# ILA LP Model Solutions
# Fall 2013

**1.** **Learning Objectives:**
2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

**Learning Outcomes:**
(2a) Describe in detail product types, benefits and features.

(3a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
  (i) Riders
  (ii) Policyholder dividends
  (iii) Equity linked
  (iv) Embedded options
  (v) Return of premium
  (vi) Secondary guarantees
  (vii) Payout annuity benefits
  (viii) Crediting methodology
  (ix) Other non-guaranteed elements.

**Sources:**
LP-105-07: Life and Annuity Products and Features

**Commentary on Question:**
*Commentary listed underneath question component.*

**Solution:**
(a) Evaluate the suitability of a Term product versus a Universal Life product with respect to the following:

  (i) Intended length of time for the life insurance protection

  (ii) Premium and charge structure

  (iii) Death Benefit options available

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**1.** **Continued**

**Commentary on Question**:
*To receive maximum points, candidates needed to evaluate the suitability of the product for each numbered item in addition to providing an explanation of each aspect of the product.*

(i)     Term –Typically provides coverage for a specific period of time (typically 10-30 years) and only provides a death benefit if the insured dies during that time.  This is very suitable for the situation because the term of the insurance could be aligned with the term of the mortgage.
Universal Life –Typically provides coverage for life.  This is not as suitable as the protection time is longer than the term of the mortgage which is what is needed.

(ii)    Term – Premiums can be level, decreasing, or increasing.  Premiums are typically calculated by taking the number of units of coverage multiplied by that year's premium per unit.  This is suitable as the premiums are typically low and guaranteed.  It is also simple for the bank to administer.
Universal Life – Typically has flexible premium payments and an account value.  The account value increases with premium and interest and decreases for cost of insurance and expense charges.  This is not as suitable since the account value feature is not needed as much for mortgage protection.  It also has more of an administrative system requirement.

(iii)   Term –Typically has a level death benefit but can also have an increasing or decreasing death benefit schedule.  A decreasing death benefit which is the most suitable to match the amortization schedule for the mortgage.
Universal Life – Typically has two death benefit options.  Option 1 or A pays the specified amount of the policy and option 2 or B pays the specified amount plus the cash value.  Both of these provide more of a death benefit than needed for the amortization of the loan but could be suitable if the bank wants to target clients who want protection beyond the amount of the mortgage.

# 1. Continued

(b) CDL plans to launch a competitively priced non-participating decreasing Term life product.

   (i) Explain why an attained age premium scale is not suitable.

   (ii) Describe the challenges presented by the following select and ultimate premium scales:
   - Renewal premiums are set **lower** than a newly issued policy at that age
   - Renewal premiums are set **higher** than a newly issued policy at that age

   **Commentary on Question**:
   *In part (i) some candidates incorrectly equated attained age premium scales to ART or YRT premiums and did not receive credit.*

   (i) An attained age scale is not suitable because it is difficult to develop an attained age scale sufficiently competitive for a wide range of issue ages. If an attained age scale is used, policies that are of different durations but the same age will use the same rate. For a product with a long coverage period, the inforce policies with the same attained age could be in a wide range of durations. This is less of a problem for a shorter coverage period term. The selective power of underwriting has deteriorated to various degrees for a certain attained age.

   (ii) Renewal premiums are set lower – This will encourage persistency because the policy holder has nothing to gain by applying for a new policy. But it may not reflect that mortality may deteriorate as time elapses since underwriting.
   Renewal premiums are set higher - This recognizes the mortality deterioration that occurs after underwriting but does not encourage persistency. The persistency issue may be exacerbated since it is a decreasing face amount product. The premium will be high in later years in relationship to the decreasing death benefit. Healthy insureds may lapse the policy and obtain better rates on a new policy while unhealthy insureds will stay inforce and cause mortality deterioration. This could lead to a death spiral problem.

(c) CDL proposes adding a conversion option to the decreasing term product. Explain why mortality anti-selection occurs on policies converted from decreasing term products.

# 1. Continued

**Commentary on Question**:
*Most candidates did reasonably well on this section, by describing how unhealthy lives would not pass underwriting.*

Policyholders who chose to buy a decreasing term at the time of purchase likely made that purchase in anticipation of a decreasing need for insurance protection. Toward the end of the coverage period and right before expiration, the policy usually has a small face amount to reflect that the insurance need should have diminished by then. If the policyholder exercises the conversion right at that time, they likely have more information regarding their health than the insurer does. Unhealthy people such as this could not get the insurance elsewhere if they were to be underwritten again so they are more likely to convert. Healthy people will be able to go through underwriting to get a new policy so will not exercise the conversion right as much. It also could mean that there is a new need that has emerged which was not foreseen or underwritten at the time of the initial purchase.

**2.**    **Learning Objectives:**
1.    The candidate will understand feasibility step of new product and how it drives design.

**Learning Outcomes:**
(1b)    Describe tax regulation and perform calculations to evaluate compliance.

**Sources:**
Marino and Grobe, Canadian Taxation of Life Insurance, 5th Edition
- Chapter 1 The History of Life Insurance Policy Taxation
- Chapter 3 Taxation of Life Insurance Policies, Dispositions, and Selected Valuation

Life Insurance and Modified Endowments Under IRC §7702 and §7702A
- Chapter 2 The Requirements for Qualification
- Chapter 3 Computing Limitations (Interest, Mortality and Expense Assumptions)
- Chapter 4 Computing Limitations (Future Benefits, Death Benefits, …)

**Commentary on Question:**
*For the non-numerical portions of the question, candidates generally dumped the relevant lists on the page but failed to actually answer the question – i.e. compare and contrast. For the numerical pieces, the candidates generally did well. Candidates made minor mistakes like getting the timing wrong or missing the premium load but so that led to a lot of part marks. Candidates either knew the topic or did not including the nation-specific pieces.*

**Solution:**
(a)    Compare and contrast the criteria to meet the Definition of Life Insurance in the U.S. and to meet the Exempt Test Policy (ETP) definition in Canada.

   **Commentary on Question**:
   *Candidates did a good job listing the tax regulations for each country but most candidates didn't compare and contrast the two countries like the question asked. Answers were generally poorly organized.*

   The goal of both countries is to provide tax shelter for insurance contracts that are acquired primarily for insurance protection. In Canada, an exempt policy is a policy that is exempt from accrual taxation. In the U.S. the actuarial test are to ensure the investment component is limited.

   Canada compares the actual policy to a theoretical benchmark exempt test policy (ETP) which is an endowment to at age 85 policy with a 20 year premium period. U.S to meet the definition of life insurance it needs to meet two criteria; the contract must be a life insurance contract under applicable law and the contract must meet at least one of the two actuarial tests (Cash Value Accumulation or Guideline Premium Test)

**2.** **Continued**

Differences

Canada the accumulated fund of the ETP is based on the interest and mortality charges used in the designing of the product. U.S. assumptions used to calculate the benchmark are prescribed.

Canada accumulation fund uses a 20 Pay premium while the U.S. CVAT is a single pay. The Endowment age for Canada is 85 while in the U.S. CVAT the endowment age is 100.

U.S. CVAT has to be passed at all times while in Canada the policy only needs to be passed on anniversary.

Similarities

U.S. CVAT is prospective test like Canada; the GPT has a 60 day grace period at the end of the contract year to bring the policy back to compliance, just like Canada.

U.S. GPT testing is performed on every policy anniversary just like in Canada.

(b)    Determine the maximum premium that can be paid in year 4 to pass:

(i)    The Cash Value Accumulation Test (CVAT) for a U.S. policy.

(ii)   The exempt test for a Canadian policy without having to create a new ETP

**Commentary on Question**:
*General confusion with the timing of the test as the appropriate death benefit was not used. Candidates knew most of the formulas but struggled with applying the interest correctly. Most candidates forgot to apply the 8% rule in part two.*

(i)
Max AV = DB (3) x NSP (duration 4)
=1,095,686 x .1895 = 207,683

MAX AV = [AV(3)+ Prem(1-PremLoad)-COI]*(1+i)

Premium = [(Max AV/1.035 + COI - AV(3) )]/.95

= 116,499

**2.** **Continued**

(ii)

Max AV(4) = (AF per $1 benchmark)*($1,000,000+ AV(3))*1.08

$$= (0.1256) * (1,095,686) * (1.08)$$
$$= \$148,628$$

Max AV(4) = (AV(3) + 95% * Max Premium(4)  - COI(4))*1.035

Max Premium(4) = [(Max AV(4)/1.035 + COI(4) - AV(3) )]/0.95

$$= \$56,438$$

(c)    Recommend, using numerical examples, how to maintain the exempt status in Canada.

**Commentary on Question**:
*This question was done poorly by basically all candidates.  They didn't understand how to properly start a new exempt test policy or carry the information over from question (b).*

If the client would like to avoid paying tax they would have to options;
1.  Reduce the premium paid down to $56,438 and return $68,582

2.  Increase the death benefit which will mean we will start a new ETP at age 48

AV(1) = .04x(Face Amount) = AV(0) + (95% x 68,562 - 5.7 x (Face Amount)/1000)*1.035

Face Amount = (0.95 * 68,562 * 1.035)/(0.04 + 0.0057*1.035)
$$= \$1,468,729$$

(d)    The policyholder would like to pay a 150,000 premium at the beginning of year 4. Determine if the policy would pass the U.S. Guideline Premium Test at the end of year 4.  Show all work.

**Commentary on Question**:
*Candidates generally did well on part (d). Not dividing by (1 – Premium Load) was the most common mistake.*

**Guideline Single Premium = FA x NSP (3) / (1 – Premium Load)**
GSP = 1,000,000 x .1858 / 0.95 = 195,579

## 2.    Continued

**Guideline Level Premium = FA x NSP (GLP - Option 2) / Annuity factor / (1 – Premium Load)**
GLP = 1,000,000 x 1.06010 / 17.56197 / 0.95 = 63,540
Premiums paid after 3 years = 105,000
Limit at end of year 4 = Max(GSP, 4x GLP) = Max(195,579 ; 4 x 63,540) = 254,162

Total premiums paid if payment of 150,000 = 255,000

**If a premium of 150,000 is paid, the policy will fail the GPT test**

(e)    Calculate:

   (i)    The taxable gain and the Adjusted Cost Base (ACB) after the partial withdrawal on a Canadian policy.

   (ii)    The taxable gain for a U.S. policy and the basis after the partial withdrawal.

**Commentary on Question**:
*Candidates did well on the Canadian part but not as well on the U.S. part. For the U.S. piece, candidates generally did not discuss the distinction between MEC and non-MEC; they assumed non-MEC and went from there.*

**(i)    Canada**
Total Premiums paid = 35,000 x 3 = 105,000
Minus NCPI = 1054+1268+1500 = 3,822
**ACB = 101,178**

Prorated ACB = 75000 / 95,686 = 78%
Prorated ACB = 78% x 101,178 = 79,305

**Since amount withdrawn is less than prorated ACB, there is no taxable gain.**
ACB after partial withdrawal = ACB prior to withdrawal + taxable gain - Amount withdrawn

**ACB after partial withdrawal = 101,178 + 0 - 75,000 = 26,178**

**2.** **Continued**

**(ii)** **U.S.**
**The taxable gain depends whether the policy is a MEC or a non MEC.**
If the policy is a MEC, then the distribution will be taxed on a LIFO basis which means the withdrawal will be taxed up to the amount of the interest credited in the contract.
Assuming MEC, since the Account Value is lower than the total of premiums paid, there is no interest gain in the contract therefore the taxable gain is 0
It the policy is a non-MEC, the partial withdrawal is less the total of premiums paid therefore, the taxable gain is 0 since for a non-MEC, it is FIFO basis.

## 3.   Learning Objectives:
1.  The candidate will understand feasibility step of new product and how it drives design.

2.  The candidate will understand the design and purpose of various product types, benefits and features.

3.  The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

**Learning Outcomes:**
(1e)   Recommend ways to close the gaps between design and the internal/external constraints.

(1f)   Describe non-forfeiture regulation and perform calculations to evaluate compliance.

(2a)   Describe in detail product types, benefits and features.

(3a)   Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
   (i)     Riders
   (ii)    Policyholder dividends
   (iii)   Equity linked
   (iv)    Embedded options
   (v)     Return of premium
   (vi)    Secondary guarantees
   (vii)   Payout annuity benefits
   (viii)  Crediting methodology
   (ix)    Other non-guaranteed elements.

(3c)   Analyze results and recommend appropriate action from an array of risk and profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value

(3d)   Analyze the capital requirements for a product and describe solutions such as securitization.

(3e)   Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results.

**Sources:**
LP-102-07: Equity Indexed Annuities: Product Design and Pricing Consideration

Hard, Investment Guarantees, Chapter 13 Equity Indexed Annuities

**3.** **Continued**

LP-105-07: Life and Annuity Products and Features

LP-121-12: Life Insurance and Annuity Non-forfeiture Practices

LP-123-13: NAIC Standard Non-forfeiture Law for Individual Deferred Annuities

**Commentary on Question:**
*To receive full marks on this question, candidates should elaborate on their question by providing more explanations for written parts, and provide the formulas and interim steps for calculation parts.*

**Solution:**
(a) Explain how each of the following product features will affect the cost of the EIA:

      (i)     Participation rate

      (ii)    Cap

      (iii)   Margin

**Commentary on Question**:
*Most candidates were able to state the relationship between the feature and the EIA cost, but only half of the candidates provided an explanation to support their statement.*

Index-Based interest = Participation rate is * raw Index Growth%
- A lower participation rate decreases the cost of the EIA by reducing the credited rate (vice versa)

Index-Based interest = min( raw Index Growth % , Cap )
- A low cap decreases the cost of the EIA by limiting the credited rate (vice versa)

Index-Based interest = raw Index Growth % - Margin
- A high margin decreases cost of EIA by reducing the credited rate (vice versa)

(b) List four major differences between a Variable Annuity and an EIA. Assume each only has one fund available.

**Commentary on Question**:
*Most candidates did relatively well in this question and were able to answer at least 3 differences. Candidates should note that the question is focusing on the product feature, not the management of the product.*

# 3. Continued

Answer four of the following:

EIA contracts are relatively short-term compared to VA
EIA usually have terms between 5~7 years

EIA guarantee is in the form of a call option on the underlying equity index
VA guarantee is in the form of a put option on the underlying equity index

The EIA guarantee is usually in-the-money at maturity.
The VA guarantee is rarely in-the-money at maturity.

In EIAs, the equity indices are price return
In VAs, the equity indices are total return. i.e. They allow for dividend
reinvestment

In VAs, there is a separate fund invested in the underlying equity
There is no such separate fund in EIAs.

SEC Registration:
VA products are registered
Most EIA are not so non-registered agents can sell non-registered EIAs but not
VAs

(c) Calculate the final account value using each of the following methods:

(i) Point to Point

(ii) Average Index Growth

(iii) High Water Mark

(iv) Point to Point with annual ratchet

**Commentary on Question**:
*Most candidates were able to accurately calculate the final account value.*

GMAV at time 5 = GMAV5 = 0.9 * Prem * 1.035 = 104,335

Point to point
Formula: AVPTP = Premium * ( [Participation Rate] * { [Final Closing Level] /
[Initial Closing Level] - 1 } + 1 )
AVfinal = 104,500 = max (100,000 * 1045 / 1000, GMAV5)

**3.** **Continued**

Average Index Growth
AVavg = Premium * Average ( [Yearly Closing Level] ) / [Initial Closing Level]
AVavg = 102,400 = 100,000 * { ( 1050 + 900 + 1100 + 1025 + 1045 ) / 5 } / 1000
AVfinal = 104,335 = max ( AVavg , GMAV5 )

High Water Mark
AVHWM = Premium * max ( [Yearly Closing level] ) / [Initial Closing Level]
AVfinal = 110,000 = max (100,000 * ( 1100 / 1000 ) , GMAV5 )

Point to Point with Annual Ratchet
AVPTP Ratchet = Premium * $\prod$ { 1 + max ( [Participation Rate] * (St / St-1) , 0 ) }
AVPTP Ratchet = 130,837 = 100,000 * max( 1050 / 1000 , 1 ) * max( 900 / 1050 , 1 ) * max( 1100 / 900 , 1 ) * max( 1025 / 1100 , 1 ) * max( 1045 / 1025 , 1 )
AVfinal = 130,837 = max ( AVPTP Ratchet , GMAV5 )

(d) Determine the profit as a percentage of premium if the EIA uses:

(i) A point to point growth method

(ii) A point to point growth method with a cap of 8%

**Commentary on Question**:
*Most candidates struggled with the strike price of the call option, and the proration to derive the option cost.*

(i)

Identify that strategy should be: Buy a bond and Buy a call option

Strike = S0 / α * ( GMAV / P - ( 1 - α ) ) = 1000 / 1 * ( 1043.35 P / P - ( 1 - 1) ) = 1043.35

Price of call option with strike of 1043.35
Call1043.35 = 3.35 / 10 * Call1050 + 6.65 / 10 * Call1040 = 0.335 ( 89 ) + 0.665 * (93) = 91.66

Number of option contracts to buy is α * P / S0

Cost of option = [Number of contracts to buy] * Price of option
 = α * P / S0 * Call1043.35 = 91.66 / 1000 P = 9.167% P

Bond Price = GMAV / ( 1 + r )t = 0.9 * 1.035 / 1.045 * P = 85.755% P

**3.** **Continued**

Profit = Premium - Expenses - Bond cost - Option Cost
Profit = P - 1% P - 85.755% P - 9.167% P = 4.078% P

(ii)

Use a call spread option i.e. Buy a call (with strike of 1043.35) and sell a call (with strike of 1080)
Profit = Profit from part 1 + Profit from selling a call with strike of 1080
Profit = 4.078% + 77 / 1000 P = 11.778% P

(e) ECC is planning on launching their EIA in Australia, Canada and the United States.

Explain the minimum Non-forfeiture laws in each of the countries with respect to EIAs.

**Commentary on Question**:
*Most candidates were able to provide the minimum values for US, but some has omitted the deductions.*

Canada & Australia: There are no minimum nonforfeiture law

US:
Minimum values = ( Net considerations - deductions ) accumulated @ defined interest rate

Net considerations = 87.5% of gross considerations (premium)

Deductions: any prior withdrawals or partial surrenders; an annual contract charge of 50; any premium tax paid by the company; the amount of indebtedness to the company on the contact including interest due and accrued

Accumulation rate: 5yr constant maturity treasury rate reduced by 225 basis points (125 for deferred annuity and an additional 100 for EIA), minimum at 1% and maximum at 3%.

**4.** **Learning Objectives:**
2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

4. The candidate will understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

**Learning Outcomes:**
(2a) Describe in detail product types, benefits and features.

(2b) Construct and recommend a design that is consistent with the market needs identified in the idea generation.

(3a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
  (i) Riders
  (ii) Policyholder dividends
  (iii) Equity linked
  (iv) Embedded options
  (v) Return of premium
  (vi) Secondary guarantees
  (vii) Payout annuity benefits
  (viii) Crediting methodology
  (ix) Other non-guaranteed elements.

(3c) Analyze results and recommend appropriate action from an array of risk and profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value
(3e) Describe when a stochastic model should be used, its advantages and disadvantages, how to build it and how to analyze its results.

(4a) Describe and evaluate compliance with illustration regulation and other policy form regulations

(4d) Recommend changes to non-guaranteed elements for deviations from expected.

**Sources:**
Lapse Experience Under Lapse Supported Products, Product Matters, December (63) 2005

Hardy, Investment Guarantees, 2003, Chapter 1 Investment Guarantees

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**4.** **Continued**

Is This Correction Good for Life Insurance, Rostislav Kongoun Zilber – Product Development News, Feb. 2011

LP-120-11: Session PD-5: Pricing Best Practices

LP-126-13: Pricing Critical Illness Insurance in Canada, Mooney

LP-127-13: Product Design of Critical Illness Insurance in Canada

Level Term Lapse Rates – Lessons Learned Here and in Canada, Product Matters, Oct 2011

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 3 Pricing Assumptions

**Commentary on Question:**
*The question tested the Candidate's understanding of Lapse-Supported products, including the amount of available experience. It also tested their knowledge of the lapse experience of the product. The Candidate also needed to know the features of different types of Critical Illness products. Further commentary is made following each part.*

**Solution:**
(a)

    (i)    Describe the availability and credibility of lapse rate experience in the U.S. and Canada for lapse-supported products.

    (ii)    JLB proposes a level 5% lapse rate assumption at all durations. Critique this proposal based on available industry experience for No-Lapse Guarantee Universal Life policies.

    **Commentary on Question**:
    *Part (a) required the Candidate to understand that the persistency for lapse-supported products is not level by policy duration. A number of Candidates did not understand this. Some candidates who understood this point did not know that persistency graded down by duration to the ultimate level. Many Candidates did know that experience for No-Lapse Guarantee Universal Life policies was generally not available and less credible.*

    (i)    US companies have been struggling to develop best estimate lapse assumptions for lapse-supported products. Ultimate lapse rates may not be statistically credible, as shown by lapse studies.

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# 4. Continued

(ii) Canadian UL Level COI products are similar to US NLG UL products. Lapses for Lapse supported Products are as follows: Policy Year 1: about 4%-5%, grading down to about 2%-3% in Policy Year 5. Lapses continue to grade down to the ultimate level of about 1%-2%, and remain fairly level. Therefore a 5% level lapse rate assumption is not appropriate.

(b)

(i) Assess the need and marketability of the Full Acceleration Critical Illness Rider.

(ii) Explain how a low interest rate environment can affect the marketability of this product.

**Commentary on Question**:
*A number of Candidates did not know the product features of the Full Acceleration Critical Illness Rider. Many Candidates did not know the specific uses and needs for the Rider, although most candidates did mention that the accelerated rider provides CI and death protection. Some indicated the need for CI, e.g., higher incidence rates, older people being concerned about their health and the cost of care if there was a serious illness. Most candidates did mention that the premium for the accelerated rider is lower than 2 separate policies (one CI and one life insurance). Very few mentioned the need for CI when taking out a mortgage or being used by banks for Creditor products. Most Candidates did not do well in Part (ii), although many did say the marketability of the product would be lower.*

(i) The Rider can be compared to having 2 products: one for CI protection and one for death protection. The Rider is best suited to situations where there is a need for both products, i.e., CI and death protection. A good example of this is when someone takes out a mortgage. Another application occurs when one needs CI protection but is underinsured for death protection. The product is also used by banks for their creditor mortgage products. The resulting premium is lower than for the 2 separate product, CI and death protection.

(ii) During times of low interest rates and tight corporate spreads, companies turn to real estate in many instances. Low interest rate periods are typically associated with periods of deflation or disinflation and economic weakness. This implies higher vacancies and less money for mortgages. Therefore, in the low interest rate environment, the marketability of the Acceleration CI rider will be lessened.

**4.** **Continued**

(c)

    (i)     Contrast the Standalone Critical Illness and the Full Acceleration Critical Illness product types.

    (ii)    Explain how a reinsurer can add value to the design and pricing of a Critical Illness product.

**Commentary on Question**:
*A number of Candidates did not know the key features of both products, e.g., the premium relationships. Many mentioned that the Standalone CI would be more expensive than the accelerated product, which is incorrect. Most candidates did fairly well on part (i). However, only a few mentioned that there are partial acceleration products. Many Candidates did know how reinsurers add value to the pricing and design of the product. A number of Candidates did mention that Reinsurers often provide the incidence rates for CI.*

    (i)    Since there is a benefit payable on death as well as on CI for the Acceleration CI product, there is no need for a 30-day survival period. For Acceleration CI, the premium is higher than a Standalone CI because death protection is also included. Premium is lower than for 2 separate products, Standalone CI and Term insurance, because it only pays once. There is also a Partial Acceleration CI product, where a percent of the face amount is paid for CI.

    (ii)    The reinsurer can provide incidence rates, since experience is limited. The reinsurer can also help in developing premium rates, by offering commercial product-modeling software, which assists with setting assumptions for expected costs, profit objectives, and capital allocations. They can also provide a commercial premium quotation service to obtain target premium rates. A reinsurer can also help by providing competitive analysis.

**5.** **Learning Objectives:**
4.    The candidate will understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

**Learning Outcomes:**
(4a)    Describe and evaluate compliance with illustration regulation and other policy form regulations.

**Sources:**
LP-124-13: Role of the Actuary in Product Roll-Out

**Commentary on Question:**
*This question primarily tests candidates' understanding of policy form and actuarial memorandum regulations. Candidates are expected to understand the regulation, and apply that knowledge to construct policy form and actuarial memorandum in a given situation.*

**Solution:**
(a)    Describe the transmittal letter to be included in the policy form filing.

**Commentary on Question**:
*The cognitive level of this part of the question is retrieval. This was a very specific list from a study note. The candidates either knew the list or they did not.*

The transmittal letter is part of the policy form filing and should include the following items:
- Company name: ABC Life Insurance Company
- Contact person name and information
- Product description
- Marketing and/or distribution method
- Identification of any previous product which this filing is replacing
- A statement whether the new product be sold using an illustration
- Description of any innovative features or unique provisions
- A listing of the materials included in the filing
- If required, the filing fee

(b)    Critique the Actuarial Memorandum.

**Commentary on Question**:
*The cognitive level of this part of the question is analysis. The candidate is required to recognize what is done well and what is unusual in the provided Actuarial Memorandum. Those candidates that only stated the faults of the Memorandum received partial marks.*

# 5.    Continued

The following items received credit most commonly:
- The description of the Statutory Reserves basis is fine
- No description of bonus or special credit is mentioned since product doesn't have any
- The Actuarial Memorandum is missing but should include the following items:
    - Description of any features that affect non-forfeiture values and whether policy satisfies the minimum non-forfeiture requirements
    - Tables of guaranteed cost of insurance rates
    - Guaranteed annual interest rate of 1.5%
    - Available underwriting classes
    - Minimum and maximum face amounts
- The Actuarial Memorandum should clarify that the guaranteed mortality table is based on age-last-birthday and is smoker distinct
- The Actuarial Memorandum should state that only death benefit option 2 (face amount plus account value) is offered with this policy

## 6.

**Learning Objectives:**

2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

**Learning Outcomes:**

(2a) Describe in detail product types, benefits and features.

(3a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
   (i) Riders
   (ii) Policyholder dividends
   (iii) Equity linked
   (iv) Embedded options
   (v) Return of premium
   (vi) Secondary guarantees
   (vii) Payout annuity benefits
   (viii) Crediting methodology
   (ix) Other non-guaranteed elements.

(3b) Identify and explain the setting of an appropriate assumption for risk and other factors such as:
   (i) Available experience data
   (ii) The marketplace
   (iii) Underwriting
   (iv) Distribution channel characteristics
   (v) Reinsurance
   (vi) Expenses (fixed, variable, marginal)
   (vii) Taxes (income and premium)
   (viii) Investment strategy

**Sources:**

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 3 Pricing Assumptions

LP-105-07: Life and Annuity Products and Features

LP-107-07: Experience Assumptions for Individual Life Insurance and Annuities

Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans (pages 14 – 31 and 40 – 51 only)

**Commentary on Question:**
*Commentary listed underneath question component.*

**6.**    **Continued**

**Solution:**

(a)    List reasons why mortality and lapse experience can vary widely from company to company.

**Commentary on Question**:
*Most answers gave reasons for mortality differences but failed to give sufficient reasons for lapses to differ.*

Mortality (any 4 of these would have been sufficient)
- Personal risk factors
- Environmental risk factors
- Location risk factors
- Medical risk factors
- Cultural risk factors
- Company underwriting
- War and Conflict

Lapse (any 4 of these would have been sufficient)
- The manner in which the policy was sold
- Perceived value of the company
- Degree of understanding of the product by the insured
- Ability to pay
- Agents attitude
- Customers commitment
- Ease of paying
- Product features

(b)

   (i)    Calculate the 95% confidence interval for the mortality rate.  Show all work.

   (ii)    Evaluate whether this data should be used to set the mortality assumption.

   **Commentary on Question**:
   *This question was generally done well.  Some answers only calculated the 95% CI of the expected number of claims but failed to continue on with the CI for the mortality rate.*

   (i)
            estimated mortality rate: q=
            *0.0008*
            Expected number of claims for n = 5000 policies : E=nq
            4

**6.** **Continued**

*Variance of expected claims for n = 5000 policies : Var = npq*

*3.9968*
95% confidence interval of expected claims: E+- 1.96* (Var) ^(0.5)
=4+-(1.96)*(3.9968)^0.5
=4+-3.92


95% confidence interval of mortality rate: (E+- 1.96* (Var) ^(0.5))/n
=0.0008 +- .000784

(ii) The confidence interval is plus or minus 98% of the estimated mortality. The CI is to wide. This is not a credible estimate for setting the mortality assumption.

(c)
(i) Explain the phenomenon that is occurring at policy duration 10.

(ii) Predict the impact of these lapse rates on mortality experience beyond policy duration 10.

(iii) Recommend a change to the premium structure to increase persistency. Justify your recommendation.

**Commentary on Question**:
*The first 2 parts of this question were answered very well. Part 3 was done quite poorly. For part 3 there was not enough justification given for the recommendations provided.*

(i) The phenomenon is called "Shock Lapse". It occurs in the final year of the initial term period. 'It is caused by the large jump in premiums in the renewal period that drive healthy lives to lapse their coverage and re-underwrite for lower premiums.

(ii) The mortality experience after the shock lapse is generally deteriorated. This deterioration is cause by the healthy lives lapsing and re-underwriting to take advantage of lower premiums at older initial terms.

# 6. Continued

      (iii)    'In order for ABC to increase persistency it would need to charge a renewal premium that is close to the premium that is offered to a newly issued policy at that age. This could be justified by arguing that lower renewal rates recognize that expenses are lower in renewal years. There would also be less anti-selective lapse if renewal rates are lower thereby improving mortality of the renewal group.

(d)    Explain the shortcomings of using Return on Investment as a profitability measure for new products.

- Calculation cannot be done if all policy years are profitable (cannot find an interest rate so that the PV = 0)
- Results can be misleading if the first year cost is very low compared to renewal profits. Ex, can get ROIs of 1000%.
- Can have multiple solutions if profits alternate being +ve and –ve
- Does not capture profit in dollars

(e)    Recommend which proposal senior management should approve under each scenario. Justify your recommendation.

**Commentary on Question**:
*The key to answering this question well was to discuss each of the Products in terms of each profit measure. Through the discussion products could be systematically excluded to narrow down to the most reasonable recommendation. This question was generally done well.*

Scenario 1
- Company is demanding a return of 15% and so Product B should not be recommended
- Product D has a high breakeven year and so should not be recommended. (a product that does not break even for many years will require capital for a long time)
- Product C has the highest new business strain which would take up lots of capital
- Therefore, recommend Product A

Scenario 2
- If lapse risk is the only concern, then company likely wants an early break-even year
- Product B has the earliest break-even year
- Product A and C have a higher breakeven year but higher ROI

**6.** **Continued**

- However Product A has a lower VNB and Product C has high strain and so
- Recommend Product B as it has the earliest break-even year without reducing dramatically other profit metrics

Scenario 3
- If Shareholders want a 14% return then can eliminate Product B
- If willing to contribute significant capital then can have high new business strain and could accept a higher break-even year
- Product C has the highest VNB, but with high strain and a mid break-even year
- If looking to maximum profitability, then recommend Product C

## 7. Learning Objectives:

2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

**Learning Outcomes:**

(2a) Describe in detail product types, benefits and features.

(3a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
  (i) Riders
  (ii) Policyholder dividends
  (iii) Equity linked
  (iv) Embedded options
  (v) Return of premium
  (vi) Secondary guarantees
  (vii) Payout annuity benefits
  (viii) Crediting methodology
  (ix) Other non-guaranteed elements.

**Sources:**

LP-105-07: Life and Annuity Products and Features

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 3 Pricing Assumptions

**Commentary on Question:**
*Commentary listed underneath question component.*

**Solution:**

(a) Describe the types and uses of substandard ratings.

### Commentary on Question:
*Many candidates answered table multiples and flat extras. Most of the candidates did not provide exclusion and declines as substandard ratings. In general, candidates did relatively well in this part.*

There are a few types of substandard ratings:
(i) Table Multiples;
(ii) Flat Extras;
(iii) Exclusions; and
(iv) Declines.

**7.** **Continued**

Table Multiples are used for medical impairments or other rating factors where the extra mortality is a relatively constant percentage of standard mortality. Table multiples are neither suitable nor necessary for impairments involving hazards that are essentially temporary.

A Flat Extra premium is used where the extra mortality appears to be a constant number of extra deaths per thousand, or a decreasing percentage of standard mortality.

An exclusion is used in cases involving a potential hazard which does not currently exist, or is difficult to assess.

Advanced in age/ Lien Method/ Return of Premium can be also used as substandard ratings.

(b) Discuss modifications that should be made to pricing assumptions when modeling substandard life policies.

**Commentary on Question**:
*Many candidates mentioned mortality and expense. Some of them also mentioned lapse. Many of them missed the interest rate comment, probably because the question asked for modifications to the pricing assumptions. If it is not changed, then the students may not state that. For mortality and expense assumption, a common answer is to state "higher mortality and higher underwriting expense". Candidates are encouraged to consider all assumptions and expand their answers. Furthermore, many papers stated reinsurance/ commission/ reserve. I would categorize the reinsurance/ commission as contractual more than pricing assumptions.*

The following is a list of pricing assumptions when modeling substandard life policies:

(i) Mortality:
- Some modification of the mortality table might be appropriate for substandard experience premiums as the relationship of substandard to standard mortality may not be a constant percentage for all ages.
- Experience net extra premiums are based on multiples of a table of standard mortality rates.
- The theoretically correct method is to have four sets of UW guidelines with separate mortality debits for Males/Females, and Smokers/NonSmokers, with four separate schedules of extra premiums.
- The pattern of extra mortality by age or duration varies according to the nature of the impairment.

**7.** **Continued**

      (ii)    Lapse
- High early duration lapse rates tend to increase the cost of substandard insurance as there is an increase in the initial expense element because it is amortized among fewer policies.
- Later duration lapse rates should be reduced as the likelihood of getting the same or better rating in the future is unlikely.
- There is also an increase in the initial expected extra mortality because of the effect of antiselection at lapse is for the better risks to lapse.
- If a "Level Extra Premium" is charged, an early lapse can have a favorable financial effect.

      (iii)    Interest
- For most forms of Term insurance, interest rates are not an important assumption in the pricing.
- For this reason, no change in assumption is required for substandard policies.

      (iv)    Expense
Underwriting cost:
- Higher underwriting cost for substandard cases, because they require more underwriting information than standard cases.
- More underwriting tests, such as APS, ECGs, and medical exams, are required with substandard cases.
- Substandard cases often require more time to be spent in Underwriting with a more experienced underwriter.

Maintenance expense:
- Maintenance expenses are generally the same for substandard and standard business.
- Substandard policies may incur additional expenses connected with requests for reduction/removal of ratings.

- Not taken rates for Substandard policies are higher than for standard policies.
- The rate of "not taken" also increases as the level of substandardness increases.

(c)    Explain the advantages and disadvantages of not paying agent commission on the additional substandard premium.

**Commentary on Question**:
*Many candidates stated this proposal would provide disincentive to agents for this part.*

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# 7. Continued

Advantages of not paying agent commission on the additional substandard premium:
- In theory, it will reduce the required extra premiums to cover the additional risks and/or hazards.
- Will make the policy more attractive to the policyholders.

Disadvantages of not paying agent commission on the additional substandard premium:
- Paying commissions is an inducement to the agent to make the extra effort required to deliver a substandard policy.\
- Agents may take all their business, not just the substandard business, to another carrier where they feel they are being appropriately compensated for their services.

(d)    Evaluate Marketing's proposal to offer a return of the substandard premium if the policyholder is still alive at time of expiry of the Term policy at no cost.

**Commentary on Question**:
*Candidates should state the position whether the proposal is a good one or a bad idea with reasons. For those who thought it was a bad idea, many of them stated that it should not be a free benefit. However, not many of them stated other reasons to gain additional marks. If there is only one out of four reasons, candidates would only get 25% of the full mark for this particular part.*

This marketing's proposal is not a good idea for the following reasons.

- This proposal would not work from a profitability perspective as it is not a "free" benefit.
- This type of return of premium would require an additional premium, which in turn would make the rating more expensive than it currently is and therefore harder to sell.
- Marketing's proposal will assist with closing the sale of the rating to the client as most rated policyholders do not see themselves as "unhealthy", but policyholders would need to pay for this additional benefit.

**8.** **Learning Objectives:**

2. The candidate will understand the design and purpose of various product types, benefits and features.

3. The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

**Learning Outcomes:**

(2a) Describe in detail product types, benefits and features.

(3a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
  (i) Riders
  (ii) Policyholder dividends
  (iii) Equity linked
  (iv) Embedded options
  (v) Return of premium
  (vi) Secondary guarantees
  (vii) Payout annuity benefits
  (viii) Crediting methodology
  (ix) Other non-guaranteed elements.

(3b) Identify and explain the setting of an appropriate assumption for risk and other factors such as:
  (i) Available experience data
  (ii) The marketplace
  (iii) Underwriting
  (iv) Distribution channel characteristics
  (v) Reinsurance
  (vi) Expenses (fixed, variable, marginal)
  (vii) Taxes (income and premium)
  (viii) Investment strategy

(3c) Analyze results and recommend appropriate action from an array of risk and profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value

**Sources:**

Atkinson & Dallas, Life Insurance Products and Finance, Chapter 3 Pricing Assumptions

LP-105-07: Life and Annuity Products and Features

LP-119-11: A Comprehensive Guide to Measuring and Managing Life Insurance Company Expenses, Gutterman, Chapter 5

# 8. Continued

Report on the Lapse and Mortality Experience of Post-Level Premium Term Plans (pages 14-31 and 40-51 only)

**Commentary on Question:**
*Commentary listed underneath question component.*

**Solution:**
(a) Recommend whether RKA should pursue this strategy. Show your work.

**Commentary on Question:**
*Overall, candidates did very well on this question. The decision to pursue or not this strategy was clearly stated and adequately justified. Some candidates wrongly incorporated the upfront expenses into the calculation.*

First, we calculate the expected profit under the current approach

E[profits] = E[PV of premiums]-E[PV of benefits]-Upfront expenses
= 500(4.45)-250,000(0.0065)-600
= 0

Under the simplified approach,
E[profits] = E[PV of premiums]-E[PV of benefits]-Upfront expenses
= P(4)-250,000(0.008)-350
= 4P-2350

To generate the same expected profit, the simplified approach would have to charge an annual premium of P=2350/4=587.5

Given that the competition limits our ability to increase premiums by more than 5% (which would yield a new premium of 500(1.05)=525), RKA should NOT pursue this strategy.

The change in underwriting philosophy does not produce enough expense savings to offset the changes in increased mortality caused by the simplified underwriting.

(b) Assess the risks of adopting this simplified underwriting approach under an independent broker distribution system.

**Commentary on Question:**
*Candidates should assess the impact of adopting the simplified underwriting approach **under an independent broker system**. This is different than assessing the impact of adopting a simplified underwriting approach. Also, some candidates focused exclusively on how commissions affect a broker distribution system.*

# 8.     Continued

Independent brokers typically sell products from multiple companies.  They can therefore anti-select against the companies.  They can analyze different companies' prices and place their clients where their profile results in the cheapest price.

Brokers will direct "healthy" clients to other companies' products that require a more comprehensive underwriting process and hence result in a cheaper premium.  Alternatively, substandard risks who will likely not pass a more stringent underwriting process may qualify under a simplified underwriting approach.  If the premium is competitive, brokers will direct their substandard risk clients to RKA.  This will likely result in a higher than expected mortality experience.

Also, brokers have relatively high lapse rate.  Brokers may encourage good risks to lapse and purchase a new policy.  This will entitle them to their first-year commission.  Brokers distribution is also very commission sensitive.

(c)     RKA wants to add a conversion option to the T5 product.

   (i)     Describe three possible methods to price for the additional cost of this conversion option.

   (ii)    Recommend one of the three methods assuming RKA wants to cover the future cost of excess mortality.

**Commentary on Question**:
*For (i), candidates need to list and DESCRIBE each of the three methods. Most candidates did not describe the methods.  As for (ii), the recommendation should be clear and an adequate rationale for the recommendation should be provided. Many candidates did not identify the right method.*

Three possible methods (together with their description) are:

1.  The additional cost is borne by all policyholders
    - Cost included in the base premium
    - Result in a lower cost per person
    - Reduce anti-selection

2.  The additional cost is borne by all people willing to pay to have to option available
    - Extra premium is charged for only those who have the option available
    - Result in a higher cost per person than in 1.
    - Some anti-selection

**8.**    **Continued**

3. The additional cost is borne only by those who exercise
    - Premium does not include the price of option
    - Option is priced upon conversion
    - Most common, especially on conversion to other term products
    - High anti-selection – conversion only if profitable for the policyholder

If RKA wants to cover the future cost of excess mortality, we recommend Method 1 – additional cost by borne by all policyholders.  Indeed, the base premium includes the price of option.  Given that this method results in the lowest cost per person, we expect more policyholders to convert.  This results in the lowest anti-selection effect among the three methods.

**9.**

**Learning Objectives:**

2.      The candidate will understand the design and purpose of various product types, benefits and features.

3.      The candidate will understand the relationship between the product features, their inherent risks, and the selection of appropriate pricing assumptions, profit measures and modeling approaches.

4.      The candidate will understand actuarial requirements of product implementation and the monitoring of experience versus product assumptions.

**Learning Outcomes:**

(2a)    Describe in detail product types, benefits and features.

(2b)    Construct and recommend a design that is consistent with the market needs identified in the idea generation.

(3c)    Analyze results and recommend appropriate action from an array of risk and profit measures such as: Statutory, GAAP, Return on Equity, Market Consistent Pricing, Embedded Value.

(4b)    Evaluate, through the use of Experience Studies, how actual experience varies from expected relative but not limited to: mortality, investment returns, expenses and policyholder behavior such as policy and premium persistency.

**Sources:**

LP-118-11: Traditional Versus Market Consistent Product Pricing, Senjeeb Kumar

LP-126-13: Pricing Critical Illness Insurance in Canada, Mooney

LP-127-13: Product Design of Critical Illness Insurance in Canada

Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies, CIA Education Note, July 2002 (Exclude Appendices)

**Commentary on Question:**
*This question tests wide a range of learning outcomes and syllabus material. The candidate should be able to synthesize material from different areas of the syllabus to compare product features, as well as perform calculations that require critical thinking.*

*To obtain maximum points on this question, a candidate would need to perform well on both the economic capital calculation and the actual to expected incidence calculation. An exact and precise final answer for both sections would not be necessary for full credit, but the candidate would need to have clearly explained the framework and performed the majority of calculations correctly.*

# 9. Continued

*Most candidates had trouble fully answering part (a) of the question. This was due to candidates focusing more on the individual product features of each product, rather than explicitly comparing the features of each and how they were the same or different.*

*It was very rare for candidates to calculate both part (b) and part (c) fully correctly, and far less than half of the candidates had the final answer correct for even one part. However, most candidates still performed well on the calculations overall and only made small calculation errors or missed relatively minor components.*

**Solution:**

(a)    Compare the product features and pricing assumptions for critical illness versus traditional term life insurance.

**Commentary on Question**:
*Little to no candidates made as many points as given in the list below. This list is a thorough, yet not exhaustive, list of points that received credit that were commonly cited by candidates.*

- The primary difference is that the contingency covered is critical illness rather than death.
- There is limited CI experience data for morbidity compared with mortality for term insurance.
- The product design for both products requires risk management to avoid antiselection at issue; underwriting for critical illness is similar to that for preferred life insurance
- The product framework is very similar between CI and term insurance (e.g. 10 year renewable term, T100)
- Can likely uses the same assumptions for sales compensation, expenses, and taxes (for the equivalent product)
- Critical illness and term insurance can actually be combined into one product via Acceleration CI whereby the face amount is paid at the earlier of critical illness or death
- Can also have Partial acceleration (% of face is paid for CI and policy continues in force as death protection)
- Critical illness premiums are significantly higher than the comparable term policy (due to higher incidence rates). However, the face amount of the average life insurance policy is much higher than that of the average CI policy.
- Reinsurers could play a significant role in the pricing of both products
- In terms of the pricing assumptions, a CI incidence rate is analogous to a mortality rate for term insurance

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**9.** **Continued**

(b)     Calculate the diversification factor for investment mismatch.  Show all work.

   **Commentary on Question**:
   *Many candidates miscalculated the operational risk and investment mismatch components, and often used the same formulas applied for the morbidity and lapse components.  Some candidates erroneously incorporated the present value of premiums in the operational risk calculations, while others incorrectly did not include it in the investment mismatch component.*

   *If a candidate miscalculated these components but still performed the rest of the calculation correctly, including applying the diversification factors and using the ERC formula to solve for the investment mismatch factor, the candidate still received significant credit.*

   Morbidity Component (pre diversification)
   = (PV Premiums less Benefits and Expenses under Best Estimate) - (PV Premiums less PV Benefits and Expenses under 30% Morbidity Shock)
   = (5,365,000 - 4,854,000 - 150,000) - (4,986,000 - 5,522,000 - 135,000)
   = 361,000 - (-671,000)
   = 1,032,000

   Morbidity Component (post diversification)
   = (Morbidity Component pre divers.) x (Morbidity divers. Factor)
   = 1,032,000 x 80%  = 825,600

   Lapse Component (pre diversification)
   = (PV Premiums less Benefits and Expenses under Best Estimate) - (PV Premiums less PV Benefits and Expenses under 50% Lapse Shock)
   = (5,365,000 - 4,854,000 - 150,000) - (5,398,000 - 4,971,000 - 155,000)
   = 361,000 - (272,000)
   = 89,000

   Lapse Component (post diversification)
   = (Lapse Component pre divers.) x (Lapse divers. factor)
   = 89,000 x 85%
   = 75,650

   Operational Risk Component (pre diversification)
   = (PV Benefits and Expenses under Best Estimate) x (Operational Risk Charge)
   = (4,854,000 + 150,000) x 1%
   = 50,040

## 9. Continued

Operational Risk Component (post diversification)
= (Operational Risk Component pre divers.) x (Op Risk divers. factor)
= 50,040 x 70%
= 35,028

Investment Mismatch Component (pre diversification)
= (PV Premiums less PV Benefits and Expenses under Best Estimate) x
(Investment Mismatch Charge)
= (5,365,000 - 4,854,000 - 150,000) x 2%
= 7,220

To determine the diversification factor for investment mismatch, solve for X:

ERC = Morbidity Component (post) + Lapse Component (post) + Operational
Component (post) + Investment Mismatch Component (pre) * X%

938,083 = 825,600 + 75,650 + 35,028 + 7,220 * X%

X% = 1,805 / 7,220 = 25%

(c)   Calculate the blended actual to expected (A/E) incidence ratio for male preferred
and female preferred using the Normalized Method for credibility.  Show all
work.

**Commentary on Question**:
*Some candidates provided written explanations for the steps that would need to be
performed, often accompanied by formulas, but did not perform the actual
calculations.  In these instances, the credit received was dependent on the quality
of the written answer. If the candidate provided a thorough explanation that
clearly demonstrated the candidate knew the framework for solving the problem,
significant credit was given.  However, little credit would be given if the
candidate only provided vague steps and explanations.*

*For example, if a candidate wrote "Final step: Normalize," the candidate would
receive minimal credit.  A candidate who wrote "Final step: Normalize the above
ratios by multiplying them by the ratio of Expected Claims based on total
company blended expected morbidity over the Expected Claims based on
credibility of the sub-categories" would receive full credit for that step's written
explanation.  The candidate must demonstrate he or she knows what it means to
"normalize."*

*Some candidates calculated only the male preferred and female preferred
credibility factors and blended expected morbidity ratios.  Doing this received
only partial credit.*

**9.** **Continued**

Step 1: Calculate the credibility factors (CF) for the total company and for each of the subcategories.

Total Company CF = min{sqrt(638/3007),1} = 0.461

Male Standard CF = min{sqrt(275/3007),1} = 0.302
Male Preferred CF = min{sqrt(146/3007),1} = 0.220
Female Standard CF = min{sqrt(129/3007),1} = 0.207
Female Preferred CF = min{sqrt(88/3007),1} = 0.171

Step 2: Calculate the total company blended expected morbidity ratio and corresponding expected claims.

Total Company Blended Expected Morbidity Ratio
= 0.461 x 83.2% + (1-0.461) x 90.9%
= 87.35%

Corresponding Expected Claims
= (87.35%) x (total expected claims using industry morbidity table @ 100%)
= (87.35%) x (638 / 0.832)  = 669.8

Step 3: Calculate the expected number of claims for the total company using the claims and credibility of the sub-categories.

Blended expected morbidity ratios (sub-category credibility):
  Male Standard = 0.302 x 98.9% + (1-0.302) x 110.4%  = 106.9%
  Male Preferred = 0.220 x 66.1% + (1-0.220) x 60.3%  = 61.6%
  Female Standard = 0.207 x 90.0% + (1-0.207) x 115.6%  = 110.3%
  Female Preferred = 0.171 x 70.5% + (1-0.171) x 58.8%  = 60.8%

Total Expected claims
=106.9%x(275/0.989)+61.6%x(146/0.661)+110.3%x(129/0.900)+60.8%x(88/0.705)
=297.2 + 136.1 + 158.1 + 75.9
= 667.3

Step 4: Normalize the A/E ratios of the subcategories by the ratio of the total expected claims from Step 2 to the total expected claims from Step 3

Male Preferred A/E ratio (blended) = 61.6% x (669.8 / 667.3) = 61.8%
Female Preferred A/E ratio (blended) = 60.8% x (669.8 / 667.3) = 61.0%

**10.** **Learning Objectives:**
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**Learning Outcomes:**
(2a) Describe in detail product types, benefits and features.

(3a) Identify and explain the setting of an appropriate assumption for product characteristics such as the following:
   (i) Riders
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   (iv) Embedded options
   (v) Return of premium
   (vi) Secondary guarantees
   (vii) Payout annuity benefits
   (viii) Crediting methodology
   (ix) Other non-guaranteed elements.

**Sources:**
LP-102-07: Equity Indexed Annuities: Product Design and Pricing Consideration

LP-107-07: Experience Assumptions for Individual Life Insurance and Annuities

EIUL: The Devil's in the Details, Product Matters, August (62) 2005

**Commentary on Question:**
*This question tests the understanding of equity-indexed products (equity-indexed universal life product in this case), the understanding of how replication of portfolios work, be able to recommend changes to product features to reduce risk. Overall, this question was not done well, with the majority of difficulties arising from failing to perform the calculations of part (c).*

**Solution:**
(a) List the steps necessary to establish experience assumptions with respect to EIUL product features.

   **Commentary on Question**:
   *Part (a) asked for a list of steps necessary to establish experience assumptions. While it mentioned that it was in respect to EIUL products, the answer seems to be applicable to all product types. Most candidates did very well on this section.*

# 10. Continued

1. Identify the assumptions required
2. Determine the structure of each assumption
3. Analyze experience and trends for each assumption
4. Review experience and update assumptions for reasonableness, consistency, and appropriateness
5. Document assumptions
6. Monitor assumptions going forward

(b) Compare and contrast static and dynamic hedges with respect to index-based interest funding.

**Commentary on Question**:
*Most candidates did well on this section as well. Most could come up with the basic difference of a "buy and hold" strategy for static hedging vs. a continuous rebalance for dynamic hedging. Most discussed expenses and type of options purchased as well. Fewer candidates discussed hedge percentages, volume levels of purchases, and downside protection for dynamic hedging.*

Static Hedging
- Buy and hold investment strategy
- Involves over the counter purchases
- Most common purchase is call/spread options on the index
- Hedge percentage is usually lower than 100% due to projected mortality and lapsation
- Low volumes can make it difficult to purchase an appropriate hedge

Dynamic Hedging
- Requires continuous rebalancing (by monitoring the delta and other greeks of the liability portfolio)
- Frequent rebalancing lowers the chance of hedging error, but leads to transaction costs
- A disadvantage of dynamic hedging is that it does not provide for downside protection

(c)

(i) Design a one-year static hedge for the interest credited on this contract, using one-year call options. Assume a net earned rate of 5%.

(ii) Illustrate the payoff of your hedge design.

(iii) Calculate the gain/loss from the hedge. Show all work.

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# 10. Continued

**Commentary on Question**:
*This was by far the hardest part of the question for most candidates. Part (i) seemed like it was not well understood by the candidates. Most candidates mentioned buying a call option with a strike price of 1,000 and selling a call option with a strike price of 1,100, but the rest of the answer was rarely given. Part (ii) was answered successfully more often and was probably the highest scored section of part (c). Part (iii) was also very difficult for the candidates, but there were a small percentage of candidates who did solve this part correctly. Those who did not solve the problem correctly could usually give the correct formula that should be used, but they just could not apply the formula to the problem correctly.*

Part (i):
- The first step to designing a static hedge is calculating the anticipated crediting balance. This is done by averaging the account value at time 0 and at time .5.
- AV(0) = 1,183 – (50,000 - 1,183) * 2.5 / 1,000 = 1,061.17
- AV(.5) = 1,061.17 – (50,000 – 1,061.17) * 2.5/1,000 = 938.83
- Anticipated crediting balance = (1,061.17 + 938.83) / 2 = 1,000
- To hedge the downside risk, we need to invest an amount in the general account that will equal the anticipated crediting balance at the end of time 1, the value = 1,000 / 1.05 = 952.38
- The option budget then equals the account value less than amount invested in the general account, this equals 1,000 – 952.38 = 47.62
- To fund the interest credited to the anticipated credited balance, buy a call option with a strike price of 1,000 and sell a call option with a strike price of 1,100

Part (ii):
- If the index < 1,000 => return = 0
- If the index is between 1,000 and 1,100 => the return is the index less 1,000
- If the index > 1,000 => the return = 100

Part (iii)
- First you need to calculate the ATM option price
- Then you need to calculate the OTM option price
- ATM option price less the OTM option price equals the cost of the call/spread option
- The gain or loss results from the price of the call/spread option compared to the option budget solved for in part (i)

# 10. Continued

- ATM option price:
  - d1 = ln(1,000/1,000)+(0.04+(0.18^2)/2)*(1))/(0.18*sqrt(1)) = 0.3122
  - d2 = d1 - 0.18*sqrt(1) = 0.1322
  - $\Phi$(d1) = 0.62
  - $\Phi$(d2) = 0.55
  - ATM Call Price = 1,000*0.62 - 1,000*e^(-0.04)*0.55 = 91.57
- OTM option price:
  - d1 = ln(1,000/1,100)+(0.04+(0.18^2)/2)*(1))/(0.18*sqrt(1)) = -0.2173
  - d2 = d1 - 0.18*sqrt(1) = -0.3973
  - $\Phi$(d1) = 0.41
  - $\Phi$(d2) = 0.35
  - OTM Call Price = 1,000*0.41 - 1,100*e^(-0.04)*0.35 = 40.10
- Call/spread option price = 91.57 – 40.10 = 51.47
- Hedge results in a Loss = 47.62 – 51.47 = Loss of 3.85

(d) With respect to EIUL interest funding:

(i) Describe possible scenarios which would impact your ability to hedge the interest funding.

(ii) Propose two potential solutions with respect to EIUL product features to mitigate these scenarios.

**Commentary on Question**:
*This part of the question was inconsistent for the candidates. The candidates either did really well on this part of the question or did not score any points at all. For part (i), most candidates mentioned either high volatility or low interest rates, but very few put them together. For part (ii), most candidates who did well mentioned lower caps or participation rates less than 100%. Some mentioned a margin on the index. Very few mentioned volatility swaps.*

Part (i):
- High volatility – increases the price of the call/spread option making the option more difficult to afford
- Low interest environment – lower interest rates lead to a lower earned rate on a company's general account, lowering the company's option budget
- A particularly difficult situation for a company is a combination of high market volatility and a low interest rate environment

# 10. Continued

Part (ii):
- A volatility swap could be used to lock in the current market volatility and help control the price of the call/spread option
- Decrease the cap percentage to reduce the cost of the call/spread option
- Introducing a participation rate percentage less than 100% will lower the index-based return
- A margin can be applied to the index growth to lower the index-based return