GH SPC Model Solutions
Spring 2014

1. Learning Objectives:

1. The candidate will understand pricing, risk management, and reserving for individual long duration health contracts such as Disability Income, Long Term Care, Critical Illness, and Medicare Supplement.

Learning Outcomes:

(a) The candidate will be able to identify the difference between short-duration and long-duration pricing and reserving methods

(b) Understand and utilize experience studies in setting assumptions for long-duration contracts

(c) Understand reserve calculations / adequacy for long-duration contracts

Sources:

Disability Income Insurance: The Unique Risk, Fifth Edition, Soule, Chapters 16 and 19

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe the types of experience studies that are commonly applied to disability income business and explain their advantages and disadvantages.

Commentary on Question:

While candidates generally did a good job at identifying the names of the experience studies that are commonly applied to DI business, one of which was embedded within question 1b, they tended to do more poorly at providing an adequate description of the studies, as well as identifying meaningful advantages and disadvantages of each.

The experience studies that could be described include:

<u>Morbidity (or actual-to-expected) studies</u>

- These studies review both the actual rates of disability and recovery
- Deviations from expected could be due to external factors such as economic changes affecting certain classes of occupations.

1. Continued

- This is the most preferable study for the evaluation of disability experience.
- Few companies have sufficient internal data to perform a credible analysis
- The studies often break down if reviewing individual experience cells.

Loss ratio studies

- Credibility issues surrounding morbidity studies often necessitate the use of loss ratio studies.
- There are two types of ratios used: The cash-claims ratios (paid claims over premiums) and the incurred-claims ratios (claims + estimated outstanding liabilities over premiums).
- Loss ratio studies can be misleading, especially in the early durations before underwriting has worn off.

(b) Explain the two types of loss ratio studies that can be performed.

Commentary on Question:
While candidates did well at identifying the loss ratio studies, many explanations were not awarded full marks due to incompleteness. It was not enough to "explain" an incurred-claims ratio as (paid incurred claims + reserves) / (premium), for example. Candidates seemed confused about how to answer this part without simply repeating part of their answer to part A.

Cash-claims ratio

- Paid claims divided by premiums.
- Often considered inadequate and misleading because:
  - The paid claims do not include the reserve liability for outstanding claims
  - The ratio includes total premiums, which includes the amounts for future liabilities to be incurred
  - The results in the early durations of a policy may be unreasonably low due to underwriting not having worn off

Incurred-claims ratio

- The numerator includes active life reserves and disabled life reserves.
- This ratio provides a more accurate indication of the health of the business.
- The interest component can be excluded from the ratio in order to further improve the value of the estimate.

1. Continued

(c) Perform a cash-claims ratio study by year based on the data available from BII. Comment on the results in the context of advantages and disadvantages of that type of study. Show your work.

Commentary on Question:

Most candidates did very well on this question, but many candidates lost points by not calculating the total loss ratio across the entire time period. For commenting on the results, many candidates listed advantages and disadvantages of cash-claims ratio study, but that was not sufficient to gain full credit. For full credit, candidates had to explain what conclusions could be credibly reached from the calculation.

	2008	2009	2010	2011	2012	Total
Premiums received ($000s)	$38.7	$40.1	$39.2	$39.1	$38.5	$195.6
Claims Paid ($000s)	$17.8	$20.2	$21.3	$28.4	$29.9	$117.6
Cash-Claims Ratio	**46.0%**	**50.4%**	**54.3%**	**72.6%**	**77.7%**	**60.1%**

- There is a clear trend upwards in the cash-claims ratios, which is consistent with the underwriting wear-off evident in this type of loss ratio.
- The results can be misleading as the cash-claims ratio excludes active and disabled life reserves.
- There is a significant increase in the loss ratio from 2010 to 2011, which might indicate future issues with the block of business as more underwriting wears off and selection issues become more apparent.

(d) Describe the two key types of disability reserves that could be considered for a disability study.

Commentary on Question:

Candidates generally did an excellent job on this question.

The two key types of disability reserves are:

Active Life Reserves

These reserves measure the present value of claims that future disabled lives will incur.

1. Continued

Disabled Life Reserves

These reserves measure the present value of claims that current disabled lives will incur.

(e) As you review the block of business that BII is considering purchasing, you discover that there are actually many different rating factors and product types included in this block, and additional analysis of the claims may be necessary. Explain the key parameters that should be analyzed.

Commentary on Question:
Candidates generally did an excellent job on this question. While candidates were not require to list all the following parameters to receive full marks, they did need to list most and provide an adequate explanation for each in order to receive full marks.

The following parameters should be analyzed:

- Occupation class – differences in morbidities and claim experience from one occupation to another
- Occupation – each occupation within a class may exhibit specific behaviors regarding disability claim experience
- Policy form – underwriting built in policy form will affect experience morbidity
- Extra benefits – optional benefits may affect morbidity
- Age – very important parameter since used as a rate variable
- Duration – age of the business on the books is generally a key driver with respect to current and future experience
- Elimination period – longer elimination periods generally correlate to improved experience
- Benefit period – longer benefit periods generally correlate to worse experience
- Indemnity – value of benefit is often a determinant in the experience
- Income – the relationship of income to the benefit is a key determinant in the experience
- Geography – experience often varies by area
- Agent and agency – experience can be evaluated by the channel it comes in to determine which produce the best performing business
- Sex – generally different experience at different ages between the genders
- Mode – the frequency of payment generally affects experience

1. Continued

- Smoking status – smoking status affects future health and future experience, and is often a rating facto

2. Learning Objectives:

2. The candidate will understand and evaluate the risk associated with health insurance and plan sponsorship and recommend strategies for mitigating the risk.

Learning Outcomes:

(a) Discuss ERM risks and risks specific to the health insurance industry

(b) Describe and recommend methods used to analyze, evaluate and mitigate the risks

(c) Calculate capital needs for a given insurer

(d) Describe components on an Economic Capital model

Sources:

Financial Enterprise Risk Management, Sweeting, 2011; Chapters 1, 8, 18

ASOP 46: Risk Evaluation in Enterprise Risk Management

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Explain how ERM reduces the volatility an organization faces.

Commentary on Question:

Candidates struggled with this question. Many candidates provided the answer to a different question: "What is Enterprise Risk Management?" However, the question was asking how ERM can reduce volatility. For example, many responses included that ERM considers risks holistically, but no explanation was provided as to why or how that feature of ERM can reduce a company's volatility.

ERM can help reduce the volatility an organization faces by:

- Increasing the likelihood of selecting projects with the best risk-adjusted return possible
- Ensuring that the total amount of risk taken is consistent with the corporate appetite for risk
- Providing a consistent framework in terms of how risks are identified, reported, and treated
- Recognizing concentrations, diversifications, and interactions among risks
- Uncovering internal hedges, reducing the need to hedge each risk separately
- Ensuring a carefully chosen and consistent response to risk across the organization
- Managing risks on a holistic basis ensures that fewer risks get missed due to lack of ownership.

2. Continued

(b) Describe risk identification techniques and identify those best suited for Risky Business.

Commentary on Question:

Candidates generally did a good job at identifying and describing the various risk identification techniques, but either did a poor job at selecting the techniques best suited for Risky Business, or did not provide any suggestions at all. Furthermore, several candidates described risk identification tools, such as SWOT analysis, as opposed to techniques. While not all techniques needed to be listed and described to receive full marks, most of them were required.

- Brainstorming
  - A group discussion led by a facilitator in order to draw out as many different points as possible
  - Ensure that as broad a range of points as possible is investigated and discussed in depth.
  - Not suitable Risky Business: company's hierarchical structure inhibits some from more freely expressing their opinions when their superiors are in the room.
- Independent Group Analysis
  - Small group setting
  - Each participant writes down risks he or she believes could be realized – silently, no collaboration among group members.
  - Facilitator aggregates the results
  - Group discussion follows
  - Risks are then independently ranked, and the aggregated results are considered an objective ranking of the company's most pertinent risks.
  - This would be a suitable technique for Risky Business, as employees would feel more empowered to express opinions.
- Surveys
  - Asks questions about different aspects of the organization in order to draw out the risk faced.
  - Ensures wider participation by employees.
  - This would be a suitable technique for Risky Business – surveys are likely to receive more honest answers.
- Gap Analysis
  - A type of survey that asks questions to identify both the desired and actual levels of risk exposure.
  - Could be suitable for Risky Business for the same reasons as the survey.
- Delphi Technique
  - A type of survey where experts are asked to comment on risks anonymously and independently.
  - Considering that Risky Business retained you as a consulting actuary, this is a likely technique for Risky Business

2. Continued

- Interviews
  - Not appropriate for risky business, as employees might feel intimidated.
  - Can be very costly from both a time and resource standpoint.
- Working Groups
  - Groups comprised of a small number of individuals who have familiarity with the issues of concern.
  - Not a recommended technique. Employees might be hesitant to be honest for fear of upsetting their superiors.

(c) Define economic capital.

Commentary on Question:
While most candidates spoke to the need to cover unexpected adverse events, many omitted the risk tolerance and time horizon components of the definition.

Economic capital is the additional value of funds needed to cover potential outgoings, falls in asset values and rises in liabilities at some given risk tolerance over a specified time horizon.

(d) Explain key considerations for an actuary reviewing an economic capital model.

Commentary on Question:
Most candidates provided the considerations related to Risk Evaluation Models from ASOP 46. However, the question was specifically addressing the considerations surrounding Economic Capital Models, also in ASOP 46.

Key considerations include:

- The appropriateness of the selected time frame, basis of measuring loss, and risk metric underlying the organization's definition of economic capital relative to how it is used to support strategic decisions.
- The degree to which the economic capital model reflects the significant risks of the organization and the interdependencies of those risks in a consistent and comprehensive manner.
- The appropriateness of the method used to model each risk. Some risks are more appropriately modeled stochastically while others may be more appropriately modeled using stress tests.

(e) Define and explain in an ERM framework

(i) Shareholder Value, and

(ii) Shareholder Value Added

2. Continued

Commentary on Question:
Most candidates were able to correctly define the mathematical definitions of SV and SVA, but were not successful at translating the formula into words.

(i) Shareholder Value (SV)

- represents the present value of a business
- present value of all cash flows expected in the future.
- Mathematically, SV is defined as:

$$SV = Economic\ Capital * \frac{Ra - Rg}{Rh - Rg}$$

Where:
R_a = risk-adjusted rate of return on capital (RAROC)
R_h = hurdle rate of the investment
R_g = rate of growth of cash flows

(ii) Shareholder Value Added (SVA)

- represents the present value of future cash flows in excess of the economic capital invested in a product.
- Mathematically, SVA is defined as:

$$SVA = SV - Economic\ Capital$$

f. Assume the Risky Business will maintain the 2011-2012 observed rate of cash flow growth going forward. Calculate both:
(i) Shareholder Value, and

(ii) Shareholder Value Added

Commentary on Question:
Most candidates did extremely well on this question. While it should have been implied to calculate the Economic Capital (EC) using the 2012 Economic Income Created (EIC), many candidates provided the calculations for both years. Candidates who did not provide their response based on 2012 data were penalized.

Components of SV and SVA:
R_a = risk-adjusted rate of return on capital = 4.5% (given)
R_h = hurdle rate of the investment = 3.0% (given)
R_g = rate of growth of cash flows = 410/400 – 1 = 2.5%

$$Economic\ Capital = \frac{EIC}{Ra - Rh} = \frac{\$124.7\text{M}}{4.5\% - 3.0\%} = \$8{,}313.3\text{M}$$

2. Continued

Therefore:

$$SV = Economic\ Capital * \frac{Ra - Rg}{Rh - Rg} = \$8{,}313.3\text{M} * \frac{4.5\% - 2.5\%}{3.0\% - 2.5\%}$$
$$= \mathbf{\$33{,}253.3M}$$

and

$$SVA = SV - Economic\ Capital = \$33{,}253.3\text{M} - \$8{,}313.3\text{M} = \mathbf{\$24{,}940.0M}$$

3. Learning Objectives:

3. The candidate will understand an actuarial appraisal.

Learning Outcomes:

(a) Differentiate the components of an actuarial appraisal versus an embedded value.

(b) Describe an approach for preparing and actuarial appraisal.

(c) Describe risks associated with interpreting an actuarial appraisal and an embedded value.

Sources:

GH-C104-07, p. 116

GH-C103-07 pages 14 and 15 of the PDF 12 and 13

Commentary on Question:

For part A, both option 1 and option 2 were accepted as they were from two parts of the syllabus discussing the same topic. In part C several students didn't know how to handle the cost of capital.

Solution:

(a) Identify items sellers typically include in their report in addition to the actuarial appraisal, and describe what these additional items provide to the buyer

Option 1:
projection of statutory earnings and capital requirements along with the DCF values, the appraisal report should illustrate the annual earnings and capital requirements of the business
provides insights into patterns of profitability
will facilitate analysis regarding capital needs and financing alternatives
initial level of capital needed by the buyer to in order to support the acquired business
sensitivity analyses
show impact of critical assumptions
impact of changes in interest rate and equity
can be deterministic scenarios or stochastic analysis

Option 2:
Description of the scope of the assignment and it's intended use
any reliances and limitations the actuary placed on his/her work product
description of the business entity being valued

3. Continued

the actuarial appraisal values
the methodology and assumptions used
the validation techniques and results
adjustments to the value net worth and provisions for cost of capital
how federal income taxes were considered
the expected stream of earnings from which the actuarial appraisals were determined
any deviations from the standard and whether it is in the actuarial appraisal

(b) You have supplied your actuarial appraisal report to a consulting actuary hired to conduct due diligence on your company. Describe adjustments buyers typically make in developing their edition of the actuarial appraisal report.

appropriate discount rate
adjust certain experience and product management assumptions
adjust new business values of goodwill premium for future business capacity
reflect the benefits from anticipated synergies or cost savings, and from one-time acquisition costs, directly in their assumptions
specific structure anticipated by a buyer may have an impact on the appraisal values, including tax benefits or cost

(c) Calculate your company's Actuarial Appraisal Value. Show your work.

1. Adjusted Statutory Book Value		$100.0
2. Value of Business In Force as of 12/31/2012		
Pre-tax Existing Business	$200.0	
Federal Income Taxes	($65.0)	
Cost of Capital	($25.0)	
After Tax Exisiting Business		$110.0
3. Value of New Business from 12/31/2012		
Pre-tax Future Business before Unallocate Expenses	$220.0	
Unallocated Expenses	($10.0)	
Pre-tax Future Business after Unallocated Expenses	$210.0	
Federal Income Taxes	($105.0)	
Cost of Capital Based on 200% RBC	($35.0)	
Subtotal After Tax Future Business		$70.0
Actuarial Appraisal Value		$280.0

4. Learning Objectives:

4. The candidate will understand and apply risk adjustment in the context of predictive modeling.

Learning Outcomes:

(a) Develop and evaluate risk adjustments based on commonly used clinical data and grouping methods

(b) Apply risk adjustment to underwriting, pricing, claims and care management situations

(c) Describe typical predictive modeling techniques

(d) Evaluate the appropriateness of each technique

Sources:

Duncan, Chapter 16, pages 254-262

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Identify the steps you would take to execute a care management program.

Commentary on Question:

Max 3 points for Economic Modeling bullet and details

- Choose a Disease or Condition
- Intervenability
  - Is the condition you select able to have an opportunity to affect the outcome through an intervention program
- Identify the Population
- Plan the Intervention
- Economic Modeling of the Proposed Program
  - Risk varies with populations as well as over time
  - Patients can move between risk categories
  - A small percentage of the population will account for a disproportionately large percentage of expense

(b) Describe program metrics that should be explicitly recognized under the Risk Management Economic Model.

- The number and risk-intensity of members to be targeted.
- Types and cost-structure of interventions to be used in the program

4. Continued

  - A successful program will combine multiple interventions of different types, cost-structures, and results
- The number of nurses and other staff required to deliver the program and their cost, and other program costs.
  - The largest component of program savings is achieved through reduced hospital admissions and lengths-of-stay
- The methodology for contacting and engaging or enrolling members.
- The rules for integrating the program with the rest of the care management system
  - Programs can refer or triage members elsewhere for services
- The timing and numbers of program members to be contacted, contacts, engagements, and interventions
- The predicted behavior of the target population absent intervention, and the predicted effectiveness of the intervention at modifying that behavior.

(c) Calculate the return on investment (ROI) range, based on the target condition range. Assume there is a nurse staffing ratio of 125 participants per nurse. Show your work.

		Low Target	High Target
Eligible Members	100,000	1	2
Members with Target Condition Range	11%-22%	11,000	22,000
High-Risk Members	20%	2,200	4,400
Reachable	45%	990	1980
Admissions/High-Risk Member/Year	1.18	1,168	2,336
Behavior Change Factor Applied to Admission Reduction	33%	386	771
Per Admission Cost	$11,750	$4,529,696	$9,059,391
Gross Savings		$4,529,696	$9,059,391
Gross PMPM Savings		$3.77	$7.55
Program Costs			
Fixed Cost	$2,500,000	$2,500,000	$2,500,000
Cost Per Nurse	$125,000	$990,000	$1,980,000
Non-Nursing Variable Cost (Per Participant Per Month)	$95.00	$1,128,600	$2,257,200
Program Costs		$4,618,600	$6,737,200
Program Cost PMPM		$3.85	$5.61
ROI		0.98	1.34

(d) Recommend one of the two outsourcing approaches. Justify your answer and show your work.

4. Continued

		Low Target	High Target
Eligible Members	100,000	1	2
Members with Target Condition Range	11%-22%	11,000	22,000
High-Risk Members	20%	2,200	4,400
Reachable	60%	1320	2640
Admissions/High-Risk Member/Year	1.18	1,558	3,115
Behavior Change Factor Applied to Admission Reduction	33%	514	1,028
Per Admission Cost	$11,750	$6,039,594	$12,079,188
Gross Savings		$6,039,594	$12,079,188
Gross PMPM Savings		$5.03	$10.07
Program Costs			
Fixed Cost	$2,500,000	$2,500,000	$2,500,000
Cost Per Nurse	$125,000	$1,320,000	$2,640,000
Non-Nursing Variable Cost (Per Participant Per Month)	$75.00	$1,188,000	$2,376,000
Program Costs		$5,008,000	$7,516,000
Program Cost PMPM		$4.17	$6.26
ROI		1.21	1.61

Scenario 2 promises higher savings and a better return on investment, but I recommend scenario 1 because the risks for the program performance are assumed by the vendor.