Question 1

a)

1. Aptitude – agents with above average skills and knowledge require less financing
2. Company training program – higher quality will reduce need for financing
3. Company and agency reputation – large, well-known, well-regarded companies will attract better agents and may require less financing
4. Commission schedule – more financing might be needed if commissions are levelized
5. Annualization of commissions – less financing needed if first year commissions are annualized
6. Personal circumstances – more financing may be needed it, for example, agent has many dependents
7. Company philosophy – level of compensation, experienced vs. green agents

b)

1. Variable Training Allowance Plan
   - Paid in addition to commissions
   - Encourages production, rewards high producers proportionately
   - Less expensive
   - Meets president's criteria of low cost and retaining good producers

2. Fixed Training Allowance Plan
   - Paid in addition to commissions
   - Does not vary with production
   - Does not reward high producers proportionately

3. Salary
   - Can be costly, especially if production is low
   - High producers not rewarded
   - Does not meet president's criteria

4. Advances
   - Lowest cost
   - Typically annualization of 1st year commissions

5. Line of Credit Plans
   - Income stable if debits and credits are constant
   - Costly to administer
   - Income may fall after agent comes off plan
   - Does not meet president's criteria

Questions 2 – 4 pertain to the case study.
Each question should be answered independently.

Question 2

a)

Determine death and lapse rates from random number S for each policy:
- if $S \leq$ pricing expected rate, then q = 1, otherwise q = 0
- assume death occurs before lapse, so check for death first

Policy 1: lapses in year 1
Policy 2: survives to year 3 then dies
Policy 3: survives to year 2 then dies
Policy 4: survives to year 2 then lapses
Policy 5: survives to year 2 then dies

b)

Value-based earnings are comprised of three elements:
- earnings on business in-force at the beginning of the year
- earnings on adjusted capital and surplus $\Rightarrow$ equals zero since free surplus is zero (given)
- earnings on new business issued during the year $\Rightarrow$ also zero since policies are inforce (given)

Value of business in-force = PV of future distributable earnings @ hurdle rate

Determine elements of product cash flow for Policy A/B:

	Year 1	Year 2	Year 3
Premiums, net of reins (90%)	A: 300*(1-90%)=30	A: 30 B: 30	A: 30 B: 0 (lapsed in yr 2)
Expenses (no acquisition since policies > 10 Years inforce)	A: 25 B: 25	A: 25*1.024 = 25.6 B: 25.6	A: 25.6*1.024 = 26.21 B: 0
Coinsurance allowances (23% from case study)	A: 300*90%*23=69 B: 69	A: 69 B: 69	A: 69 B: 0
Death benefits, net of reins (discount to BOY at 12%)	A: 0 B: 0	A: 0 B: 0	A: 100,000*(1-90%) / B: 0
Total Net Product CF	=60-50+138 =148	= 60-51.2+138 = 146.8	= 30-26.21 + 69 – 8,928.57 = -8855.97
Investment Income on CF + Res:	= 12% * (146.8 + 2*100*63) = 1529.76	= 12% * (146.8 + 2*100*72) = 1745.62	= 12% * (-8855.97 + 100*84) = -54.69
Increase in Reserve	A: 100*(72-63)=900 B: 900	A: 100*(84-72)=1,200 B: 100*(0-72)=7,200	A: 100*(0-84)= -8400 B: 0
Solvency Earnings (given tax = 0):	= 148+1529.76-1800 = -122.24	= 146.8 + 1745.62+6000 =7892.42	= -8855.97-54.69 + 8400 = -510.48
Investment Income on Required Surplus	A: 6%*100*5.50=33 B: 33	A: 6%100*6.50=39 B: 39	A: 6%*100*8.00=48 B: 0
Increase in Req'd Surplus	A: 100*(6.5-5.5)=100 B: 100	A: 100*(8-6.5) = 150 B: 100*(0-6.5) = -650	A: 100*(0-8) = -800 B: 0
Distributable Earnings	= 122.24+66-200 = -256.24	= 7892.42 +78 +500 = 8470.42	= -510.48 + 48 + 48 + 800 = 337.52

Value of inforce business at BOY 1 is the distributable earnings discounted at hurdle rate of 15%.

= -256.24 / 1.15 + 8,470.42 / 1.15^2 + 337.52 / 1.15^3

= 6,403.96

Value-based earnings in year 1 is the value of inforce business, multiplied by the hurdle rate:
= 6,403.96 * 15%
= 960.59

c)

Generally, value-based earnings should be calculated using assumptions based on recent experience

- May be appropriate to sue pricing assumptions if experience can be brought in line with pricing assumptions in a reasonable timeframe.

Adjusting for excess expenses involves the following four steps:

Calculate value of business inforce using pricing assumptions

Quantify the difference between pricing assumptions and current experience

Determine a plan of action to make the difference disappear over a relatively short period of time (e.g. 3-5 yrs)

- Saturn should take action to address the deteriorating lapse experience witnessed in recent years (1999 A/E was 120%) – correcting this will spread expenses over a larger unit base

- Could plan to reduce actual expenses

Deduct the PV of excess expense at hurdle rate from value of business inforce

- This step is optional ⇒ effect is to "reserve" for the excess expense

d)

Value of business in force using pricing assumptions is 6,403.96 (from part (b))

Quantify difference:

- current unit expenses are $50 per policy (given) ⇒ $100
- pricing expenses are $25 per policy (given) ⇒ $50
- difference is $50

Assume the difference is reduced linearly over the 3-year period, i.e.
Year 1: 50
Year 2: 33.33
Year 3: 16.67

PV = 50 / 1.15 + 33.33 / 1.15^2 + 16.67 / 1.15^3 = 79.64

Adjust value of business inforce at the beginning of year 1 by deducting the PV of excess expense
= 6,403.96 – 79.64
= 6,324.32

Reduce the value-based earnings from part (b) by the excess expense in year 1:
= 960.59 – 50
= 910.59

Return on value for year 1 is then the adjusted value-based earnings in year divided by the adjusted value of business inforce:
= 910.59 / 6,324.32
= 14.4%

c)

<u>Interest Rates</u>

T100 represents a significant long-term implicit interest rate guarantee

We are given (case study) that the long-term risk-free ROR has been in the 5% - 6.5% range in recent years

The pricing interest rate of 12% seems very aggressive given the current interest rate environment

This suggests there may be a risky investment strategy which may put company at unacceptable level of risk

We are given (case study) that Saturn is not known for its ALM expertise

Recommend reducing pricing interest rate to something much closer to risk-free curve (6-7% range)

Lapse Rates

Most critical pricing assumption
T100 is a lapse-supported product
Nonforfeiture value < natural reserve ⇒ profit on lapse
In Canada, earliest guidance came from CIA VTP#1 ⇒ ultimate lapse rate should rarely exceed 3%

Other considerations identified by CIA:

Market sophistication
Rational consumers will select against company (by not lapsing)
Saturn's primary markets are affluent families and affluent pre-retirees ⇒ should expect lower lapses

Issue Age/Lifestyle
Replacement of coverage for younger insureds more prevalent due to changing needs/lifestyles

Insurance needs well-defined for older insureds ⇒ less likely to lapse

Saturn's primary markets are pre-retirement age ⇒ may justify higher lapse assumptions

Insured Annuities/Back-to-Backs
T100 premiums funded by immediate annuity on life insured

Guaranteed source of income to pay premiums ⇒ lapse should be close to zero

Saturn does not offer immediate annuities, so they are less exposed to this risk ⇒ may justify higher lapse assumption

Quality of Sale/Distribution Channel
Large cases may have better persistency, although they may be shopped around more

A growth in T100 sales through Saturn's new direct channel may justify higher lapses as there is limited policyholder service

Saturn's predominantly brokerage operation may expose them the company to more sophisticated markets, but also to more replacement activity

Levelized Commissions
More financial incentive to broker to keep policy inforce

No specific information given on Saturn's commission pattern, however, the high acquistion expenses (175% of FYP) suggests commissions are not levelized $\Rightarrow$ May justify higher lapse assumption

Ultimate pricing lapse rate is 7% $\Rightarrow$ this is significantly higher than the CIA recommended maximum of 3%

There are a number of considerations pertaining to Saturn Life which may justify higher lapse rates than average, but lapse rate should still be at or below 3%

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Questions 2 - 4 pertain to the case study
Each question should be answered independently.

Question 3

a)

Non-loaned rate = 5.45%
Fixed loan rate = 8.0%
Variable loan rate = 8.3%

Under direct recognition, dividend reflects level of policy loans at the policy level.
Under aggregate approach, policy loan interest and balance are included in dividend interest rate for all policies.

Dividend interest rates for both variable loan and fixed loan policies are currently higher than non-loaned dividend scale.
For policies with large loans, switch to aggregate approach will result in a decrease in dividend scale.

b)

Mortality:

- Increased underwriting for option will lead to lower expected mortality
- Increased coverage amount will lead to lower expected mortality
- From 1995-1999, actual to expected mortality ratio shows deteriorating trend

Current mortality experience assumption may be appropriate for pricing new option.

If term conversations are included in mortality study, no adjustment to mortality assumption needed.
If conversion costs included in term pricing, should include a conversion cost in pricing of new option.

Anti-selection is increased in later durations with ART premiums, so need to adjust for selective lapses.

Lapse:

- Lapses usually occur on premium dates
- Lapses "skew" assumption will be different for dividend option than for base plan
- Slope of renewal rates will impact lapse rates in later years
- Increase coverage amount may lead to higher later lapse rates

May want to use term assumptions rather than par whole life assumptions

c)
i)

Need to consider policyholders' reasonable expectations, based on:

- Contract provisions
- What company has done in the past
- Agent and marketing representation
- Communications with policyholder

Must consider impact of various interest scenarios on liability and asset cash flows
Base interest scenario should reflect current investment structure

PADs are added to provide for uncertainty in assumptions
PADs generally smaller for par than for non-par

Expected dividends are included in projected cashflows
Valuation dividend scale includes both regular and termination dividends, but not ownership dividends

c)
ii)

- New dividend options have approximately the same value, can recognize cash equivalent
- May need to value one year term portion of coverage as is

Change to aggregate loan recognition

- Base interest scenario should reflect impact of policy loans
- Asset cash flows should be updated to reflect policy loans
- Valuation dividend scale should be updated to reflect impact of policy loans
- Any adjustment for loans at policy level should be removed

Question 4

a)
All of the following should be male/female and nonsmoker/smoker distinct:

Premium rates
Mortality rates
Morbidity rates
Termination rates
Substandard extra waiver premiums

Limit coverage to 60/65 – too hard to distinguish between disability and retirement at older ages

Premiums used – should be net cost – adjust for commission and premium tax

Interest – long-term conservative rate – 10% too high

Mercury's available risk free rates show 10% not conservative

Mortality – better to use pricing mortality of the base plan

Lapses – may use lapses from the base plan
May be conservative not to use any lapse rates

Average size – Average size of Mercury's par products 100,000 – so 50,000 may be a poor choice

Morbidity rates – if possible adjust intercompany rates for company experience

Termination rates – if not enough data available use intercompany
Usually monthly first couple of years
Check to be sure the 60-day waiting period is what is used in Mercury's Rider

Recovery – 0% as few people recover from disabled status beyond retirement

Substandard – Limit to least substandard risks

b)

Most UL flexible premium – hard to determine what amount should be waived
Choices:
Waive monthly deductions
Waive all deductions for mortality/expenses/extra riders
Specific amount that would keep policy in force if guaranteed interest and charges were applied – this amount may not have any relationship to the premium paid

Question 5

a)

The amortization of the DAC is based on estimated gross profits (EGP)
EGP's are driven by the spreads relative to the fund values
Fund values are driven by investments, which may be volatile
When investments fall (or rise), you could experience a reduction (or increase) in your EGP's, triggering significant catch-up adjustments in DAC and impacting GAAP earnings during 'unlocking'
The corridor provides a smoothing mechanism for the amortization of DAC, thus smoothing GAAP earnings

b)

Capitalize those expenses that vary with and directly related to production of new business
Usually includes initial commissions and renewal commissions in excess of ultimate service commissions
Usually include underwriting and issue expenses
The 'k' factor cannot exceed unity at issue
If it does, reduce deferrable expenses to point where k = 1. Don't set up DAC if k is negative.

c)

You will need to create a probability distribution for the movement of equity returns given current returns
Need assumptions to govern these returns: long term means and variances if equity returns (based on historical results)
Need assumptions regarding whether funds can be modeled separately or in aggregate (and interrelationships)
Assumptions for investment expenses

d)

Considerations for ASP 23 – Data Quality
Need to be aware of original source/use of data
Is it appropriate for use in this model
Can we rely on this data
But should check for reasonableness, comprehensiveness and consistency
Are there limitations on data – imperfections
Would they result in a material bias
Report should be prepared documenting above

e)

ASP 21 – Actuary's responsibility to Auditor applies, as we are contributing elements used in the financial statements

We need to disclose in reports
- Data sources, processes, assumptions, method
- Suitability/appropriateness and conclusions
- Relationships with client

Respect confidentiality
Work with should be documented so another actuary can follow
Keep documentation in safe custody for reasonable time

f)

Embedded value = PV (Distributable Earnings) at hurdle rate
Hurdle rate may be cost of capital (possibly based on product risk)
Start with profits from model and make adjustments for
- Distributable earnings
  - Need required capital, investment on return on capital

Question 6

a)
Units purchased = (Premium * (1 – Load) * Investment %) / Unit Value
Account Value = Total Units * Unit Value

Date	Units Purchased in A	Units Purchased in B
1/1/96	750 * .95 / 5.5 = 129.55	250 * .95 / 17.5 = 13.57
1/1/97	750 * .95 / 7.0 = 101.79	250 * .95 / 16.5 = 14.39
1/1/98	750 * .95 / 89.06	250 * .95 / 17.5 = 19.00

Surrender charge 1/1/2000 = 6%

Gross Withdrawal = Net Withdrawal * Investment % / Unit Value

Units Sold of A = 531.91 * 0.5 / 9.25 = 28.75

Units Sold of B = 531.91 * 0.5 / 15.00 = 17.73

1/1/2001 Total Units of A = 291.64
Total Units of B = 29.23

Account Value = 291.64 * 11 + 29.23 * 16.5 = 3690.43

b)
Initial payment

Stock A: 10000 * 7.00 * (50 / 1000) = 3,500.00
Stock B: 1000 * 16.50 * (50 / 1000) = 825.00

Total initial Payment = $4,325.00

NIF = Ending Value / Beginning Value

Payment (t) = Payment (t – 1) * NIF / (1 + AIR)

On 1/1/1998:

Stock A: 3500 * (8 / 7) / 1.03 = 3883.49
Stock B: 825 * (12.5 / 16.5) / 1.03 = 606.80

Payment on 1/1/1998 = $4,490.29

On 1/1/1999:

Stock A: 3883.49 * (7.5 / 8) / 1.03 = 3534.73
Stock B: 606.80 * (12.5 / 12.5) / 1.03 = 589.12

Payment on 1/1/1999 = $4123.86

Question 7

a)

Reinsurance
Shifts risk, required capital, assets, liabilities, capital, earnings
Expense allowance lowers capital requirements allowing for more new business
Stabilizes earnings
Beneficial effect on taxes
Reinsurance is quicker and has a lower cost versus debt

Debt
Interest paid on debt is tax deductible in some jurisdictions
Low risk capital and may require a lower rate of return for investors
Good for backing low capital needs (excess reserves)
The more money is borrowed, the greater the risk of failure, the higher the cost of borrowing and rating agencies may decrease ratings.

Surplus Notes
Viewed as equity for solvency purposes
Viewed as debt by rating agencies
Similar to bond debt, except payments are subject to ongoing regulatory approval
If regulators prevent payments, company is not in default

b)

i)

An investment of 385 million with an ROI of 13% produces earnings of 59 million.
Reinsurer requires 46% of annual earnings = 13 million

After reinsurance
ROE = (50 – 13) / (385 – 128) = 14.4%
Reinsurer's ROE = 13 / 128 = 10.2%

ii)

before
debt
earnings = 600 million, ROE = 18%, equity = 3,333.33 million
debt = 3,333.33 * (.4 / .6) = 2,222.22 million

after bond offering
new debt = 2,222.22 + 1152 = 3,374.22 million
new equity = 3,333.33 – 1,152 = 3,181.33 million
after tax earnings = 600 – (.055) * 1,152 = 536.6 million
ROE = 536.6 / 2,181.33 = 24.6%

Questions 8 – 10 pertain to the Case Study.

Question 8

Part A

1. Geographic
   Region, city versus rural, ...

2. Demographic
   Age and income

3. Psychographic
   Lifestyle, values, ...

4. Behavioral
   Frequency using a product feature...

Part B

Mercury Life chose demographic segment – affluent, pre-retired and retired

Advantages
Common approach and easy to identify
Preferences are associated with demographic variables
Affluent buyers are likely to buy larger policies and have better persistency

Disadvantages
Income and wealth do not always predict best customers
People in same demographic have very different personalities and values
Affluent buyers are more demanding and tend to shop for best price

Part C

Need more product options to achieve goal of more products per insured
Products are good fit for affluent market and bank distribution
Already has experience with simple annuity product
Annuity sales have been declining

i)

SPDA with bailout
Need to test sensitivity of bailout and determine appropriate spread
Popular when interest rates fall because customer can surrender without charge

ii)

SPMVA Annuity
Complicated administration
Protects company from disintermediation risk
Reduces surrenders, lowers capital requirements, and lowers required stat reserves

iii)

EIA
Very complex pricing
Complicated administration
Will help compete with variable sales without SEC requirements
Complex investment required, including options for hedging

Part D

SPDA
Declining surrender charge over 10 years in consistent with market
SC must meet regulatory and competitive needs
SC is too high relative to commissions
I recommend grading from 7% to 0% over a seven-year period
10% fpw common in market
Could guarantee rate for 1 to 3 years
Should reduce guarantee rate from 4% to 3% to reduce risk and be standard in industry
Bailout rate set at current credited rate is too expensive
    Will force reduction in credited rate (or profits)
    Should set 1% to 2% below current credited rate

SPMVA Annuity
Declining surrender charge over 7 years in consistent with market
SC must meet regulatory and competitive needs
SC is too low relative to 10% commission
    Company exposed if customer lapses early
Should make MVA period the same as the guar interest rate period
    If do not, then consider shock lapses after 5 and 7 years
Should have multiple guarantee periods to compete in MVA market
The MVA formula is standard except:
    "b" should be a rate based on the remaining period
    "c" should be between .0025 and .005
10% fpw common in market
    Clarify if cumulative and if MVA applies

EIA
Should use S&P 500 because more recognized and more liquid options
Index period could be longer (7 to 10 years) because stocks are long term inv.
Participation rate is most visible feature
    Guaranteeing for index period is normal, but must carefully hedge
High water index return is expensive, but has market appeal
    Could use a form of averaging to reduce option cost and increase participation
Guarantee minimum is market standard
Make sure commission is competitive enough for distribution
    Trailer commission formula is too complex; make just % of account value
10% fpw common in market, but could make hedging more challenging

Part E

ML profit objectives:

Return on surplus > 10%, profit margin > 5%, break even year < 10 years

Problems with ROI

Blows up if all years profitable

Too high if real small loss in first year

Later year losses produce multiple ROIs

Should always use more than one pricing measure

One measure does not capture all the risks

Other common pricing measures

ROA, surplus strain, ROE, profit as a % of reserves or revenue

Question 9

Lapse Rate

Should not be level

Should be lower in surrender charge period and then there should be a shock lapse rate at the end of the SC period

Lowering lapse rate assumption will increase death benefit cost

Volatility

This is way too low

Should be based on implied volatility which is more like 30%, not on historical volatility

Changing this assumption will have a major impact on death benefit cost

Will increase with volatility

This is one of the most important assumptions

Age of Owner:

45 seems a bit young, something like 55 would reflect better annuity market

increasing the average age will significantly increase the cost

Average Asset Return

8% seems reasonable
increase the return would decrease the cost

Mortality

100% of 1983IAM is high
May want to reduce to something more like 80%
This will decrease the cost, since q_x will be lower and less death benefit will be paid

Surrender Charge

This schedule is reasonable and in line with industry

However should be a % of premium rather than Account Value because if market drops surrender charge would stay level

Better for companies and industry standard

% if premium instead of % of AV would increase profits if market downturn and lots surrender

Death Benefit

5-year ratchet, no age limit

not competitive

should put an age limit (e.g. 80)
this will limit cost

Could add a roll-up of premiums guaranteed

Consider annual ratchet instead of 5 year

These items increase the Death Benefit cost

Conclusion

The death benefit is not very generous and the assumptions used are too generous

Making most of the above changes increases the cost of the Death Benefit, but reflects appropriate pricing

Should not offer a GMDB if it cannot be supported

Consider charging for GMDB (additional M&E charge)
This would reduce the net cost

Consider reinsuring to allow a better benefit

In general, the assumptions are very aggressive and death benefit not competitive
Cannot do much here to lower cost of death benefit and improve the DB feature to be competitive

Question 10

a)

The listed attach strategies are those of a market challenger; Mercury Life.

Frontal attack – attack the PPG head on matching product, advertising, distribution. To be successful in a frontal attack, one needs to have 3 to 1 resources against their attacker. Mercury Life has excellent brand value and name recognition that can be used in this attack. They are also financially strong and have a well-trained field staff.

Environmental Strategy – surround the competitor in an attempt to choke out an area or resource. Mercury could target a line or segment of banks that PPG currently services and take over this segment by targeting an area where they are currently strong such as older, wealthier areas.

Product Proliferation – develop several products on types of life and annuity products, specifically at the banking industry. Creating a variety of products to meet the needs of a variety of users could edge PPG out as they are limited in the products they offer to those with affiliated insurance companies. They also don't have the product/insurance knowledge to target the needs of their customers.

Product Innovation Strategy – Similar to product proliferation where variations of existing products were created, product innovation creates products specifically for the banking market to fit the customer's needs. These could be straightforward, easily underwritten, savings oriented products. PPG would not be able to come up with such creative ideas with their lack of insurance knowledge.

Improved Service Strategy – Mercury has a highly productive, well-trained field staff. This staff could work with the banks to extend knowledge as to how the banks could offer more to their clients. They can offer investment experience and underwriting knowledge. Coordinating efforts with Mercury Life could give improved name recognition and financial strength to the banks as Mercury is a very highly rated company.

Distribution Innovation Strategy – banks could distribute the life and annuity products directly through their own staff, trained staff, or Mercury Life's agents working in the banks or they could distribute the products indirectly by having Mercury Life contact the potential insureds directly. The direct approach would be more competitive as PPG currently works off lists of customers. Mercury should be able to offer the products in a more timely manner as they are not acting as a middleman as PPG. Because of this they should also be able to offer their products and services at better prices for the banks or customers. Mercury Life could also use telemarketing or internet to attract sales.

b)

Evaluate the Decisions and Dynamics of using PPG, Inc.

Existing agents are better trained to sell Mercury Life's product

Some customers might value Mercury Life's brand value and reputation

Is it possible that PPG, Inc. could sell more?

PPG, Inc. has marketplace knowledge which Mercury Life would need to build from scratch

Estimate the cost of selling different volumes through each channel

Compare compensation levels for PPG, Inc. and existing agencies.

Comparison should include any expense allowances

Overrides

Commissions paid to banks

Evaluate the vertical conflict

ML and PPG, Inc. might have incompatible goals

PPG, Inc. may not master the details of ML's products

Is PPG, Inc. willing to cooperate

PPG, Inc.'s reputation

The number and characteristics of other companies that PPG, Inc. represents

Evaluate the potential for multichannel conflict

Multichannel conflict can occur when a company has two or more channels that serve the same market

Some person may be approached independently by an ML agent and PPG , Inc

Question 11

a)

i)

Survey Consumers

- Conduct consumer focus groups
- Collect data via questionnaire on consumer demographics, attitudes toward income annuities, etc.

ii)

Analyze Data Gathered

- Use factor analysis to remove highly correlated variables
- Apply cluster analysis to create different segments

iii)

Profile Consumers

- Profile clusters, looking at demographics, media patterns, etc.
- Give each segment a name based on its dominant characteristics

b)

Pricing Considerations for Medically Underwritten SPIA v. Non-Underwritten SPIA

Pricing Considerations:

- Underwriting acquisition expense
- Commissions
- Premium Tax
- Administrative Expenses
- Mortality
    - Modify income annuity mortality assumption to reflect information gained through underwriting
    - Need gender-distinct mortality rates
    - Reflect realistic mortality with some margin for potential mortality improvement using projection factors
    - Statutory Surplus Strain
        - Solvency reserves will exceed pricing or economic reserves
        - First year increase in reserve usually greater than premium collected
    - Federal Income Tax
    - Cost of Capital
    - Interest Rates used to discount projected benefit payments

Pricing Similar to Non-Underwritten SPIA except:
Medical underwriting expense
Expected mortality will be different

Benefit payment pattern

c)

Methods for Modifying SPIA Mortality for Substandard: Appropriateness of each method with respect to pricing, solvency-based and income-based reserves.

Methods for modifying mortality given a reduced life expectancy of n years:

Constant Multiple Mortality

- Solve for a constant multiplier applied to standard mortality such that resulting life expectancy is n years
- Maintains the level of extra mortality at all durations, even though mortality for some impairments may improve
- For pricing, need to use realistic assumptions like the one this method produces
- Solvency-based reserves are conservative to allow regulators to monitor company financial health; defers profits
- Income-based reserves allocate profit to period earned, use realistic assumptions to set

Rated Age Mortality

- Increase issue age until life expectancy at the modified use age in n years
- Maintains the level of extra mortality at all durations, even though mortality for some impairments may improve
- Most common method used to price substandard annuities – easy to administer and produces reasonable premium rates
- For solvency-based reserves, you could reach the end of the valuation table if mortality improves – not the best method for this reason

Constant Extra Deaths Mortality

- Determine the constant addition of deaths per 1000 to standard mortality such that resulting life expectancy is n years
- Produces the highest initial level of mortality that grades to standard mortality at the end of the valuation table.
- For solvency-based reserves, this method is most appropriate since mortality conservatively grades to standard
- Not good for income-based reserves, since pattern of mortality is not realistic

d)

Stochastic Methods to Evaluate Mortality Risk

Seriatim Stochastic Modeling

- Step 1: Select distribution function (not needed for Seriatim)
- Step 2: Choose a random number generator & generate a random number S

between 0 and 1

- Step 3: If S is less than or equal to the probability of death, then the life dies and qd is set equal to 1; otherwise, qd = 0

Binomial Stochastic Modeling

- Can use one random number to determine stochastic outcome for n policies at once
- Step 1: Select distribution function: create Binomial cumulative distribution function F(x) for the number of deaths x in the period based on n policies in force
- Step 2: Choose a random number generator & generate a random number S between 0 and 1
- Step 3: For $F(x-1) < S \leq F(x)$, then x is the number of deaths and qd = x/n

Limitations of Stochastic Modeling

- Hard to model multiple policies on the same life – could have different issue ages
- Hard to model simultaneous accidental deaths on joint policies

Question 12

a)

Several strategies which ABC Life could employ if it is a market leader

- Maintain price, believing it would not lose too much profit or market share, and could regain market share if necessary
- Maintain price and add value by improving product, services or communication
- Reduce price, if no enhancements can be implemented. ABC would hope that costs would fall with volume changes, although it would lose market share because market is price sensitive, and it would be hard to rebuild once lost
- Increase price and improve quality
- Launch a low price fighter product to compete on price and retain current product

If competitor has the preferred product, ABC would need to add this feature to remain competitive.
ABC could be selected against if they stay with the current product.

b)

The critical assumptions to develop preferred underwriting are:

- Determine discount aggregate to apply to aggregate mortality

- Keys are
  - the aggregate mortality rate used,
  - screening tools, such as para-med, and blood profile,
  - strictness and level of criteria used to qualify for preferred and
  - the company's practice on underwriting exceptions

- Another consideration is the percentage of applicants desired to qualify
  - with stricter underwriting, the discount can be greater
    - e.g. from 5% to 30%, with most companies in the 10% to 20% range

- Percentage expected to qualify
  - ABC will decide where it wants to fall in the range and then determine criteria
  - A lower percentage will increase the competitiveness of the rate
  - there could be pressure on ABC to make exceptions
    - If faced with producer and applicant dissatisfaction with lower % assumption

- A higher than expected Not Taken rate will result in higher expenses

- If the percentage to qualify is high the rate may not be very different than the aggregate rate

Question 13

Definition

- An analysis of the adequacy of reserves and related items in light of the assets supporting them, to meet the obligations of an insurer.

Considerations

- Type and depth of asset adequacy analysis will vary with the nature of the risks
- May use a single analysis for reserves in the aggregate or a number of analyses for each of several blocks of business

Analysis Methods

1. Cash Flow testing
   - Generally appropriate for products and/or investment strategies where future cash flows may differ under different economic or interest-rate scenarios

2. Demonstrate the block of business being tested is highly isk-controlled or the reserve basis is so conservative that reasonably anticipated deviations from current assumptions are provided for.

3. Gross premium reserve tests
   - May be appropriate if business is not highly sensitive to economic or interest rate risks, but is sensitive to obligation risk.

4. Loss Ratio Methods

Assumption Bases

1. Adaptation of company experience or industry studies.

2. Use of a determininistic scenario or set of scenarios.

3. Statistical distributions or stochastic methods

- Assumption bases chosen should be suitable for the business and risks involved.
- The number and types of scenarios tested should be adequate.

Modeling

- Generally based on in-force mix, asset mix, current yields, investment policy, etc.
- May be based on data that predates the valuation date.
  - If based on a date prior to the valuation date the actuarial memo should state that the appointed actuary has:
    - confirmed the reasonableness of this data; and
    - is satisfied no material events have occurred prior to the valuation date that would invalidate the analysis

Use of Prior Studies

- May be based on asset adequacy analysis performed prior to the valuation date
  - If based on a date prior to the valuation date the actuarial memo should state that the appointed actuary has:
    - confirmed the reasonableness of this study; and
    - is satisfied no material events have occurred prior to the valuation date that would invalidate the analysis

Testing Horizon

- Should test over a period that extends to a point at which reserves on a closed block are immaterial.

Completeness and Consistency

- Analysis should consider all anticipated cash flows.

Question 14

Report

- Identification of the actuary (qualification)
- Relationship with the organization being audited
- The scope of the activity
- Signature of the actuary
- Disclose any deviation from standard
- Should document the procedure, assumption, tests, evidence and
    - Test in agreement with company's record
    - Show co-ordination with the auditor
    - Resolution to exceptional, unusual matters
- Should disclose source of data, assumptions, and methods used and appraise their suitability

Method

Take into account the average number of days from death to date of notice and expected death claims

Test performed

- To see the smoothness of total paid claims in cash + change in pending claims + change in IBNR from time to time
- Check any catastrophic event to see if need additional consideration
- Test change in average reporting lag for previous years to see if there is major change
- Test the average death claim amount for previous years to see if it is stable, smooth
    - Can also check the variance for claim amount to see whether it's volatile or not

Question 15

a)

GAAP Equity (GE) = Statutory Reserves
+ Statutory Surplus
- GAAP Benefit Reserves
+ GAAP Deferred Acquisition Cost Asset

GE (2001) = 23.1 + 51.7 + 10.3 – 6 = 79.7
GE (2002) = 50.5 + 117.2 + 61.8 – 9 = 210.5
GE (2003) = 80.2 + 187.7 + 166.6 – 39.2 = 395.3

GAAP ROE = Gaap net Income / GAAP Equity

GROE (2001) = 5.1 / 790.7 = 6.4%
GROE (2002) = 12.3 / 210.5 = 5.8%
GROE (2003) = 20.2 / 395.3 = 5.1%

Three-year ROE geometric average = $\left[(1.064)(1.058)(1.051)\right]^{(1/3)} - 1 = 5.8\%$

Since the three-year ROE < Cost of Capital

This project will destroy economic value. It should not be undertaken.

b)

Limit maximum exposure on any one life
Partner with reinsurer to obtain

- Underwriting guidance
- Pricing guidance

Could write new business faster than capital would otherwise support

- Use expense allowances
- Reserve credits

Reduce mortality fluctuations