SOCIETY OF ACTUARIES
Introduction to Ratemaking & Reserving

Exam GIIRR

AFTERNOON SESSION

Date: Wednesday, November 2, 2016
Time: 1:30 p.m. – 3:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 8 questions numbered 12 through 19 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.

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Exam GIIRR-Front Cover

****BEGINNING OF EXAMINATION****
Afternoon Session
Beginning with Question 12

12. (*4 points*) You are investigating data for ABC Auto Insurers and have been given the following information:

Calendar Year (CY)	Earned Vehicles	Earned Premiums (000)	Premium On-Level Factor to CY 2015
2010	60,700	17,250	1.070
2011	60,900	17,500	1.050
2012	64,800	18,900	1.036
2013	61,100	18,900	1.023
2014	61,300	19,200	1.010
2015	63,600	20,100	1.000

(a) (*0.5 points*) Identify two possible anomalies related to earned vehicles.

(b) (*1 point*) Provide a likely explanation for each anomaly identified in part (a).

(c) (*1 point*) Calculate the average on-level earned premiums for each calendar year.

(d) (*0.5 points*) Identify a possible anomaly related to the average on-level earned premiums calculated in part (c).

(e) (*1 point*) Provide two likely explanations for the anomaly identified in part (d).

13. (*5 points*) Your company is forecasting future experience for a line of business for planning purposes and you are given the following information:

Calendar Year	Forecasted Earned Exposures
2016	6,500
2017	6,630
2018	6,760

Selected claim frequency at 2015 level	8.0%
Selected claim severity at 2015 level	17,000
ULAE ratio as a percent of claims	5%
Annual frequency trend	–1%
Annual severity trend	7%
2015 average earned premium at current rate level	1,900
Annual premium trend	2%
Fixed expense per exposure	60
Annual fixed expense trend	0%
Variable expense ratio as a percent of premium	12%

The base forecast scenario assumes no rate changes over the 2016-2018 forecast period.

(a) (*1 point*) Explain whether an increase or decrease in profit for this line of business should be expected over the next three years under the base scenario.

(b) (*3.5 points*) Calculate the forecasted profit for calendar year 2018.

(c) (*0.5 points*) State two actions the company can take in order to increase profits in 2018.

14. (*4 points*) You are estimating ultimate claims using the development-based frequency-severity method and are given the following information:

Accident Year	Projected Ultimate Severity based on Development Method
2011	7,800
2012	8,400
2013	8,900
2014	9,200
2015	8,500

- The annual severity trend is 5%.
- Accident year 2014 ultimate counts are 1,300.
- Accident year 2015 ultimate counts are 1,200.

(a) (*2 points*) Estimate the ultimate claims for accident years 2014 and 2015.

(b) (*0.5 points*) Explain why the frequency-severity method may not provide an appropriate selection of ultimate claims for accident years 2011 through 2013.

You are monitoring the results given the following information:

Accident Year	Reported Claims as of Dec. 31, 2015	Reported Claims as of Mar. 31, 2016	Expected % Reported as of Dec. 31, 2015
2014			87%
2015	9,500,000	9,800,000	77%

(c) (*1 point*) Calculate the difference between the actual and expected reported claims from December 31, 2015 through March 31, 2016 for accident year 2015, using linear interpolation.

(d) (*0.5 points*) Describe what the answer to part (c) implies about the selection of the development-based frequency-severity method as the basis for the estimate of ultimate claims.

15. (*8 points*)

(a) (*0.5 points*) State one weakness of the Benktander method.

(b) (*1 point*) Explain the challenge reinsurers face when using the Cape Cod method to estimate ultimate claims.

(c) (*0.5 points*) Describe two situations where Berquist-Sherman adjustments are most commonly implemented.

You are the reserving actuary at BJX Insurance Company and you have prepared the following estimates of ultimate claims as of December 31, 2015.

Estimated Ultimate Claims (000)				
Accident Year	**Development Method**		**Bornhuetter Ferguson Method**	
	Reported	**Paid**	**Reported**	**Paid**
	(A)	**(B)**	**(C)**	**(D)**
2010	***544***	***430***	***534***	***430***
2011	***456***	***451***	***455***	***451***
2012	481	474	479	474
2013	591	575	557	508
2014	678	643	585	527
2015	***776***	***717***	***605***	***550***
Total	**3,526**	**3,290**	**3,215**	**2,940**

Estimated Ultimate Claims (000)				
Accident Year	**Benktander Method (one iteration)**		**Cape Cod Method**	
	Reported	**Paid**	**Reported**	**Paid**
	(E)	**(F)**	**(G)**	**(H)**
2010	***534***	***430***	***538***	***432***
2011	***456***	***451***	***461***	***454***
2012	480	474	489	480
2013	579	517	576	516
2014	622	532	618	537
2015	***648***	***552***	***648***	***561***
Total	**3,319**	**2,956**	**3,330**	**2,980**

15. Continued

Your estimates reflect the following assumptions:

- Growth has been steady.
- The a priori expected claim ratio is constant for all accident years.
- Development factor selections are based on a simple 3-year average with one exception: accident year 2010 reported data is excluded from the averages due to one large reported claim.

In addition, you are presented with the following changing conditions:

- A large claim occurred in March, 2010. The claim was reported immediately and a case reserve for the full policy limit was established and remains unpaid as of December 31, 2015.
- During the first six months of 2011 claim payments were accelerated due to implementation of a new claim processing system.
- A new head of the claim department was hired in June, 2013. She has been encouraging claim staff to set more conservative case reserve estimates since her arrival.
- Accident year claim experience has been deteriorating from 2013 to 2015.

Recognizing that some methods produce better results than others under certain circumstances, you choose one result for each accident year for your final selections. A method may be selected for more than one accident year.

(d) (*6 points*) Provide the following for accident years 2010, 2011 and 2015 separately:

(i) The column letter from the table above that corresponds to your selection of ultimate claims, and

(ii) Justification for your selection.

16. (*4 points*) You are conducting a ratemaking analysis for a portfolio of automobile insurance policies.

(a) (*1 point*) Identify two sources of data that an insurer can use in determining expenses for ratemaking.

(b) (*1 point*) Describe when it is appropriate to use each source identified in part (a).

You are given the following information:

Experience Period (semi-annual)	Fixed Expenses	Trended Earned Premiums at Current Rate Level
2015-1	110,000	1,692,000
2015-2	125,000	1,667,000
2016-1	119,000	1,750,000
2016-2	122,000	1,768,000

- All rates are effective between April 1, 2017 and March 31, 2018.
- All policies are annual and they are written and earned evenly through the year.
- The annual trend rate for fixed expenses is 1.25%.

(c) (*2 points*) Recommend a fixed expense ratio as a percentage of premiums to be used for ratemaking purposes. Justify your recommendation.

17. (*5 points*) Grossi and Kunreuther define epistemic uncertainty as "the uncertainty due to lack of information or knowledge of the hazard." Two ways of reducing epistemic uncertainty are (1) collecting more data and (2) having more accurate data or models.

A catastrophe model comprises four modules: hazard, inventory, vulnerability, and loss.

(a) (*2.5 points*) Provide, for each module, either:

(i) An explanation of why it may not be possible to reduce epistemic uncertainty by collecting more data, or

(ii) A hurricane or earthquake example of how collecting more data may reduce epistemic uncertainty.

(b) (*2.5 points*) Provide, for each module, either:

(i) An explanation of why it may not be possible to reduce epistemic uncertainty by improving the accuracy of the data or model, or

(ii) A hurricane or earthquake example of how improving the accuracy of the data or model may reduce epistemic uncertainty.

18. (*5 points*) You are conducting a risk classification analysis for a book of business that has only two rating variables.

(a) (*0.5 points*) Explain how a minimum bias method improves the accuracy of the risk classification analysis.

You are given the following ratemaking information:

Territory	Class	Earned Exposures	Pure Premium
A	1	100	600
B	1	120	500
A	2	150	750
B	2	180	400

(b) (*1 point*) Determine whether or not there is distributional bias between these risk territories and classes.

(c) (*1 point*) Determine whether or not there is dependence between these risk territories and classes.

(d) (*1 point*) Recommend an approach that will best replicate observed pure premiums for this case. Justify your recommendation.

You are given the following ratemaking information from a one-way and minimum bias analysis of a different book of business. The minimum bias analysis is done using the balance principle.

Rating Variable 1	Rating Variable 2	One-Way Pure Premium	Minimum Bias Pure Premium	Difference
1	A	437	455	–4%
1	B	593	598	–1%
1	C	577	555	4%
2	A	394	404	–2%
2	B	535	531	1%
2	C	521	493	6%
3	A	775	784	–1%
3	B	1,053	1,031	2%
3	C	1,025	957	7%
Total		**589**	**589**	

18. Continued

(e) (*1 point*) Explain how the use of relativities from the one-way analysis instead of relativities from the minimum bias analysis creates the potential for adverse selection.

The total exposure-weighted absolute errors are 936,673 for the one-way analysis and 876,385 for the minimum bias analysis. Your colleague recommends using the minimum bias analysis.

(f) (*0.5 points*) Critique your colleague's recommendation.

19. (*5 points*) A commercial general liability insurance policy is sold with a 500,000 per-occurrence limit. A single incident occurs and is covered during the term of this policy resulting in a claim of 700,000 indemnity plus 150,000 allocated loss adjustment expenses (ALAE).

(a) (*0.5 points*) Calculate the amount the insurer would pay if the policy limit applies only to indemnity.

(b) (*0.5 points*) State why an insurer would want ALAE included in the policy limit.

You are given the following censored data for an increased limits analysis you are doing:

Claim Range	Counts In Interval	Capped Claims
100,000 Limit Policies		
0 – 100,000	2,000	138,000,000
250,000 Limit Policies		
0 – 100,000	820	53,300,000
100,000 – 250,000	1,070	171,200,000
500,000 Limit Policies		
0 – 100,000	870	53,070,000
100,000 – 250,000	630	95,760,000
250,000 – 500,000	270	89,100,000

(c) (*2 points*) Calculate the limited average severity for the 100,000 to 250,000 layer.

(d) (*2 points*) Calculate the increased limit factor at the 500,000 limit, assuming the basic limit of liability is 100,000.

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

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