SOCIETY OF ACTUARIES
Introduction to Ratemaking & Reserving

Exam GIIRR

MORNING SESSION

Date: Wednesday, April 26, 2017
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 12 questions numbered 1 through 12.

   b) The afternoon session consists of 7 questions numbered 13 through 19.

   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.

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Exam GIIRR-Front Cover

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

1. (*4 points*) You are analyzing the following 12-month policies:

- Policy #1 was originally written on April 1, 2013 for a premium of 750, was renewed each year, and was still in force on December 31, 2016.
- Policy #2 was originally written on July 1, 2014 for a premium of 1,000, was renewed on July 1, 2015, and was cancelled on April 1, 2016.

There was a premium level increase of 4% effective May 1, 2015 for each policy upon its renewal. All rating characteristics remained the same for each policy at each renewal.

(a) (*0.5 points*) Calculate the 2015 calendar year total written premiums.

(b) (*1.5 points*) Calculate the 2015 and 2016 calendar year total earned premiums.

(c) (*1 point*) Calculate the total unearned premiums as of December 31, 2015.

(d) (*0.5 points*) Calculate the 2015 total earned premiums adjusted to the current rate level.

Prior to entering into this business, the company had considered selling all policies as 6-month terms with the 6-month premiums being 50% of the annual premiums for each policy.

(e) (*0.5 points*) Calculate the inforce premium as of December 1, 2015 for each of these two 6-month policies.

2. (*6 points*) You are given the following information:

Accident Year	Reported Claims (000)					
	12	24	36	48	60	72
2010	1,500	2,550	3,060	3,213	3,245	3,245
2011	1,200	2,040	2,468	2,592	2,618	2,618
2012	1,300	2,340	2,785	2,924	2,953	
2013	1,200	2,160	2,592	2,722		
2014	1,300	2,340	2,808			
2015	1,300	2,600				
2016	1,400					

Accident Year	Age-to-Age-Development Factors				
	12-24	24-36	36-48	48-60	60-72
2010	1.70	1.20	1.05	1.01	1.00
2011	1.70	1.21	1.05	1.01	1.00
2012	1.80	1.19	1.05	1.01	
2013	1.80	1.20	1.05		
2014	1.80	1.20			
2015	2.00				

Accident Year	Earned Premiums (000)	A Priori Expected Claims (000)	A Priori Claims Ratio
2013	4,160	2,706	65%
2014	4,440	2,885	65%
2015	4,570	2,970	65%
2016	4,710	3,060	65%

- There is no development beyond 60 months.
- Accident year 2015 includes an unusual large claim of 260,000. The claim was reported at 15 months and settled at 21 months.
- The a priori claims ratios were estimated by a pricing actuary in 2015.

2. Continued

(a) (*3.5 points*) Calculate projected ultimate claims for accident years 2015 and 2016 using the following methods:

(i) Development method

(ii) Bornhuetter Ferguson method

(iii) Benktander method, one iteration

(b) (*0.5 points*) Recommend an estimate of ultimate claims for each of accident years 2015 and 2016 and justify your recommendation.

(c) (*0.5 points*) Calculate accident year 2015 and 2016 IBNR reserves as of December 31, 2016 using your recommendations from part (b).

You are the reserving actuary and company management has recommended using the a priori claims ratio from pricing to record accident year 2015 and 2016 IBNR reserves as of December 31, 2016.

(d) (*1 point*) Critique management's recommendation.

(e) (*0.5 points*) Calculate the accident year 2016 expected reported claims from December 31, 2016 to March 31, 2017 using your recommendations from part (b) and linear interpolation.

3. (*5 points*)

(a) (*1 point*) State two primary approaches used to determine deductible factors for ratemaking.

(b) (*1.5 points*) Provide an example demonstrating how average severity can *increase* when deductibles are increased.

(c) (*1.5 points*) Provide an example demonstrating how average severity can *decrease* when deductibles are increased.

(d) (*1 point*) Explain how order of operation in applying deductibles and policy limits could produce different claims for the insurer.

4. (*5 points*) You are estimating ultimate claims using the frequency-severity closure method.

(a) (*1 point*) Describe two approaches that could be used to deal with high and volatile claims in later maturity ages when analyzing incremental paid severity.

(b) (*1 point*) Identify two decisions that need to be made with respect to the type of counts to be used.

You are given the following table of incremental closed counts and selected ultimate counts.

Accident Year	Incremental Closed Counts					Selected Ultimate Counts
	12	24	36	48	60	
2012	1,640	750	300	130	50	2,870
2013	1,760	760	320	140		3,030
2014	1,370	590	250			2,350
2015	1,290	570				2,230
2016	1,320					2,270

(c) (*2 points*) Calculate the proportion of closed counts at each maturity for accident year 2012.

(d) (*1 point*) Calculate the projected incremental closed counts at each duration for accident year 2016, using the ratios calculated in part (c).

5. (*6 points*) You work as a pricing actuary for Green State Protection (GSP), an insurer specializing in homeowners coverage in the state of Colorado. GSP would like to vary rates in the state of Colorado based on the physical location of the insured properties.

(a) (*0.5 points*) Describe why an actuary might use location as a risk characteristic for ratemaking purposes.

(b) (*0.5 points*) Describe two practical considerations for creating territorial boundaries for establishing insurance rates.

You are given the following information:

Territory	Calendar Year 2016 Exposures	Weighted Average Trended Ultimate Pure Premium	Credibility	Industry Relativity used for Compliment of Credibility
Western (W)	5,000	150	25%	0.6
Eastern (E)	20,000	250	80%	1.2

(c) (*2 points*) Calculate the indicated territory relativity for the Eastern territory relative to the Western territory using the pure premium approach.

The average household income is considerably higher in the territory with the lower rate.

(d) (*0.5 points*) Describe how social adequacy is different from equity in developing a risk classification system.

GSP has noticed claim experience varies greatly depending on the type of roofing material on the property and would like to include roofing material as a rating variable. A preliminary analysis indicates roofing material may not be independent with territory.

(e) (*1.5 points*) Explain three alternative procedures to incorporate this new variable into the analysis, including a consideration of how each procedure deals with the dependence.

Weather related claims have increased in recent years. Wind-hail claims continually increase in the Eastern territory and several large wildfires have resulted in increased property claims state-wide. While wildfire claims do not occur each year, you believe these catastrophes are happening with a greater frequency.

(f) (*1 point*) Explain how you would reflect a potential higher frequency in prospective rates.

6. (*5 points*) You are estimating ultimate claims for a products liability line of business, and are given the following information evaluated as of December 31, 2016:

Accident Year	Earned Premiums	Paid Claims	Paid Cumulative Development Factors
2014	25,000	6,700	2.600
2015	26,000	5,300	3.500
2016	27,000	2,100	9.000

- All policies are annual and they are written and earned evenly throughout the year.
- A rate decrease of 5% was effective January 1, 2015.
- Tort reform resulted in an estimated claim decrease of 10% for all accidents on or after January 1, 2015.
- Annual claim trend is 3%.
- You have identified considerable volatility in the development pattern.

(a) (*4 points*) Calculate the projected ultimate claims for all accident years using the Cape Cod method.

You are considering using the Generalized Cape Cod method to derive another projection of ultimate claims.

(b) (*1 point*) Select a decay rate and justify your selection.

7. (*4 points*) Your company, EB General Insurance, has just hired a new CFO who has no previous experience with the general insurance industry. The new CFO has made the following four statements:

(i) The reinsurers should rely on the case estimates provided by EB General Insurance.

(ii) The case estimates for automobile liability tend to increase over time and case estimates for automobile physical damage tend to decrease over time. Therefore, the modeling of estimates can be simplified by aggregating these coverages and assuming the increases and decreases will offset.

(iii) Large corporate clients are more effective at managing risk, and therefore more likely to self-insure and less likely to purchase insurance from EB General Insurance.

(iv) EB General Insurance should rely on software programs to project ultimate claims based on the appropriate actuarial methodology.

Provide *either* one argument for, *or* one argument against each statement the CFO has made.

8. (*5 points*) You are estimating unpaid unallocated loss adjustment expenses (ULAE) as of December 31, 2016 using the Wendy Johnson count-based method.

You are given the following information:

Historical ULAE				
Calendar Year	Paid ULAE (000)	Counts		
		Newly Reported	Open	Closed
2014	185	116	105	132
2015	187	108	92	121
2016	163	111	83	120

Projected ULAE		
Calendar Year	Counts	
	Newly Reported	Closed
2017	16	55
2018	5	29
2019	-	20

(a) (*1 point*) Calculate the projected open counts for calendar years 2017, 2018, and 2019.

You are given the following additional information:

- The past annual claim trend rate through 2016 is 0%.
- The future annual claim trend rate after 2016 is 2%.

Selected weights for the three different types of claim counts:

Newly reported counts	30%
Open counts	50%
Closed counts	20%

(b) (*4 points*) Estimate the unpaid ULAE as of December 31, 2016 using a simple three-year average of historical experience.

9. (*6 points*) You are considering using a new type of exposure base in your actuarial work relating to auto liability coverage. The new exposure base has the following characteristics:

(i) It is based on self-evaluations,

(ii) The evaluations are mailed in by the insureds along with application,

(iii) It is not currently used in industry, and

(iv) It is well correlated with the risk being insured.

(a) (*2 points*) Evaluate the appropriateness of this new exposure base.

You are estimating ultimate claims using the expected method.

(b) (*1 point*) Identify three situations where the expected method is frequently used for projecting ultimate claims.

You are given the following information about Auto Liability Company (ALC), which has been selling automobile insurance for five years:

- All policies are annual policies and are issued on January 1 of each year.
- For 2012, the earned premium is 40,000,000 and earned vehicles are 150,000.
- Tort reform was instituted on January 1, 2013, resulting in a reduction in severity of 25%.
- ALC introduced a 20% discount on January 1, 2014 that is applicable to 30% of its customers.
- The selected expected claim ratio is 80% at the 2016 cost and rate level.
- The selected pure premium is 200 at the 2016 cost level.
- The annual pure premium trend is 2.0%.
- ALC has had no rate changes in the past five years**.**

(c) (*3 points*) Calculate the expected claims for 2012 using the expected method with the following approaches:

(i) Claim ratio

(ii) Pure premium

10. (*5 points*)

(a) (*2 points*) Describe the following:

(i) Claims-made policy

(ii) Occurrence policy

(iii) Tail policy

(iv) Nose coverage

(b) (*1 point*) Explain two scenarios where claims-made policies are preferable over occurrence policies for insurers.

(c) (*0.5 points*) Describe the risk of reserve inadequacy for claims-made policies relative to occurrence policies.

A physician has a mature medical malpractice claims-made policy in place from January 1, 2017 to December 31, 2017 and is considering two options for 2018.

Policy A: Mature claims-made policy: January 1, 2018 to December 31, 2018

Policy B: Occurrence policy: January 1, 2018 to December 31, 2018

(d) (*0.5 points*) Describe which policy is likely to cost more and under what condition.

Explain the coverage provided by each of the policies A and B for the following incidents:

(e) (*0.5 points*) An incident occurring on November 7, 2017, reported on August 12, 2019.

(f) (*0.5 points*) An incident occurring on June 16, 2018, reported on October 28, 2019.

11. (*5 points*) You are conducting a ratemaking analysis and are given the following information:

Calendar Year	Amounts in Thousands				
	Earned Exposures	**Direct Written Premiums**	**Direct Earned Premiums**	**Total Commission Expenses and Premium Taxes**	**General Expenses**
2014	20.0	10,400	10,200	1,352	1,530
2015	21.0	10,800	10,600	1,318	1,547
2016	22.8	11,400	11,200	1,312	1,710

- 30% of general expenses are fixed expenses.
- Unallocated loss adjustment expenses have been 9% of claims for each of the past three years, and are expected to drop to 8% for the next five years due to a system update that will cost 960,000 to implement.
- The number of insureds in the future rating period is projected to be 24,000.
- The expected annual claim cost per insured for the future rating period is 1,000.
- The profit provision is 5% of premium.

(a) (*1.5 points*) Calculate the total variable expense ratio for each calendar year.

(b) (*1 point*) Recommend the total variable expense ratio to use in ratemaking. Justify your recommendation.

(c) (*1.5 points*) Recommend the fixed expense per exposure to use in ratemaking. Justify your recommendation.

(d) (*0.5 points*) Calculate the indicated rate.

Your company allocates ULAE to each line of business based on counts.

(e) (*0.5 points*) Explain why allocating ULAE based on counts may not be appropriate for pricing purposes.

12. (*4 points*) You are conducting diagnostic tests for changing levels of case reserve adequacy. As part of your investigations into IBNR reserves, you are given the following information:

Accident Year	Reported Claims		
	12	24	36
2014	51,800	72,300	102,500
2015	55,700	98,800	
2016	88,300		

Accident Year	Paid Claims		
	12	24	36
2014	31,800	52,000	82,500
2015	34,000	55,700	
2016	36,400		

Accident Year	Reported Counts		
	12	24	36
2014	800	1,030	1,250
2015	830	1,070	
2016	850		

Accident Year	Closed Counts		
	12	24	36
2014	600	840	1,150
2015	620	880	
2016	640		

- The annual severity trend is 4%.
- There is no development after 36 months.

(a) (*1 point*) Calculate the average case estimate triangle.

(b) (*0.5 points*) Explain why the triangle in part (a) indicates reducing, increasing or stable case reserve adequacy.

(c) (*2.5 points*) Calculate ultimate claims for all accident years using the reported development method, with a Berquist-Sherman adjustment.

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

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