SOCIETY OF ACTUARIES
Introduction to Ratemaking & Reserving

Exam GIIRR

AFTERNOON SESSION

Date: Wednesday, November 1, 2017
Time: 1:30 p.m. – 3:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 8 questions numbered 13 through 20 for a total of 40 points. 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 since 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.

Printed in the U.S.A.
Exam GIIRR-Front Cover

****BEGINNING OF EXAMINATION****
Afternoon Session
Beginning with Question 13

13. (*5 points*)

(a) (*1.5 points*) Explain three ways a development triangle can be useful in investigative testing.

(b) (*1.5 points*) Explain the value of each of the following additional investigative tests in analyzing claims data:

(i) Ratio of closed counts to reported counts

(ii) Ratio of counts closed with no payment to closed counts

(iii) Average case estimates

You are analyzing claims data for a line of business and are given the following triangles:

Accident Year	Ratios of Paid to Reported Claims			
	12	24	36	48
2013	0.11	0.18	0.28	0.40
2014	0.14	0.27	0.37	
2015	0.16	0.24		
2016	0.18			

Accident Year	Average Reported Claims			
	12	24	36	48
2013	5,200	6,300	7,400	9,400
2014	3,700	4,800	6,600	
2015	3,900	5,800		
2016	7,100			

(c) (*1 point*) Identify two anomalies in the ratio of paid claims to reported claims triangle that might require further investigation.

(d) (*1 point*) Identify two anomalies in the average reported claims triangle that might require further investigation.

14. (*5 points*) You are conducting a ratemaking analysis for a homeowners line of business and are given the following information:

Accident Year	Earned Exposures	Trended Earned Premium at Current Rates	Total Ultimate Claims
2012	7,800	7,920,000	4,910,000
2013	8,100	8,220,000	5,060,000
2014	8,300	8,430,000	7,940,000
2015	8,500	8,630,000	5,930,000
2016	8,600	8,730,000	5,780,000
Total	**41,300**	**41,930,000**	**29,620,000**

- The total ultimate claims include claims of 2,350,000 from a major ice storm that occurred on March 1, 2014.
- The ice storm is considered an unusual event that you expect to occur once every 10 years.
- The annual severity trend is 4%.
- The annual frequency trend is –1%.
- Rates will be effective November 1, 2017 for one year.
- All policies are written for 6-month policy terms and are written and earned evenly throughout the year.

(a) (*2.5 points*) Calculate a loading for ice storm claims to use in your ratemaking analysis.

You are given the following additional information:

- Unallocated loss adjustment expenses are 8% of claims.
- The fixed expenses to premium ratio is 4%.
- The variable expenses to premium ratio is 19%.
- The profit and contingencies to premium ratio is 5%.

(b) (*2.5 points*) Calculate the indicated rate level change based on the latest three years' experience.

15. (*4 points*) In the 2011 Public Policy Monograph titled "On Risk Classification", the American Academy of Actuaries identifies three success criteria for an insurance system that is "intended to serve the needs of a broad at-risk group over a long time horizon".

One of the three criteria states that the security system will have access to sufficient resources to fulfill its policy obligations.

(a) (*0.5 points*) Describe how an effective risk classification system can assist an insurance system in achieving the criterion noted above.

(b) (*1.5 points*) Define distributional bias in the context of risk classification systems, including a numerical example with a 2×2 risk classification matrix.

(c) (*1.5 points*) Define dependence in the context of risk classification systems, including a numerical example with a 2×2 risk classification matrix.

(d) (*0.5 points*) Describe an approach that can be used to resolve:

(i) Distributional bias in the context of risk classification systems

(ii) Dependence in the context of risk classification systems

16. (*6 points*) A university group, comprised of three schools, self-insures their workers compensation coverage. The funding level and allocation to each school is determined using an experience rating program.

(a) (*0.5 points*) State two reasons why a group of schools might want to self-insure their risk.

(b) (*1 point*) Provide an example of an experience rating program objective that might conflict with each of the following objectives of a self-insurance program:

(i) Stability in the allocations from year-to-year

(ii) An allocation formula that is simple to apply and easy to understand

You are analyzing claims experience by school to recommend next year's allocation of premium to each school. Next year's allocation is based on experience rating using payroll as the exposure input to the analysis. You are given the following information:

School	Payroll (000)	% of Total			
		Payroll	Limited Claims Last 3 years	Limited Claims Last 5 years	Claim Counts
X	8,080	20%	30%	30%	22%
Y	10,100	25%	35%	30%	22%
Z	22,220	55%	35%	40%	56%
Total	**40,400**	**100%**	**100%**	**100%**	**100%**

Experience modification factors are calculated for each school in the self-insurance program using the following three approaches:

- Limited claims last 3 years
- Limited claims last 5 years
- Claim counts

(c) (*1 point*) Explain which approach would result in an allocation that would satisfy each of the following objectives of the self-insurance program:

(i) Stability of year-to-year allocation

(ii) Encourage the schools to participate in risk control activities

16. Continued

The standard for full credibility is 40,000,000 of payroll, with partial credibility given by the square root rule.

(d) (*2 points*) Calculate next year's allocation using the allocation base from part (c)(i).

The group has decided that actual claims should never be assigned a credibility of less than 0.50 for any school.

(e) (*1.5 points*) Explain how the allocation for School X is affected by this change in credibility.

17. (*5 points*) You are estimating ultimate claims using the development method. You have displayed the data in a development triangle and calculated age-to-age development factors.

(a) (*1 point*) List the next five steps of the development method.

You are considering various methods for estimating tail factors.

(b) (*1.5 points*) Explain one advantage and one disadvantage for each of the following approaches:

(i) Bondy method

(ii) Algebraic method

(iii) Use of benchmark data

You are estimating unpaid claims for a growing line of business that started in 2013 and are given the following information:

Accident Year	Cumulative Reported Claims (000)	
	12	24
2013	140	260
2014	230	395
2015	300	520

You decide to recommend a 12-to-24 month development factor based on one of the following averages:

- Simple all-years average
- Volume-weighted average

(c) (*1 point*) Recommend a development factor and justify your recommendation.

A colleague recommends also considering a medial average for the development factor recommendation in part (c).

(d) (*0.5 points*) Describe one disadvantage of using a medial average for your development factor recommendation in part (c).

17. Continued

Ultimate claims as of December 31, 2016 were determined from the development method. You are monitoring emerging results and are provided with the following information:

Accident Year	Actual Versus Expected Claims from December 31, 2016 to March 31, 2017 (000)			
	Expected Reported Claims	Actual Reported Claims	Expected Paid Claims	Actual Paid Claims
2013	4	2	3	1
2014	15	12	11	8
2015	39	30	32	24
2016	79	62	64	53

(e) (*1 point*) Describe two likely explanations for the differences between the expected and actual claims in this situation.

18. (*4 points*) You are estimating premium liabilities as of December 31, 2016 and are given the following information:

- Gross unearned premiums are 15,000.
- There is a 30% quota share reinsurance treaty.
- Policy year 2016 gross expected claims ratio (including ALAE) as of January 1, 2016, from company's Business Plan was 70%.
- Policy year 2016 gross indicated claims ratio (including ALAE) evaluated as of December 31, 2016 is 72.5% due to an unusual large loss in April 2016 which is not likely to reoccur.
- The ULAE ratio is 9.1%.
- Commissions of 15% of premiums have already been paid. There are no incentive commissions.
- Maintenance expenses are 8% of gross unearned premiums.
- A rate decrease of 5% will be effective January 1 2017.

(a) (*3 points*) Calculate the net premium liabilities as of December 31, 2016.

(b) (*0.5 points*) Determine either the premium deficiency reserve or the equity in the unearned premium as of December 31, 2016 and label accordingly.

(c) (*0.5 points*) State the purpose of a premium deficiency reserve.

THIS PAGE INTENTIONALLY LEFT BLANK

19. (*5 points*)

(a) (*1 point*) Define the following terms:

(i) trigger for coverage

(ii) retroactive date

(iii) extended reporting endorsement

(iv) prior acts coverage

Assume that C_{ij} represents ultimate claims with *i* equal to the accident year lag and *j* equal to the report year.

Accident Year Lag by Report Year Matrix							
Accident Year Lag	**Report Year**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
0	$C_{0,1}$	$C_{0,2}$	$C_{0,3}$	$C_{0,4}$	$C_{0,5}$	$C_{0,6}$	$C_{0,7}$
1	$C_{1,1}$	$C_{1,2}$	$C_{1,3}$	$C_{1,4}$	$C_{1,5}$	$C_{1,6}$	$C_{1,7}$
2	$C_{2,1}$	$C_{2,2}$	$C_{2,3}$	$C_{2,4}$	$C_{2,5}$	$C_{2,6}$	$C_{2,7}$
3	$C_{3,1}$	$C_{3,2}$	$C_{3,3}$	$C_{3,4}$	$C_{3,5}$	$C_{3,6}$	$C_{3,7}$
4+	$C_{4+,1}$	$C_{4+,2}$	$C_{4+,3}$	$C_{4+,4}$	$C_{4+,5}$	$C_{4+,6}$	$C_{4+,7}$

(b) (*2 points*) State a formula for pure premium using notation underlying the C_{ij} cells in the table above for each of the following items:

(i) Occurrence policy for year 1

(ii) Third-year claims-made policy for year 3 with retroactive date January 1, year 3

(iii) Mature claims-made policy for report year 3

(iv) Extended reporting endorsement for mature claims-made policy effective January 1, year 2 terminating December 31, year 2

19. Continued

(c) (*2 points*) Identify the coverage gap for the following situations:

(i) First-year claims-made policy effective January 1, year 1 and second-year claims-made policy effective January 1, year 4

(ii) Occurrence policy effective January 1, year 1 and mature claims-made policy effective January 1, year 6

20. (*6 points*) You are adjusting historical premiums to current rate levels.

(a) (*1 point*) Identify two key requirements for an insurer to be able to use the extension of exposures method.

(b) (*0.5 points*) Explain why the extension of exposures method is less valuable for commercial lines that apply experience rating and/or schedule rating.

(c) (*0.5 points*) Explain how the extension of exposures method could be applied to commercial lines that apply experience rating and/or schedule rating.

You have determined that the extension of exposures method is not appropriate for XYZ Insurer and are given the following information:

Effective Date of Rate Change	% Rate Change
April 1, 2014	8%
July 1, 2015	–10%
July 1, 2017	8%

- Premiums are written and earned evenly throughout the year.
- All policies are written for 24-month policy terms.
- There were no rate changes prior to 2014.
- Each rate change applies to all policies written on or after the effective date of the rate change.

(d) (*1.5 points*) Calculate the weighted average rate level value for calendar year 2014.

(e) (*2.5 points*) Calculate the premium on-level factor for 2014 for the purpose of:

(i) Projecting ultimate claims as of December 31, 2017

(ii) Ratemaking analysis

****END OF EXAMINATION****
Afternoon Session

USE THIS PAGE FOR YOUR SCRATCH WORK

USE THIS PAGE FOR YOUR SCRATCH WORK