SOCIETY OF ACTUARIES®

Advanced Topics in General Insurance

Exam GIADV

Date: Tuesday, October 30, 2018
Time: 2:00 p.m. – 4:15 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has a total of 40 points.

   This exam consists of 8 questions, numbered 1 through 8.

   The points for each question are indicated at the beginning of the question.

2. Failure to stop writing after time is called will result in the disqualification of your answers or further disciplinary action.

3. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.

Written-Answer Instructions

1. Write your candidate number at the top of each sheet. Your name must not appear.

2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.

3. The answer should be confined to the question as set.

4. When you are asked to calculate, show all your work including any applicable formulas.

5. When you finish, insert all your written-answer sheets into the Essay Answer Envelope. Be sure to hand in all your answer sheets because they cannot be accepted later. Seal the envelope and write your candidate number in the space provided on the outside of the envelope. Check the appropriate box to indicate Exam GIADV.

6. Be sure your written-answer envelope is signed because if it is not, your examination will not be graded.

Tournez le cahier d'examen pour la version française.

1. (*6 points*) Tolerant Reinsurance Company has written a proportional treaty with the following characteristics:

Sliding scale commission:

Loss Ratio	Commission
40% or below	20%
40%-60%	Sliding 0.5:1
60% or above	10%

Profit commission:

Margin for Expenses	15%
Percent Returned to Ceding Insurer	40%

The loss ratio for 2017 was 65%.

(a) (*1 point*) Calculate the technical ratio (loss ratio plus commission ratio) for 2017.

Any losses in excess of a 60% loss ratio are carried forward to the following year's commission calculations. The 2018 loss ratio is uniformly distributed from 30% to 70%.

(b) (*4 points*) Calculate the expected technical ratio for 2018.

(c) (*1 point*) Describe two complications with pricing the effect of carryforward provisions.

2. (*4 points*) Risky Business, Inc. (RBI) has written two contracts for earthquake losses. RBI's earthquake model indicates there are four possible outcomes in the next year. The following table provides, for each outcome, the probability and the payment under each contract.

Outcome	Probability	Contract X Payment	Contract Y Payment
P	0.90	0	0
Q	0.05	500	1,000
R	0.03	2,000	0
S	0.02	0	3,000

RBI calculates risk loads based on variance using a multiplier of $\lambda = 0.0001$.

(a) (*1 point*) Calculate the risk load for the two contracts combined.

(b) (*1.5 points*) Calculate the renewal risk load for each contract using the Marginal Variance method.

(c) (*1.5 points*) Calculate the renewal risk load for each contract using the Shapley method.

3. (*4 points*) You are setting the premium for a one-year policy using the following assumptions:

- The premium will be collected at policy inception.
- Expenses of 20 will be paid at policy inception.
- Losses are expected to be 80 and will be paid at policy expiration.
- The tax rate on all income is 20% and taxes will be paid at policy expiration.
- Equity of 50 supports the policy.
- The risk-free rate is 2%.
- The risk-adjusted rate for losses is –2%.

(a) (*2.5 points*) Calculate the premium for this policy using the Risk Adjusted Discount Technique.

(b) (*1.5 points*) Describe three criticisms of the Risk Adjusted Discounted Technique as applied to insurance models.

4. (*8 points*) One of the assumptions of Mack's model of loss development is that
$E(C_{i,k+1} \mid C_{i,1},\ldots,C_{i,k}) = C_{i,k} f_k$.

(a) (*1.5 points*) Explain whether this implies that observed development factors within a given accident year are uncorrelated, independent, neither, or both.

(b) (*1.5 points*) State Mack's other two assumptions.

Mack proposes a test for correlation between development factors that uses Spearman's rank correlation coefficient.

(c) (*3 points*) Demonstrate that the weighted average test statistic for the triangle below is −0.24.

Accident Year	Development Year						
	1	2	3	4	5	6	7
1	9,146	12,176	17,670	18,546	18,128	18,517	18,888
2	10,834	15,902	20,884	23,304	22,887	23,371	
3	11,946	15,697	20,478	22,854	20,718		
4	12,414	19,333	38,991	42,905			
5	14,284	20,888	25,210				
6	15,648	17,240					
7	17,221						
	Age-to-Age Factors						
1	1.3313	1.4512	1.0496	0.9775	1.0215	1.0200	
2	1.4678	1.3133	1.1159	0.9821	1.0211		
3	1.3140	1.3046	1.1160	0.9065			
4	1.5574	2.0168	1.1004				
5	1.4623	1.2069					
6	1.1017						

(d) (*1 point*) State the conclusion that should be drawn from the test. Justify your answer.

Venter suggests alternatives to Mack's model that should be considered.

(e) (*1 point*) Describe two such alternative models.

5.   (*5 points*) You are given the following triangle of cumulative paid losses:

		Evaluation Date		
Accident Year	Onlevel Premium	December 31, 2015	December 31, 2016	September 30, 2017
2015	10,000	6,000	5,900	6,200
2016	8,500		4,000	5,500
2017	9,000			3,000

You apply Clark's stochastic reserving model using the Cape Cod method and a loglogistic distribution with cumulative distribution function $G(x) = \dfrac{x^\omega}{x^\omega + \theta^\omega}$ where x is in months.

Clark states that one of the assumptions of the model is that the expected loss emergence will be strictly increasing.

(a)   (*0.5 points*) Explain why the accident year 2015 pattern showing a decrease from December 31, 2015 to December 31, 2016 does not violate this assumption.

The maximum likelihood estimates of two of the parameters are $\theta = 1.8968$ and $\omega = 1.0300$.

(b)   (*2 points*) Demonstrate that the maximum likelihood estimate of *ELR* is 0.6291.

(c)   (*1 point*) Estimate the reserve for the three accident years combined.

(d)   (*0.5 points*) Estimate the expected payments that will be made during the last three months of 2017 for accident year 2016.

Clark notes that an alternative distribution to the loglogistic is the Weibull.

(e)   (*0.5 points*) Describe a situation where the Weibull is likely to be more appropriate.

The evaluation dates are not equally spaced.

(f)   (*0.5 points*) Explain why Mack's formulas are not appropriate in this situation.

6. (*4 points*) A bolt-on approach can be used for determining risk margins.

    (a)   (*1 point*) Describe what is meant by a bolt-on approach.

Marshall et al. proposes a risk analysis framework that requires a combination of quantitative and qualitative techniques.

    (b)   (*1 point*) Explain why quantitative techniques alone are insufficient when determining risk margins and must be supplemented by qualitative techniques.

    (c)   (*2 points*) Provide an example where qualitative techniques may be used in each of the following activities:

        (i)   Preparing the claims portfolio for analysis

        (ii)   Analyzing internal systemic risk

        (iii)   Analyzing external systemic risk

        (iv)   Determining correlation effects

7. (*4 points*)

    (a)   (*1.5 points*) Define the following terms associated with Table L in a retrospective rating plan:

        (i)   The entry ratio, r

        (ii)   The Table L charge, $\phi^*(r)$

        (iii)   The Table L savings, $\psi^*(r)$

The loss elimination ratio is 20%. A risk may have actual limited loss ratio 20%, 30%, 40%, 50% or 60%, each with equal probability.

    (b)   (*2.5 points*) Complete the following Table L for this risk:

r	$\phi^*(r)$	$\psi^*(r)$
0.00		
0.20		
0.40		
0.60		
0.80		
1.00		
1.20		
1.40		
1.60		
1.80		
2.00		

8. (*5 points*) Very Patient Reinsurance Company has been asked to price a property per risk excess treaty for accident year 2019 covering the layer 4,000,000 excess of 1,000,000.

You are given the following information:

- The following loss experience has been provided, evaluated as of 12/31/2017:

Accident Year	Untrended Loss
2015	1,100,000
2015	2,200,000
2016	900,000
2016	1,400,000
2017	800,000
2017	1,800,000

- All losses of at least 500,000 are shown.
- On level subject premium is 6,000,000 for each year from 2015-2017.
- Loss trend is 6% per year.
- The insured value of each property is 5,000,000.
- The following accident year development factors are applicable to losses in the layer 4,000,000 excess of 1,000,000:

12-Ultimate	1.50
24-Ultimate	1.20
36-Ultimate	1.00

(a) (*2 points*) Estimate the experience rating loss cost as a percentage of the subject premium.

(b) (*0.5 points*) Define free cover.

8.   **Continued**

The following exposure factors are considered appropriate for pricing this treaty:

Percent of Insured Value	Exposure Factor
10%	30%
20%	50%
30%	61%
40%	69%
50%	75%
60%	80%
70%	85%
80%	89%
90%	92%
100%	95%
110%	98%
120%	100%

(c)   (*2 points*) Calculate a suitable adjustment to the loss cost using these exposure factors to estimate the cost of free cover.

(d)   (*0.5 points*) Assess whether these exposure factors would be appropriate for pricing coverage on properties valued at 20 million.

END OF EXAMINATION

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