- Calculate cost of each source of capital and weight based on company's mix of capital
- Cost of equity is sum of risk-free rate and risk premium
- Cost of long-term debt is based on long-term interest rate at which company could borrow
- Since interest is tax-deductible, need to use an after-tax rate

Percentage of debt	=	294.4 / (294.4 + 184) =		61.5%
Percentage of equity	=	100% - 61.5%	=	38.5%
Cost of equity	=	risk-free rate + risk premium		
	=	5% + 7%	=	12%

Solution 16 (continued)

Cost of debt = Interest rate on debt * (1 - tax rate)
= 7.2% * (1 – 0.40) = 3.72%

Weighted average Cost of Capital = % debt * cost of debt + % equity * cost of equity

= 61.5% * 3.72% + 38.5% * 12% = 6.91%

- If GAAP ROE > WACC, unit is generating economic value
- If GAAP ROE > GAAP equity growth rate, unit is generating free cash flow
- Desirable to emphasize growth in profit centers that produce RoE > WACC

Equity Growth Rates

Center A	(37/23) ^ (1/5) – 1	=	9.98%
Center B	(17/11) ^ (1/5) – 1	=	9.10%
Center C	(74/57) ^ (1/5) – 1	=	5.36%
Center D	(139/93)^(1/5) – 1	=	8.37%
Total Co.	(277/184)^(1/5) – 1	=	8.53%

- Profit centers A and C are generating economic value
- Profit centers A, B, and D are consuming free cash flow
- Profit center C is generating free cash flow
- Total company level ROE > WACC, so creating economic value
- Total company level ROE < total company equity growth rate, so free cash flow being consumed
- Reduce investment in center B and D, or try to raise RoE
- Increase investment in center C