GH SPC Model Solutions
Spring 2015

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:
(1c)   Understand reserve calculations / adequacy for long duration-contracts.

Sources:
Claim Reserve Model – How actuaries rely upon the claim data they receive; LTC News

Commentary on Question:
The purpose of this question was to calculate the APV of the claim reserve (also called the disabled life reserve) for a LTC or LTD type product. The calculations are for members on claim. Premiums are not part of this question.

Solution:
(a)   Based on the expected continuance, calculate the projected claim reserves for each product immediately following:

(i)   the first payment; and

(ii)   the second payment.

Show your work.

Commentary on Question:
When someone goes on claim the insurer sets up a claim reserve to account for the expected future payments. Payments are made from that reserve until the member goes off claim.

1. Continued

Based on the expected continuance, calculate the total projected claim reserves for both products:

(i) Immediately after the first payment

Product 1: 1000*.5*$500 = $250,000
Product 2: 1000*.5*$300 + 1000*.2*$500= $250,000

(ii) Immediately after the second payment for product 2:

1000 * $500 * 20% = $100,000

(b) Determine the variance between actual and expected income in the first year. Show your work.

Commentary on Question:
Experience almost never matches expected. This part asks what happens to the income as experience changes. Products 1 and 2 are combined in the model solution.

Determine Actual Payment at End of Year 1: $500*600 + $300*400 = $420,000

Determine Revised Projected Reserve after Second Payment: $500 * 400 * 20%/50% = $80,000

Expense decrease: $420,000 + $80,000 - $500,000 = $0

Income remains unchanged.

(c) For Product 2, membership at the end of the first year was actually determined to be 380. Calculate the change in income at the end of year 1. Show your work.

Commentary on Question:
Sometimes further information comes in after the financial results were reported. In this case 20 people on claim died. This affects the income in two ways. The second payment is $6,000 less than expected and the reserve needed for the third payment decreases by $4,000. So the income for the company is actually $10,000 more than reported.

Income will be understated by 20 * $300 + 20 * 20%/50% * 500 = $10,000

1. Continued

(d) Describe methods to adjust for the impact of unreported deaths.

Commentary on Question:
Part C describes a reporting error based on bad data. This question looks at ways to make the reporting more accurate.

- Study past company mortality and lapse experience, compare to SOA or industry experience studies.
  - o Decide if continuance factors need adjustment.
- Verify who is still alive by performing a death audit.

(e) Describe other ways the income statement for long-term care indemnity insurance could be distorted and the effect these distortions have on the income statement.

Commentary on Question:
Full credit was given the listing two ways of income statement could be distorted as well as the resulting effect on the income statement.

- A paid claim may not yet be recorded as of the valuation date. This would overstate profits.
- Claims may be closed out too early before the last payments have been recorded.
  This will understate reserves and overstate profits.

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:
(2b) Complete a capital needs assessment
- Understand capital needs for a given insurer
- Determine actions needed to address issues identified by assessment

(2c) Integrate reinsurance arrangements within an overall risk management strategy of company plan/sponsor

Sources:
Bluhm 6th Edition, Chapter 22

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Your boss has compared Admiral's RBC ratio to a competitor, Cadet Reed Insurance Company, which has an RBC of 700%. Your boss concludes that Cadet Reed is in a better financial position than Admiral.

State whether you agree with his opinion. Justify your answer.

Commentary on Question:
Most candidates answered this part correctly.

I disagree with my boss.
RBC is used for the purpose of identifying financially weak companies.
A different formula would be used to identify relative strength.
In fact, recent opinion is that too high of an RBC may be bad as it represents hoarding of surplus.

(b) Calculate the Mandatory Control Level given the following:

Asset Risk for Affiliates	50	(millions)
Asset Risk for Other Assets	36	
Underwriting Risk	103	
Credit Risk	10	
Business Risk	17	

Show your work.

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2. **Continued**

> **Commentary on Question**:
> *Candidates generally did well on this part. Full points were given if candidates correctly included the names of the types of risk included in the formula.*
>
> Mandatory Control Level = RBCAC/2 x 70% = 160.88/2 x 70% = 56.3 million.
> RBCAC = H0 + (H1^2 + h2^2 + H3^2 + H4^2)^0.5
> H0 = asset risk for affiliates
> H1 = other asset risk
> H2 = UW risk
> H3 = credit risk
> H4 = business risk
> RBCAC = 50 + (36^2+103^2+10^2+17^2)^0.5 = 160.88

(c)   There is a market shock, and your total assets fall to $200 million. Determine if any regulatory action is warranted. Show your work.

> RBC ratio = Total Adjusted Capital / Authorize Control Level = 200M/(RBCAC/2)
>
> = 200m/(160.88m/2) = 249%
> 249>200 so no action needed
>
> 0 - 70% Mandatory control
> 70% - 100% Authorized Control
> 100% - 150% Regulatory Action
> 150% - 200% Company Action
> > 200% OK

(d)   Calculate the revised RBC ratio. Show your work.

> Expected Loss = 90%*0+5%*100 + 3%*300 + 1.5%*500 + 0.5%*800=25.5M
> Expected Reinsurance value = (25.5-18)* 90% = 6.75M
> Reinsurance value is applied as a reduction to H2;
> H0 : no change
> H1: no change
> H2: decreases by 6.75M
> H3: no change
> H4: no change
> RBCAC = 50 + (36^2 + 96.25^2 + 10^2 + 17^2)^0.5 = 154.6M
> TAC = 200M - 2M = 198
> RBC ratio = TAC/RBCAC/2 = 198/(154.6/2) = 256% Still OK

2.   **Continued**

(e)   Explain the directional impact the purchase of reinsurance may have on the risks
        that are included in the RBC formula.

H0: increases, depends on validity of reinsurer's assets to pay claims
H1: stays the same
H2: decreases, there is less exposure to claims after reinsurance
H3: stays same
H4: stays same

3. **Learning Objectives:**
3.   The candidate will understand an actuarial appraisal.

Learning Outcomes:
(3a)   Differentiate the components of an actuarial appraisal versus an embedded value.

(3b)   Describe an approach for preparing an actuarial appraisal.

Sources:
Study Note GHS-109-14, Study Note GHS-110-14

Commentary on Question:
Candidates performed extremely well on this question, particularly part a and d.
Candidates typically only answered one or two of the requirements to get full credit for
part c.

Solution:
(a)   Describe circumstances that lead to buyer and seller fit in an acquisition.

*   Business is profitable, but not core to seller
*   Block of business good, but not with seller's marketing and admin costs, can be fixed by buyer
*   Block of business has poor operating results due to management of seller, can be rectified by buyer
*   The reputation of the seller may prevent corrective actions (e.g. rate increases, termination, etc.)
*   A win-win transaction occurs due to reserve lock-in
*   A regulatory fire sale may occur, which may give the buyer better negotiating power Maximum of 4 rubric points awarded

(b)   Explain in detail the three components of an actuarial appraisal.

Adjusted Book Value – net worth of an insurance company adjusted non-admitted assets and liabilities, includes:
*   Capital and surplus
*   Asset Valuation Reserve (AVR) and Interest Maintenance Reserve (IMR)
*   Deferred Tax Asset
*   Non-admitted Assets
*   Other Adjustments

Existing Business Value – value attributable to company based on business in-force as of appraisal date

determined by creating detailed models of all material lines of business as of appraisal date

3. **Continued**

Future Business Value – economic value of the business as projected in the future, including level and profitability of new business to be produced

(c)   Describe common sources used to develop assumptions in an actuarial appraisal.

- The company's own experience based on an analysis of historical performance
- Company management expectations, as reflected in management's internal plan, product pricing, or actuarial valuation analysis
- Industry experience for comparable blocks of business, especially when information on the line of business for sale is not credible
- Actuarial appraisals should be adjusted for potential synergies that might come with buyer handling the business

(d)   Calculate the value of the block of business that Bell is considering acquiring. Show your work.

The appraisal is done by calculating the distributable (discounted) cash flow

Distributable Cash Flow = After-Tax Earnings minus Increase in Required Capital
=Premium + Investment Income – Benefits – Expenses – Commissions – Increase in Statutory Reserves – Taxes – Increase in Required Capital

=$2,450 + $100 - $1,770 - $310 - $120 - $50 - $110 - $70
=$130 million

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

Learning Outcomes:
(4c)   Describe typical predictive modeling techniques.

(4d)   Evaluate the appropriateness of each technique.

Sources:
Healthcare Risk Adjustment and Predictive Modeling, Duncan
- Chapter 1, Introduction to Health Risk
- Chapter 7, Introduction to Modeling

Commentary on Question:
Students were expected to understand how risk factors affect claims, perform calculations for a predictive model, interpret the results, and make a recommendation.

Solution:
(a)   Describe key risk factors that indicate that an individual will generate high claims.

   Commentary on Question:
   Most students did well listing these factors. A detailed description of these factors was not necessary.

   - Inherent risk factors such as age and sex
   - Medical condition such as diabetes
   - Family history or risk factors
   - Lifestyle factors such as smoking
   - External factors such as geography

(b)   Describe ways to evaluate the quality of a predictive model.

   Commentary on Question:
   Students needed to both name the ways to evaluate a predictive model and provide a brief description. Most students did well here.

   - Parsimony: model should use as few variables as possible
   - Identifiability: issues can arise if # of variables > than # of equations
   - Goodness of fit: model's ability to explain behavior of variables, eg., R^2
   - Theoretical consistency: relationships depicted in the model should be compared to the theoretical relationships between variables, and the results should be plausible
   - Predictive power: model should be tested on a test dataset, which could be data excluded from the modeling process

4. **Continued**

(c)   Calculate the predicted cost using ITCA's current model for:

    (i)   Male #1,

    (ii)   Male #2,

    (iii)   Female #1, and

    (iv)   Female #2.

Show your work.

Commentary on Question:
This relatively straightforward calculation was performed correctly by the vast majority of students. Students who showed their work but who made a calculation mistake still received most of the points.

    (i)   412 x 2 + 438 x 2 + 0.4 x 1,200 + 782 x 1 + 124 x 3 – 55 = 3,279

    (ii)   0.4 x 550 + 1,278 x 1 + 124 x 2 – 55 = 1,691

    (iii)   412 x 3 + 438 x 1 + 0.4 x 2,200 + 782 x 1 + 3,251 x 1 + 124 x 3 – 55 = 6,904

    (iv)   412 x 2 + 438 x 2 + 0.4 x 1,100 + 1,278 x 1 + 124 x 4 – 55 = 3,859

(d)   Draft a report to ITCA citing at least three changes that should be considered in the current model based on the predicted versus actual results. Justify your answers.

Commentary on Question:
Credit was given for other plausible changes to the model. Most students cited the addition of a gender variable.

- Add a variable for gender since females' actual cost was higher than expected and males' actual cost was less than expected
- Reduce or exclude prior period claim costs from model since it seems to have little correlation to actual costs
- Total number of condition categories could be adjusted to differentiate type of condition since the number of conditions doesn't track well to costs, especially for the females. Account for possible correlations of individual conditions.

4.   **Continued**

(e)   Critique the consultant's assertion and justify your answer.

Commentary on Question:
The most important point here is that adjusted R^2 is a better measure than R^2.
A few students listed items to consider but missed out on some points by failing to critique the consultant's assertion.

- The consultant's assertion is faulty
- R^2 is not the only factor to consider
- R^2 always goes up with addition of more variables
- A 0.02 improvement is not enough to justify adding 10 variables
- Parsimony was not considered
- Many independent variables are correlated so adding them doesn't improve fit
- The consultant's model may be overfitting the model to the data sample
- Adjusted R^2 should be used since it normalizes with respect to degrees of freedom