Guide to SOA Written Exams

How to be Successful on an SOA Written Exam

Version 2, 2014

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1. Introduction

The purpose of this document is to provide useful information for candidates taking written-answer examinations. In addition, we have included examples that illustrate many of the concepts. We hope this proves helpful as you prepare for your exam.

1.1. Version 2

This is the second version of the document. There have been no major changes in SOA policies and procedures since the first version was released. This version reflects a few things that have happened during that period.

- The fellowship exams were restructured and renamed. This document reflects those changes. However, the examples continue to be from the prior structure as the principles they illustrate are still valid.

- The preliminary examination on life contingencies (MLC) added a written-answer component in 2014. Some specific advice for this exam has been added.

1.2. Strategic Principles

In 2010, the SOA Board of Directors adopted a set of strategic principles for education. The full set of principles is available at http://www.soa.org/education/general-info/edu-strategic-principles.aspx. For you the most important one is #6:

Assessment Methods Principle: Select assessment methods that are appropriate for the subject matter and effectively discriminate between candidates who have and who have not met the standards set for the material being assessed.

Much of this document is devoted to explaining how the SOA goes about living up to this principle with regard to written-answer exams. In what follows, we will refer to these more simply as WA exams.

1.2.1. Appropriate Assessment Methods

When the SOA's examination system was re-designed during 2005-2007 a key change was that material was classified into several categories with regard to importance and testing methods. The material that is selected for the WA exams (as well as multiple-choice exams) is deemed to be of high importance and therefore must be rigorously tested. That means proctored exams with a carefully constructed grading process.

Because this material is complex and covers a wide range of actuarial practice, written-answer examinations are the appropriate means for assessing knowledge. This allows us to test higher-level concepts and for partial credit to be awarded when grading responses.

1.2.2. Discrimination Between Candidates Who Have And Who Have Not Met The Standards

Because of the importance of the material on the FSA exams, it is important to do the best possible job. This requires careful construction of questions and a grading process that appropriately awards credit and employs careful and accurate grading.

2. Curriculum Development

2.1. Curriculum Committees

There is a curriculum committee for each fellowship track as well for each preliminary examination. The main task for each of these committees is to set the learning objectives and the course of reading for the exams in that track. Specific responsibilities include:

- Review and update the learning objectives and course of reading at least annually.

- Identify and select new study material.

- Identify study note authors and oversee study note development and review.

- Review new study material and ensure it is available to the Examination Committees when they need it.

2.1.1. <u>Timing</u>

The examination committees generally prepare two exams simultaneously. As a result, the syllabus is normally fully reviewed and revised only once per year. The following schedule has been set, though, as always, the home page for a given exam should be regularly consulted for updates.

These exams have syllabi posted in the Fall with the syllabus effective for exams the following Spring and Fall.

- Strategic Decision Making (CFE track)

- Quantitative Finance and Investment Core (QFI track)

- Life Finance and Valuation (ILA track)

- Design and Accounting (Retirement Benefits track)

- Group and Health Advanced (GH track)

- Group and Health Specialty (GH track)

These exams have syllabi posted in the Spring with the syllabus effective for exams the following Spring and Fall.

- Foundations in Corporate Finance and ERM (CFE track)

- Enterprise Risk Management (all tracks)

- Quantitative Finance and Investment Advanced (QFI track)

- Investment Risk Management (QFI track)

- Life Pricing (ILA track)

- Life Risk Management (ILA track)

- Funding and Regulation (Retirement Benefits track)

▪ Retirement Plan Investment and Risk Management (RB track)

▪ Group and Health Core (GH track)

The exams of the General Insurance track are relatively new and an update schedule has yet to be established. The MLC exam is more stable, with no set timetable for changes.

Should the need to make interim changes to the syllabus occur, for example, due to new textbook editions, changes to the case study, significant developments affecting exam topics, etc., such changes will be reflected on the syllabus applicable to the second exam administration following the full syllabus update. Our expectation is that if interim syllabus changes are made, they will be minor and will be announced well in advance of the following exam administration. If interim syllabus changes are made, all changes will be prominently noted on the Updates page when the interim syllabus is published.

The previous paragraph arises because when preparing a syllabus that covers two exams, events can transpire that require adjustments for the second administration. A thorough review and revision of the syllabus will occur only once per year. In all cases, every attempt will be made to avoid syllabus changes during the four months prior to each exam administration.

2.2. Learning Objectives/Outcomes

The syllabus for each exam presents both learning objectives and learning outcomes.

Learning objectives express **what** candidates are expected to learn. They are stated broadly, and they represent the constructs of knowing and understanding, reflect the scope of a course, guide the development of examination specifications, and inform candidates about the content of the examination.

Learning outcomes describe **how** graders will know that a candidate has mastered a concept.

As presented in the syllabus, learning outcomes occur within learning objectives.

2.2.1. Goal Of The Education Process

Our goal is that, by the time of the examination, candidates will have met those learning objectives and will be able to demonstrate their capabilities on the examination. Note that the outcomes are stated in terms of being able to "do" something, as opposed to "knowing" something. This is a subtle difference, but important when it comes to being successful on the examination.

2.2.2. Learning Outcomes And Exam Questions

In this section we go through three examples of actual exam questions and show (with the help of the model solution) how the questions relate to the learning outcomes. One is a question tied to a limited set of outcomes, one is a question based on the exam's case study and one is an integrated question that crosses several outcomes and is also based on the exam's case study. While most of the examples in this document are from examinations that are no longer being given, the points being made continue to be relevant.

2.2.2.1. A Question Tied to a Limited Set of Outcomes

This example is from Fall 2010, Retirement Benefits DP-US.

Question 2 from this exam had two parts. The questions were:

(a) (*3 points*) Describe the taxation of death benefits distributed from a qualified plan in the form of a lump-sum versus a periodic form of payment.

(b) (*2 points*) Describe the situations where penalty taxes are imposed in addition to federal income taxes on qualified plan distributions.

These questions both relate to Learning Objective 2 – "The candidate will understand how the regulatory environment affects plan design and understand how to apply relevant restrictions." Both questions are about taxes and so point to learning outcome 2d – "The candidate will be able to test for plan design restrictions intended to control the use of tax incentives." The key resource is the book by Allen, et al. and in particular Chapter 31. So these questions relate to a single learning outcome and the information comes from a single source.

2.2.2.2. A Question Based on the Case Study

This example is also from Fall 2010, Retirement Benefits DP-US

Question 4 from this exam is based on the exam's case study and covers more than one learning outcome. The case study provides a lot of information about the National Oil Company (NOC) and its pension plan. In this question, NOC is acquiring the salaried workforce of a smaller competitor, ABC. As a result, NOC is reviewing its current plan. After providing some information about ABC's programs, the question stem states the following:

NOC is considering two proposals for the ongoing retirement strategy.

Proposal 1 – All ABC salaried employees would be covered under the current NOC Salaried plan and ABC SERP participants would be covered under the current NOC SERP Plan.

Proposal 2 – After the transaction, all NOC and ABC salaried employees would be covered under ABC's defined contribution plan. All SERP participants would also be covered under a new defined contribution SERP, with employer allocations equal to 4% of earnings.

(a)   (7 points) Discuss the advantages and disadvantages of each proposal.

(b)   (3 points) Recommend a proposal from (a) to NOC's Board of Directors. Provide support for your recommendation.

There are two sets of objectives/outcomes covered. The first is Objective 1 – "The candidate will be able to analyze different types of registered/qualified defined benefit and defined contribution plans, as well as retiree health plans" and Outcome 1b – "Describe the process and apply the principles of conversions from one plan type to another." The second is Objective 3 – "The candidate will be able to analyze plans designed for executives or the highly paid" and Outcome 3c – "The candidate will be able to integrate a plan for executives with the basic benefit plan."

The source material for these questions is Chapters 3, 14 and 17 of Allen, et al.

Because this is a case study question, answers must relate to NOC, and in particular, some of the corporate objectives laid out in Question 3. That is, the discussion of advantages and disadvantages should be done in the context of the case study situation. The model solution points out that either proposal can be advocated in part (b). Success depends on making appropriate arguments for the favored proposal.

2.2.2.3. An Integrated Question Crossing Several Learning Outcomes

This example is from the Fall 2010 Group Health DP exam,

Question 6 is also based on the exam's case study.

(*10 points*) You receive a call from Jacob Marley of the Great Expectations' marketing department. He claims that the small group HSA rates have been too high. You only have available the experience shown in "Exhibit 1.a. Base Rate Review for Old London Market."

(a)   (5 points) List and explain how the evidence in Exhibit 1.a. supports Jacob Marley's assertion.

(b)   (3 points) Explain three of the greatest risks to Great Expectations in transitioning to substantially lower rates. Justify your response.

(c)   (2 points) Outline a message to Jacob Marley explaining the expected timing and process required to roll out a major small group HSA rate change.

Because the list of outcomes covered is large, we have not listed the objectives. The outcomes covered are:

(1c)   Identify which participants would find each coverage a valued benefit and why.

(1e)   Evaluate potential financial, legal and moral risks associated with each coverage.

(5d)   Determine the potential impact on the cost of complying with the regulation.

(8a)   Identify and evaluate sources of data needed for pricing and underwriting including the quality, appropriateness and limitations of each data source.

(8b)   Identify and evaluate the rating parameters needed to evaluate and manage a book-of-business.

(8c)   Develop experience analysis (claims cost and expenses)

    (i)   Construct the appropriate models

    (ii)   Develop the appropriate assumption, including trend, anti-selection, etc.

(8d)   Recommend appropriate actions following the study including:

    (i)   Areas for further study;

    (ii)   Changes in coverage, eligibility requirements or funding strategy.

(8h)   Modify manual rates to reflect specific plan values including benefits for which little or no data is available.

(8i)   Construct a rating model to be used for rating individual customers or plan designs.

The model solution lists eight different sources that are called upon to answer the questions. The model solution noted that candidates were expected to synthesize information provided from the case study with the readings.

3. Examination Development

3.1. Examination Committees

There is a committee for each examination. The examination committees' overall goal is to test each candidate's understanding of the subject matter as defined in the Learning Objectives. Every effort is made to ensure that the questions fall within the scope of the syllabus. However, candidates should be aware that they may be asked to apply something from the syllabus to situations that are not explicitly covered in the syllabus. The use of integrated questions (see Section 3.6) is an example. But even within a discrete topic, the ability to generalize what you have learned to new situations is one of the ways learning at higher cognitive levels can be tested.

Complete coverage of all parts of the syllabus is not practical for every examination every year, but the goal is to develop well-rounded examinations containing representative, high-quality questions that test the candidate's understanding and ability to make use of material from many parts of the syllabus.

Trick questions are avoided, and the wording of each question is carefully considered to eliminate possible ambiguities. The SOA's goal is to ensure that all qualified candidates become members, without putting inappropriate barriers in their path; it is not to restrict membership.

As noted in the next section, preliminary versions of each examination are thoroughly reviewed in relation to all of these factors before the final examination is set.

3.2. Steps In Exam Preparation

Following are the general steps taken to create an exam:

1. Draft questions with outlines of the solution are written by item writers.
2. Questions are reviewed/improved by committee members.
3. Further review is undertaken by a committee's officers at an in-person pre-review session. The result is a draft version of the exam.
4. The draft exam is reviewed by the general officer (the top officer for that particular exam) and other reviewers representing the curriculum committee and the Education Executive at Central Review. Input is also obtained from an independent person who takes the draft exam under exam-like conditions.
5. The final version of exam is reviewed by the exam chair and approved by the general officer.
6. Grading guides are developed and reviewed along with the questions through each stage of the process.
7. Final model solutions are developed after questions and grading guides are finalized, and further refined to add commentary after the grading process is complete.
8. The exam chair signs off on the grading guides and model solutions.

3.3. Case Study

Many of the FSA exams use a case study. This is a good way to bring real-life applications into the study setting. A common misconception is that the case study is simply another study note. In fact, the case study is used to link to as much of the syllabus material as possible, and references to the case study will appear on the examination. It is a good idea to read through the case study first, or shortly after it is available, and refer back to the case study as new topics are covered. As a reminder, candidates will not be permitted to bring their copy of the case study into the examination room. A copy is included in the examination booklet.

3.4. Cognitive Levels

There are many systems for describing cognitive levels. They typically range from simple recall of memorized facts to synthesis of a complex set of facts. The SOA uses a four-level approach due to Marzano.[1] The listing that follows is from lowest cognitive level to highest.

- Retrieval – This usually requires a list derived from a single source and mostly relies on memorization.

- Comprehension – This requires distilling or summarizing knowledge from a source (synthesis) or re-presenting information in a different form or in your own words.

- Analysis – This requires an evaluation of information and a subsequent explanation based on that evaluation, for example, comparison of whether items are alike or different, identifying strengths and weaknesses, generalization of the previous two levels to a new situation or an error analysis.

- Knowledge utilization – This requires an analysis and comparison of information, drawing a conclusion, and the subsequent explanation/justification of one or more facets of that evaluation/comparison/conclusion. It often expects a solution, decision or recommendation, with justification.

A single question may relate to more than one level. Exam committees are expected to focus (but not exclusively) on the higher three levels.

3.5. Verb List

Understanding how verbs are used may be one of the most important things you can take away from this document. When exam committees write questions, they mean what they say. If they ask you to list something, they are expecting to see a list.

The following verbs are often used by item writers when constructing questions. They are split into groups aligned with the cognitive levels described in the previous section. Note that question writers are not restricted to this list. Also note that some verbs may be appropriate for more than one cognitive level, in which case the rest of the wording of the question should make clear what cognitive level is expected.

Retrieval

- Define – Provide the definition, no interpretation is called for.

- List – Provide a listing of items.

- State or Write down – these are similar, both calling for a definitive expression, with no analysis.

Comprehension

- Apply – Use a specified methodology to solve a problem.

- Approximate – There is either not enough information provided to determine the exact value or there is a commonly-used approximation.

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[1] A summary of these four levels (plus two that we do not use) is available at http://www.marzanoresearch.com/documents/free_resources/classroom_tools/standards_assessment/ taxonomy_summary_sheet.pdf

- Calculate – Generally, this is higher than retrieval as some thought will go into selecting the appropriate formula.

- Derive – Calls for providing the mathematical steps that lead to a given formula.

- Describe – This asks for some information about specific items, showing that you understand what those items mean. A description is not a list; each item needs supporting information.

- Explain – This calls for even more information than describe, showing that you can convey "why" or "how." A connection is expected between the items and something else. Could be at the next level, depending on the complexity of the situation.

- Interpret – You are to draw conclusions that either justify an action or enhance the reader's understanding. Can also be used to literally ask you to interpret what a graph or formula means. Could be at the next level, depending on the complexity of the situation.

- Identify – This is different from "List" as you are expected to filter the material by choosing items that are relevant to the question.

- Sketch – This means to draw a picture such as a graph or diagram.

- Summarize – Take the available information and concisely convey it to the reader.

- Verify – Show that a statement is correct in the given context. Depending on the nature of the problem could be at the analysis level.

Analysis

- Analyze – Make some sense of and possibly draw conclusions from a collection of information.

- Assess – Differs from analyze in that it usually calls for making a conclusion, such as deciding whether a course of action should be adopted.

- Compare / Contrast – There must be at least two items being considered. Both similarities and differences are to be articulated, but no conclusion is expected.

- Critique – This does not imply that only faults/errors are to be presented. A critique can also point out what was done well.

- Evaluate – Calls for an opinion and may include several of the above components. It does not refer to a numerical calculation. Depending on the complexity of the situation, could be at the next level.

- Explain or Interpret – See above.

Knowledge Utilization

- Construct/Create/Design/Develop – In all of these cases you are to build something that can be used to answer the question. It may be a model, a decision-making framework, or a process for accomplishing a goal, among others.

- Evaluate – See above.

- Justify – You are to provide an explanation supporting an answer, for example, a recommendation.

- Propose/Recommend – You are to make a decision regarding what to do about a situation. Note that there may be more than one reasonable choice and your grade will depend on the support you provide for your choice.

- Revise – Something has already been proposed or recommended, but based on new information or the application of a different method, there may be a new conclusion.

The way verbs are used determines their cognitive level. For example, you might be asked to "Describe how the design would change if …" You are not merely being asked to state something in your own words, you are being asked to draw a conclusion based on changing circumstances, so *describe* here is likely to be in the knowledge utilization category.

3.5.1. Examples of Verb Use

All these examples are taken from recent examinations. We have not repeated the entire question, just the part that employs the verb. Each question is followed by the answer from the model solution. The verb is underlined (which is not true in the actual question). At times commentary is provided, which can be identified by italic font.

3.5.1.1. From Advanced Finance and ERM (AFE)

Define strategic risk.

Solution

The array of external events that can devastate a company's growth trajectory and shareholder values.

As with a dictionary definition, it is compact and to the point. It is not necessary to define each term in the definition (such as external events, growth trajectory or shareholder value). This and the next example are at the lowest cognitive level because you are asked to reproduce something that is in the syllabus material.

3.5.1.2. From Group and Health (GH)

Define antiselection.

Solution

Antiselection is the result of a member having advanced knowledge of a potential claim and choosing benefits that are financially in his/her best interest.

3.5.1.3. From GH

List and explain how the evidence in Exhibit 1.a. supports Jacob Marley's assertion.

Solution

- Rates are too high - The exhibit supports a rate decrease. However, in addition there are some potential issues with the exhibit.

- Loss Ratio is very low - Revenue PMPM is the second highest. For the high deductible plan, revenue should be closer to the HRA.

- Catastrophic claims are lower than expected - The expected amount is the same for all plans. For an HSA, large claims should be lower.

- Pharmacy rate is the same for all plans - For a high deductible plan, pharmacy rates should be lower.

▪ Trend factor - is the same for all plans.

There are two verbs in this question. The list in the solution is the item before each hyphen with the explanation coming afterward. Although "list" is often associated with a low cognitive level, here it is not a case of reproducing a memorized list but rather presenting an understanding of the problem in list format. This indicates that verbs are not always tied to a particular cognitive level.

3.5.1.4. From General Insurance Introduction to Ratemaking and Reserving (IRR)

Select estimates of ultimate claims for 2008 and 2012 and justify your selections.

2008:

▪ Select 57,800.

▪ Reason: Claims are fully developed for 2008 (reported CDF = 1.0) and there is no evidence that further change will occur.

2012:

▪ Select BF estimate of 45,350.

▪ Reason: Immature so select a blended method.

Providing the two numbers is sufficient to have selected an estimate. The second bullet provides the justification.

3.5.1.5. From AFE

Approximate the 95% confidence interval for the CTE (95) estimate.

The solution shows the numerical work needed to produce this approximation.

A specific approximation recommended in one of the required textbooks is used in the model solution. A reasonable alternative approximation would be acceptable.

3.5.1.6. From Models for Life Contingencies (MLC)

Using the normal approximation without continuity correction, calculate $\Pr(Z > 400)$. Explain why this answer differs from your answer in part (c)

Z has a mean of 107 and a standard deviation of 190. Then, where Z^* has a standard normal distribution,

$$\Pr(Z > 400) \approx \Pr\left(Z^* > \frac{400 - 107}{190} = 1.54 \right) = 1 - \Phi(1.54) = 1 - 0.9382 = 0.0618.$$

Z is a single observation. The normal distribution provides a reasonable approximation when either the random variable is the average of many observations (Central Limit Theorem) or the single observation has approximately a normal distribution. With 75% of the probability at zero, Z is far from normal.

This is not an actual exam question (as the exam has yet to be given as of this writing). It is taken from the sample questions prepared by the exam committee. By showing how the number 1.54 was obtained, you can demonstrate understanding and also retain an opportunity for partial credit should a calculation error be made.

3.5.1.7. From Financial Economic Theory and Engineering (FETE)

<u>Calculate</u> q, the risk neutral probability, to two decimal places.

The solution presents a formula for calculating this value and then inserts the numbers from the question.

This is a fairly simple formula and calculation. It is a good idea to present the formula in your answer just in case you make a calculator mistake or take an incorrect value from the question. In the former case, you would receive most of the credit, if the only error is in your calculation. In the latter case you would receive some credit for knowing which formula to use, but not full credit if the wrong values are extracted from the question.

3.5.1.8. From FETE

<u>Derive</u> the value of this contract at issue; define all symbols.

<u>Solution</u>

The value of the option at expiration is $\max(U_T, V_T)$.

It can be written as $U_T + \max(V_T - U_T, 0)$, that is, the value of U at time T plus the value of a call option on the difference with a strike price of zero. The value at time 0 is
$e^{-rT}E(U_T) + V_0 e^{-qvT}N(d_1) - U_0 e^{-quT}N(d_2)$ where $E(U_T)$ is the expected value of U_T in a risk neutral world. Because $E(U_T) = e^{(r-qu)T}U_0$ the value at time 0 becomes
$U_0 e^{-quT} + V_0 e^{-qvT}N(d_1) - U_0 e^{-quT}N(d_2)$ where $d_1 = [\ln(V_0/U_0) + (qu - qv + s^2/2)T]/(sT^{0.5})$,
$d_2 = d_1 - sT^{0.5}$ and $s^2 = s_u^2 + s_v^2 - 2\rho s_u s_v$. In these formulas, U_0 and V_0 are the time zero prices, qu and qv are the dividend yields, s_u and s_v are the volatilities and ρ is the correlation coefficient.

Because you were asked to derive, it is not sufficient to present the final formula. It must be obtained from some more basic formulas, with explanation.

3.5.1.9. From AFE

<u>Describe</u> four characteristics of ideal insurance company Boards of Directors which lead to good governance.

<u>Solution</u>

Independence – Directors do not have significant ties to the company beforehand such that their decisions are impaired by how they will be affected. This also ensures good management.

Knowledge of Industry – Able to understand how the business works, products, risks, etc.

Committee structure set up to facilitate involvement from all board members; not insular.

Appropriate Size – Too small (5-6) is ineffective or dominated by one or 2 people; too large (18+) is unwieldy; right would be 10-12 or similar.

It is not sufficient to produce a list of characteristics; each of them must be described.

3.5.1.10. From GH

<u>Explain</u> three of the greatest risks to Great Expectations in transitioning to substantially lower rates. <u>Justify</u> your response.

<u>Solution</u>

▪ Selection – If we lower rates too much, healthy members will leave the other plans to join the HSA. Experience in the other plans will worsen and overall profits will drop.

▪ Regulatory – Might not allow the needed corrections.

▪ Pricing – Due to the credibility of the information and/or potentially incomplete data, these new rates may be priced too low. Future experience could worsen and cause profitability or solvency issues.

For each risk there are two things to communicate. First, an explanation of the risk that demonstrates you understand it. The second is relating these risks to Great Expectations.

3.5.1.11. From Individual Life and Annuities (ILA, Appeared On Both U.S. And Canadian Versions)

A suggestion has been made to set dividends using the Equivalent Single Age approach rather than the Exact Age approach. <u>Analyze</u> the appropriateness of this suggestion in the context of policyholder equity.

<u>Solution</u>

Reasons for exact age: Using an equivalent single age would have a different mortality slope than the actual mortality slopes of the two lives. Select mortality gains will be smaller and less offsetting to acquisition expenses. Reserve/cash values will be different which will impact the interest component of dividends.

Reasons for using equivalent single age: Do not need complex administration and illustration capabilities (i.e. greatly reduces expenses). Exact age assumes lives are independent which often they are not under joint products.

The model solution then notes that a recommendation regarding the appropriateness of the suggestion must be made, though a particular choice is not required.

The model solution provides arguments for each side. However, your analysis must indicate either agreement or disagreement with the suggestion.

3.5.1.12. From ILA (Appeared On Both U.S. And Canadian Versions)

<u>Contrast</u> the pricing considerations for a single life vs. a joint last survivor product.

<u>Solution</u>

▪ Mortality will be different for a single vs. joint life policy due to joint products primarily being sold to older individuals and married individuals. With married individuals, need to consider that lives are not necessarily independent due to joint accident risk and lonely heart syndrome. Also must consider more substandard or declined lives.

▪ Persistency is better as clients of joint products are affluent and generally buy the product to fill a specific need.

▪ Expenses are higher as need to underwrite two lives and may need more complex administration and illustration systems.

▪ Retention limits and reinsurance rates may be higher for joint products as generally larger face amount policies.

Because you are asked to contrast, where possible, it is not enough to say they are different, an explanation of how they are different must be provided.

3.5.1.13. From ILA (Appeared On Both U.S. And Canadian Versions)

<u>Critique</u> the lapse assumption originally set for the product as shown in the following table.

<u>Solution</u>

- Lapses are generally lower for females than males, which is opposite of what was in the table

- It is appropriate to have a higher lapse rate once the surrender charge period is over

- Should reflect product design, i.e., a spike in lapse after year 10 when COIs increase

The lapse assumption should also vary by:

- Age at issue

- Policy size

- Marketing method

You will notice that bullet points have been used in some of the solutions displayed. Bullets may serve to more clearly indicate when you are moving to the next point to be made. But the bullets must still contain sufficient information to respond to the level of the verb. This question is of a higher cognitive level because you must recognize what is normal and what is unusual in the provided results.

3.5.1.14. From AFE

<u>Identify</u> and <u>describe</u> the categories of the interest rate risk. For strategy 1, <u>evaluate</u> the importance of each risk as high, medium, low or not applicable.

<u>Solution</u>

- Yield Curve Risk: Movement of the yield curve will adversely affect value of liabilities. High Risk

- Basis Risk: Risk that assets and liabilities, based on different interest rate bases, impact financial results. High Risk.

- Reinvestment Risk: Risk related to assets being shorter term than liabilities and rates being lower, forcing reinvestment into assets with lower yield. Medium to High Risk.

Each of the three parts responds to the three verbs. First the risk is identified by name. Second, a brief description is provided. Third, the risk is evaluated.

3.5.1.15. From GH

<u>Develop</u> talking points to illustrate current and expected future market trends in dental insurance.

<u>Solution:</u>

Current trends

- High medical cost increases put pressure on dental plans to offer low cost dental plans to employers. Employees' contribution percentage growing.

Future trends

- Voluntary plans expected to grow in popularity.

- Consumer driven tools becoming more popular.

    Use of treatment cost estimators for members to estimate out of pocket costs and compare fees of providers.

    Defined contribution plans offer opportunities to manage member costs through flexible spending accounts, medical reimbursement accounts and health reimbursement arrangements. Employees can buy a core benefit or buy up additional coverage with their own money.

- More online self service to employees and employers to access data about providers and claims payment information.

- Shortages of dentists will put pressure on building and maintaining networks.

Bullet points are sufficient given that talking points were requested.

3.5.1.16. From Retirement Benefits (RB, U.S.)

Recommend a transition plan for the current Salaried Pension Plan members. Provide support for your recommendation.

Solution

- Freeze the final average pay benefit and begin accruing future benefits in the cash balance plan. However, as a transition, provide for the continued accrual of benefits in the old plan for the next five years if it would produce a greater accrued benefit. In this way, employees close to retirement will be protected from losing benefits for a period of time and NOC will be able to use the new design to attract new employees.

- Another advantage to this approach is that it will result in no wear-away of benefits for any employees.

- In addition, NOC should provide extensive communication and education to all affected employees so that they fully understand:

    1. The company's reasons for making the change
    2. How the change affects them

A specific plan must be recommended. It is not necessary to provide alternative plans, as you will only receive credit for your specific recommendation. It is necessary to provide support for your recommended plan. Alternative recommendations to the one given in the model solution can earn credit provided they are reasonable and supported.

3.5.1.17. RB (Both U.S. And Canada)

Evaluate the following proposed Target Date Fund design: (design not provided here)

Solution

Well diversified, professional managed portfolio designed to meet the investor's objectives through a single, convenient investment vehicle.

Target date funds (TDF) can address problems in traditional designs

    Members have little or no understanding of finance/investment

    No interest in obtaining knowledge

    Long term thinking/planning is foreign to most

With no deadlines, members tend to not make changes when necessary

More choices not better than fewer

Many members tend to choose money market funds. For younger members, this will most likely lead to inadequate retirement assets. However, this exposes the member to inflation risk and longevity risk. Most participants make the mistake of not taking on enough risk. Most participants' portfolios are significantly under diversified. In some cases, managers may also make shifts between asset classes based on their outlook, and this can further enhance the participant's returns. TDFs can form a core part of portfolio and offer other employee-managed investments to supplement.

Provide significant benefits for the plan sponsors as well

Offer a certain level of investment advice in a pre-packaged vehicle

A way to simplify the investment process for participants and reduce (but not eliminate) education needs

Better retirement planning promotes orderly succession and workforce planning

Help meet fiduciary obligations

Members may appreciate the additional guidance and simplicity of the option

The interest rate risk is minimized because the appropriate fund has a predesigned diversified portfolio with an appropriate age-related weighting to cash and fixed income, including investments in long-term bonds. Stock market risk is addressed by providing a fund with diversified investments, with the equity component reducing as retirement gets nearer.

Automatically reallocate the investments over time to be more conservative.

Increase in fixed income and decrease in equity is consistent with this goal.

Changing balances represents trade-off between risk and reward.

Addresses common problem of individuals not rebalancing to meet changing needs.

Addresses other investment behavioral problems. E.g., chasing winners, inertia, equal weighting to all choices, etc.

Care should be taken to communicate that if such a fund is used in addition to other funds, then the overall asset allocation may not fit the investor profile. TDFs assume that all investors become more risk averse at the same rate as reflected into the allocation shifts.

In fact, individual risk may vary, depending on:

Other retirement income sources, family money, health, lifestyle, etc.

Conservative portfolio for 2010 retirements, does not consider that the participant has many years to live in retirement.

May not address inflation risk adequately.

Should maintain some equity content for inflation hedge.

But to correct for this, individual can choose a "target maturity" that is later in their retirement years.

Geographic diversification of equities and bonds may be inadequate.

Foreign stock/bonds may be a substantial pool for potential investments relative to domestic stocks/bonds.

But introduces currency risk for individuals.

Small allocation to long-short equities strategy can produce additional returns that may be uncorrelated to market, offering diversification.

More opportunities with shorts because:

Fewer investors on the short side

Greater universe of stocks from which to choose

No constraint on active short position (can only reduce long position to zero)

Can take advantage of management fraud/overconfidence

Can take advantage of sell-side "buy" recommendations

But introduce leverage and exposure to margin calls

Exposure to unlimited losses on short positions

Number of available funds is too low.

Significant differences in risks between employees to have only three choices.

Inclusion of company stock is questionable

Especially for 2040 fund with 30% allocation

Undiversified investment

Could cause employee relations problems if stock falls

Creates agency issues between management and employees

Danger of loss of job and loss or retirement income assets at same time

May not be permitted by legislation

But strengthen link between employee and corporate interests

Other issues that could be addressed but details not provided

Active vs. passive management

Level of fees

Diversification of equity position by cap size and/or style (value/growth)

Distribution of fixed income portfolio by quality and/or duration

The length of this answer is reasonable as the question was worth 10 points, which implies an expectation of 30 minutes effort. It is reasonable to expect there will be a lot of different dimensions to be evaluated.

3.5.1.18. From AFE

Identify and describe three ways in which Zoolander could exploit the strategic risk from competitor: Emerging Global Rivals, to gain a competitive advantage. For each of these, propose how each could be achieved at Zoolander.

1. Info Advantage

   ▪ Access better and more timely information about events, allowing a superior response

2. Speed Advantage

   ▪ Speed of response to changed circumstances

   ▪ By acting faster than competitor can turn threat into opportunity

3. Experience/Knowledge Advantage

  ▪ Past experience with similar crises and knowledge of effect on market enables better response than other firms

4. Info Advantage

  ▪ Conduct market survey

  ▪ Use their own employees as source of information

  ▪ Invest in information network

5. Speed Advantage

  ▪ Have small teams that are allowed to make decisions without senior management overview

  ▪ Share information widely across the organization

6. Experience/Knowledge Advantage

  ▪ Hire personnel that have different experience

  ▪ Acquire firm in unfamiliar market

This is a three-verb question. The advantages are named and described. The proposal expects something that is relevant to the problem presented in the case study.

3.5.1.19. From GH

Recommend a network for each product from the choices above and explain the considerations and potential shortfalls associated with each recommendation.

Medicaid HMO – Network C

The Medicaid population is usually the urban poor. The providers need to be accessible from public transit and their needs tend to be maternity and behavior health services.

Price Conscious PPO – Network B

For a commercial PPO product, the providers should be geographically dispersed and a broad range of services provided. In order to keep cost down, a smaller network should be used so better discounts can be negotiated.

Worker's Comp – Network D

Worker's Comp members are injured and disabled. Rehab and Orthopedic services are required.

A specific recommendation must be provided for each product. Reasons to support your recommendations are also needed.

3.6. Integrated Questions

Examination questions often ask you to integrate material from multiple sources. This means that the syllabus should not be viewed as a set of independent readings, each with its own focus and dedicated exam questions. One definition of an integrated question is that it:

▪ Tests multiple learning objectives from multiple sources and requires higher cognitive skills.

Integrated questions are usually assigned more points (often 8 or more). They tend to look like the questions that might come from a high-placed executive or a sophisticated client.

They tend to be built on a common stem that leads to multiple analyses that lead to recommendations. An example of an integrated question was presented in Section 2.2.2.3.

3.7. Point Values

Exams contain 20 points per examination hour. That translates to three minutes per point, which is a good guideline when working through an exam. It is unusual for a question to be worth less than three points and integrated questions are often in the 10-15 point range. The points assigned to the question are designed to allow time for reading the question and thinking about how to answer it. You are not expected to be writing for the entire allocated time.

4. Grading and Pass Mark Setting

4.1. Guiding Principles

The key principles are:

- Answers are graded according to objective standards.

- Anonymity of candidates is fully preserved.

The first principle is met through the use of detailed grading guides that ensure different graders will take a similar approach to the question.

The second principle is met through the use of candidate numbers.

4.2. Overview Of The Grading Process

The exam papers are separated by question and sent to the graders for evaluation. Depending on the questions, the number of papers and the number of graders, some graders may grade more than one question and some questions may be distributed to two or more graders. Graders use a guide that was drafted by the examination committee. There are significant differences between a grading guide and a model solution (discussed in Section 5).

- A grading guide gives specific direction in how to allocate points.

- A grading guide indicates cases where not every item on a list or every discussion point is needed to get full credit.

- A grading guide shows alternative answers that may receive credit.

Examples of high and low scoring papers are provided in Section 6.4. Note that the SOA does not release the grading guide nor will it release how any individual paper was scored.

Prior to grading, a preliminary pass mark is set. Papers whose total score is well above this mark receive no further grading and have passed the exam. Papers whose score is well below this mark also receive no further grading and will fail. The remaining papers (often one-third to one-half) will be re-graded independently by a different grader. If there is a discrepancy in the scores, the graders have a face-to-face discussion to resolve any differences.

After this step, the scores are final and all that remains is the setting of the pass mark.

4.3. Setting Pass Marks

4.3.1. <u>Content Based</u>

Recall that one of the strategic principles is to discriminate effectively between candidates who have and who have not met the standards set for the material being assessed. Two approaches that cannot meet this principle (for written-answer exams) are having either a pass mark or a passing percentage that is constant across each exam administration. The former does not allow for variability in the questions and the latter does not allow for variability in the quality of the candidates. To meet this principle the pass mark must be based on the content of the examination.

The examinations are meant to measure the candidates' level of achievement of the required learning objectives, and their required level of capability of accomplishing specified learning outcomes.

4.3.2. Written–Answer Pass Mark Setting

Before the exam is administered, the exam committee sets a preliminary pass mark by analyzing each question and determining what a well-prepared candidate should know and be able to demonstrate to achieve a passing grade. After the exam is administered and first grading of all questions has taken place, a tentative pass mark is set where actual performance statistics are balanced against the preliminary pass mark. When second grading is completed, the actual performance statistics are recalculated to factor in any score changes.

The examination committee then determines the final pass mark by again balancing actual performance statistics against the preliminary pass mark while taking into account other factors such as time pressure that may have occurred on some questions.

4.3.3. Setting the Final Pass Mark

With the use of content-based pass marks, fluctuation in pass rates from sitting to sitting is expected. The final decision is reached by consultation between the Chairperson and Vice-Chairpersons of the individual examination committees and the executive officers of the Education committee. In the event that a proposed pass mark produces a pass rate that deviates significantly from pass rates experienced in prior exam sessions, the deviation must be supported by analysis and an explanation of the basis for the pass mark must be reported to the SOA Board of Directors.

4.3.4. Reporting Results

Grades are reported on a 0 to 10 scale. Passing grades range from 6 to 10; failing grades range from 0 to 5. On this scale, the interval is 10 percent of the score required to pass; for example, a grade of 5 means failing with a score of at least 90 percent but less than 100 percent of the score required to pass. A grade of 0 does not mean that the candidate received no points, but that the candidate's score was less than 50 percent of the score required to pass.

Candidates who fail an exam also receive a breakdown of results by question. For each question a score of 0 through 10 is assigned. The process begins by assigning an *adjusted standard score* to each question. These scores are set so that they add up to the pass mark and also reflect the knowledge that a well-prepared candidate should be able to demonstrate under exam conditions. The 0 to 10 score is then assigned by noting the decile percent of the candidate's score relative to the adjusted standard score. For example, suppose a 6-point question has an adjusted standard score of 4.7 and a candidate's score on the question is 3.5. The candidate's score is 74% of the adjusted standard score and thus a decile score of 3 is assigned.

It should be noted that a weighted average (by question point values) of these decile scores will rarely reproduce the overall decile score for the examination. Some of this is due to rounding. Another factor is the lower bound of zero. In the previous example, any score below 2.35 will earn a decile score of 0, yet the degree to which the score is below 2.35 will affect the overall score.

4.4. Defective Questions

4.4.1. Changing the Grading Guide

Truly defective questions rarely occur, but in the course of grading papers, graders may come across a candidate solution that appears to be correct, but does not align with the grading guide. If confirmed, the guide is altered to include this alternative possibility. All other papers have the opportunity to earn points under the revised guide.

This is relevant with regard to a question candidates have often asked. What if we do it differently at work, or there have been regulatory changes since the exam was set, or I know the reading was wrong? As noted

above, reasonable alternative answers will be accepted. It is in your best interest to note within your examination paper instances where you think your answer deviates from the syllabus to ensure that the grader is aware.

Of course, if you spot errors in the reading materials, the best thing you can do is contact the SOA at education@soa.org so they can be corrected prior to the exam.

4.4.2. Truly Defective Questions

On rare occasions, a question contains an error or may have multiple interpretations. Examples might include typographical errors, ambiguities, or questions that test material no longer covered in the Course of Reading. Candidates who believe that a question is defective should write to education@soa.org within two weeks of the date the examination was administered. This letter should explain in detail why the question seems to be defective. The Examination Committee will investigate all questions brought to its attention in this way, and may make allowances in the grading process, if appropriate. The Examination Committee may make use of candidates' examination books to determine whether their scores should be adjusted. The committee makes no guarantee it can consider correspondence that does not reach the SOA office within two weeks after the examination administration.

5. Model Solutions

5.1. Model Solution Overview

The purpose of model solutions is to help candidates prepare for subsequent exams. A secondary purpose is for candidates to assess their performance on the exam just taken. Examination committees attempt to have model solutions published within two weeks after grades are released.

A model solution represents a response that will receive the full number of points. It represents a well-constructed answer that focuses on the most important points expected to be included in the response, and it is responsive to the cognitive level indicated by the question verb. Because candidates do not always need to cover every possible aspect of the solution to receive full points, the model solution may not have every item from the grading guide. If your answer was correct, it will have received credit even if it did not appear as part of the model solution.

5.2. Additional Components Of A Model Solution

Model solutions indicate the learning objectives and the syllabus sources that provide information for answering the question. There may also be commentary that describes areas where candidates did well and where they performed poorly.

5.3. An Example

The following is from Question 1 on the Fall 2010 ILA-DP examination (both U.S. and Canadian versions). Items in italic are commentary for this document and were not part of the published model solution.

5.3.1. <u>The Question</u>

(*6 points*) You are given the following information with respect to product initiatives for three life insurance companies:

Company A wants to grow rapidly and has decided to enter the term market. The company plans to set premiums 10% lower than any of its competitors in order to build market share.

Company B believes it can sell more products by increasing term life sales and then cross selling other core products to a newly acquired customer base. The company plans to reduce the premiums of its term life product in order to increase total company sales.

Company C has been a leader in the whole life insurance market for many years. The company plans to re-price premiums on its core whole life products to be in line with the competition and use its exceptional customer service and reputation to generate sales. The premium charged will cover all costs associated with selling and administering the product.

(a)　(*2 points*) Explain the pricing objective of each company.

(b)　(*2.5 points*) Explain the pricing strategy used by each company for its product initiative.

(c)　(*1.5 points*) Determine which pricing objective and pricing strategy best fit the profile of the company described in the case study. Justify your answer.

5.3.2. The Model Solution

Learning Objectives:

(2)   Understand the drivers of product design (the idea generation step).

Learning Outcomes:

(2a)   Identify customers and their needs – internal and/or external.

(2b)   Analyze how the following drive product design:

- Company strengths and weaknesses

- Economic forces

- Marketplace demographics

- Consumer behavior

- Distribution channel behavior

- Competition

The specific learning outcomes are stated followed by the reading that supplies key information for responding to the question.

Sources:

LOMA, Insurance Marketing, 2010, Ch. 2-5 and 7-8

The commentary that follows is more detailed than is provided on some other exam's model solutions. Not every solution provides each of the components.

Commentary on Question:

The first part states the high-level knowledge and ability that is to be demonstrated.

The question was trying to test the following:

- Demonstrate a thorough understanding of the pricing objectives of a company.

- Demonstrate a thorough understanding of the pricing strategies of a company.

- Demonstrate that the candidate can analyze the different aspects of a company and decide which objective and which strategy works best for that company.

The next part identifies the cognitive level of each part.

Cognitive skill level for part (a) and (b) is comprehension, for part (c) it is knowledge utilization.

This part identifies what is needed to do well.

Important considerations for receiving maximum points include the following:

- Part (a): Listing the correct objectives for each company and including one or two items describing the objective.

- Part (b): Listing the correct strategies for each company and including one or two items describing the strategy.

- Part (c): Answering which objective and which strategy best suited Met Life was the most important part of the question. Justifying the answer by analyzing Met Life and listing some of the company's strengths and weaknesses helped as well

The final part is a commentary on the observed performance of candidates.

For parts (a) and (b), most candidates seemed a bit confused on the difference between a pricing objective and a pricing strategy. A number of candidates put the pricing strategies as an answer to the pricing objectives and then described the strategies as an answer to what the pricing strategies actually were. Many candidates simply listed the objectives and strategies without any further analysis.

For the most part, many more candidates knew the pricing strategies rather than knowing the pricing objectives. For part (c), most candidates really struggled for what the question was asking for. Many candidates recognized that company C in the question was most similar to Met Life, but very few candidates actually listed the strategy or objective that most suited Met Life. Also, many candidates explained a few of Met Life's features, but very few listed the features from the answer key. There was a line in the answer key that gave credit for explaining features of Met Life not on the answer sheet and most candidates were able to get credit for that.

Note – When grading, candidates who answered part (a) within (b) or vice-versa still received credit. Where candidates lost points was in a failure to respond to (a) anywhere.

Solution:

This particular model solution is in bullet points throughout. That is acceptable for the type of question asked.

(a)   Explain the pricing objectives of each company.

Company A

- Competition Oriented
- Uses Penetration Pricing to increase market share
- Could be Predatory Pricing if the price does not cover all the costs associated with selling the product
- Promotional efforts revolve around the company's low price

Company B

- Sales Oriented
- Focus is on the level of sales that the company can achieve
- Increase in sales does not necessarily mean an increase in profits, but the company does hope that enhanced market status will eventually lead to more profits

Company C

- Profit Oriented
- Focus is on product's return measures (ROI, ROA, etc…) or profit measures
- This objective can be used for the entire company or on a product by product basis

(b)   Explain the pricing strategy used by each company for its product initiative.

<u>Company A</u>

- Competition Driven
- Focus is on competitor's prices
- Penetration Pricing is used to build market share
- May be used to discourage potential competitors from entering the market

<u>Company B</u>

- Customer Driven
- Focus is on a price that customers or distributors will find acceptable
- Promotional Pricing is used as the Term Life prices are reduced to increase the company's customer base which should result in future sales across other product lines
- Price leaders can use this strategy to attract new customers who will then buy additional, more profitable products

<u>Company C</u>

- Cost Driven
- Focus is on setting a price that will cover company costs and then adding a margin
- Works best when companies have a great reputation for customer service or if they have great brand recognition (market leader)
- Strategy might not be effective in competitive markets

(c)   Determine which pricing objective and pricing strategy best fit the profile of the company described in the case study. Justify your answer.

A key component of this last part is that the choices are related to the company as described in the case study. It is not necessary to quote the case study pages in your solution.

- Pricing Objective is Profit Oriented.

- Pricing Strategy is Cost Driven.

- Met Life is a market leader which means they can price based on profit targets, covering all costs with a margin for profit.

- Met continually reviews underwriting and pricing guidelines so policies stay competitive and supportive of their marketing strategies and profitability goals (from Case Study page 10).

- Some of Met's competitors have more competitive pricing (from Case Study page 29).

6. Suggestions Regarding Answering Questions

6.1. Introduction

In this section we provide some suggestions that may be helpful as you prepare for and take a WA exam.

If there is one key piece of advice we can give it is to make it as easy as possible for the grader to award you points. You can do this by:

- Numbering your pages;

- Being clear which part of the question you are answering;

- Writing clearly and legibly;

- Presenting information in a logical order (don't direct them all over the page to follow your work); and

- Writing no more than is necessary.

Graders do their best to determine what you are trying to convey, but they are not mind readers. They can only use the information you provide.

6.2. Preparing For The Examination

People have various ways to learn material and to prepare for an examination. There is no single method we can recommend that will work for all candidates. We can, however, provide some general items that we believe will work for everyone.

- Review the introductory study note to get an overview of the exam objectives and expected outcomes.

- Review the case study and refer back to it often to get a good idea of how the elements of the case study relate to the various topics.

- Read the original syllabus material.

- If you choose to buy them, use study guides to help you organize your study.

- Review prior exams and model solutions, particularly the more recent model solutions that have been constructed under the format described earlier.

- Consider finding a mentor and joining (or creating) a study group. You can gain both by teaching others and by learning from them. Because there is no pre-set pass rate, your chance of passing is not affected by how well others do.

6.3. Writing The Examination

Here are some useful tips:

Do

- Read the questions thoroughly before you begin to write. Plan your answer in advance so your writing is more focused.

- Answer the question that was asked, not the question you expected.

- Take note of the verb(s) used and respond accordingly.

- Allocate your time according to the points assigned to each problem. Generally it is better to give partial answers to several questions than to spend extra time providing perfect answers to a few questions.

- Consider sketching an outline of your responses or other notes as they come to mind before writing your more formal answer.

- Use bullet and number lists when appropriate. Well-constructed sentences and paragraphs are not essential, as long as your points are made. However, there may be times when formal writing is needed, such as a question that asks you to draft a brief report.

- Be sure bullet and number lists are consistent with the verb. For example if you are asked to explain something, lists of one or two-word items are not sufficient.

- Use as much paper as you need. Consider leaving some blank area between sections of a question so that you can easily add more points if you think of them later.

- Present both sides of the question when a discussion is expected.

- Recognize when an integrated question is asked and be sure to draw on several parts of the syllabus in your answer.

- Make a choice when asked to choose between options A and B. There is not always a uniquely correct solution, so either choice will earn points (though one may earn more) provided a strong argument is made for that choice.

- Understand that partial credit is available at most all steps. For example, if you know a formula is to be used but don't have time to calculate the result, write it down. Also, show intermediate calculations so that you can receive partial credit even if your final answer is wrong.

- Write down facts that appear too obvious to be worth points, provided they are responsive to the question asked.

- Answer case study questions in the context of the case study. For example, if asked about the advantages of a certain course of action, choose items that are advantages for this company in this setting, not general advantages of that action.

Don't

- Perform a brain dump of everything you know. While credit is not lost for providing extraneous information, there is a good chance you will lose focus with regard to the question asked and waste time by writing too much.

- Make obscure interpretations or spend time looking for the "trick" in the question. Questions are designed to be straightforward.

- Refer to an earlier question as each question is graded separately. It is okay to refer to an earlier sub-part of a question, as the entire question will be graded by the same grader.

▪ Write that something is true and then write that it is false and then expect to get credit for the accurate statement and not lose it for the inaccurate statement. It is true that points are not deducted for erroneous information, but it is also true no points are awarded for contradictory statements.

▪ Hedge your answer if a definitive statement (such as being asked for a recommendation) is called for.

6.4. Sample Candidate Responses

We present and analyze two candidate responses to a question from an ILA exam. As usual, items in italics are not part of the actual candidate response.

6.4.1. The Question

(*7 points*) You have been asked to assist in the design and pricing of a Variable Annuity product with a Guaranteed Minimum Death Benefit (GMDB) and a Guaranteed Minimum Maturity Benefit (GMMB). The product offers a range of fund options with varying levels of investment risk.

You are given the following:

Maturity	3 months
Deposit Amount	100
Guarantee Level	100
Management Expense Ratio	3%/12 Deducted at the beginning of each month
Margin Offset	1%/12 Collected monthly in advance
Risk-Free Force of Interest	4%

The stock returns for the underlying funds were randomly generated for 10 scenarios using a Regime-Switching Lognormal model with the following liability present values under each of the first 9 scenarios.

Scenario	1	2	3	4	5	6	7	8	9
L_0	-0.36	2.15	-0.98	-1.11	0.56	0.08	-0.22	3.09	-4.45

The simulated values of the stock return process for the 10th scenario were:

t (month)	0	1	2	3
S_t	1.00	0.98	0.99	0.94

(a) (*1 point*) Explain why stochastic pricing is better suited than traditional pricing techniques for the pricing of equity-based guarantees.

(b) (*3 points*) Estimate the CTE(80) present value of liability using the simulations above, assuming no deaths or withdrawals. Show all work.

(c)   (*3 points*) Recommend changes to the product design to reduce risk to the company. Justify your answer

6.4.2. Model Solution

(a)   Explain why stochastic pricing is better suited than traditional pricing techniques for the pricing of equity-based guarantees.

Traditional pricing is better suited for more traditional forms of insurance where benefits are fixed and guaranteed.

Sensitivity to extreme scenarios and tail risk cannot be measured with a few deterministic scenarios.

Traditional actuarial techniques for pricing utilize deterministic techniques (i.e. best estimate, PFADs, sensitivity testing) because it relies heavily on diversification and the law of large numbers.

Equity linked insurance requires a stochastic approach because:

- Volatility of outcomes is significant

- Claims occur with low frequency and high severity

- Allows consideration of the entire distribution

- Allows modeling of dynamic policyholder behavior

- Individual risks are largely non-diversifiable (i.e. dependent)

- Provides a more thorough understanding of the risks

(b)   Estimate the CTE(80) present value of liability using the simulations above, assuming no deaths or withdrawals.

F(t) = Market Value of Separate Account at time t

F(t) = F(0) x [S(t) x (1-m)^t]/S(0)

F(1) = 100 x [0.98 x (1 – 0.03/12)^1] / 1.00 = 97.755

F(2) = 100 x [0.99 x (1 – 0.03/12)^2] / 1.00 = 98.5056

F(3) = 100 x [0.94 x (1 – 0.03/12)^3] / 1.00 = 93.2968

M(t) = Income at time t from guaranteed risk charge for t = 0, 1, 2

M(t) = mc x F(t)

C(t) = Liability cash flow at time t from the contract

C(t) = -M(t) for t = 0, 1, 2

C(t) = Max[0, G – F(t)] for t = 3

C(0) = -0.01/12 x 100 = -0.08333

C(1) = -0.01/12 x 97.755 = -0.08146

C(2) = -0.01/12 x 98.5056 = -0.08209

C(3) = Max[0, 100 – 93.2968] = 6.7032

L(0) = Present value of future liabilities, discounted at a constant risk free force of interest of 4%

L(0) = Sum of [C(t) x Exp(-rt)] sum from t = 0 to 3

L(0) = [-0.08333 x Exp(-0.04/12 x 0) – 0.08146 x Exp(-0.04/12 x 1)

-0.08209 x Exp(-0.04/12 x 2) + 6.7032 x Exp(-0.04/12 x 3)]

L(0) = 6.39

Estimated CTE(alpha) = mean of the largest N x (1-alpha) simulations

The two largest simulations are generated from scenarios 8 and 10.

Estimated CTE(80%) = (3.09 + 6.39) / 2 = 4.74

(c) Recommend changes to the product design to reduce risk to the company.

Longer GMMB maturity period than 3 months will give time for a recovery after a large initial market drop.

Asset allocation restrictions e.g. maximum equity percentage of 80%

Age restrictions – Age caps will reduce the mortality risk associated with the GMDB

Vary charge for guarantees based on volatility of fund choice

Reduce the guarantee percentage below 100%

Remove guarantees

Increase amount charge for guarantees

Cut off tail risk – Cap the tail loss on the death and maturity benefit

6.4.3. Low Scoring Response

This was not the lowest scoring paper, scoring at about the 10th percentile. Typically, the papers that tended to score below this level had major parts of the solution missing.

As can be seen, this candidate's work was easy to read and follow. While it can't be seen, it is also true that this candidate's handwriting was clear enough that all the words could be easily identified.

(a) Stochastic pricing may help see distribution of results

better understand risk mitigation and diversification

pinpoint scenarios to analyze

traditional pricing is hard to treat equity based guarantee since lack of credibility

hard to interpret results

not capture nature of risk

The main problem with this solution is that it is incomplete. Not only does it miss many key points, but the points made are not fully explained. For example, in what way does traditional pricing lack credibility and what risks are not captured?

(b)   For the 10th scenario

$$PV = \left(94 \cdot (1 - 3\% / 12)^3 - 100\right) / (1 + 4\%)^{0.25} +$$

$$\frac{100 \cdot 1\% / 12}{(1 + 4\%)^0} + \frac{100 \cdot 0.98 \cdot 1\% / 12}{(1 + 4\%)^{1/12}} + \frac{100 \cdot 0.99 \cdot 1\% / 12}{(1 + 4\%)^{2/12}}$$

$$= -6.39$$

$$CTE(80) = -6.39 - 0.36 - 0.98 - 1.11 + 0.56 + 0.08 - 0.22 - 4.45 / 8 = -1.61$$

A small error was not incorporating 4% as a force of interest. Also, the margin offset changes are based on the stock price and not on the fund value. These turn out to be small errors and in the end, the PV is accurate to two decimal places, though the sign is wrong. A major mistake was averaging eight scenarios rather than two.

(c)   Limit GMMB to % of deposit amount

change PTP to average

add margin, participate rate

increase the management expense ratio

As a three point question, the candidate should know that more than this is expected. The format is acceptable in that short responses in list form are sufficient.

6.4.4. <u>A High-Scoring Candidate</u>

This response was among the highest scoring papers.

(a)   Losses are path dependent

- Wide distribution of profits/losses

- Low frequency, high severity losses

- Volatility of equity based returns

- Deterministic price would result in no loss and the guarantee would be out-of-the-money pricing results are therefore meaningless or hard to interpret

- Stochastic pricing acknowledges up front that expectations likely will not come to fruition

- Better risk management

- Allows for modeling of policyholder behavior (in-the-money vs. out-of-the money guaranteed options)

- Understand the tail of the distribution of losses

The candidate made most of the points from the model solution and presented them in a clear manner.

(b) Scenario 10 – calculate Lo

Month	$F_{M_{beg}}$	M	M_{offset}	$F_{M_{end}}$	GMDB	GMMB
0	100	0.25	0.0833	99.75	0	0
1	97.755	0.244	0.0815	97.71	0	0
2	98.506	0.246	0.0821	98.2596	0	0
3	93.297	0.233	0.0777	93.064	0	6.936

$$F_{M_{beg+1}} = F_{M_{end}}(S_t / S_{t-1})$$

$$L_0 = PV(\text{GMMB}) - PV(\text{Margin offset})$$

$$= 6.936e^{-0.04 \cdot 3/12} - PV(\text{Margin offset})$$

$$= 6.86698 - 0.25 - 0.24 - 0.24 = 6.13698$$

CTE(80) = Avg Lo for worst 20% of scenarios

10 scenarios   CTE(80) = Avg of worst 2 scenarios

Worst two are scenario 8 and 10

CTE(80) = (3.09 + 6.14)/2 = 4.615

This candidate did an excellent job of laying out the solution. There is a minor error in that while the candidate noted that the PVs should be of margin offsets, the management charges were used instead. The candidate also did not explicitly show how those values were discounted.

(c) Limit funds choices to those that are less risky

- Have charges vary by riskiness of fund, higher risk = higher charge

- Limit issue ages to younger people to reduce mortality risk of GMDB

- Set the guarantee level to something less than 100% of the deposit amount (75% for example)

- Guide policyholder investment choices

All of the suggestions were on the list provided in the model solution. While it is not known if the candidate received full points for this part, it is not always necessary to cover every point in the model solution to receive full credit.