DP-IU and DP-IC Complete Illustrative Solutions
November 2008

*All solutions apply to both United States and Canada unless otherwise specified.

1.   **Learning Objectives:** 1
Learning Outcome: 1B
Source: Macro Pricing: A Comprehensive Product Development Process;
                                 pages 12-16
Cognitive Skill: Recall, Analysis, Application

Solution:
(a)   Project-based analysis:
   1   Allows the use of common sense
   2   Factors in the effect of a change in demand – expected production is taken into account
   3   Takes into account the cost of development including startup costs
   4   Recognizes the total impact to the company (profit)
   5   Shifting of incentives for both actuarial and marketing – no longer political reasons for choosing price, purely economic
   6   Provides best chance for reaching optimal price

(b)   Price $= p$

$$f(p) = 40,000,000 / p^2$$

Profit = Revenue – Marginal Expenses – Non-marginal expenses

$$= p * f(p) - 150 * f(p) - 50,000$$
$$= 40M * p / p^2 - 6000M / p^2 - 50,000$$
$$= 40M / p - 6000M / p^2 - 50,000$$

Take the derivative of the above and set equal to 0

$$f'(p) = -40M / p^2 + 12000M / p^3 = 0$$
$$12000M / p^3 = 40M / p^2$$
$$12000M = 40Mp$$
$$p = 300$$

Optimal price $= 300$
Sales value $= f(300) = 40M /(300)^2 = 444.44$ units
Profit $= 300 * 444.44 - 150 * 444.44 - 50000 = 16666.66$

2. **Learning Objectives:** 6E – Equity Indexed Annuities Product Design & Pricing
Considerations; Understand the relationship between product design and selection of appropriate assumptions for pricing the product.

Learning Outcome: How assumption setting reflects investment strategy e.g., hedging
Source: ILA-D-102-07 (Equity Indexed Annuities: Product Design and Pricing Considerations)
Cognitive Skill: Application, Recall, Synthesis

Solution:

(a)   Index Based Interest Budget = Premium – PV of GMAV Costs – PV of Expenses and Profit

$$= 1000 - 1000 * 87.5\% * (1.03)^{10} / (1.05)^{10} - 100$$
$$= \$178.08$$

(b)   Static Hedging
          Buy and hold strategy purchasing over the counter options
          Purchase Call-Spread option on the index
                  Purchase a plain vanilla call option
                  Sell a call option with strike equal to the cap rate
          Need to determine funding ratio
                  Funding generally < 100% due to lapses and mortality
          Requires economies of scale due to high costs of low OTC volumes
          No guarantee the dealers will want to deal at low volumes
      Dynamic Hedging
          Required monitoring of the Delta and other Greeks
          Delta = expected change in price of derivative given change in price of underlying security
          Requires constant monitoring of portfolio and recalculation of Delta
          Fully funded if Delta * Notional Amount is held
          Cost of hedge is sum of resulting small losses
          Cost is unknown until the end of the hedging period
          Balance required between higher rebalance frequency and transaction costs
          Does not provide downside protection, whereas EIA guaranteed not to go negative

(c)   (i)   Lower interest rates put strain on EIA funding
               Greater amount of premium required to fund GMAV

       (ii)   Higher volatility increases call option prices
               Longer time period to maturity, the more volatility affects option prices

       (iii)   Lower participation rate
               Introduce a margin
               Introduce a cap
               Shorten guarantee period
               Allow participation rate or cap to be reset periodically
               Change index growth measurement to averaging to smooth volatility

3. **Learning Objectives:** 1, 2, 6, 7
Learning Outcomes: 1B, 2(A, B, D, E, F), 6(A, B, C, D), 7(A, B)
Sources: LOMA (Ch5 pg 113-115, Ch14 pg 309-311), A&D (Ch5 pgs 277-285 & 300-301, Ch11 pgs 525-526, Ch3 pg 129 & 203-204 & 208-210)
Cognitive Skill: Recall & Application

Solution:
(a) Mortality Assumption should include underwritten experience, so Group Life experience should not be used.

Type of People Buying the Products Are Dissimilar
Personal risk factors
Environment risk factors
Location risk factors
Quality, accessibility, cost, and extent of available medical care
Cultural differences
Wars, armed conflict, epidemics, natural disasters

Underwriting with Multiple Risk Classes vs Simplified Underwriting
Change to Underwriting Practices or Different Underwriting practices by product
Smoker vs nonsmoker classes
Level of medical underwriting used
　　Medical
　　Paramedical
　　Nonmedical
　　Simplified Issue

Aggregate
- rates vary only by attained age
Select
- rates vary by issue age and policy year
Select and Ultimate
- rates vary by attained age, issue age and policy year

(b) Full cost/fully allocated expenses
-All co exps are allocated so that @ proper units total co exp reproduced
Too much focus on including full costs rather than the customers
Results in products priced too high or too low
When costs are too high co focuses on lowering costs expecting to become
　　competitive not realizing that the competitors are also working to lower costs
Relevant cost/marginal expense pricing
-the co allocates only relevant costs that are affected by changes in sales
The average variable cost may not be the incremental cost of the next unit
Including depreciation expenses that may vary greatly from year to year
Treating a single cost as all relevant or irrelevant
Ignoring opportunity costs

3. **Continued**

(c)   Profit margin $= [\text{Prem} - \text{Prem}(\text{Acq Exp\%Prem} + \text{Comm}) - (\text{Acq Exp Per Pol}) -$

$(\text{Maint Exp Per Pol}) - (DB)q(1/1.075)^{(½)}]/\text{Prem}$

Profit margin $= [400 - 400(5\% + 10\%) - 40 - 10 - (1,000,000)(0.00005)$

$(0.9645)]/400 = [400 - 60 - 40 - 10 - 48]/400 = 242/400 = 0.605$

Premium margin = PV of the change in prof from a 1% change in prem/PV of a
1% change in prem

Premium margin $= \{[404 - 404(5\% + 10\%) - 40 - 10 - (1,000,000)(0.00005)$

$(0.9645)] - [400 - 400(5\% + 10\%) - 40 - 10 - (1,000,000)$

$(0.00005)(0.9645)]\}/(404 - 400) = \{[404 - 404(5\% + 10\%)] -$

$[400 - 400(5\% + 10\%)]\}/4 = [4 - 4(5\% + 10\%)]/4$

$= (4 - 0.6)/4 = (1 - 0.15) = 0.85$

(d)   (i)   Current Value – value of transactions with co. and cust. assuming current
pattern continues

Potential Value – the realized value based on increased sales/spending
and/or reduced exp.

(ii)   A = Retain

Retain Customers but be careful about future investment in them

B = Develop

Develop and maximize the future profits represented by these customers

C = Maintain

Goal is to minimize or eliminate the drain on resources and profitability

D = Nurture

Goal/strategy is to improve profitability

(iii)   PV Prof as % Prem $= [\text{Prem} - \text{Prem}(\text{Acq Exp\%Prem} + \text{OH Acq}$

$\text{Exp\%Prem} + \text{Comm}) - (\text{Acq Exp Per Pol} + \text{OH Acq Exp Per Pol})$

$-(\text{Maint Exp Per Pol} + \text{OH Maint Exp Per Pol}) - (DB)q(1/1.075)^{(½)}]/$

Prem PV Prof as % Prem $= [400 - 400(5\% + 2.5\% + 10\%) -$

$(40 + 10) - (10 + 5) - (1,000,000)(0.00005)(0.9645) = [400 -$

$70 - 50 - 15 - 48]/400 = 217/400 = 0.5425$

Current Value $= [(\text{GL Prem})(\text{GL PV Prof as\%Prem}) + (\text{UL Prem})$

$(\text{UL PV Prof as \% Prem})]/\text{COC}$

Current Value of Dist Chnl $= [(60 \times 0.0075) + (40 \times 0.015)]/0.15$

$= [0.45 + 0.60]/0.15 = 7$

Potential Value = (Term Prem)(Term PV Prof as % Prem)/COC

Potential Value $= (25 \times 0.5425)/0.15 = 90$

RKA Life is in D, Nurture.

3. **Continued**

(e)   Market Penetration
       -same product and same market
       Market Development
       -same product and new market
       Product Development
       -modify existing/related new product and same market
       Horizontal Diversification
       -new/unrelated product and same market
       Concentric Diversification
       -modify existing/related new product and new market
       Conglomerate Diversification
       -new/unrelated product and new/unrelated market
       RKA Life is using product development since it is a related new product and the
              same distribution.

4. **Learning Objectives:** 8A, B

Learning Outcome: Price products with different features including embedded option (conversion privilege) and identify the most influential assumptions for the particular feature.

Source: ILA-D105-07

Cognitive Skill: Recall & Application

Solution:

(a)   Cost is borne by those who exercise the option
- Cost of option is not included in base premium

Cost is borne by those who want the option available
- Premiums are charges until the option is used

Cost is borne by all policyholders no matter if they use the option or not
- Dilutes the cost

(b)   Coverage utilization rate
- Percentage of insureds who exercise the option

Average percentage of face amount converted

Lapses
- Tends to be lower after people exercise the conversion option

Mortality
- Mortality post conversion most likely includes anti-selection

(c)   Cost of option in year 7 = Cost of option elected in year 7 + cost in year 7 for options elected in prior years

Cost of option elected in year 7 = Reserve credit + (option expense/average size) × number of conversions/radix

Cost in year 7 for options elected in prior years = Sum of [(number of conversions/radix) × % face amount converted × option charge]

Cost of option elected in year 7 $= 9 \times 0.75 + (157/100) \times (30/1,500) = 6.78$

Cost in year 7 for option elected in prior years:
Year 5 $= (20/1,500) \times 0.75 \times 2 = 0.02$
Year 6 $= (30/1,500) \times 0.75 \times 4 = 0.06$
Total cost in prior years $= 0.08$

Total cost of options $= 6.86$

5. **Learning Objectives:** 7

Learning Outcome: 7A, B, C, E – Measure profitability
Source: Life Insurance Products and Finance; pages 514-534
Cognitive Skill: Recall, Analysis, Application

Solution:
(a)   (i)   The company is stock or mutual
                 • Owner of stock company uses capital to bear risk so discount rate
                   should consider cost of capital and long term financial results to the
                   stock owner
        (ii)   Current interest rate level
                 • This is the opportunity cost
                 • The discount rate should consider the investment on similar investments
        (iii)   Tax Rate
                 • Aftertax rate is used to discount negative profits
        (iv)   Product Design
                 • Product design has much impact on the risk of the product
                 • This will turn to risk capital requirement and risk of capital
                 • The higher the risk you bare, the higher discount rate
        (v)   Negative profits after first year
                 • The negative profits after the first years means more investment needed
                 • Discount rate using 2 discount rates for positive or negative cash flow.
                 • If $PVFP(t) < 0$ then $PVFP(t-1) = PVFP(t)/[1 + j(t)] + \text{Profit}(t-1)$
                   where $j(t)$ is aftertax rate used on negative cash flows
                 • If $PVFP(t) > 0$ then $PVFP(t-1) = PVFP(t)/[1 + i(t)] + \text{Profit}(t-1)$
                   where $i(t)$ is rate used on positive cash flows

(b)   ROI
        • Rate of return that will make the PV of profits = 0
        • More than one rate possible if sign changes
        • Uses distributable earns or solvency earnings
        • Discount rate has no impact
        ROE
        • PV after tax returns / PV equity
        • Should use hurdle rate to discount
        Profits as a % of Premium
        • PV profits / PV premiums
        • Discount rate will impact
        Break Even year
        • First year accumulated profits > 0
        • Discount rate has no impact

5.   **Continued**

Embedded Value
- PV profits using hurdle rate
- Hurdle rate based on cost of capital
- Discount rate/hurdle rate very important – will affect value

NB strain
- FY loss / FY premium
- Discount rate has no impact unless losses in years 2 – 3 which are discounted.

(c)   PV premium @ $7.5\% = 400 + 400(1.075)^{-1} + 400(1.075)^{-2} + 400(1.075)^{-3}$
$$= 1440.21$$

Stream A

Profits as % of Premium
$$= -1000(1.075)^{-1} + 300(1.075)^{-2} + 300(1.075)^{-3} + 700(1.075)^{-4} / 1440.21$$
$$= 95.02 / 1440.21$$
$$= 6.6\%$$

Embedded Value - -45.2

Stream B
Profits as a % of Premium
$$= 92.74 / 1440.21$$
$$= 6.4\%$$

Embedded Value $= 16.71$

Stream B optimal because embedded value is larger and positive and profit as % of premium $> 6\%$.

6. **Learning Objectives:** 5, 6

Learning Outcomes: Identify gaps between the product design and operations of the company and procedures and systems; explain the effect of each assumption on product pricing; special assumptions per special features.

Sources: Product Development Challenges in a Principles-Based World, Pages 17-20 Across America, Valuation Actuaries are being Warmly Welcomed to Product Development Project Teams, Pages 8-11 Hidden Costs of Administering Complex Problems, Pages 30-31 Atkinson & Dallas, Ch. 3

Cognitive Skills: Recall, Synthesis

Solution:

(a) (i)

Principle Based Approach
– Reserve and capital methods no longer formulated and will require the actuary's judgment
– Use company experience if credible
– Do stochastic projections for products with significant tail risk
  o Model interest rates and equity assumptions
  o May not be needed if it can be proven that product has no tail risk
  o Pricing actuary may require stochastic on stochastic which is very complex
– Applies prospectively, old business will continue to use formula based approach
  o May cause issues in allocating expenses

Formula Based
– Reserve and capital methods are formulated

(ii)
– Valuation and pricing actuary must work together more
  o This will lead to better profitability
– May also involve marketing
– Valuation actuary must set valuation assumptions
  o Based on same best estimates as the pricing assumptions
  o VA responsible for determining margins
– Pricing actuary must use reserves with margins set by valuation in pricing projections
  o Also needs to balance competitiveness with profitability
– Each area gets a better understanding of the product and functions of the other area
– Assumptions don't have to be the same, but differences should be documented and justifiable

6. **Continued**

(b)   (i)
  − Will need to track from day 1
  − When needed, manual calculations may need to be performed
    o Errors occur
    o Costly resources used
  − If company builds a system it will add to development costs
  − Recommend delaying the launch until the system work has been done

(ii)
  − Persistency will be higher, especially for years preceding the bonus
  − Once the bonus is paid, there may be a spike in lapses
  − This needs to be considered when pricing the product
  − Can produce inequity between the policies that persist and the policies that lapse
  − The bonus seems high, recommend reducing the bonus to reduce lapses sensitivity and inequity risk
  − Should use scenario testing to better understand risk

7.   **Learning Objectives:** 2 Understanding the Drivers for Product Design (The Idea Step)
Learning Outcome: Analyze the advantages/disadvantages of different internal drivers.
Source: Marketing for Actuaries – Chapter 4, Pages 1-12 and Chapter 5
Cognitive Skill: Recall, Synthesis

Solution:
(a)

- (1) Career Agent Distribution System
    - (i) Primarily can only sell products of one company
    - (ii) Adv – Co has a high degree of control over agents
    - (iii) Adv – Agents are more loyal
    - (iv) DisAdv – Very Costly
    - (b) General Agency
        - (i) Independent contractors that appoint agents on behalf of the company
    - (c) Branch Offices
        - (i) Branch managers are employees of the home office and recruit and train career agents
- (2) Multiple Line Agents
    - (a) Sell P&C and life insurance products
    - (b) Adv – Efficient way to reach the middle income market
- (3) Home Service (Debit) Agents
    - (a) Collect premium in policyholders home monthly or weekly
    - (b) Adv – Service orphaned policies
    - (c) Adv – Way to reach low income or rural markets
    - (d) DisAdv – not used much anymore
- (4) Brokerage Distribution
    - (a) Independent contractors
    - (b) DisAdv – Can sell products of multiple companies
    - (c) DisAdv – Less loyal than career agents
- (5) Personal Producing General Agents
    - (a) Agents receive commissions, overrides, and expense allowances
    - (b) Adv – Can set minimum production requirements to ensure loyalty
- (6) Financial Planners
    - (a) Financial planner that helps clients with a wide range of financial issues
    - (b) Adv – Trusted by policyholder
    - (c) DisAdv – are usually fee for service advisors
- (7) Stockbrokers and Mutual Fund Salespeople
    - (a) Normally good at selling variable products
- (8) Accountants
    - (a) Financial professionals that are respected by their clients

7.   **Continued**

        (9)   Worksite Marking
- (a) Sell insurance products at workplace
- (b) Adv – Economies of scale and opportunity to sell group products
- (c) Adv – Employee gets non-intrusive sales process
- (d) DisAdv – Takes 2 sales to make 1 (Sell to employer then employee)

        (10)   Banks
- (a) Adv – Have been successful in selling annuities
- (b) DisAdv – Difficulty in selling for negative life events (life insurance)
- (c) DisAdv – Regulatory Constraints

        (11)   Direct Marketing
- (a) Uses one or a combination of the following media to sell insurance:
  - (i) TV, Fax, Internet, Email, Mail, and/or Telemarketing
- (b) Adv – No agents and therefore no commissions
- (c) DisAdv – Low response rates

(b)(i) PV of Vested Comp –

$\text{Agt} - P(t) = 1$ for all years

PV = Sum from $t = 1$ to 5 of $[\text{Comm}\%(t) \times \text{Prem} - P(t) \times v^{(t-1)} \times 1]$
Where $v = 1/1.03$

$\text{PV} = (40\% \times 1 \times v^0 \times 1) + (10\% \times 0.85 \times v^1 \times 1) + (5\% \times 0.75 \times v^2 \times 1) + (3\% \times 0.70 \times v^3 \times 1) + (2\% \times 0.60 \times v^4 \times 1) = 54.775\%$

PV of Non-Vested Comp –

PV = Sum from $t = 1$ to 5 of $[\text{Comm}\%(t) \times \text{Prem} - P(t) \times v^{(t-1)} \times \text{Agt} - P(t)]$
Where $v = 1/1.03$

$\text{PV} = (40\% \times 1 \times v^0 \times 1) + (10\% \times 0.85 \times v^1 \times 0.9) + (5\% \times 0.75 \times v^2 \times 0.85) + (3\% \times 0.70 \times v^3 \times 0.7) + (2\% \times 0.60 \times v^4 \times 0.65) = 52.47\%$

Vested Comp > Non-Vested Comp

(b)(ii) One must equate the present value of level compensation to the present value on non-level (heaped) compensation based on a discount rate of 3%.

The first year comp rate based on a level comp structure would be less than heaped first year rate. Renewal rates under a level comp structure would be greater than renewal rates under a heaped comp structure. This lowers first year acquisition costs and increases income in year 1, but spreads out comp costs lowering income in renewal years. Discounting comp costs based on a 15% ROI target would then mean the PV of level compensation would be less than the PV of heaped compensation. Level compensation would increase profits. Also because first year acquisition costs are lower under a level compensation structure, first year surplus strain is also reduced.

8. **Learning Objectives:** 1, 2, 7, 9

Learning Outcome: Describe the steps in the product development process. Describe the iterative process in planning and actuarial development. Analyze how the forces of the marketplace and competition affect design. Understand the use of profit measures.

Source: UL Secondary Guarantee: Rebirth of Fixed Life? VUL Secondary Guar: Catalyst for Sales Rebound. LOMA Life and Health Insurance Marketing. Stochastic Pricing Session 62. RSA Vol 27 #2 Stochastic Pricing

Cognitive Skill: Recall, Synthesis

Solution:

(a) Feasibility questions:
- What regulatory requirements are there? Is it easy to enter or exit the new field?
- What sales representative education is needed?
- Does the product work with the distribution system?
- What is the target market or demographics?
- What is the competition?
- What is the shelf life?
- What effect will it have on existing product sales?
- What sales aids will be needed?
- How will it be advertised?
- What administrative changes are needed?
- How much time and resources are needed?
- What implementation barriers are there?
- Does it fit the company goals and mission?

(b) Impact and cost of key features of Secondary Guarantee
- Guarantee that coverage continues if certain conditions met even if cash value goes to zero.
- Length of guarantee can be short, intermediate or lifetime
  - Required premium increases with length of guarantee
  - Recommend a short term guarantee to keep cost low
- Need method to measure the required premium
  - Cumulative premiums requires the sum of premiums less withdrawals and debt to be greater than sum of monthly premiums
  - Interest adjusted premiums accumulates payments and withdrawals with interest
  - Shadow Account Value – separate account value using unique credited rates, COIs and loads; guarantee is met if shadow account value is positive
  - Above allowed with or without catch up provision. Without catch up – requirements must be met on every date. With catch up – requirements met only when cash value is negative
  - Including interest and allowing catch up will keep the cost lower

8. **Continued**

(c) High level plan for stochastic pricing
- Create a stochastic model
  - Models vary from simple to complex; choose moderate complexity
  - Many models to choose from – log normal, mean reversion, regime-switching, interest rate, Black Scholes, etc.
  - Recommend a specific model (e.g. mean reversion)
- Choose assumptions/risk factors to model
  - Key factors: interest rates, mortality, lapses
- Generate scenarios
  - Recommend number of scenarios (e.g. 1000)
  - Recommend either risk neutral or real world
- Determine policy holder behavior to model
  - Recommend dynamic lapses
- Need a method to report results
  - Possible measures are Sum of Distributable Earnings (DE), PV of DE, Internal Rate of Return, CTE measures
  - Recommend specific measure to look at results

9. **Learning Objectives:** 4, 8
Learning Outcome: Describe in detail the basic benefit/product types and their uses,
                   identify the most influential assumptions for the particular feature
Source: Atkinson & Dallas Ch. 1, ILA-D106-07
Cognitive Skill: Recall, Application

Solution:
(a)

- Premiums to be waived
  - Reflect commissions on premiums to be waived?
  - Do not include premium tax in premiums to be waived
  - Sex-distinct premiums should be used
  - If select & ultimate, calculate single waiver premium for each age using ultimate mortality
- Interest rate
  - Use long-term conservative rate
- Lapses
  - It is conservative to use no lapses, but if used should be the same as the underlying base policy
- Expenses
  - Claim investigation
  - Use marginal expenses with portion of overhead
- Active Life mortality
  - Use same assumption as base plan
- Morbidity
  - Morbidity probability of becoming disabled and staying disabled
  - Termination rate – probability of recovery or death

(b)

- Accelerated Death Benefit (ADB)
  - Pays accelerated death benefit if terminally ill
- Accidental death & Dismemberment
  - Pays lump sum if lose a limb and become disabled
- Critical Illness (CI)
  - Pays death benefit for listed illness
- Long-term care
  - Pays benefit (typically monthly) when receiving long-term care (at home or in a nursing home facility)
- Total & Permanent Disability (TPD)
  - Pays a lump sum when the insured becomes totally & permanently disabled
- Disability Income (DI)
  - Typically pays a fixed monthly benefit once the insured qualifies as disabled
- Medical Expense Rider
  - Pays per diem expenses to cover medical costs

10. Learning Objectives: 7

Learning Outcome: 7(d) able to describe the capital requirements for the product and calculate the appropriate capital amounts. 7(a) measure profitability

Source: Atkinson & Dallas – Life Insurance Product & Finance – Chapter 10 – Required Capital

Cognitive Skill: Application

Solution:

(a)

(i) $RBC = [C2^2 + (C1 + C3)^2]^{0.5} + C4$

C1 = asset default risk

C2 = Insurance risk

C3 = Interest rate risk

C4 = other risk

Product 1: $RBC = [60^2 + (25 + 45)^2]^{0.5} + 10 = 102.2$

Product 2: $RBC = [25^2 + (45 + 60)^2]^{0.5} + 10 = 117.5$

Product 1 requires less capital

(ii)   MCCSR is sum of all risk factors vs square root of sum of squares formula under RBC

- To reflect independence, RBC has a covariance adjustment

Asset default risk

- For both, asset default factors differ for different types of assets

Insurance risk

- For both, there are insurance risk factors for mortality risk (life insurance risk) and morbidity risk

Interest rate risk

- For both, interest rate risk factors are applied to reserves
- Factors vary by withdrawal provisions and risk characteristics

Other risk

- Only applies to RBC; MCCSR does not have this component
- Factors vary for life, annuity and accident & health

Interest margin pricing risk

- Only applies to MCCSR; RBC does not have this component
- One set of factors for par and non-par business, and one set for all other business

(b)   After Tax Earned Rate = After tax earnings / Total capital

$0.12 = (120 + 300 * i) * 0.7 / 900$ where i = Asset Earned Rate

Asset Earned Rate = $i = 11.4\%$

10. Continued

Total Pre Tax Earnings $= 120 + 300 * 0.114 = 154.2$

After Reinsurance: assume $x = \%$ of business reinsured

After Tax Earnings $= 154.2 * (1 - x) * 0.7$

New Business Capital $= 600 * (1 - 1.15x)$

Required Capital $= 300 * (1 - x)$

$0.16 = 107.94 * (1 - x)/[600(1 - 1.15x) + 300(1 - x)]$

$x = \%$ reinsured $= 71.4\%$

11. **Learning Objectives:** 2, 6 – Understanding the drivers of product design; Understand relationship between product design & selection of appropriate assumptions for pricing the product.

Learning Outcome: Analyze the advantages/disadvantages of different internal drivers. Identify assumptions needed for a particular product design, including embedded options, expenses. Special assumptions per special features.

Source: LOMA Chapter 12: Pricing: A Marketing Perspective pages 262-265 Equity-indexed annuities – Product Design and Pricing Considerations Atkinson and Dallas Chapter 13, Annuity and Investment Products Hardy, Investment Guarantees – Chapter 13: Equity Indexed Annuities Hidden Costs of Administering Complex Products

Cognitive Skill: Recall, Synthesis

Solution:

(a)

Cost Driven:

- Look at the cost to the company. Add profit margin.
- Most effective in situations where company is market leader.

Competitive Driven:

- Look at the market share and what the competitors are providing
- Meet or beat the competition
- Including
  - Independent Pricing: Ignore competition
  - Cooperative Pricing: Match up the price between competitors
  - Adaptive Pricing: Review other companies' prices and charge a reasonable price compared to competitors
  - Opportunistic Pricing: Make use of the efficiencies of the company
  - Predatory Pricing: Charge price below cost to drive competitors out of the market

Customer Driven:

- Providing the product with the price that customers are willing to pay
- Including
  - Penetration pricing: Lower price to attract sales
  - Neutral Pricing: Reasonable price
  - Segmented Pricing: Different price to different groups
  - Price Skimming: High price leads to high profit; good for innovative products with little competition
  - Psychological pricing: Customers certain price ranges more appealing than others (charge $4.99 instead of $5)

11. Continued

Since the EIA is an emerging high-risk product, so should avoid competition driven strategies as it is risky to charge low price – could use price skimming. Also ABC is financially stable with high surplus ratio, and can charge higher premium to give customers access to that stability.

ABC has large, exclusive agency field force, so they can also try to expand the market share and focus on product value.

(b)
Product Design
- What index to use
- How long is the index period
- Method to calculate the index growth
  - Point-to-point: Pay-off is $Px(1 + \alpha x(Sn/So - 1))$
  - Averaging
- Presence of ratchet
- Participation rate
- Any innovative design for the index benefit
  - Either 0 or a fixed credited rate if index is above certain level
  - Use high water mark
- Any incentive for the potential buyer – e.g. bonus as percentage of premium when purchased

Pricing Issues
- Credited rate made up of two components
  - The GMAV
  - The Index-based interest component
- Lower interest rate could increase the cost of the GMAV
  - Possible solution: Use flexible premium instead of fixed premium for lower GMAV requirement if the old non-forfeiture law applies
  - Some states may allow temporary relief by lowering the interest rate used in calculating GMAV
- On index benefit part, higher volatility could increase the price of the call option
  - Possible solution: Annual reset to allow the company to change the features (cap, participation rate, etc.) of the product to reflect the higher cost
  - Use averaging method instead of point-to-point method to decrease the volatility

11. Continued

- Hedging approach
  - Static hedging: Buy and hold strategy
  - Dynamic hedging: Holding a position in the underlying security, need frequent re-balancing and there is no downside protection
- The reserving and filing processes must be understood as they are more complex than for traditional fixed annuities

(c)
Variable annuities are usually longer term.

EIA uses call option while guarantee of VA uses put option.

EIA looks at the index (without dividends) while the VA is invested in the security.

EIA is usually in the money when mature while VA guarantees are rarely in the money when mature.

EIA usually transfer the risk to the third party.

United States

12. **Learning Objectives:** 1, 2

Learning Outcomes: 1B, 2C, 2D, 2E
Sources(s):   "Term Mortality and Lapses"; "Lapse Experience Under Lapse Supported Products"; "Incorporating Dynamic Policyholder Behavior Assumptions into Pricing of Variable Annuities"; 8ILA-D101-07 Product Development Trends; Valuation of Living & DB Guarantees for VAs; Return of Premium Term"; Atkinson & Dallas, Chap 3; Marketing for Actuaries, Chap VI.
Cognitive Skill: Recall, Synthesis

Solution:
(a)

(i)   Lapse assumptions for UL w/SG are difficult to set with such little available experience. Setting lapse rates too high can be very dangerous, should use conservative assumption (1-2%). Should look at the product specifics such as whether cash values are present, type of market and distribution, and premium payment patterns.

(ii)   Term insurance is a very competitive product. Credible data is hard to find for lapse rates as well. If premiums are level and then increasing, lapses likely to occur when premiums rise. Mortality and persistency are linked in that lapses are more likely to occur in healthy lives (anti-selection) if they can get cheaper rates elsewhere. Unhealthy lives persist. Lapses are very important assumptions for return of premium term and indeterminate premium term as well.

(iii)   Lapses assumptions for VA's are very important since the higher the level of persistency the larger amount of benefits paid. Experience is limited however. Lapses on VA's w/GLB's/GDB's will normally decrease when the guarantee is in the money, however, the contrarian argument should be considered as well. Product performance will impact lapses. If there is a change in the degree of risk the customer is willing to take or if tax advantages are taken away there will be more lapses. Should sensitivity test behavior assumptions, and perhaps a dynamic lapse assumption may be appropriate. Surrender charges should be considered with respect to lapses; generally low lapse rates during surrender charge period with a spike at the end of the period. If there is a change in product or guarantee availability there will be an impact on lapses.

12. United States - Continued

(b)
- (i) Buyer – related factors – higher persistency for:
  - Older age
  - More education
  - Buyer initiated sale
- (ii) Product – related factors – higher persistency for:
  - Perm vs. term
  - Higher premium
  - Issued as applied for
- (iii) Producer – related factors – higher persistency for:
  - Aptitude and experience
  - Persistency bonuses
- (iv) Sales process – related factors – higher persistency for:
  - Needs based selling
  - Post-sale service
  - Personal delivery of policy
- (v) Outside environmental factors – higher persistency for:
  - Low unemployment rates
  - Periods of economic savings
- (vi) Other factors
  - Renewal and level commissions encourage persistency
  - Mode and method of payment of premium
  - Level of income
  - Perceived value of insurance
  - Career agent vs. broker
  - Manner in which the policy was sold
  - Agent's attitude toward persistency
  - How well client understand policy

Canada

12. **Learning Objectives:** 1, 2

Learning Outcome: 1B, 2C, 2D, 2E
Sources(s): "Term Mortality and Lapses"; "Life Insurance Costing and Risk Analysis"; "Incorporating Dynamic Policyholder Behavior Assumptions into Pricing of Variable Annuities"; 8ILA-D101-07 Product Development Trends; Valuation of Living & DB Guarantees for VAs; Return of Premium Term"; Atkinson & Dallas, Chap 3; Marketing for Actuaries, Chap VI.
Cognitive Skill: Recall, Synthesis

Solution:
(a)

(i) Lapse assumptions for UL w/NLG should use relevant experience available. Setting lapse rates too high can be very dangerous, should use conservative assumption (1-2%). Should look at the product specifics such as how it is marketed, distributed, and sold. As well as if it is lapse-supported, if there are surrender charges and any withdrawal rights. Assumptions for policyholder behavior should vary based on future expected investment performance. Careful attention should also be madeto premium payment patterns

(ii) Term insurance is a very competitive product. Credible data is hard to find for lapse rates as well. If premiums are level and then increasing, lapses likely to occur when premiums rise. Mortality and persistency are linked in that lapses are more likely to occur in healthy lives (anti-selection) if they can get cheaper rates elsewhere. Unhealthy lives persist. Lapses are very important assumptions for return of premium term and indeterminate premium term as well.

(iii) Lapses assumptions for VA's are very important since the higher the level of persistency the larger amount of benefits paid. Experience is limited however. Lapses on VA's w/GLB's/GDB's will normally decrease when the guarantee is in the money, however, the contrarian argument should be considered as well. Product performance will impact lapses. If there is a change in the degree of risk the customer is willing to take or if tax advantages are taken away there will be more lapses. Should sensitivity test behavior assumptions, and perhaps a dynamic lapse assumption may be appropriate. Surrender charges should be considered with respect to lapses; generally low lapse rates during surrender charge period with a spike at the end of the period. If there is a change in product or guarantee availability there will be an impact on lapses.

12. Canada - Continued

(b)

    (i)   Buyer – related factors – higher persistency for:
- Older age
- More education
- Buyer initiated sale

    (ii)   Product – related factors – higher persistency for:
- Perm vs. term
- Higher premium
- Issued as applied for

    (iii)   Producer – related factors – higher persistency for:
- Aptitude and experience
- Persistency bonuses

    (iv)   Sales process – related factors – higher persistency for:
- Needs based selling
- Post-sale service
- Personal delivery of policy

    (v)   Outside environmental factors – higher persistency for:
- Low unemployment rates
- Periods of economic savings

    (vi)   Other factors
- Renewal and level commissions encourage persistency
- Mode and method of payment of premium
- Level of income
- Perceived value of insurance
- Career agent vs. broker
- Manner in which the policy was sold
- Agent's attitude toward persistency
- How well client understand policy

13. **Learning Objectives:** 4, 6, 8

Learning Outcome: Describe basic product types, Select appropriate assumptions, price products with different benefits
Source: ILA-D107-07, ILA-D105-07, Atkinson & Dallas ch. 3
Cognitive Skill: Recall, Synthesis

Solution:
(a)

Credibility of Data
Homogeneous population
Separate classes, if possible
Quality of Data
Consider sources
Industry Data
Recent Data
Sample size for credibility
Use Actual or Similar Experience
Similar product
Similar underwriting
Other companies and products, only if necessary
Reflect trends
Mortality improvement
Company and External Factors
Quality of underwriting
Target market
Sensitivity Test

(b)

Constant Multiple
Multiply each qx by same factor
Disadvantage: increase is retained for all durations
Constant Extra Deaths
Add constant to each qx
Advantage: it can be removed after a period
May overstate younger/understate older age mortality
Rated Age
Qx for each age is changed to $qx+n$
Disadvantage: reserves fall off quickly
Disadvantage: increase is retained for all durations
Advantage: easy to use

13. **Continued**

(c)   Expectation is that
"Substandard Mortality" is expected to be $1.20 \times$ experience table

However, the price(premium) is based on
"Substandard Mortality" using a Rated Age mortality (no 1.20 factor)

Note: The mortality assumption is what you expect to happen, not necessarily what you use to calculate the premium that will be charged. In this case, the student is being asked to evaluate the appropriateness of charging premium based on a method that is "easy to use" (see part (b)) versus using your true mortality expectation.

Premium = [(Sum of PV of benefit) + Expenses]/$(1 - \text{Commission } \%)$
- PV of benefit: Use Spot Rates for discounting
  - Probability of Death at time 1 / 1.03
  - Probability of Death at time 2 / 1.033^2
  - Probability of Death at time 3 / 1.036^3
  - etc

1) Price Assumed = Premium based on the mortality assumption
   - Start at age 85
   - Assume substandard mortality at each age is 1.2 x worse than standard at the same age
   - $q_x{}' = q_x \times 1.20$

Premium = 32,602 = [10,000 x ((1-.09 x 1.2)/1.03 + (1-.9 x 1.2) x (1-.1 x 1.2)/1.033^2 + (1-.9 x 1.2) x (1-.1 x 1.2) x (1 - .11 x 1.2)/1.036^3 + (1-.9 x 1.2) x (1-.1 x 1.2) x (1 - .11 x 1.2) x (1- .12 x 1.2)/1.04^4 + (1-.9 x 1.2) x (1-.1 x 1.2) x (1 - .11 x 1.2) x (1- .12 x 1.2) x (1- .13 x 1.2)/1.044^5) + 400] / [1-.04]

2) Price Charged = Premium based on Rated Age method
   - Start at age 85
   - Assume substandard age 85 mortality is standard age 86 mortality
   - $q_x{}' = q_{x+1}$ (basically means start at age 86, don't multiply by 1.2)

Premium = 29,192 = [10,000 x (.9/1.03 + .9 x .89/1.033^2 + .9 x .89 x .88/1.036^3 + .9 x .89 x .88 x .87/1.04^4) + 200] / [1-.04]

$$\text{Premium} = 29{,}192 = 10{,}000(0.9/1.033 + 0.9 \times 0.89/1.033^2 + 0.9 * 0.89 * 0.88/1.033^3 + 0.9 * 0.89 * 0.87 * /1.033^4)$$

The premium charged will be lower than the expected cost of the benefits.
The price may be competitive but may also be too low.
I would recommend increasing the Rated Age to Age + 2.

14. **Learning Objectives:** 8A, B

Learning Outcome: Price deferred annuity products understanding the pricing considerations, the most important assumptions and understanding MVA feature on a FPDA product

Source: Life and Annuity Products and Features; Atkinson & Dallas, Life Insurance Products and Finance, Chapter 13; Product Development Trends

Cognitive Skill: Recall, Application

Solution:

(a)

Consumer
- Longer guarantee period
- Higher Interest Rate guarantee
- Potential for capital gains

Company
- Reduces disintermediation risk
- Lower risk results in lower reserves and lower required capital
- Saver's mentality promotes persistency

(b)

MVA Formula and limitation
- Formula must recognize up and down adjustments
- Ignore if changes less than a certain spread

Valuation Basis
- Uses CARVM
- MVA type B
- Less strain if MVA adjustment is taken into account in reserving

Number of Guarantee Periods
- Most popular terms 2, 3, 4, 7, and 10
- Can it be rolled over after the guarantee period?

Shock lapse after the guarantee period
Commissions with MVA features
- Test various compensation patterns

System administration & Expenses
- Special features (MVA formula, limitation, multiple guarantee periods
- Additional expenses should be included in pricing

14. Continued

(c)

$$\text{MVA} = ((1+i)/(1+j+s))^t$$

i = rate guaranteed on current contract
j = rate guaranteed on new contract with guaranteed period t
t = Amount of time remaining in current guarantee period
s = additional margin

(i) At end of year 3
First deposit: $\text{AV} = 10000*(1.05)^3 = 11{,}576.25$
$\text{MVA} = ((1+0.05)/(1+0.04+0.005))^2 = 1.0095923$
$\text{CSV} = (11576.25 \times \text{MVA}) \times (1-\text{Surrender charge \%})$
So 1st deposit surrender value $= 11{,}576.25 \times 1.009592271 \times (1-0.07) = 10{,}869.18$
2nd deposit value at beginning of policy year 4: $10000 \times 1.06^2 = 11{,}236$
$\text{MVA} = ((1+0.06)/(1+0.07+0.005))^4 = 0.94534$
So 2nd deposit surrender value $= 11{,}236 \times 0.94534 * (1-0.07) = 9{,}878.34$
And total surrender value beginning of year $4 = 20{,}757.53$

(ii) At end of year 5
First deposit: $10{,}000(1.05)^5 \times 1 \times (1-0.03) = 12{,}379.93$
No MVA for 1st deposit in year 6 since no more years left in guarantee period
Second deposit: $10{,}000(1.06)^4 \times (1.06/1.0625)^2 \times (1-0.03) = 12{,}188.47$
And total surrender value beginning of year $6 = 24{,}568.40$

15. **Learning Objectives:** 8A, 9 B&C

Learning Outcome: Interpret results of a stochastic model, Understand pricing of riders
Source: Hardy, Investment Guarantees, Ch 6: Modeling the Guarantee
  Liability; Ch. 9: Risk Measures
Cognitive Skill: Recall, Application

Solution:
(a)
Calculate PV GMMB Cost

$\text{GMMB}(t) = \max(\text{GMMB}(t-1), \ \text{FV}(t) \times (1 - \text{margin}))$

$\text{Final GMMB Cost} = \text{Max}(\text{GMMB}(5) - \text{FV}(5), 0)$

$\text{PV GMMB Cost} = \text{Final GMMB Cost} / (1.05)^5$

	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
Issue	100	100	100	100	100
Year 1	100	103.95	103.95	108.90	103.95
Year 2	100	108.90	103.95	108.90	108.90
Year 3	100	108.90	108.90	108.90	108.90
Year 4	103.95	108.90	113.85	108.90	118.80
Year 5	110	108.90	113.85	108.90	125
Final cost	0	8.90	3.85	18.90	0
PV Cost	**0**	**6.9734**	**3.0166**	**14.8086**	**0**

Calculate PV Margins

$\text{Scen1} - \text{PV Margin} = 0.01 \times (90/1.05 + 95/1.05^2 + 100/1.05^3 + 105/1.05^4) = 3.4465$

$\text{Scen2} - \text{PV Margin} = 0.01 \times (105/1.05 + 110/1.05^2 + 105/1.05^3 + 110/1.05^4) = 3.8097$

$\text{Scen3} - \text{PV Margin} = 0.01 \times (105/1.05 + 100/1.05^2 + 110/1.05^3 + 115/1.05^4) = 3.8033$

$\text{Scen4} - \text{PV Margin} = 0.01 \times (110/1.05 + 95/1.05^2 + 90/1.05^3 + 95/1.05^4) = 3.4683$

$\text{Scen5} - \text{PV Margin} = 0.01 \times (105/1.05 + 110/1.05^2 + 110/1.05^3 + 120/1.05^4) = 3.9352$

Calculate Loss

$\text{Loss} = \text{PV GMMB} - \text{PV Margin}$

$\text{L1} = -3.4465$

$\text{L2} = 3.1637$

$\text{L3} = -0.7867$

$\text{L4} = 11.3403$

$\text{L5} = -3.9352$

CTE (60)

= average of the worst 40% (2 scenarios)

$= (\text{L2} + \text{L4})/2 = (3.1637 + 11.3403)/2$

$= 7.252$

15. **Continued**

(b)
CTE measure is coherent
CTE considers length of tail, quartile considers just a single point
CTE is less sensitive to sampling variability because it is an average

United States

16. **Learning Objectives:** 3

Learning Outcome: Describe and analyze tax implications within product design.
Assess the risks underlying the design of certain products and
features that affect taxation and other risks.

Source: Life Insurance Modified Endowments pp 24-34, 46 Atkinson &
Dallas, Chapter 2 pp 104-107

Cognitive Skill: Recall, Application, Syntheses

Solution:

(a)   (i)   CVAT test
- The CSV under the contract can at no time exceed the NSP required to fund the future benefits
- NSP is the premium that would be paid to fund future death benefits, qualified additional benefits and endowment benefits
- Mortality assumption = min(reasonable mortality rate, 1980 CSO) after 10/21/1988, before use contract's mortality or valuation rate if none specified
- Interest assumption = max(4%, initial guaranteed interest rate)
- CSV does not include surrender charges or loans

      (ii)   Guideline Premium Test & Cash Value Corridor Test
Intended to regulate buildup of CSV vs. DB risk
Satisfied if <u>both</u> are met:
- Premium limit = max(GSP, sum of GLPs)
- DB $\geq$ (specified %)*CSV

GSP:
- The premium required to fund future DB's, endowment benefits and qualified additional benefits
- Expense charges included in calculation
- Mortality same as CVAT plus any reasonable expense charges
- Interest = max(6%, guaranteed rate in contract)

GLP is calculated same as GSP but with interest = max(4%, guaranteed rate in contract)

16. United States - Continued

(b)   CVAT at issue

$CSV_0 = AV(\text{no surrender charges}) = 7500*(1-0.07) = 6975$

$NSP = A_{35} \text{ at } 4\% * \text{Face} = 0.24682*50{,}000 = 12{,}341$

$NSP > CSV$ therefore pass CVAT at issue

CVAT at time 10

$A_{45} \text{ at } 4\% * \text{Face} = 0.34071*50000 = 17035.5$

$CSV_{10} = 17{,}000$ since do not consider SCs

$NSP > CSV$ therefore pass CVAT at time 10

Therefore meet definition of life insurance under CVAT up to time 10

Guideline Prem/CV Corridor Test at issue

$GSP = (\text{Face} * A_{35} \text{ at } 6\%)/(1-\text{prem load}) = 0.13951*50000/0.93 = 7500.53$

$GLP = (Face * A_{35} \text{ at } 4\%)/[(1-\text{prem load})*a_{35} \text{ at } 4\%] = 677.64$

$\text{Max}(GSP, \text{sum GLP}) = \max(7500.53, 677.64) = 7500.53 >$ gross prem of 7500

$\text{Min DB} = CV_0 * \text{corridor at } 35 = 6975*2.5 = 17437.5 < 50{,}000 \text{ DB}$

Pass Guideline premium/CV Corridor test at issue

Guideline Prem/CV Corridor Test at time 10

$\text{Max}(GSP, \text{sum GLP}) = (7500.53, 10*677.64) = 7500.53 >$ gross prem of 7500

$\text{Min DB} = CV_{10} * \text{corridor age } 45 = 17000*2.15 = 36550 < 50000 \text{ DB}$

Pass GP/CV corridor at time 10

Qualifies as life insurance under 7702 since meets both tests

(c)   Nothing in law limits choice
Once choice is made needs to be consistent for entire product (paid-up additions, etc) over life of the policy, except for
- Change due to non-forfeiture acceptance
- Change to cure a failed product

Prospective CVAT
- Generally for traditional life
- Hard to implement for flexible prem (con)
- Harder to correct errors in policy design (con)
- Easier admin than guideline premium (pro)
- Must meet at all future points in time (pro for traditional, con for flex)

Retrospective guideline prem/CV corridor
- Can accommodate multiple funding options/prem patterns (pro)
- Generally for UL
- Requires extensive record keeping (con)
- Prone to admin errors (con)
- Can initially fail test but be brought back into compliance through prem refunds (pro)

I would recommend guideline premium test as this is a flexible prem product

16. United States - Continued

    (d)   MEC therefore LIFO treatment – decreases gain first

$$\text{Gain} = \text{AV} - \text{Prem paid}$$

$$\text{Gain before} = 17000 - 7500 = 9500$$

Partial withdrawal < 9500 therefore all taxed since MEC

$$\text{Taxable income} = 3000$$

$$\text{Remaining AV} = \text{AV before} - \text{withdrawal} = 14000$$

$$\text{Remaining gain} = \text{gain before} - \text{withdrawal} = 6500$$

Remaining premium $= 7500$ since all gain was not used

$$\text{Tax} = \text{taxable income} * \text{tax rate} = 900$$

Additional 10% tax on income due to withdrawal before age $59.5 = 3000 * 0.1 = 300$

$$\text{Total tax} = 900 + 300 = 1200$$

Canada

16. **Learning Objectives:** 3 (Canadian track)
Learning Outcome: Understand tax issues related to exempt vs. non-exempt policies, and understand the movement of the adjusted cost basis (ACB)
Sources: *Canadian Taxation of Life Insurance* (3rd ed.) Chapter 1 & 3, Pages 9-14, 56-71 *Notes on the Taxation of Life Ins Policies and Annuity Contracts*, pgs. 1, 20-21
Cognitive Skill: Recall, Application

Solution:

(a) A premium is a prescribed premium if it exceeds the premium that was scheduled to be paid and that was fixed and determined on or before December 1, 1982.

Allowances for prescribed premiums:
- Change in underwriting class
- Premium mode change
- Addition or deletion of riders
- Premium linked to index
- Policy dividends and accumulated dividends being used to purchase additional insurance
- Redating lapsed policies within 60 days after the calendar year of lapse or redating inforce policies to reduce policy loan indebtedness
- Correcting the premium
- Payment of policy loan interest (that has not been deducted as an interest expense)

An increase in death benefit is a prescribed increase if the resulting death benefit exceeds the death benefit at the time that was fixed and determined on or before December 1, 1982.

Allowances for prescribed increases:
- An increase resulting from the application of policy dividends (to buy paid-up additions)
- An increase as provided under new money policies (as a result of interest, mortality, or expense considerations) or policies with CPI indexed death benefits pursuant to the policy's terms on Dec. 1, 1982
- An increase resulting from the return on death of premiums that were pre-paid, but otherwise not prescribed
- An increase because the death benefit is a mathematical function of the CSV, provided that it is not attributable to the payment of prescribed premiums
- A gratuitous increase by the insurer on the class basis

16. continued - Canada

(b)

Taxes = Tax Rate * Policy Gain (PG), where PG = Proceeds of Disposition – ACB

$ACB_{i+1} = ACB_i$ + (Prems + Divs for PUAs + Int on Loans + PG + Loan Repayments)
        - (Proceeds of dispositions + NCPI charges)

where proceeds of dispositions = full/partial surrenders/withdrawals, dividends, loans

Key Differences between "old" rules (Dec 1, 1982 effective) and "new" rules (Dec 2, 1982 effective):

➢   old: taxes on policy gains are only on dispositions, no NCPI, no proration on partial withdrawals

➢   new: accrual taxation, NCPI deducted from ACB, proration of ACB on partial withdrawals

At the end of 2004, <u>Accumulated premiums = 23 * 7,500 = $172,500</u>

(i)

Calculating ACB for pre-Dec 2, 1982 policy ("grandfathered policies")

2004

ACB (before partial withdrawal) = 172,500 + 7,500 – 7,500 = 172,500

PG = 0, since partial withdrawal < ACB (before)

ACB (after) = 172,500 – 100,000 = **$72,500**

2005

ACB = 72,500 + 7,500 + 3,000 – 3,000 = **$80,000**

2006

ACB (before loan) = 80,000 + 7,500 + 3,500 – 3,500 = $87,500

PG = 90,000 – 87,500 = $2,500

Taxes = 50% * 2,500 = **$1,250**

ACB (after loan) = 87,500 + 2,500 – 90,000 = **$0**

2007

Policy loan is repaid. Since the PG of $2,500 was already applied to income in 2006, the first $2,500 will NOT go towards the ACB, only $87,500 of the loan repayment will go towards the ACB. The $2,500 can be deducted from income.

So ACB = 0 + 7,500 + 4,000 + 87,500 – 4,000 = $**95,000**

Taxes = 50% * -2,500 = **-$1,250**

ACB at Dec 31, 2007 is **$95,000**. Total taxes payable = 1,250-1,250 = $**0**.

16. continued - Canada

(ii)

Calculating ACB for post-Dec 1, 1982 policy ("new rules")

2004
ACB (before partial withdrawal) = 172,500 + 7,500 – (7,500 + 27,500) = 145,000
Prorate ACB when calculating PG
PG = 100,000 - (100,000/250,000) * 145,000 = $42,000
Taxes = 50% * 42,000 = **$21,000**
ACB (after) = 145,000 + 42,000 – 100,000 = **$87,000**

2005
ACB = 87,000 + 7,500 + 3,000 – (3,000 + 5,500) = **$89,000**

2006
ACB (before loan) = 89,000 + 7,500 + 3,500 – (3,500 + 6,000) = $90,500
PG = 0, since policy loan < ACB (before)
ACB (after loan) = 90,500– 90,000 = **$500**

2007
ACB = 500 + 7,500 + 4,000 + 90,000 – (4,000 + 7,000) = $**91,000**

ACB at Dec 31, 2007 is **$91,000**. Total taxes payable = **$21,000**.

Canada

17. **Learning Objectives:** 3 (Canadian track)

Learning Outcome: Understand the difference between Segregated funds and Mutual funds. Also understand the tax implications on Segregated funds.

Sources: *Canadian Taxation of Life Insurance* (3rd ed.) Chapter 12 & 18, Pages 354-355, 433-435

Cognitive Skill: Recall, Application

Solution:

(a)

Need to differentiate Segregated Funds and Mutual funds, from the perspective of the <u>fund holder.</u>

- Segregated Funds provide a minimum guarantee on the return of premiums (typically 75% or 100%) upon maturity or death, whereas mutual fund do not
- Segregated Funds are regulated under provincial insurance regulation, whereas mutual funds are regulated under securities legislation
- Beneficiaries can be named on Segregated Funds, not on Mutual funds
- Segregated funds are protected from creditors during the owner's lifetime, not the case with mutual funds
- Exemption from probate fees upon death of the life insured. Probate fees are payable upon death with Mutual Funds
- <u>Capital losses</u> would "flow-through" to the fund holder of Segregated funds, but not on mutual funds

(b)

Income (SF) = Inv Inc + Capital Gain/Loss on Seg + Other Capital Gain/Loss on Other Investments

Taxable Income (SF) = Inv Inc + [50%*Max(Total Capital Gain/Loss from all sources, 0]

Income (MF) = Inv Inc + Capital Gain on Mutual Fund (or 0 if Capital Loss) + Other Capital Gain/Loss on Other Investments

Taxable Income (MF) = Inv Inc + [50%*Max(Total Capital Gain from Mutual Fund (or 0 if Capital Loss) + Capital Gain/Loss from other, 0)]

<u>Joe (Seg Fund)</u>

	Income	Taxable Income
2005	$150 + 1,000 + 1,000 = \$2,150$	$150 + 50\% * (1,000 + 1,000) = \$1,150$
2006	$200 - 600 + 2,200 = \$1,800$	$200 + 50\% * (-600 + 2,200) = \$1,000$
2007	$250 + 1,500 - 500 = \$1,250$	$250 + 50\% * (1,500 - 500) = \$750$

17. **Canada - Continued**

Mary (Mutual Fund)

	Income	Taxable Income
2005	$650 + 0 + 2,200 = \$2,850$	$650 + 50\% * (0 + 2,200) = \$1,750$
2006	$550 + 500 + 1,000 = \$2,050$	$550 + 50\% * (500 + 1,000) = \$1,300$
2007	$475 + 750 - 500 = \$725$	$475 + 50\% * (750 - 500) = \$600$