ILA LP Model Solutions
Spring 2017

1. **Learning Objectives:**

1. The candidate will understand various insurance products, markets, and regulatory regimes.

Learning Outcomes:

(1a) Describe insurance product types, benefits, and features including reinsurance.

(1b) Evaluate insurance markets, consumer needs, distribution channels, and regulatory regimes.

Sources:

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

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

Commentary on Question:

Commentary listed underneath each question component.

Solution:

(a) Calculate the minimum nonforfeiture amount at the end of the first three policy years assuming that the initial CMT applies for all future periods and the single premium is 10,000. Show all work.

Commentary on Question:

This question tested the candidates' knowledge of the Standard Nonforfeiture Law for Individual Deferred Annuities. Candidates generally did well with identifying which CMT rate to use to calculate the Standard Nonforfeiture Law interest rate, but few remembered to round the calculated interest rate to the nearest 1/20 of 1% (i.e. nearest 0.05%).

- SNL Interest Rate = Min(3%, Max(1%, 3.69% - 1.25%)) = 2.44%, rounded to 2.45%

1. Continued

To receive full credit, the candidate needed to apply the interest rate to the correct minimum nonforfeiture amount formula and calculate the correct minimum nonforfeiture amount for all three years. Candidates did well in recognizing the annual contract charge of $50 and that the net premium = 87.5% of the single premium, but only a fraction of the candidates calculated the correct minimum amount for all 3 years.

Year	Min NF Amnt BOY	Net Prem	Annual Charge	Interest at 2.45%	Min NF Amnt EOY	
1	-	8,750	50	213	8,913	Interest = (8,750 - 50) x 0.0245 = 213
2	8,913	-	50	217	9,080	Interest = (8,913 - 50) x 0.0245 = 217
3	9,080	-	50	221	9,252	Interest = (9,080 - 50) x 0.0245 = 221

(b)

(i) Demonstrate how the cash surrender values fail the retrospective test.

(ii) Recommend four product design changes that will make the product compliant with the minimum nonforfeiture requirements. Justify your answer.

Commentary on Question:
Commentary on part (b), if appropriate. Click here to enter text.

This question tested the candidates' ability to apply the assumptions given in the problem to the cash surrender value formula for a single premium deferred annuity.

(i) To receive full credit for part (i), the candidate needed to calculate the cash surrender value formula for all 3 years, while demonstrating that the cash surrender value failed the minimum nonforfeiture requirements.

Most candidates recognized that the cash surrender value that was calculated was less than the minimum nonforfeiture amount calculated in (a) and thus failed the requirement, but only a handful of candidates calculated the correct cash surrender values. Many candidates incorrectly included the commission expense in the formula for the account value. Some candidates incorrectly multiplied the surrender charge percentage to the account value instead of to the single premium.

With Premium Load only in Year 1									
AV		Prem		Annual	AV		Surrender Charges		
BOY	Prem	Load	Int 2%	Charge	EOY		SC%	SC	CV EOY
-	10,000	200	196	85	9,911		10%	1,000	8,911
9,911	-	-	198	85	10,024		9%	900	9,124
10,024	-	-	200	85	10,140		8%	800	9,340

1. Continued

Since the cash surrender value in year 1 of 8,911 < Min NF amount in year 1 above of 8,913, it fails the test.

(ii) For part (ii), candidates needed to recommend design changes that would have allowed the product to comply with the minimum nonforfeiture requirements.

Examples include but are not limited to:

- Increase the guaranteed interest rate – increasing the guaranteed interest rate will increase the account value, which will subsequently increase the cash surrender value
- Reduce the Periodic Fee – lowering this deduction will result in an increase to the account value, which will subsequently increase the cash surrender value
- Reduce the premium load – lowering this load will result in an increase to the account value, which will subsequently increase the cash surrender value
- Reduce the surrender charges – reducing the surrender charges will increase the cash surrender value

Candidates overall did well in identifying ways to increase the cash surrender value, but justification was required in order to achieve full credit for this question.

2. Learning Objectives:

1. The candidate will understand various insurance products, markets, and regulatory regimes.

3. The candidate will understand actuarial requirements of product governance, implementation, operations, and management.

Learning Outcomes:

(1a) Describe insurance product types, benefits, and features including reinsurance.

(1b) Evaluate insurance markets, consumer needs, distribution channels, and regulatory regimes.

(3a) Describe governance and implementation requirements, principles, and practices.

Sources:

LP-124-13: Role of the Actuary in Product Roll-out

The Art and Science of Life Insurance Distribution, Bennett and Zultowski, 2014, Ch. 3 – 7

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

Commentary on Question:

Candidates generally answered part (c) well. Candidate had the most trouble answering part (d).

Solution:

(a)

(i) Describe the types of compensation typically used for each distribution channel.

(ii) Recommend a distribution channel for each of EBB's proposed products. Justify your answer.

Commentary on Question:

For (a) (i), most candidates generally did well describing the compensation for the independent agent and career agent, but failed to point out the key differences in compensation for the other three channels.

For (a) (ii), most of the candidates were able to identify Direct Marketing as the best distribution channel for Term with a strong justification, but had difficulty identifying the best channel for other products or justifying their recommendation of channels.

2. Continued

(i) Describe the types of compensation typically used for each distribution channel.

- Financial Advisors: Fee based compensation is common (some cannot receive product commission).
- Independent Agents: Product commissions and bonuses, recognition events/travel
- Career Agents: Comp comes through commissions and overrides to managers. Depending on structure may have some salary. Expense allowances and financing/advances. Health insurance, Benefits.
- Home Service Agents: commissions paid on growth of agent's entire block of business
- Direct Marketing: compensation expenses much lower than other channels

(ii) Recommend a distribution channel for each of EBB's proposed products. Justify your answer.

<u>Guaranteed Issue 10-Year Term:</u>

- Recommendation - direct marketing
- Appropriate for guaranteed issue products that require little agent/client contact
- Only challenge may be price competition if EBB is not competitive

<u>IUL with NLG:</u>

- Recommendation - independent agents
- Work well with wealthy clients and complex products
- May be less expensive and difficult to manage than career agents
- Some financial advisors are not able to life insurance, and would have to partner with life agents

or

- Recommendation - career agents
- Work well with wealthy clients and complex products
- Agents are only allowed to sell your products, may be beneficial since products may not be competitive

<u>Variable Annuities:</u>

- Recommendation - financial advisors
- Can meet requirements of wealthy, sophisticated clients well.
- Correct registrations for selling variable annuities

<u>Single Premium Immediate Annuities:</u>

- Recommendation - financial advisors
- Can meet requirements of wealthy, sophisticated clients well.
- May be less expensive and difficult to manage than career agents

2. Continued

(b) Evaluate the appropriateness of each product for EBB's target market. Justify your answer.

Commentary on Question:
Most of the candidates correctly identified Term as a product that is not appropriate for wealthy clients. Most of the candidates were able to identify Variable Annuities as the most appropriate product for wealthy clients. However, many candidates struggled to clearly identify whether IUL and SPIA was appropriate or not. Partial credit was given to answers that included a reasonable justification, such as the No Lapse Guarantee being unattractive to wealthy clients.

Guaranteed Issue 10-Year Term:
- Unlikely to be attractive to wealthy clients, generally sold to lower/middle income market
- Too expensive
- Wealthy clients typically healthier and able to get cheaper prices via full underwriting

IUL with NLG:
- More attractive to wealthy clients who may be looking for more complex products
- Provides flexibility (premium flexibility, death benefit option, index account choice)
- NLG may not be attractive if not competitively priced

Variable Annuities:
- Attractive to target market
- Provides clients with a retirement savings vehicle with growth potential
- Provides flexibility (partial withdrawals, investment choice)

Single Premium Immediate Annuities:
- May be attractive to wealthy clients
- May be used as a source of supplemental retirement income
- EBB may not be able to offer competitive rates which would made product less attractive

(c) List items that must be submitted as part of the product filing with a state department of insurance.

Commentary on Question:
Candidates generally did well on this part. Partial credit was given to candidates that commented on the more details of the items instead of calling the item out exactly.

2. Continued

- Transmittal Letter
- Specimen policy form
- Readability Certification
- Description of any variable items (statement of variability)
- Actuarial Memorandum
- Any required disclosures to policyholders
- Filing fee if required

(d) Compare the requirements of the proposed replacement procedures to those required by the NAIC Model Life Insurance and Annuities Replacement Regulation

Commentary on Question:
Most candidates struggled with part (d) and weren't able to point out the difference between requirements by the NAIC Model Life Insurance and Annuities Replacement Regulation vs what was proposed for EBB. Some proposals by EEB were similar but not exactly in line with the NAIC requirements and candidates had difficulty identifying the parts that deviated from the regulation.

1. You must deliver the standard NAIC pamphlet, and not one developed by the company
2. The contact should be made within 5 days of replacement, not necessarily before initiation. Need to show illustrated costs and benefits. Do not need the contact info and policy form
3. This is consistent with the reg
4. The existing insurer is required to send this (not optional). Must be within 5 days of receiving notification (not 30)
5. The free look period must be extended to 30 days, compared to 10 days for a new sale. This is longer than what is proposed

3. Learning Objectives:

1. The candidate will understand various insurance products, markets, and regulatory regimes.

Learning Outcomes:

(1b) Evaluate insurance markets, consumer needs, distribution channels, and regulatory regimes.

(1c) Construct, evaluate and recommend product designs that are consistent with market needs, tax and regulatory requirements, and company business objectives.

- Evaluate the feasibility of proposed designs. Recommend designs.

Sources:

Life Insurance and Modified Endowments Under IRC §7702 and §7702A, Chapters, 2, 3, 4, 6

2008 Supplement to Life Insurance and Modified Endowments Under IRC §7702 and §7702A, Pages 3-33, 40-56, 71-81, Appendices A-C

Commentary on Question:

This question tests the candidate's understanding of QABs and the impact to the 7702 and 7702A limitations for QABs and non-QABs. The candidate is expected to identify which rider is a QAB and demonstrate how the limitations are impacted. The tax treatment of MEC and non-MEC policies for withdrawals vs policy loans is also a key testing point.

Solution:

(a) Explain how the actuarial limitations under 7702 and 7702A will change with these riders.

Commentary on Question:

In this section, the candidate is expected to identify whether each of the riders is a QAB or not and explain the different impact on the 7702 and 7702A limitations for the two riders. Full credit is given if the candidate identified ADB as QAB and HI as non-QAB, and identified the correct impact on limitations for these two riders. For the QAB rider impact, it is important for the candidate to note 1) it is the rider charges that impact the limitation, and 2) the impact is an increase to the limitation. Most candidates were able to identify which rider is QAB, but a general mistake is saying that the benefits of the rider are increasing the limitation instead of the charges.

QABs as defined under section 101(f) are included in the guideline limitations (eligible for prefunding) and 7702A limits. As a general rule, when a QAB is present in a life insurance contract, the actuarial limitations under 7702 and 7702A may be increased to reflect the charges imposed for these limits.

3. Continued

Accidental Death Benefit rider is a QAB and therefore the charges can be incorporated in the guideline calculations.

Hospital Indemnity ABR are non-QABs, and their charges are not included in the guideline calculation limits (not allowed to prefund).

(b)

(i) Calculate the guideline single premium and guideline level premiums for this policy.

(ii) Calculate the guideline limit in policy year 30.

(iii) Calculate the 7-pay premium under section 7702A.

Show all work.

Commentary on Question:
The candidate is expected to understand the computational rules for the Guideline Limits as well as 7-pay premium limits. One important testing point here is the treatment of QAB charges, which is a continuation of part (a). The candidate is expected to include the QAB charges in the calculation unless assumptions are made about not selecting the QAB rider.

To earn full credit, a candidate is expected to either have the same results as the model solution or explicitly write out the assumption of not selecting the rider, and complete the calculation correctly based on that assumption.

(i)

GSP = [Face/1000 * NSP@6% + Policy Load yr 1 +
(Policy Fee + ADB charge) * annuity due @6%] / (1 - premium load)

GSP = (174 * 100 + 250 + (75 + 80) * 14.50) / .9

GSP = 22108.33

GLP = [Face/1000 * NSP@4% / annuity due@4% + 250 / annuity due@4%
+ policy fee + ADB charge] / (1 - premium load)

GLP = (100 * 291 / 18.43 + 250 / 18.43 + 75 + 80) /.9

GLP = 1941.68

3. Continued

(ii)

Guideline Limit = Maximum (GSP, sum of GLPs)
GSP for year 30: 22,108 from the first step above, as the GSP doesn't change in this case
GLP for year 30: 1,941.68 for 30 years = 58,250.40
Hence, the limit is 58,250

(iii)

7PP = (Face/1000 * NSP@4% + ADB charge * annuity due @ 45, 4%)
/ annuity due @ 45,4%,7yrs

7PP = (100*291 + 80*18.43)/6.19

7PP = 4939.32

(c) Calculate the tax implications in year 16 assuming the cash value is 30,000, for the following:

(i) withdrawal of 22,000 for a non-MEC policy

(ii) policy loan of 22,000 for a non-MEC policy

(iii) withdrawal of 22,000 for a MEC policy

(iv) policy loan of 22,000 for a MEC policy

Commentary on Question:
In this section, the candidates are expected to understand the different tax treatment for MEC and non-MEC policies. Full credit is given if the candidate identified the applicable tax treatment for each case, and correctly calculated the tax amount (any income tax rate could be selected by the candidate). One common omission is about penalty tax. Some candidates didn't consider the applicability of penalty tax while others incorrectly treated the exception based on issue age rather than attained age. Most candidates were able to calculate the correct taxable income.

Assume that tax rate is 30%.
If HI rider is not selected, investments = 16 * 1250 = 20,000
If HI rider is selected, investments should be reduced by the HI charge.
Investments = 16 * (1250 – 50) = 19,200

3. Continued

Model solutions below are demonstrated assuming HI rider is not selected

(i)
For Non-MEC, withdrawals come out of the investment first and then the gain.
Withdrawal exceeds investment by 22,000 - 1,250 * 16 = 2,000
Tax = 2000 * 30% = 600

(ii)
For Non-MEC, the policyholder can take a loan without it being treated as a distribution.
Taxes = 0

(iii)
For MEC, a policy loan is treated as taxable income to the extent that the cash value of the contract exceeds the investment in the contract.
The gain in the contract is 30,000- 1,250*16 = 10,000
Tax = 10000 * 30% = 3000
No Penalty tax since attached age is greater than age 59 1/2

(iv)
For MEC, withdrawal is treated as taxable income to the extent that the cash value of the contract exceeds the investment in the contract.
The gain in the contract is 30,000- 1,250*16 = 10,000
Tax = 10000 * 30% = 3000
No Penalty tax since attached age is greater than age 59 1/2

(d) Explain the income tax treatment of the HI rider assuming a significant gain in the contract and the policy is:

(i) A non-MEC

(ii) A MEC

Commentary on Question:
This section tests the candidates' understanding of the tax treatment of additional benefits that are not QABs. Full credit is given if the candidate clearly states that the charges for HI rider are considered distributions and correctly identifies the tax treatment of distributions for MEC and non-MEC. Candidates had difficulty explaining the correct treatment.

3. Continued

(i)
Since the Hospital Indemnity Acceleration Benefit is a non-QAB, the charges are considered distributions and reduce the investment in the contract.

Charges are taxable as ordinary income to the extent the investment has previously been reduced to zero (FIFO basis).

(ii)
Since the Hospital Indemnity Acceleration Benefit is a non-QAB, the charges are considered distributions, and reduce the investment in the contract after the gain is fully covered (LIFO basis).

Therefore, the charges are taxable as ordinary income on a LIFO basis.

4. Learning Objectives:

2. The candidate will understand the relationship between product features, inherent risks, and the methods and measures to design and price products.

Learning Outcomes:

(2a) Identify, assess, and develop appropriate assumptions to reflect factors such as product characteristics, risks, policyholder behavior, and company actions.
- Describe and apply the uses of predictive modeling.

(2b) Assess and critique performance measures, risk measures, and modeling approaches. Recommend their uses in product management.

(2c) Develop and evaluate a product's performance, capital requirements, tax and regulatory requirements, and risk profile.

Sources:

Interesting Challenges for Insurers, Fenton, Scanlon, Iyers - Product Matters

Atkinson & Dallas, Life Insurance Products and Finance, Chapters 10, 11, 13

Risk Based Pricing – Risk Management at Point of Sale "Product Matters" June 2009

LP-114-09: CIA Research Paper, Life Insurance Costing and Risk Analysis, June 2008

CIA 2015 - Lapse Experience under UL Level COI Policies, Sep 2015, pp. 4 – 8

SOA Research 2012 - Report on Premium Persistency Assumptions Study of Flexible Premium UL Products, Milliman, pp. 9 - 1

LP-113-09: Swiss Re, Economics of Insurance: How Insurers Create Value for Shareholders

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) For JKL's UL and VUL products:

(i) Describe the risks associated with using a level COI option.

(ii) Describe the risks associated with using a YRT COI option.

(iii) Propose a sensitivity test to better assess each risk identified above.

4. Continued

Commentary on Question:
For parts (i) and (ii), to receive full credit, candidates needed to list as well as briefly describe the risks associated with the product. Candidates tended to list only one or two risks, rather than listing all the appropriate risks. Candidates often did not describe the risk. As a result, candidates generally performed poorly on this section.

For part (iii), candidates needed to list the sensitivity tests that will be used to test each of the risks listed in (i) and (ii). Candidates often described the sensitivity tests for only some of the risks they had listed in (i) and (ii,), which caused candidates to perform poorly on this section as well.

(i) Product risks for Level COI (LCOI):

1. Interest rate guarantee is embedded in VUL LCOI product: the Level COI charge is accumulated in insurer's general account on the pricing interest rate, which is guaranteeing current interest rate for a long period of time without investing in assets that will support the guarantees even if interest rate fall.
2. UL LCOI is a lapse supported product. The ultimate lapse rate is very low. There is a large lapse risk for this product.
3. UL LCOI is exposed to investment performance risk. If the fund performs poorly, lower M&E charges would be collected by the Company.
4. Mortality and expense risks: the COI charge and Expense charge may be lower than the actual benefits and expenses.

(ii) Product risks for YRT COI:

1. UL YRT is exposed to investment performance risk. If the fund performs poorly, lower M&E charges would be collected by the Company.
2. Poor fund performance will probably mean lower persistency for VUL YRT product, which means fewer fund on which the M&E charge is collected.
3. The premium persistency / funding level have potential effect on the VUL product performance. Lower funding level means lower M&E charge, also higher lapse rate for YRT COI VUL product.
4. Mortality and expense risks: the COI charge and Expense charge may be lower than the actual benefits and expenses.

4. Continued

(iii) Sensitivity tests to propose:

1. Interest Rate Guarantee: Lower the pricing interest rate to 2-3%, for example.
2. Lapse Risk: lower the ultimate lapse rate from the best estimate 2% to 0% for example.
3. Performance Risk: Lower the fund return / credit rate assumption.
4. Premium persistency/funding: Lower the premium persistency assumption. The use of multiple premium funding patterns can also be a means of sensitivity test.
5. Mortality & expense Risk: Higher mortality and expense assumptions.

(b) The risk of each COI option is measured using either IRR or value of new business (VNB) profit metrics.

(i) Explain advantages and disadvantages of each profit metric.

(ii) Recommend which profit metric would best reflect the risks of each of the COI options. Justify your answer.

Commentary on Question:
Overall, candidates did well on part (b).

For part (i), candidates needed to give a list of pros and cons for each profit metric. Needed eight of the advantages or disadvantages below for full credit.

For part (ii), some candidates failed to give a recommendation while others gave a recommendation, but did not justify it. Partial credit was given for a recommendation with no justification.

(i) IRR Advantages:

- Compare various potential dissimilar investments
- Helps ensure adequate return from the shareholder perspective
- Easily understood by management as it is related to ROE

IRR Disadvantages:

- Does not convey absolute dollar profits
- Does not convey emergence of profit
- Sensitive where there is low surplus usage
- Not linear, changes in profit can't be related to changes in IRR

4. Continued

VNB Advantages:

- Can indicate value created by a new product
- Good macro pricing tool to compare alternatives
- Identifies poor value blocks that need to be addressed

VNB Disadvantages:

- Very sensitive to choice of discount rate
- VNB cannot be used by itself, also need to use some other metric like IRR

(ii) Recommend using VNB. It is a good metric to compare similar alternatives. It also gives a dollar value of the product, which makes it easier to compare the two results.

(c) Explain which COI option will produce a higher VNB assuming risk-based pricing.

Commentary on Question:
Most candidates correctly identified that the YRT COI produces the higher VNB. However, candidates struggled with a full explanation for why VNB would be higher for the YRT COI.

Under a risk-based pricing approach, the YRT COI VUL will produce a higher VNB.

VNB results will vary depending on:

1. Level of guarantees – Level COIs would have higher guarantees, which would decrease VNB.
2. Amount of asset risk borne by insurers/shareholders – LCOI overcharges in early durations and undercharges in the later durations. There is more asset risk borne by the insurers with LCOI than YRT COI where the COI charges follow a similar pattern to the expected mortality. The higher asset risk in LCOI leads to lower VNB.
3. Management discretion to mitigate adverse experience – Management has the ability to adjust future premiums, credited rates or policyholder dividends. With YRT COI's, management has more discretion to change COI's, which would lead to a higher VNB.

LCOI VUL will have lower or negative "Present value of future profit after tax" component.

4. Continued

The investment income and the discount rate on Level COI general account should both be risk free rate because the level COI changes and the benefits are pure insurance cash flow. However, Level COI charges are determined using corporate bond earned rate under the traditional embedded value and IRR pricing. The Level COI charged at early years will be accredited with risk free rate and will be insufficient to cover the claims for the old ages. There will be losses in future years under Risk based pricing.

5. Learning Objectives:

2. The candidate will understand the relationship between product features, inherent risks, and the methods and measures to design and price products.

Learning Outcomes:

(2a) Identify, assess, and develop appropriate assumptions to reflect factors such as product characteristics, risks, policyholder behavior, and company actions.
- Describe and apply the uses of predictive modeling.

Sources:

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

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) List four product design changes to reduce option costs.

Commentary on Question:

Most Candidates did quite well on part A. Some candidates suggested altering or electing different Standard Nonforfeiture Law calculations which are not part of product design.

Product design changes that can be made to reduce option costs are:
Reduce the cap
Increase the margin
Reduce the participation rate
Shorten the index period less than 5
Use an average indexing method rather than a point to point

(b)

(i) Describe two major forms of hedging to mitigate option risk for an EIA.

(ii) Describe advantages and disadvantage of these forms.

Commentary on Question:

Most candidates were able to identify static and dynamic hedging. Full credit was given for describing what a static and dynamic hedge is. A few candidates referred to reinsurance as hedging. Most candidates received partial credit for advantages and disadvantages.

5. Continued

1) Static hedging is a buy and hold strategy. This involves the purchase of an over the counter option, most typically a call-spread option.

   Advantages
   Provides downside protection
   Conservative hedging strategy

   Disadvantages
   Dealers do not want to provide options at low fixed costs
   High premium volume is needed

2) Dynamic Hedging – maintain a replicating portfolio, monitor the greeks (delta) and rebalance as the index changes.

   Advantage
   Assets and liability cashflows can match exactly

   Disadvantage
   No downside protection
   High transaction costs
   To mitigate transaction costs, rebalancing needs to be less frequent
   Constant monitoring and rebalancing of the portfolio is needed for best hedging
   Involves actual position, not structured like a call option

(c) The earned rate of the assets backing the GMAV has declined from 7% to 4% since the original pricing of the product. Calculate the percentage impact this decrease in the earned rate would have on a single premium of 100. Show all work.

Commentary on Question:
Candidates typically did very well or very poorly on this. Some candidates applied the participation rate in the GMAV calculation rather than 87.5 or 90%. Either SNFL percent of premium received full credit.
To receive full credit, the candidate needed to show an understanding that the calculations of PV(GMAV @ earned rate) result in a percentage and the impact should be the difference of percents, rather than a ratio.

Cost of the option is calculated as:
Present value of GMAV(time 5) at each the current and original earned rate. The difference in these costs represents the percentage impact to the single premium.

5. Continued

A = GMAV(5) = 0.9 *100* (1.03)^5 = 104.33
B = A / [100 * (1 + current interest)^5] = 104.33 / 140.5 = 74.38%
C = A / [100 * (1 + original interest)^5] = 104.33 / 121.67 = 85.75%
C – B = 11.37%

(d) Calculate the following at the end of years 2 and 4 as a percentage of the single premium:

(i) Index account value

(ii) GMAV

(iii) Cash value

Show all work.

Commentary on Question:
This questioned the candidates understanding of a point-to-point index calculation as well as the application of the product design to produce an account value, guaranteed minimum account value as well as surrender value. Candidates overall did quite well on this question. In the calculation of GMAV full credit was given for utilizing the interest rate as it was given in the question, or by calculating the rate based on SNFL. Full credit was also given if the percent of premium used for the GMAV was either 87.5 or 90%.
Some students missed the 2 year point-to-point and calculated as if it was a 1 year.

Growth Rate(t) = S(t)/S(t-2) – 1
IAV(t) = IAV(t-2) * (1 + Max{Min[Growth Rate * Participation Rate – Margin), Cap] Floor})

		Growth	PR - .97	Margin - .005	Floor - 0	Cap - 0.1	IAV
t=0	1000						1
t=2	1120	0.1200	0.1164	0.1114	0.1114	0.1	1.1
t=4	1135	0.0134	0.0130	0.0080	0.0080	0.0080	1.1088

GMAV(t) = .875 * P * (1 + i) ^ t
GMAV(2) = .875 * (1.035)^2 = .9373
GMAV(4) = .875 * (1.035)^4 = 1.004

CSV(t) = Max(IAV(t), GMAV(t))
CSV(2) = 1.1
CSV(4) = 1.1088

6. Learning Objectives:

1. The candidate will understand various insurance products, markets, and regulatory regimes.

2. The candidate will understand the relationship between product features, inherent risks, and the methods and measures to design and price products.

Learning Outcomes:

(1a) Describe insurance product types, benefits, and features including reinsurance.

(2b) Assess and critique performance measures, risk measures, and modeling approaches. Recommend their uses in product management.

Sources:

Atkinson and Dallas, Life Ins. Products and Finance, Ch. 2

Relationship of IRR to ROI on a Level Term Life Insurance Policy, Product Matters, June 2013, pp. 18 – 21

Commentary on Question:

This question tested the candidates' knowledge of pricing strategies (part a) and understanding of internal rate of return (IRR) and return on investment (ROI) (part b). Part a required explanation of the pricing strategies and application to a practical example. Part b required calculation of returns under the two different methods and then demonstration of understanding of reasons for potential differences between the two methods. The question was answered reasonably well by candidates, although many candidates struggled in part b in the application of the formulas and explanation of the differences, normally citing only one or two reasons.

Solution:

(a)

(i) Describe the difference between buyer-oriented and competition-oriented pricing strategies.

(ii) Describe each buyer-oriented strategy.

(iii) Assess whether each strategy is appropriate for JJD.

6. Continued

Commentary on Question:
To receive full credit for this question, candidates were required to explain the various pricing strategies and analyse their appropriateness for JDD's two-year term insurance product. Common mistakes made by candidates were not properly identifying that the neutral pricing strategy was inappropriate due to the lack of sales that strategy would generate or recommending the segmented pricing strategy, incorrectly concluding that pricing by demographic characteristics (age, gender, etc) reflected customer behaviour, not an inherent reflection of risk in pricing.

(i) Buyer-oriented strategies ignore competition and focus on setting a price taking into consideration the buyers.

Competition-oriented strategies take into consideration what other companies are charging.

(ii) Penetration pricing - setting prices low enough to generate a much higher level of sales. Works best with commodity-like products such as term insurance. Higher commissions can be offered if product is similar to competitors' products to induce sales.

Neutral pricing - setting prices at a level that most buyer would consider reasonable; would neither attract nor discourage many buyers. Price and commissions are in line with industry. Common in life insurance industry.

Segmented pricing - setting different price levels for different kinds of buyers with different behaviors. Price discounts available on large policy or corporate products to reflect lower commissions and expense savings.

Skim pricing - setting a high price that maximizes a company's profit margins. Usually done with products that are in short supply and high demand.

(iii) Penetration pricing - appropriate for JDD as the product is term and most likely their term product will be similar to other competitors'.

Neutral pricing - inappropriate for JDD as this is the first time JDD is offering term. By setting price in line with the industry, JDD would not be able to make much sales.

Segmented pricing - inappropriate as term insurance price varies by age and gender to balance premium and benefits, and not to account for different behaviours of different groups of customers.

6. Continued

Skim pricing - inappropriate as their term product will be similar to other competitors', thus unable to charge a higher price.

(b)

(i) Calculate the annual GAAP ROI for years 1 and 2.

(ii) Calculate the statutory IRR.

(iii) Explain why GAAP ROI and Statutory IRR may differ.

Commentary on Question:
In general, many candidates struggled with this question, overcomplicating the calculation, incorrectly applying the Stat/GAAP differences adjustment, or incorrectly using the data provided. Some candidates mixed up the ROI vs IRR concepts. For part (iii), full credit was awarded for providing at least three correct reasons. Many candidates were aware that DAC is a GAAP concept, but did not use that information to explain why GAAP ROI and Statutory IRR may be different.

(i) $$\text{GAAP ROI} = \frac{\text{(GAAP Income + Interest on Required Capital)}}{\text{(Required Capital + Stat/GAAP Differences)}}$$

Interest on Required Capital = 4% * 1000 = 40 (year 1)
Interest on Required Capital = 4% * 650 = 26 (year 2)

GAAP ROI = (90+40)/(1000+135) = 11.45% (year 1)
GAAP ROI = (90+26)/(650+90) = 15.68% (year 2)

(ii) For stat IRR, we seek i such that $-100 + 75/(i+i) + 40/(1+i)^2 = 0$
i.e. calculate IRR using statutory cash flows

The quadratic formula produces i = 11.03%

(iii) Reasons why GAAP ROI and Statutory IRR may differ include:
a. DAC interest rate not equal to IRR rate
b. Existence of required capital based on assets, reserves, or insurance inforce net of reserves
c. Existence of DAC tax
d. Statutory reserves not equal to GAAP reserves
e. GAAP reserve mortality not equal to pricing mortality
f. Lapse rate for GAAP reserves and DAC amortization not equal to pricing lapse rate

7. Learning Objectives:

1. The candidate will understand various insurance products, markets, and regulatory regimes.

2. The candidate will understand the relationship between product features, inherent risks, and the methods and measures to design and price products.

3. The candidate will understand actuarial requirements of product governance, implementation, operations, and management.

Learning Outcomes:

(1a) Describe insurance product types, benefits, and features including reinsurance.

(2a) Identify, assess, and develop appropriate assumptions to reflect factors such as product characteristics, risks, policyholder behavior, and company actions.
- Describe and apply the uses of predictive modeling.

(2b) Assess and critique performance measures, risk measures, and modeling approaches. Recommend their uses in product management.

(3b) Apply practices related to product management.
- Describe how to monitor and evaluate actual experience such as benefits, persistency, and utilization including the use of experience studies and supplementary data sources.
- Describe and assess practices related to data quality.
- Recommend changes to non-guaranteed elements such as credited rates and policyholder dividends.

(3c) Design and evaluate product management strategies. Recommend the product strategy.

Sources:

LP-XXX-16: Evolving Strategies to Improve Inforce Post-Level Term Profitability, Product Matters, Feb 2015, pp. 23-29

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

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

CIA 2014 - Lapse Experience Study for 10-year Term Insurance, Jan 2014, pp. 6 -32

Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies, CIA Education Note, July 2002 (Exclude Appendices)
www.actuaries.ca/members/publications/2002/202037e.pdf

7. Continued

SOA - Society of Actuaries, Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans, pp. 3 – 98

LP-114-09: CIA Research Paper, Life Insurance Costing and Risk Analysis, June 2008

Commentary on Question:
Commentary listed underneath question component.

Solution:

(a)

(i) Describe three strategies to improve inforce post-level term profitability.

(ii) List advantages and disadvantages of each strategy.

Commentary on Question:
Candidates who clearly described each strategy and listed appropriate advantages and disadvantages did well on this part. No credit was given for alternative strategies, such as reinsurance or conversion options in the post-level term, as those strategies do not focus specifically on post-level term profitability.

1. Simplified Re-Underwriting - give policyholder option to fill out simple questionnaire as Policy Level Term approaches in order to receive lower rates. Those who do not fill it out default to guaranteed YRT rates.
Advantages:
- Less arbitrary since carrier learns about insured's current mortality profile
- Sense of fairness
- Helps address selective lapsation

Disadvantages:
- May alert the policyholder of pending premium jump, causing more lapses or term conversions
- Implementation challenges including defining questions, how to ask, how to incent agents

2. Graded Approach – Post-Level Term rates increase at much smaller increments until a future anniversary (eg. 5 durations post end of term). Following the end of the graded period, rates jump to the original YRT schedule.
Advantages:
- Allows insurer to ease into higher rates that are more attractive to policyholder, while retaining right to increase rates if experience emerges
- Moderating premium jump encourages policyholders to maintain coverage, rather than go through re-underwriting

7. Continued

Disadvantages:
- Best risks will still leave, as new level premium coverage will likely be cheaper
- Most companies will have limited reliable YRT experience

3. Class-Continuation Approach - modify rate increase based on insured's original select risk class, with rates converging to an ultimate rate in later durations.
Advantages:
- Rewards best risks by raising their rates the least, encouraging persistency
- Worst risks priced most closely to YRT ceiling, providing encouragement to lapse expensive coverage
- Companies can draw on mortality experience from permanent insurance

Disadvantages:
- Best risks still need to get to same ultimate rates, so rate increases after initial increase will need to be much greater
- Selective lapsation risk will be highest, as policies originally issued as preferred who have since suffered an impairment will keep policies inforce

(b) Describe the impacts the new underwriting criteria would have on the following:

(i) Mortality

(ii) Lapse

(iii) Expenses

Commentary on Question:
Generally, candidates did well on part i) and iii), but struggled to understand that policies in preferred classes will have lower lapses after undergoing stricter underwriting and receiving lower premium rates.

(i) Better mortality experience emerges from stricter underwriting. Mortality rates on preferred policies are lower than standard policies.

(ii) Preferred policies have lower lapses, even in the post-level term, as preferred policies have lower premium rates under stricter underwriting criteria.

(iii) Initial underwriting expenses are higher for preferred policies as likely need to do more underwriting tests. Maintenance expenses are generally the same as standard policies.

7. Continued

(c) Explain why you agree or disagree with each of the following:

A. *When describing the assumptions used, many assumptions are given as high-level approximations. This is completely inappropriate since all assumptions should be fully analyzed before submission.*

B. *The following pricing results were attached to the report to compare the new preferred term product to our existing term product:*

Metric	***Existing Term***	***New Preferred Term Product***
Profit Margin	*5%*	*8%*
IRR	*10%*	*7%*

Since our main objective is to use a pricing metric that can be easily compared to the rest of the VML's product portfolio, I suggest using "profit margin" and ignoring "Internal Rate of Return (IRR)" as our primary pricing metric.

C. *Instead of presenting only the expected value of the chosen metric, please supply a range based on sensitivity analysis.*

D. *When discussing risk mitigation strategies to reduce policyholder anti-selection, "Limit exposure through sales volume" was chosen. I believe a better strategy would be to provide a premium discount if the policy remains inforce after 10 years.*

E. *Peer review is missing and is needed prior to sign-off.*

Commentary on Question:
Candidates who provided explanations and clearly stated whether they agreed or disagreed with the statement did well on this part. Partial credit was given if limited explanations were provided. Credit was still given to candidates for answers that do not match below, provided their explanations were clearly stated and well thought out.

A. Disagree. For various assumptions, the actuary determines the level of research and refinement that is appropriate. For immaterial assumptions, approximations may be appropriate.

7. Continued

B. Disagree. 'Profit margin' is good for comparing products of the same type, not different types. 'Internal Rate of 'Return' should also be used. Advantages of IRR as it relates to this question are: easily understood, good for comparing products of different types, and ROE well understood by CFOs, so IRR easily understood as it relates to ROE.

C. Agree. It is important to provide a range of results since a single point estimate can be misleading. It is also important to provide results by various sub-classes for better analysis. Lastly, sensitivity analysis will give management some indication to the level of risk in the product.

D. Agree. The best strategy to reduce policyholder anti-selection is to change the policy features. Limiting exposure will reduce total risk, but will limit the amount of business while doing so.

E. Agree. Another actuary should review the work, providing constructive criticism and ensuring that appropriate actuarial techniques are used.

8. Learning Objectives:

2. The candidate will understand the relationship between product features, inherent risks, and the methods and measures to design and price products.

Learning Outcomes:

(2a) Identify, assess, and develop appropriate assumptions to reflect factors such as product characteristics, risks, policyholder behavior, and company actions.
- Describe and apply the uses of predictive modeling.

(2b) Assess and critique performance measures, risk measures, and modeling approaches. Recommend their uses in product management.

(2c) Develop and evaluate a product's performance, capital requirements, tax and regulatory requirements, and risk profile.

Sources:

Stochastic Modeling: Theory and Reality from an Actuarial Perspective

LP-116-10: Variable Annuities, Kalberer and Ravindran , Ch. 5, 9-11

Commentary on Question:

This question tested the candidate's understanding of variable annuities with guarantees - payoff mechanics, real world vs risk neutral scenarios, relevant risk types, corresponding mitigation techniques and challenges to offering products in international markets.

Solution:

(a) Determine the present value of profits using CTE(99). Show all work.

Commentary on Question:

Performance of candidates was either very good or very poor. Those who struggled missed the mechanics of the product guarantee in relation to the profit to the insurer, counting the initial premium twice and/or discounting/accumulation rates. A significant portion of candidates did answer the question perfectly.

At time 10, the GMAB payoff is the initial premium of $1,000 accumulated at 2% per annum, i.e. $1,000 * (1.02)^10 = $1,218.99

At time 10, the policyholder is entitled to the GMAB payoff regardless of what the actual fund value is. If the actual fund value is less than the GMAB payoff, the insurance company would have to make up the difference.
In scenario #496, the insurer would have to pay $1,218.99 - $793 = $426.
In scenario #497, the insurer would have to pay $1,218.99 - $611 = $608.
Similarly, in scenarios #498-#500, the insurer pays $609, $707 and $779, respectively.

8. Continued

The discounting assumption is risk free rate of 6% compounded continuously, i.e. e^(-0.06*10).
Discounted at 6% continuously, the value of the above amounts at time zero are $234, $334, $334, $388, $428, for the five scenarios, respectively.

Although the insurer has to pay the difference between the GMAB payoff and the actual fund value, the insurer does have source of income via the rider fee. Therefore, the profit to the insurer is the rider fee, less any difference between the GMAB payoff and the actual fund value.

In scenario #496, profit = PV rider fee at time zero – PV (GMAB pay off – actual fund value) = 634 – 234 = $400.
Similarly, profits in the other scenarios are $160, $168, $51 and -$49.

CTE(99) of 500 scenarios = average of worst 1% of 500 scenarios = average of worst 5 scenarios = average of scenarios #496, …, #500.
The average of (400, 160, 168, 51, -49) is $146.2

(b) Explain whether a risk-neutral or real-world modeling approach should be used for each of the following:

(i) Hedging

(ii) Forecasting

(iii) Capital management

Commentary on Question:
This question was difficult for a large section of candidates. Many candidates got the two concepts mixed.

Hedging: Risk neutral modeling should be used. Hedging assumes no arbitrage, risk free rates, and involves the pricing of options using current market assumptions, all of which are consistent with risk neutral models.

Forecasting: Real world modeling should be used. Forecasting needs to reflect actual expectations and assess actual future values. As risk neutral models do not reflect probabilities in reality, it would not be appropriate to use risk neutral for forecasting.

Capital management: Real world modeling should be used. The purpose of capital is to protect the insurer against tail events, therefore capital modeling needs to produce meaningful distributions, which cannot be produced with risk neutral models.

8. Continued

(c) XYZ will be hedging the rider and is concerned about deterioration in the accuracy of the hedge due to movements in the fund value.

(i) Describe gamma risk and basis risk.

(ii) Suggest strategies that could be used to mitigate the gamma risk and basis risk.

Commentary on Question:
This part was also difficult for most candidates. Many candidates simply left this section blank. The candidates had relatively more success with recalling mitigation strategies.

Gamma risk arises when the value of the guarantee is non-linear whereas the value of the hedge instrument is linear, resulting in the value of the hedge developing differently from the value of the guarantee. An example is when short futures are used as a hedge instrument.

Basis risk arises when the hedge assets are not a true replication of the actual assets underlying the guarantee, resulting in the value of the hedge developing differently from the value of the guarantee. An example would be mutual funds being mapped to stock market indices. In many cases, there may exist no hedging instruments that can truly replicate the underlying assets.

Mitigating strategies include:
- Reinsurance: Transfer risks to a third party reinsurer
- Securitization: Transfer risks to external investors
- Naked or no risk management: Set up capital to provide for ultimate claims
- Static hedge: Attempt to replicate future liability cash flows at a certain point in time, based on expected policyholder behavior
- Semi-static hedge: This is a variation of the static hedge, the company uses a semi-static strategy to attempt to achieve a perfect hedge, by dynamically adjusting the hedge periodically to allow for variations in experience.
- Dynamic hedging: Dynamically match the sensitivities of the portfolio of asset protection guarantees
- Increase frequency of hedge: Rebalance hedges more frequently, at the disadvantage of increased hedge costs
- Change product features: Reduce richness of guarantees offered in the product

8. Continued

(d) Describe challenges XYZ will face if it begins offering the variable annuity product in an international market.

Commentary on Question:
Candidates generally did well on this section. Most candidates were able to discuss comprehensively the various potential challenges faced. Credit was not given where the candidates gave answers without rationale.

Foreign exchange risk: If the guarantee value of the product is denominated in a different currency from the currency of the underlying assets. For example, the guarantee may be in the currency of the local market, while the product offers underlying funds in US dollars.

Market needs, cultural differences, product design: Needs of the new market may be different from the insurer's current market. Cultural differences, state of economic development of the new market, living standards of the population will all drive market needs that are potentially different from the insurer's home market. Product design may have to be modified to meet the specific needs of the new target market.

Economic model and data: Variable annuity products with guarantees need to be priced with stochastic modeling, which calls for a substantial amount of data from which to build and calibrate the model. The data used for the insurer's home market may not be applicable to this new market. Data collection and data calibration may be a challenge.

Regulation: The regulatory environment in the new market may be vastly different from the insurer's home country. Requirements on reserve, capital, tax, actuarial standards, financial reporting and disclosure, tax and accounting standards can be very different. The insurer will need to obtain expertise on all these areas in order to operate in the new market.

9. Learning Objectives:

2. The candidate will understand the relationship between product features, inherent risks, and the methods and measures to design and price products.

Learning Outcomes:

(2a) Identify, assess, and develop appropriate assumptions to reflect factors such as product characteristics, risks, policyholder behavior, and company actions.
- Describe and apply the uses of predictive modeling.

(2b) Assess and critique performance measures, risk measures, and modeling approaches. Recommend their uses in product management.

(2c) Develop and evaluate a product's performance, capital requirements, tax and regulatory requirements, and risk profile.

Sources:

Atkinson & Dallas, Life Insurance Products and Finance, Ch. 10, 11, 13

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

LP-130-14: Life Insurance Underwriting in the United States, Ch. 1,2,4,5,6, Klein

SOA-Society of Actuaries, Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans, May 2014, pp. 3-98

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

Marketing for Actuaries, 2000 Edition, Chapters 4 pp. 12 - 31

Product Matters, Term Mortality & Lapses, Aug (62) 2005

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Evaluate management's proposal and recommend changes to pricing assumptions where appropriate. Justify your answer.

Commentary on Question:

The candidate was required to demonstrate their knowledge of term insurance assumptions and the differences in key pricing assumptions between a Term 5 and Term 10 product. To receive full credit candidates had to (i) acknowledge that management's proposal was not appropriate and (ii) recommend changes to key pricing assumptions (mortality, lapse, expenses and investment.)

9. Continued

Candidates answered this question well. Two areas where candidates did not do well are:
1) Candidates failed to "Evaluate management's proposal" and only answered the 2nd part of the question, which was to recommend assumption changes.
2) Under recommended assumption changes, many candidates forgot to recognize that the investment assumption needs to be changed. Only a limited number of papers made reference to this assumption, and very few papers received full credit.

The following solution is an example of a solution that received full credit. Other accurate responses and justifications also received full credit.

Management's proposal is not appropriate. A number of assumption changes will be required for pricing the simplified issue 5-year term (5YT) product compared to a fully underwritten 10-year term (10YT).

Mortality Assumption:
- The 5YT product uses Simplified Issue Underwriting instead of Full Underwriting, as is the case with the 10YT. This change will increase mortality.
- If ANC Life does not have internal experience for products with simplified underwriting, they may need to rely on industry experience.
- Additional anti-selection is expected due to simplified underwriting.

Lapse Assumption:
- Shock lapses for the 5YT product will occur in year 5/6 instead of in year 10/11, as is the case for the 10YT product.
- Sales of 5YT through the Career Agency will result in lower overall lapses.
- Lapses need to be reduced as the 5YT product does not have a conversion option.

Expense Assumption:
- The 5YT product will have lower acquisition expenses due to Simplified Underwriting.
- Costs will be reduced as the product does not have a conversion option.
- Commission structures will be different due to a Career sales force selling 5YT versus Brokerage for 10YT.

Investment Assumption:
- Shorter duration assets will be needed to back the 5YT, resulting in a lower investment yield.

9. Continued

(b) Propose sensitivities to be performed on each of the key assumptions for the new 5-year term product.

Commentary on Question:
The purpose of this question was to assess the candidates' ability to recommend appropriate sensitivity tests for the key pricing assumptions. To receive full credit, the candidate had to demonstrate why the suggested sensitivities were important/relevant.

Candidates did not do well in this section. Many candidates did not provide a justification for why they suggested the sensitivity, and simply stated: Mortality +/- 10%, Lapses +/- 10%, without a justification.

Very few candidates recommended sensitivity testing the investment assumption, which is consistent with part (a).

The following solution is an example of a solution that received full credit. Other accurate responses and justifications also received full credit.

Sensitivities that should be performed are:
1) Mortality: Due to the use of Simplified Underwriting, test the impact of increased mortality to determine the acceptable deterioration.
2) Lapses: Due to the use of Simplified Underwriting, test the impact of an increase in the first year lapses.
3) Expenses: Test the impact of higher than anticipated "not taken" rates.
4) Investment: Test the impact of lower investment returns due to the use of shorter assets.

(c) Calculate the profit margin using the following information for the new 5-year term product:

Year 1 Cash flows

Paid at the Beginning of the year	
Premium (level for 5 years)	2,000
Commissions	825
Issue and Underwriting Expense	200
Paid throughout the year	
Maintenance Expense	50
Death and Surrender Benefits	65

9. Continued

Year 1 Reserve and Capital

Benefit Reserve (set up at the end of policy year)	850
Required Capital	40

Distributable Earnings (calculated at the end of policy year)

Year 2	95
Year 3	120
Year 4	170
Year 5	170

Other Information

Earned Interest Rate	5%
Interest on Required Surplus	8%
Tax Rate	0%

Show all work.

Commentary on Question:
The intent of this question, was to assess the candidates' ability to:
1. *Identify and calculate the correct formula for profit margin*
2. *Use the correct interest rates for present value and investment income*
3. *Recognize the timing of cash flows when determining investment income*

To receive full credit, the candidate needed to identify what was to be calculated, and in the process, what values were missing and therefore needed to be calculated. Partial credit was given to candidates that mis-identified the need to calculate certain missing values.

For the most part, candidates did well in identifying the pieces of information that were missing and needed to be calculated.

$$\text{Profit Margin} = \frac{\text{PV of Distributable Earnings}}{\text{PV of Premiums}}$$

$$\text{PV of Premiums} = \sum_{t=1}^{n} \text{Prem}(t) * v^{t-1} \text{ where } i = 5\% \text{ and } n = 5$$
$$= 2000 * v^0 + 2000 * v^1 + 2000 * v^2 + 2000 * v^3 + 2000 * v^4$$
$$= 9{,}091.90$$

9. Continued

PV of Distributable Earnings = $\sum_{t=1}^{n}$ DistEarn(t) * v^t where i=5% and n=5

Distributable Earnings for Year 1 must be calculated.

DistEarn(1) = AfterTaxSolvEarn(1) – ReqCapIncr(1) +ATInvIncRC(1)

where AfterTaxSolvEarn(1) = PretaxSolvEarn(1) as the tax rate = 0

PretaxSolvEarn(1) = ProdCashFlow(1) + InvInc(1) – SolvResIncr(1)

ProdCashFlow(1) = Prem(1) – Expenses(1) – Benefits(1)
= 2,000 – 825 – 200 – 50 – 65
= 860

Inv Inc(1) = [Prem(1) – Comm(1) – Issue Exp(1)] * i%
- [(Maintenance Expenses + Death/Surrender Benefits)/2] * i%
= (2,000 – 825 – 200) * 5% - [(50 + 65)/2] * 5%
= 45.88

Pre-TaxSolvEarn(1) = 860 + 45.88 – 850 = 55.88

DistEarn(1) = 55.88 – 40
= 15.88

PV DistEarn = 15.88 * v^1 + 95 * v^2 + 120 * v^3+ 170 * v^4+ 170 * v^5
= 478.01

Therefore the Profit Margin = 478.01/9091.90 = 5.26%

10. Learning Objectives:

2. The candidate will understand the relationship between product features, inherent risks, and the methods and measures to design and price products.

Learning Outcomes:

(2a) Identify, assess, and develop appropriate assumptions to reflect factors such as product characteristics, risks, policyholder behavior, and company actions.
- Describe and apply the uses of predictive modeling.

Sources:

Predictive Modeling for Life Insurance by Deloitte

The Use of Predictive Analytics in the Development of Experience Studies - The Actuary 2015 vol12-iss4 pp. 26-34

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) An analysis of the inforce policy data has revealed that some policy records have missing values for one or more model variables.

(i) Describe two common methods that could be used to handle these missing values.

(ii) Explain the limitations of each method.

Commentary on Question:

This question required the candidate to understand and describe two common techniques used to handle data deficiencies and their respective limitations.

To receive full credit, the candidate had to demonstrate an understanding of two distinct methods to handle missing values as well as explain one practical limitation.

Candidates generally did well on this question. Candidates lost credit for listing instead of describing in Part A.

Method 1: Remove all records from the dataset that have missing values for certain variables

Limitations:
- May remove useful information
- Can create a biased sample or skewed answer
- Removing records may cause data credibility issues

10. Continued

Method 2: Replace missing data fields with a neutral estimate or best estimate

Limitations:

- It may be difficult to determine an appropriate value to use in the place of missing values.
- Best estimate might not give true representation of the record

(b) A competitor has recently modernized its sales process on similar products. ABC has started to lose market share as a result and plans to streamline its underwriting practices to gain a competitive advantage.

(i) Explain how a predictive model could be used to support this initiative.

(ii) Propose criteria that ABC could use to evaluate the success of new underwriting practices.

Commentary on Question:
This question tested the candidates' knowledge of the benefits of predictive modelling on full underwriting. This question required the candidates to demonstrate an understanding of the relationship between underwriting and predictive modelling uses.

Candidates did not perform well on part (i). A good model solution would include at least two benefits of predictive modelling on underwriting. Candidates most commonly lost credit for not relating the answer to the question by providing a generic list of predictive modelling advantages. Other common mistakes were to not provide sufficient detail or to not provide enough distinct ways that a predictive model can be used.

Candidates generally performed well on part (ii). Three evaluation criteria were required to obtain full credit. The most common ways candidates lost credit was by not providing enough criteria.

(i) A predictive model can be used to support this initiative by analyzing a limited set of underwriting requirements and inexpensive third-party marketing data sources to predict underwriting decisions directly within the underwriting process. In addition, models can be used to identify the higher risk applicants early in the underwriting process, streamline the experience for more straightforward risks, and free up the underwriter's time for analysis of the complex risks. Furthermore, models can be designed to identify which applicant profiles do and do not justify the cost of additional underwriting requirements (e.g. lab tests, medical records, EKG's).

10. Continued

(ii) Criteria that ABC can use to evaluate the success of new underwriting practices are as follows:
- Savings in underwriting costs (or reduced cost per app)
- Increased underwriting team efficiency (more applications processed per underwriter)
- Faster underwriting decisions / policy issue
- Increase in sales (or number of applications issued or percentage of applications issued)
- Mortality in each class is maintained at acceptable levels
- Increased underwriting team efficiency (more applications processed per underwriter)
- Savings outweigh new/additional costs (modeling costs, 3rd party data costs, increase in mortality)

(c) ABC uses traditional experience study methods to set lapse assumptions for this business based on policy duration only.

(i) Outline the potential benefits of using a predictive model for lapse assumptions.

(ii) Describe the challenges that may arise with the implementation of a predictive lapse model.

Commentary on Question:
This question tested the candidates' knowledge of advantages and limitations of predictive modelling as well as how it applies to the term product.

Candidates generally performed well on this question. Two advantages and two disadvantages earned full credit. The most common mistake candidates made was to not provide enough distinct points, but instead repeated the same point multiple times. Another common mistake was to explain how a predictive model was built; this was not asked.

(i) Advantages of switching to a predictive model approach:
- Can better understand the interaction of various factors
- Can better use the available data.
- For a term product where lapses may, in part, be driven by the renewal rates compared to those offered by competitors, this relationship and its interaction with other variables could be easier to understand than with the traditional approach.
- Predictive modeling may reveal a relationship between lapses and some factor that previously was not able to be analyzed with the traditional approach (e.g. socio-economics, demographics, etc)

10. Continued

(ii) Disadvantages of switching to a predictive model approach

- Management may be used to the traditional method and are used to seeing experience studies presented in that format.
- Predictive modelling requires practitioners to have a specialized expertise. If those involved do not have the expertise, results may be easily misinterpreted.
- Processes to support traditional methods are well established - change may increase workload
- If the predictive model experts have little or no term insurance experience, they may misinterpret the target variable or improperly transform the data.
- The predictive model may indicate a relationship that is not easily implemented in the target application.
- For term lapses, the target application is probably a pricing or valuation model which may not have been built with much flexibility to use something other than a standard lapse table