GH SPC Model Solutions
Fall 2016

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.

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:

(1a) Identify differences between short-duration contracts and long-duration contracts, from the standpoints of pricing and reserving.

(1d) Apply applicable Actuarial Standards of Practice.

(2a) Evaluate an enterprise risk management (ERM) system, including
- Describing the components on an ERM program.
- Discussing ERM risks and risks specific to the health insurance industry.
- Describing and recommending methods used to analyze, evaluate and mitigate the risks.

(2d) Understand how an Own Risk Solvency Assessment (ORSA) complements and differs from traditional risk assessment.

Sources:

GHS-103-14, ASOP #7, ASOP #22, ASOP #46, Financial Risk Management (Sweeting) Chapter 8

Commentary on Question:

Candidates did well on Parts A, D, and G.

Solution:

(a) Define CII.

CII is an insurance product that pays the face amount in the following circumstances:
1. The insured is **diagnosed** with a condition **covered** by the policy.
2. The condition meets the **definition** in the policy and is **not excluded** by any other policy provision (not life threatening controls the price).
3. The insured **survives** for a specified period following diagnosis.

1. Continued

(b) List areas of specific concern in product design of CII, giving attention to risk management and control aspects.

1. Definitions: limiting benefits for conditions that are non-life threatening when diagnosed – example: Early prostate cancer
2. Avoidance of anti-selection at issue – Example: cancer claims shortly after issue.
3. The potential high cost of benefits for some conditions beyond age 75 – Example: Alzheimer disease.
4. The potential high cost of long-term guarantees due to advances in medical science leading to earlier detection

(c) Describe how CII coverage would augment

(i) Disability Income Insurance

(ii) Life Insurance

(i) Disability Income Insurance
   a. It has been estimated that, if a large group have both CII and DI policies, only 15%-20% of those who make a claim will qualify for benefits under both policies.
   b. Keep in mind that many DI claims are for Mental / Nervous conditions or soft tissue injuries, neither of which qualifies for CII benefits.

(ii) Life Insurance
   a. Previously, people got sick and died. Today, they get sick and survive. The five year survival rate for prostate cancer is 87% and for breast cancer is 82%.
   b. As a rough rule of thumb, assume that the chance of claiming on a CII policy in a given year is 3 times that of claiming on a life insurance policy.

(d) Identify reasons why a cash flow test should be completed.

Commentary on Question:
This came out of ASOP 7: Students should know the relevant ASOPs well enough to figure out which part the question was referring to. As a question writer and a grader I strongly recommend that students to study the ASOPs on the syllabus in entirety and not rely solely on study guides and note cards.

1. Continued

The actuary should consider cash flow testing when variations in the underlying risks are likely to have a material impact on the expected cash flows in certain products, certain lines of business, or on the company. Situations that might indicate a need for cash flow testing include the following:

A. where there are **material asset risks** (for example, below investment grade bonds, assets with payment timing risks such as CMOs or mortgage-backed securities, mortgages concentrated in certain regions of the country, and large illiquid assets such as real estate);
B. where there are liabilities that have **cash flows far out into the future** (for example, structured settlement annuities with a significant reinvestment rate-of-return risk);
C. where a company has a **new or rapidly growing line of business**; and
D. where options have been granted to policyholders or borrowers and **the likelihood of anti-selection** in the exercise of these options is significant (for example, an annuity contract holder's option to surrender the annuity for cash at book value).

(e) Describe items an actuary should consider in forming an opinion as to whether an asset adequacy analysis is satisfactory.

Commentary on Question:
ASOP 22

Considerations include:
1. Reasonableness of Results: The actuary should review the modeled future economic and experience conditions and test results for reasonableness.
2. Adequacy of Reserves and Other Liabilities: When forming an opinion, the actuary should consider whether the reserves are adequate under *moderately adverse conditions*, in light of assets supporting such reserves and liabilities.
3. Analysis of Scenario Results: In the event that the supporting assets are insufficient to meet the reserves and other liabilities under a scenario, the actuary may determine that further analysis is required.
4. Aggregation During Testing: The actuary should not aggregate the reserves and other liabilities of two or more blocks of business during testing if the assets supporting the reserves and other liabilities of one block of another line of business can't be used to discharge the reserves and other liabilities of other blocks of business.
5. Aggregation of Results: After testing is done, the actuary may offset deficiencies in one business segment with sufficiencies in another business segment for the purpose of reporting and documenting the results of testing.

1. Continued

6. Trends: Test results from prior years can provide the actuary with valuable insight into the dynamics of asset adequacy analyses, particularly if successive year's results have been reconciled.
7. Management Action: Any anticipated future actions by management to address adequacy concerns identified by the actuary should be considered in forming an opinion.
8. Subsequent Events: Whether or not applicable law requires the actuary to consider subsequent events, the actuary should consider all material events that are all likely to affect the actuary's analysis up to the date the opinion is signed and disclose those events in the opinion.

(f) Describe considerations related to developing, reviewing, and maintaining models used in risk evaluation.

Commentary on Question:
ASOP 46. The key was discussing "models".

1. Determine if the **models** are **fit for the purpose** by reviewing:
   a. The degree of which the models are reproducible and adaptable to new risks
   b. The sophistication of the models in proportion to the materiality of the risks covered
   c. The practical considerations for the models, including usability, reliability, timeliness, process effectiveness, technological capabilities, and cost efficiency
   d. The inherent statistical and limitations of the models
   e. The quality, accuracy, appropriateness, timeliness, and completeness of model data
   f. The appropriateness of methodologies used for model verification and validation, calibration, and sensitivity testing
   g. The appropriateness of the cash flow and discounting methodologies used in the models

2. Determine if the **model assumptions** are **appropriate** including whether the assumptions:
   a. are supportable, appropriately documented, and allow for deviations from expected
   b. are regularly revisited to determine their appropriateness
   c. that explicitly reflect anticipated management action in response to future events are supportable and appropriately documented.

1. Continued

(g)

(i) Describe all risk identification techniques, including the advantages or disadvantages of each.

(ii) Recommend a risk identification technique that is most appropriate for CII product development. Justify your answer.

1. Brainstorming. It is important that ideas are not initially censored. A potential drawback of brainstorming is that the potential exists for "free riders" to exist – individual attending by failing to contribute. Other disadvantages include gathering all participants in a single location and convergent ("group") thinking.
2. Independent Group Analysis. All participants write down in silence and without collaboration ideas on the risks that might arise. A facilitator aggregates these risks into a discussion. Ranking of risks is done silently to avoid convergent thinking. It still is heavily dependent upon the constitution of the group.
3. Surveys. An advantage is a much larger group can be canvassed. The responses can be heavily influenced by the way the question is asked. Another disadvantage is that it may result in a low participation rate by failing to respond to the survey. Furthermore, a multiple choice response is the only way to quantify results.
4. Gap Analysis. This involves asking two types of questions, to identify both the desired and actual levels of risk exposure. If conducted by survey, it has the same pitfalls as that approach.
5. Delphi technique. A survey, where acknowledge experts are asked to comment on risks anonymously and independently. An initial survey is followed up by subsequent surveys based upon the results of the initial survey continuing until there is a consensus on the nature of the risks faced.
6. Interviews. This has the advantages of structure and independence of view that come with t a survey, but also with the advantage that if an answer is unclear, clarification can be sought immediately. Drawbacks include the framing of the question and the effort involved.
7. Working Groups. These are used once a risk is identified to investigate more thoroughly the exact nature of the risk.

Recommendation: Can be any of the above as long as justification is provided as to acknowledging the shortcomings of the approach. An example answer may be:

Perhaps a Delphi technique should be used as the company initially gathers information. As the particulars are determined and the people needed to talk to gets smaller, interviews should be used to determine the finer points of the risk.

2. Learning Objectives:

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

Learning Outcomes:

(4a) Develop and evaluate risk adjustments based on commonly used clinical data and grouping methods.

(4c) Describe typical predictive modeling techniques.

(4d) Evaluate the appropriateness of each technique.

Sources:

Duncan Chapter 14, pages 225 - 227:

Duncan Ch 14 pp224 - 225:

Commentary on Question:

Most candidates did well on parts (a) & (b) and struggled with part (c).

Solution:

(a) Describe CMS' considerations in developing risk adjustment scores for the CMS-HCC (Hierarchical Condition Categories) Risk Model.

Commentary on Question:

Most candidates did well on this part.

Demographics:
Age/sex are starting point for determining a beneficiary's risk.
Medicaid status - being dually eligible gives a higher score.
Disability Indicators - beneficiaries under 65 who are eligible for Medicare due to disability
Residence in LTC facility - separate risk model for them
ESRD - separate risk model for them
New enrollees - age/sex factors only

Prospective vs retrospective - (i) CMS-HCC uses prospective, (ii) relies on historical medical experience to develop relative risk values for future cost estimation
Calibration - CMS recalibrates its risk adjustment data every 2 years to reflect changes in financing and delivery system
Disease specific health status - (i) Disease groups produce HCCs, (ii) disease hierarchies used, (iii) disease interactions
Risk score for specific Medicare beneficiary

2. Continued

(b)

(i) Calculate the expected total payment. Show your work.

(ii) Calculate the actual total payment. Show your work.

Commentary on Question:
Most candidates were successful at this calculation.

Expected PMPM Payment to XYZ Insurance Company:
Bid of $530 PMPM < Benchmark of $540 PMPM, so
Government Payment = Bid x Risk Adjustment Score + 75% (Benchmark – Bid)
Basic Member Premium = 0 when Bid < Benchmark, and
Supplemental Member Premium = $20 (given above), so
Expected Payment = Gov't Payment + Basic Member Premium ($0 when bid < benchmark) + Supplemental Member Premium

= (Bid x Risk Adjustment Score + 75% x (Benchmark – Helper's Bid)) + $0 + $20
= $530 x 1.5 + 75% x ($540 - $530) + $20
= $795 +$7.5 + $20
= $822.50 PMPM
Expected total payment = PMPM x Member Months = $822.50 x 200,000 = $164.5 Million

Actual PMPM Payment to XYZ Insurance Company:
Bid of $545 PMPM > Benchmark of $540 PMPM, so
Government Payment = Standardized A/B Benchmark x Risk Adjustment Score
Basic Member Premium = Standardized A/B Benchmark – Standardized A/B Bid, when Bid > Benchmark, and
Supplemental Member Premium = $20 (given above), so
Actual Payment = Gov't Payment + Basic Member Premium + Supplemental Member Premium

= (Benchmark x Risk Adjustment Score) + (Benchmark – Bid) + $20
= ($540 x 1.25) + ($545 - $540) + $20
= $675 + $5 + $20
= $700 PMPM
Actual Total Payment to Helper's = PMPM x Member Months = $700 x 200,000 = $140 Million

2. Continued

(c) The Company is considering three models for provider reimbursement: Diagnostic Related Groups (DRGs) model, Episode Treatment Groups (ETGs) model, and DxCG model.

Describe each model's

(i) calibration population

(ii) data requirements

(iii) model structure

Commentary on Question:
This question gave people the most trouble; few candidates knew how to completely answer it.

DRGs (Diagnosis Related Groups) Model
Calibration Population (Duncan ch 5, page 83): Inpatient, Medicare population

Data Requirements (ch 5, page 83): Patient attributes includes –
1. Diagnosis
2. Age
3. Sex
4. co-morbidities
5. severity of illness
6. risk of dying
7. prognosis
8. treatment difficulty
9. need for intervention, and
10. resource intensity

Model Structure (ch 6, page 95): Tree Structure of DRGs, Inpatient procedure or claim (i.e., admission) is
1. Assigned to 23 groups or Major Diagnostic Categories (MDCs), then
2. Patient determine to be either "medical" or "surgical" case, depending on whether he or she had an operation room (OR) procedure
3. Combination of principal diagnosis and principal procedure is used to assign the patient to either a surgical or medical "Adjacent DRG"
4. Finally, most (but not all) Adjacent DRGs are further subdivided based on the presence or absence of complications/co-morbidities to assign a patient to a single DRG

2. Continued

ETGs (Episode Treatment Groups) Model
Calibration Population (ch 5, page 88): Inpatient, outpatient, or both

Data Requirements (ch 5, page 88): uses routinely collected inpatient and ambulatory claims data. Adjusted for patient severity, intensity, and complexity by accounting for differences in patient –
1. Age
2. Complicating conditions
3. Co-morbidities
4. Major surgeries

Model Structure (ch 5, page 88, ch 6, page 104)
1. core concepts are case-mix adjustment and clinical homogeneity. Focus in on resource utilization
2. ETGs are combined into larger groups to create ERGs (Episode Risk Groups) using Major Practice Categories (MPCs)
3. ETG is the building block, a service constitutes the foundation for the episode, or Anchor Record
4. All services related to an episode are grouped into the ETG
5. A series of clinical rules determines the groups of clusters
a. As labs, drugs, office visits are all "clustered" with the appropriate anchor record
6. ETGs reflect co-morbidities and severity so complications may result in mapping to different severity levels

DxCG Model
Calibration Population (ch 5, page 87): Commercial, Medicaid, Medicare and Workers' Compensation markets
Data Requirements (ch 5, page 87): Demographic, medical and pharmacy claims info.
Model Structure (ch 5, pages 86-87):
1. Medical risk analysis of patient populations that predict health care costs and outcomes, and identify trends and patterns in health care utilization.
2. Focus in healthcare financing, clinical management, and administrative.
3. Classifies ICD-9 codes in to 1,000+ distinct diagnosis groups (DxGroups). DxGroups are grouped into 394 Condition Categories (CCs) to calculate Relative Risk Scores (RRS).
4. RRS is a factor that yields an individual's expected resource utilization (may apply to costs or outcomes)

3. 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.

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:

(1a) Identify differences between short-duration contracts and long-duration contracts, from the standpoints of pricing and reserving.

(1d) Apply applicable Actuarial Standards of Practice.

(2b) Complete a capital needs assessment.

- Calculate capital needs for a given insurer.
- Determine actions needed to address issues identified by assessment.
- Describe components of an Economic Capital model.

(2e) Apply applicable Actuarial Standards of Practice.

Sources:

GHS-114-14 Disability Insurance: The Unique Risk (Chapter 16, Page 237)

GHS-114-14 Disability Insurance: The Unique Risk (Chapter 18, Pages 256-257)

Group Insurance Chapter 39 RBC Formulas – Pages 685-686.

GHS-116-15 NAIC Own Risk and Solvency Assessment (ORSA) Guidance Manual – Pages 9-10

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Describe considerations for the two most significant reserves in disability income (DI) insurance.

Commentary on Question:

Most candidates made comments that described the first half of what would have been considered full credit.

3. Continued

1. Active Life Reserve
   a. The typical disability income policy is on a level-premium basis.
   b. In the early years, somewhat more premium than is necessary for actual morbidity is charged.
   c. This excess premium must be set aside to offset the greater morbidity at the older issue ages when the premium will prove inadequate.
   d. The active life reserve is the depository of this excess premium.
   e. The actuary's premium rate assumptions assume a certain level of interest earnings on these reserves.
   f. Unlike life insurance, the reserves does not build up a cash or surrender value in most disability policies though some offer a ROP (return of premium) option.
   g. The size of the active life reserve varies by age, occupation class, elimination period, indemnity amount, and length of benefit period.
   h. There are problems in projecting levels of interest rates for many years in the future.
   i. The long-term nature of the disability product and selection of an interest rate assumption, therefore, have a substantial effect on profitability.

2. Disabled Life Reserve
   a. The disabled life reserve is established, reflecting each disability claim and its projected length.
   b. The basis for the reserve may be a standardized table though companies may establish more conservative or more liberal reserves if they can demonstrate that their experience substantiates different assumptions.

(b) List four principal factors that would stimulate product development of a new DI product.

Commentary on Question:
Most people did really well on this part.

1. Responding to Competitors' New Products
2. Consumer Demands
3. Claims Experience and Trends
4. Governmental Influences

(c)

(i) Calculate the NAIC Underwriting Risk (H_2) for this portfolio. Show your work.

(ii) Calculate the additional H_2 required if the company estimates it will sell an additional $20 Million in Earned Premium for a new Group LTD product. Show your work.

3. Continued

Commentary on Question:
This portion of the question was successful at helping differentiate candidates who did well on the question and who did poorly.

Coverage	$0-$50 Million Earned Premium	$50+ Million Earned Premium
Non-Cancelable Individual	35%	15%
Other Individual	25%	7%
Group Long-Term	15%	3%
Group Short-Term	5%	3%

For purposes of applying the earned premium tiers, all individual products are combined, but the individual and group products are not combined with one another, and the ordering of products is RBC-maximizing.

(i) Premium Component:
H_2 = 35% ($30 Million) + 25% ($20 Million) + 7% ($10 Million) + 15% ($40 Million)
= $10.5 Million + $5.0 Million + $0.7 Million + $6.0 Million = $22.2 Million

As the ordering of products is RBC Maximizing, the individual insurance is ordered: Non-Cancelable (higher factors) and then Guaranteed Renewable (lower factors). Group and individual are calculated separately.

Claim Reserve Component:
H_2 = 5% (Total Claim Reserves) = 5% ($750M) = $37.5 Million

Total H_2 = Premium Component + Claim Reserve Component = $59.7 Million.

(ii) Additional H_2 = 15% ($10 Million) + 3% ($10 Million) = $1.8 Million

As the company was under $50 Million threshold, the higher factor is used until total Group DI premium is at the threshold while after the threshold the lower percentage is used.

3. Continued

(d) ABC Insurance Company needs to fulfill their Own Risk and Solvency Assessment (ORSA) requirements.

(i) Describe key methodologies, assumptions, and considerations used in quantifying available capital and risk capital that should be outlined in Section 3 of an ORSA Financial Summary Report.

(ii) Identify an example from each consideration from part (i) that is used in evaluating a new DI product.

Commentary on Question:
Very few candidates got full credit for part (d).

Methodology, Assumption, Consideration	Example Method, Assumption, Consideration
Definition of Solvency (Describe how the insurer defines solvency for the purpose of determining risk capital and liquidity requirements).	(1) Cash Flow Basis or (2) Balance Sheet Basis
Accounting / Valuation Regime (Describe the accounting or valuation basis for the measurement of risk capital requirements and/or available capital.)	(1) GAAP or (2) Statutory or (3) Economic / Market Consistent (4) IFRS (5) Rating Agency Model
Business Included (Describe the subset of business included in the analysis of capital.)	New DI Product Business Assumptions
Time Horizon (Describe the time horizon over which risks were modeled and measured.)	For DI this should be Lifetime
Risks Modeled (Describe the risks included in the measurement of risk capital, including whether all relevant and material risks identified by the insurer have been considered.)	This is materially an Insurance Risk. Others were operational, credit, market, or liquidity
Quantification Method (Describe the method used to quantify the risk exposure.)	(1) Stress Test or (2) Stochastic Modeling or (3) Factor-Based Analysis
Risk Capital Metric (Describe the measurement metric used in the determination of aggregate risk capital.)	(1) Value at risk (VAR) or (2) Tail-valued-at- risk (TVAR) or (3) Probability of Ruin
Defined Security Standard (Describe the defined security standard utilized in the determination of risk capital requirements, including linkage to business strategy and objectives.	(1) AA Solvency or (2) 99.X% 1-year VAR or (3) Y% TVAR or (4) Z% of RBC
Aggregation and Diversification (Describe the method of aggregation of risks and any diversification benefits considered or calculated in the risk capital determination.)	(1) Correlation Matrix or (2) Dependency Structure (3) Full/Partial/No Diversification

4. Learning Objectives:

3. The candidate will understand an actuarial appraisal.

Learning Outcomes:

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

(3c) Describe risks associated with interpreting an actuarial appraisal and an embedded value.

Sources:

Embedded Value Calculation for a Life Insurance Company (Tremblay)

Commentary on Question:

Generally, for the entire question, candidates' results were evenly distributed between doing poorly, doing very well, and somewhere in between.

Solution:

(a) Critique the accuracy of each statement.

Commentary on Question:

Candidates should identify whether or not each statement is accurate and then provide additional commentary supporting that assertion in order to receive full credit. Some candidates chose not to elaborate and only received partial credit.

(i) This is a true statement. There needs to be a precise definition of new business to distinguish it from in-force business.

(ii) This is a true statement. Best estimate liabilities are given no value in the embedded value because they will be used to cover future liabilities or contingencies.

(iii) This is a false statement. The free capital cannot earn the hurdle rate because free capital is returned to the shareholder at the beginning of the projection. Only the locked in capital earns the hurdle rate.

(iv) This is a true statement. One must be very careful in using embedded value calculations because of the sensitivity to the assumptions underlying its calculation. To base compensation on the embedded value may induce manipulation of the underlying assumptions.

(b) Calculate the PV(AfterTaxProfits). Show your work.

Commentary on Question:

Candidates seemed to struggle with identifying the correct formula. Some candidates did not recognize the Cost of Capital should be subtracted. Partial credit was given when appropriate.

4. Continued

Embedded Value (EV) = Free Capital + Locked In Capital + PV(After Tax Profits) – PV(Cost of Capital)

PV(Cost of Capital) = PV(Hurdle Rate * Capital) – PV(After Tax Inv Income on Capital) = $90,000 – $50,000 = $40,000

EV = $1,250,000 = $100,000 + Locked In Capital + (0.7 * Locked In Capital) - $40,000

Locked In Capital = $700,000

PV(After Tax Profits) = 0.7 * $700,000 = $490,000

(c) Calculate the Embedded Value as of 12/31/2017 with these assumptions.

Commentary on Question:
Some candidates did not identify a share buyback as a negative unexpected change in Embedded Value. Partial credit was provided when appropriate.

EV(2017) = EV(2016) + Normal Increase in EV + Value Added By New Sales – Dividends Paid + Unexpected Change in EV

EV(2017) = $1,250,000 + $108,500 + $0 - $50,000 - $200,000 = $1,108,500