SOCIETY OF ACTUARIES
Introduction to Ratemaking & Reserving

Exam GIIRR

MORNING SESSION

Date: Wednesday, April 30, 2014
Time: 8:30 a.m. – 11:45 a.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has a total of 100 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 40 points).

   a) The morning session consists of 13 questions numbered 1 through 13.

   b) The afternoon session consists of 9 questions numbered 14 through 22.

   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 morning or afternoon session for Exam GIIRR.

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.

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Exam GIIRR-Front Cover

****BEGINNING OF EXAMINATION****
Morning Session

1. (*4 points*) No Name Insurance Company has written the following general liability policies:

Effective Date	Term	Premium
1/1/2012	Annual	5,000
4/1/2012	Annual	1,000
7/1/2012	6-month	500
10/1/2012	2-year	5,000
1/1/2013	Annual	2,000
7/1/2013	Annual	1,500

(a) (*3 points*) Calculate earned and written premium for calendar years 2012 and 2013. No Name does not treat multi-year policies as multiple annual policies.

(b) (*1 point*) Explain how the calculation of written and earned premium might be different if No Name Insurance Company wrote motorcycle policies in a winter climate instead of general liability policies.

2. (*7 points*) You are given the following information:

Accident Year	Reported Claims					Earned Premium
	12	24	36	48	60	
2009	140	280	336	356	363	605
2010	150	330	389	416		700
2011	120	240	288			525
2012	110	242				520
2013	130					500

Accident Year	Age-to-Age Development Factors			
	12-24	24-36	36-48	48-60
2009	2.00	1.20	1.06	1.02
2010	2.20	1.18	1.08	
2011	2.00	1.19		
2012	2.20			

- No development is expected after 60 months.
- Paid claims for accident year 2013 as of December 31, 2013 total 75.

(a) (*1 point*) Estimate the unpaid claims for accident year 2013 using the development method with simple all-year average development factors.

(b) (*0.5 point*) Calculate the accident year 2012 claims expected to be reported in 2014 using the development factors from part (a).

(c) (*0.5 point*) State the two primary assumptions of the development method.

(d) (*1 point*) Estimate the ultimate claims for accident year 2012 using the Bornhuetter Ferguson method with an expected claim ratio of 60%.

(e) (*0.5 point*) Describe two situations when the Bornhuetter Ferguson method may be preferable to the development method.

(f) (*1.5 point*) Compare actual reported claims to expected reported claims for accident year 2012 and comment on the reasonableness of the Bornhuetter Ferguson method.

2. Continued

You are monitoring the results given the following information:

Accident Year	Selected Ultimate Claims	Expected Percent Reported at Dec. 31, 2013	Reported Claims at Mar. 31, 2014	Actual versus Expected Reported Claims from Dec. 31, 2013 through Mar. 31, 2014		
				Actual	Expected	Difference
2009	363	100%	363	0	0.0	0.0
2010	428	98%	426	10	3.0	7.0
2011	312	92%	296	8	4.5	3.5
2012	314	77%	259	17	11.7	5.3
2013	320	37%	178			

(g) (*1 point*) Calculate the difference between the actual and expected reported claims from December 31, 2013 through March 31, 2014 for accident year 2013, using linear interpolation of the expected percent reported.

(h) (*1 point*) Identify two questions you might ask in your further investigation based on the results from part (g).

3. (*4 points*) You are given the following censored data:

Claim Range	Counts In Interval	Capped Claims
1,000,000 Limit Policies		
0 – 1,000,000	3,333	858,000,000
2,000,000 Limit Policies		
0 – 1,000,000	2,900	629,000,000
1,000,000 – 2,000,000	305	470,000,000
3,000,000 Limit Policies		
0 – 1,000,000	3,100	625,000,000
1,000,000 – 2,000,000	330	533,000,000
2,000,000 – 3,000,000	32	77,000,000

(a) (*2.5 points*) Calculate the increased limits factors for the 2,000,000 and 3,000,000 policy limits, assuming a 1,000,000 basic limit.

(b) (*0.5 point*) Determine the range into which a 4,000,000 increased limits factor should fall, considering consistency with the factors determined in part (a).

(c) (*0.5 point*) Explain why consistency is important for increased limits factors.

(d) (*0.5 point*) Explain why it is important to know whether claims have been capped or not in determining increased limits factors.

4. (*5 points*) You are given the following information as of December 31, 2013:

Accident Year	Incremental Closed Counts			Selected Ultimate Counts
	12	24	36	
2011	600	280	120	1,000
2012	660	308		1,100
2013	720			1,200
Selected Proportion of Closed Counts	**60%**	**70%**	**100%**	

Accident Year	Incremental Paid Claims		
	12	24	36
2011	774,000	1,535,000	1,839,000
2012	632,000	1,258,000	
2013	1,292,000		

- No development was observed or is expected after 36 months.
- Assume the annual severity trend is 3.5%.

(a) (*3 points*) Estimate total unpaid claims as of December 31, 2013 using the claims closure method.

(b) (*1 point*) Discuss how the following additional information would affect your estimate in part (a):

(i) New legislation lengthens the statute of limitations.

(ii) The company introduces a new system to accelerate claims processing and settlement.

(c) (*1 point*) Describe a situation in which a frequency and severity method is preferred to other projection methods.

5. (*4 points*) A fundamental relation connecting the insurance savings, $\psi(r)$, and the insurance charge, $\phi(r)$, in a retrospective rating plan is $\psi(r) = \phi(r) + r - 1$, where *r* is the entry ratio.

(a) (*1 point*) Describe the insurance savings and insurance charge.

(b) (*1 point*) Draw a graph with cumulative claim frequency along the x-axis and entry ratio along the y-axis, and identify the areas on the graph corresponding to $\psi(r)$ and $\phi(r)$.

(c) (*1 point*) Explain how the graph demonstrates the validity of the fundamental relation above.

(d) (*1 point*) Define $\psi(r)$ for the limiting case where losses are all equal.

6. (*5 points*) You are given the following two triangles:

Accident Year	Reported Claims Gross of Salvage – Personal Property			
	12	**24**	**36**	**48**
2010	500	950	1,055	1,066
2011	525	998	1,108	
2012	551	1,047		
2013	579			

Accident Year	Reported Salvage – Personal Property			
	12	**24**	**36**	**48**
2010	21	63	107	139
2011	22	66	112	
2012	23	69		
2013	35			

Assume a reported claims tail factor at 48 months of 1.00 and a reported salvage tail factor at 48 months of 1.15.

Estimate ultimate salvage for accident year 2013 using two different methods.

7. (*4 points*)

(a) (*1 point*) Provide two examples of expense items that are typically unallocated loss adjustment expenses (ULAE) and two examples of expense items that are typically allocated loss adjustment expenses (ALAE).

Simple Insurance Company plans to use the data in the table below to estimate unpaid ULAE as of December 31, 2013.

Calendar Year	Paid Claims	Reported Claims	Paid ULAE
2011	1,200	1,300	110
2012	1,100	1,100	110
2013	1,000	900	110
Total	3,300	3,300	330

- The total of case estimates as of December 31, 2013 is 900.
- The total IBNR as of December 31, 2013 is 1,000.

(b) (*1 point*) Explain one weakness of the classical paid-to-paid ULAE estimation method using the data from the table above.

(c) (*1 point*) Estimate unpaid ULAE as of December 31, 2013 for Simple Insurance Company using the Kittel refinement to the classical paid-to-paid method.

(d) (*1 point*) Explain the major steps in determining unpaid ULAE using a count-based method.

8. (*4 points*) Sinking Sand Insurance Company (SSIC) currently has four portfolios of policies with catastrophe exposure. A recent run of its catastrophe model has produced the following table of possible catastrophe losses in one year. The following statements apply to the model output:

- The six events listed are the only events produced by the model that have catastrophe losses for at least one of the portfolios.
- The events are mutually exclusive. At most one of them can happen in a given year.

Event Number	Probability	Possible Catastrophe Losses in Millions			
		Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4
1	0.003	100	100	400	0
2	0.003	50	100	0	0
3	0.002	100	200	0	0
4	0.002	100	50	0	0
5	0.001	100	100	0	700
6	0.001	50	50	0	0

SSIC's policy is that the probability that total losses in one year on the four portfolios exceed 250 (million) must be less than or equal to 0.005.

To meet its policy goal SSIC is considering dropping one of the portfolios. The following results were obtained from an analysis that omits each of Portfolios 3 and 4.

Measure	With Portfolio 3 Removed	With Portfolio 4 Removed
Expected Value	2.95	3.45
Standard Deviation	34.98	37.56
Probability total losses > 250	0.003	0.005

(a) (*0.5 point*) Show that the two probabilities that total losses exceed 250 were correctly calculated.

(b) (*2 points*) Recommend which of the two portfolios should be dropped. Justify your choice.

(c) (*1.5 points*) Describe each of the following special issues regarding portfolio risk. For each issue, indicate if it is addressed by the analysis performed in part (b) and then support your answer.

(i) Data quality
(ii) Uncertainty modeling
(iii) Impact of correlation

9. (*5 points*)

(a) (*0.5 point*) Define retroactive date for policies written on a claims-made basis.

(b) (*0.5 point*) Give an example of an insurance product for which claims-made coverage is prevalent ***and*** explain why this type of coverage is appropriate for that type of risk.

(c) (*1 point*) Compare claims-made and occurrence coverage on the following features:

(i) Cost, given that the underlying frequency and severity are increasing

(ii) Precision in pricing, given sudden unpredictable changes in trend or reporting pattern

(iii) Opportunity to earn investment income

(d) (*1 point*) Explain how coverage gaps can occur for insureds purchasing claims-made coverage by providing two examples.

(e) (*2 points*) Calculate the tail factor for a mature claims-made policy given a pure premium of 1,000 for occurrence coverage, a 10% annual pure premium trend, and a claims reporting pattern of 50%, 30%, 20%.

10. (*4 points*) In conducting investigative analysis for XYZ Insurer, you noted a significant change in case reserve estimates. The following information is provided:

Accident Year	Average Case Estimates		
	12	**24**	**36**
2011	5,010	5,890	8,940
2012	5,260	8,450	
2013	7,200		

Accident Year	Open Counts		
	12	**24**	**36**
2011	210	175	70
2012	240	190	
2013	250		

Accident Year	Paid Claims		
	12	**24**	**36**
2011	610,000	1,840,000	3,250,000
2012	530,000	1,640,000	
2013	570,000		

- Assume the annual severity trend for XYZ Insurer is 5%.
- Use simple average age-to-age development factors and the Bondy method for the tail factor.

(a) (*3 points*) Calculate the projected ultimate claims using the Berquist-Sherman method for XYZ Insurer.

Your analysis of XYZ Insurer has shown that there has also been a change in settlement rates.

(b) (*1 point*) Explain how you create the reported claims triangle with the Berquist-Sherman adjustments for changes in both case estimates and settlement rates.

11. (*5 points*) You are given the following information for a line of business where you are projecting ultimate claims:

Accident Year	Earned Exposures	Reported Claims as of Dec. 31, 2013
2011	5,580	702,000
2012	5,670	545,000
2013	5,460	515,000

Development Period	Age-to-Age Development Factor
12-24	1.50
24-36	1.28
36-48	1.13
48-60	1.04
Tail factor	1.02

- You select an annual frequency trend of 2.2%.
- You select an annual severity trend of 4.5%.

(a) (*4 points*) Estimate the ultimate claims for this line of business using the Cape Cod method.

(b) (*1 point*) Identify the three key components of the actuarial control cycle and illustrate with the selection and use of trend rates in reserving and ratemaking.

12. (*5 points*) You are reviewing Specific Insurance Company's estimates of ultimate claims for two books of business where conditions have been changing.

Book of business 1: Volume has remained relatively stable but the underlying claims have been deteriorating over the past ten years.

Book of business 2: Volume and claim experience have remained steady and there has been a strengthening of case estimates.

(a) (*2.5 points*) Explain whether you expect the estimate of ultimate claims to understate, overstate or be similar to actual ultimate claims for book of business 1, for the following methods:

(i) The expected method

(ii) The development method on reported claims

(iii) The Bornhuetter Ferguson method on reported claims

(b) (*2.5 points*) Explain whether you expect the estimate of ultimate claims to understate, overstate or be similar to actual ultimate claims for book of business 2, for the following methods:

(i) The expected method

(ii) The development method on reported claims

(iii) The Bornhuetter Ferguson method on reported claims

13. (*4 points*) You are estimating on-level factors for a book of business that only has annual policies with the following historical rate changes:

Effective Date of Rate Change	Rate Change Percent
July 1, 2011	+7%
April 1, 2013	–3%

In addition, a new discount of 10% was implemented on May 1, 2012 that applied to 20% of all policies and did not affect the level of insurance coverage.

(a) (*0.5 point*) State the key assumption that underlies the parallelogram method.

(b) (*3 points*) Calculate the on-level factor to be used to adjust calendar year 2011 earned premium to current rates.

(c) (*0.5 point*) Explain how you would recognize a state-mandated change in minimum policy limits in the on-level calculation.

****END OF EXAMINATION****
Morning Session

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