SOCIETY OF ACTUARIES
Introduction to Ratemaking & Reserving

Exam GIIRR

MORNING SESSION

Date: Tuesday, October 28, 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 12 questions numbered 1 through 12.

   b) The afternoon session consists of 9 questions numbered 13 through 21.

   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. (*5 points*) You are given the following information on two 12-month policies you are analyzing:

Policy #1 was originally written on April 1, 2010 for a premium of 900, was renewed each year, and was still in force on December 31, 2013.

Policy #2 was originally written on September 1, 2011 for a premium of 1,200, was renewed on September 1, 2012, and was cancelled on March 1, 2013.

- There was a premium level increase of 5% that was effective July 1, 2012 for each policy upon its renewal.
- All rating characteristics remained the same for each policy at each renewal.

(a) (*2 points*) Calculate the 2012 and 2013 calendar year total earned premiums.

(b) (*1 point*) Calculate the 2012 calendar year total written premiums.

(c) (*1 point*) Calculate the total unearned premiums as of December 31, 2012.

You are adjusting premiums to current rate levels for a ratemaking analysis.

(d) (*1 point*) Calculate the 2012 total earned premiums adjusted to current rate level.

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

Accident Year	Cumulative Reported Claims			
	12	24	36	48
2010	44,200	62,600	79,200	82,000
2011	48,600	70,300	86,900	
2012	55,000	78,600		
2013	60,800			

The following two unusually large claims (one in 2011 and the other in 2013) are included in the above reported claims triangle:

Accident Year	Cumulative Reported Large Claims		
	12	24	36
2011	6,300	6,700	7,200
2013	8,200		

(a) (*3.5 points*) Calculate the estimated ultimate claims for accident years 2011 and 2013, using the reported development method with the original Bondy method for the tail factor.

The 2011 paid claims evaluated at December 31, 2013 are 67,700.

(b) (*1 point*) Estimate the accident year 2011 case estimate, IBNR, and total claim liability.

(c) (*0.5 points*) Describe the axiomatic assumption that underlies Boor's algebraic method for determining paid claims tail factors.

The following age-to-age development factors based on paid claims have been selected:

Development Interval	Age-to-Age Factor
12-24	3.37
24-36	1.65
36-48	1.25

(d) (*1 point*) Calculate the indicated paid claims tail factor for accident year 2011 using Boor's algebraic method with the results from part (a).

3. (*5 points*) You are given the following information:

Accident Year	Earned Exposures	Projected Ultimate based on Development Method	
		Claims	Counts
2011	5,440	333,900	370
2012	5,530	359,900	376
2013	5,690	401,600	404

- The annual severity trend is 5.0%.
- The annual frequency trend is 1.5%.

(a) (*3 points*) Calculate the projected ultimate claims for all accident years using the development-based frequency-severity method.

(b) (*1 point*) State two reasons to project ultimate frequencies and severities separately.

Earned exposures are projected to be 5,700 for accident year 2014.

(c) (*1 point*) Calculate accident year 2014 projected ultimate claims for the development-based frequency-severity method.

4. (*4 points*) You are a regulator leading a group that is attempting to combine results from three commercial catastrophe models. Each model has produced three exceedance probability curves for a standard set of exposures. One of the curves is the model's best estimate of the probabilities and the other two form a 90% confidence interval. Your group's task is to produce three curves, one representing an average of the three models and two representing a confidence interval. The following table displays output from the three models.

Exceedance probabilities relate to a loss of 10 billion.

	Exceedance Probability			Return (in Years)		
Model	**5%**	**Best Est.**	**95%**	**5%**	**Best Est.**	**95%**
A	0.0022	0.0072	0.0114	455	139	88
B	0.0026	0.0080	0.0109	385	125	92
C	0.0031	0.0092	0.0117	323	109	85

For the best estimate, the combined value is a weighted average, with 50% weight on the middle of the three best estimates and 25% weight on the other two estimates.

(a) (*1 point*) Calculate the combined best estimate for both the probability and the return period.

You have observed that the period calculated in (a) is not the reciprocal of the calculated probability. You are considering two approaches for your final recommendation. They are:

- Approach 1: Estimate the return period as the reciprocal of the calculated probability.
- Approach 2: Retain the return period estimate from (a).

(b) (*1 point*) Recommend one of the two approaches to calculate the best estimate of the return based on the combined models. Justify your choice.

4. Continued

You are considering three options for combining the confidence interval estimates for the exceedance probability. They are:

- Option I: Use the same weights by model as used for combining the best estimates.
- Option II: Apply the 50% weight to the middle value regardless of which model is in the middle.
- Option III: Use the most extreme value from the three models.

(c) (*1 point*) Calculate the interval using each of the three options.

(d) (*1 point*) State the option that produces an interval that can most accurately be described as a 90% confidence interval. Justify your choice.

5. (*4 points*) You are estimating the premium liabilities for your company's financial statement, and are given the following information:

Line of Business	Unearned Premiums	Expected Claims Ratio
Gross of Reinsurance		
Property	350	80%
Liability	510	70%
Total	860	
Net of Reinsurance		
Property	320	80%
Liability	450	74%
Total	770	

- The unallocated loss adjustment expense ratio is 11%.
- The selected general expense ratio is 17%.
- The percent of general expenses applicable to unearned premiums is 25%.
- The selected incentive commission ratio is 2.8%.

(a) (*1.5 points*) Calculate the premium liabilities, both gross and net of reinsurance.

(b) (*0.5 points*) Determine the equity in unearned premiums.

Carried ceded unearned commissions are 40.

(c) (*1 point*) Calculate the maximum deferred policy acquisition expense (DPAE) that your company could record as an asset.

(d) (*1 point*) Explain the premium development component an actuary would consider when determining the premium liability for retrospectively-rated policies.

6. (*4 points*) You are given the following information:

- ERR Insurance Company writes professional liability insurance for actuaries on both a claims-made and an occurrence coverage basis.
- For policies effective January 1, 2015, the first-year claims-made pure premium is 100,000 and the occurrence pure premium is 235,000.
- Annual pure premium trend is –10% and there is a two-year reporting pattern.

(a) (*1.5 points*) Define the following terms in relation to claims-made coverage:

(i) Retroactive date

(ii) Mature claims-made coverage

(iii) Nose or prior acts coverage

(b) (*1 point*) Calculate the pure premium for the following policies:

(i) Mature claims-made coverage effective January 1, 2016

(ii) Tail coverage for a first-year claims-made policy effective January 1, 2014

(c) (*0.5 points*) Calculate the step factor for first-year claims-made coverage.

(d) (*1 point*) Explain how a longer claim payment pattern would affect the pricing of occurrence policies for ERR.

7. (*7 points*) KMR Insurance is investigating the potential reserving impact of changes in its claims handling processes. You are given the following information:

Accident Year	Closed Counts			Selected Ultimate Count
	12	24	36	
2011	120	240	288	300
2012	132	297		330
2013	160			320

Accident Year	Paid Claims		
	12	24	36
2011	13,440	27,984	36,242
2012	16,558	36,708	
2013	22,479		

Parameters for Two-Point Exponential Curve Fitting				
Accident Year	a		b	
	12&24	24&36	12&24	24&36
2011	6,455	7,681	0.006112	0.005387
2012	8,758		0.004825	

- The selected relationship between paid claims y, and closed counts x, is $y = ae^{bx}$.
- The selected tail factor is the square root of the last development factor.

(a) (*1 point*) Assess whether there is any evidence of changed claims settlement rates.

(b) (*5 points*) Estimate total unpaid claims using a Berquist-Sherman adjustment to paid claims and simple age-to-age development factors.

(c) (*1 point*) Explain whether you would expect this unpaid claims estimate to be higher or lower than that calculated from the unadjusted paid claims triangle.

8. (*4 points*) Architects Insurance Company (AIC) was recently formed to insure the professional liability exposure of a regional group of architects in the Americas. AIC invested 5,000,000 to develop and implement an integrated policy issuance and claim management system. AIC proposes establishing rates for all policies with a common effective date of January 1, 2015 using the following information:

- The initial 5,000,000 cost is to be amortized over a period of five years.
- The 2015 expected annual claim cost per insured is 10,000.
- The variable expense provision is 10% and there are no fixed expenses.
- The profit and contingency provision is 10%.
- The expected gross cost of reinsurance is 2,000 per insured.
- The expected benefit from reinsurance is 50% of gross cost.
- The 2015 expected number of insureds is 20,000, each purchasing the required policy limit of 2,000,000.
- There are no changes expected to the above assumptions over the next five years.

(a) (*1 point*) Explain whether you should include a provision for the cost of the management system in your premium rate calculation.

Regardless of your answer to part (a), AIC has decided to include the cost of the management system in its premium rate calculation.

(b) (*2 points*) Calculate AIC's indicated rate per insured for one-year policies effective January 1, 2015.

AIC management is considering a variable dividend of 5% to 10% of premium to policyholders based upon loss experience.

(c) (*1 point*) Explain the conditions under which AIC can or cannot include the expected policyholder dividend as an expense provision.

9. (*6 points*) You are calculating the indicated rate change for a personal property line of business written in Territory X, and are given the following information for Territory X:

Accident Year	Earned Premium	Earned Exposures	Ultimate Claims
2011	12,694,000	11,900	8,455,000
2012	13,489,000	12,100	9,092,000
2013	14,546,000	12,100	9,049,000

- All policies are annual policies.
- The only historical rate change for this book of business was a 7% increase that was effective May 1, 2012.
- Annual premium trend is 1.5%.
- New rates will be in effect for one year, beginning April 1, 2015.
- Ultimate claims exclude non-hurricane weather claims.

(a) (*2 points*) Calculate the earned premium adjusted to the forecast period for each year.

You are including a loading for non-hurricane weather claims in your rating calculation, with the following information:

Territory X non-hurricane weather pure premium, trended to the average accident date in the forecast period	125
Region Y non-hurricane weather pure premium, trended to the average accident date in the forecast period (Region Y includes Territory X)	185
Credibility for Territory X non-hurricane weather claims	45%

(b) (*1 point*) Calculate the Territory X loading for non-hurricane weather claims, stated as a claim ratio.

9. Continued

You are given the following additional information:

Selected ULAE to claim ratio	8%
Selected fixed expenses to premium ratio	4%
Selected variable expenses to premium ratio	17%
Selected profit and contingencies to premium ratio	5%
Countrywide ultimate claim ratio (trended, including ULAE)	74%

- The full credibility standard is based on 40,000 earned exposures, with partial credibility determined by the square root rule, and the complement of credibility is applied to the countrywide ultimate claim ratio.
- A weighting of 20%, 30% and 50% for accident years 2011, 2012 and 2013, respectively, is used to determine the weighted average trended claim ratio.

(c) (*3 points*) Calculate the indicated average rate for Territory X.

10. (*5 points*)

(a) (*0.5 points*) State two principles underlying prospective experience rating.

(b) (*1 point*) Explain how the concepts of stability and responsiveness are important in both experience rating and self-insurance cost allocation systems.

ABC Insurance Company writes general liability coverage for medium-sized manufacturers. XYZ manufacturer, in business for twenty years, has always self-insured its general liability exposure. In 2014, XYZ projected an occurrence basis claim cost between 0.40 and 0.70 per 1,000 of sales for the next three years, 2015-2017. Beginning January 1, 2015, XYZ wants to consider commercial insurance and received the following quotation from ABC, based on expected sales of 1,000,000,000 in 2015:

- The manual premium is 500,000.
- The experience-rated premium is 490,000 (subject to exposure verification).
- The schedule rating discount is 16%.
- The paid loss retrospective premium is subject to a minimum of 300,000 and a maximum of 900,000.

(c) (*1 point*) State two considerations that ABC likely made in preparing the quote.

(d) (*2.5 points*) State and support your opinion as to whether XYZ should continue to self-insure or should insure its general liability exposure with ABC.

11. (*5 points*)

(a) (*1.5 points*) Describe how the following company actions may affect claims trend:

(i) Increasing the minimum deductible from 500 to 1,000.

(ii) Increasing the minimum policy limit from 200,000 to 500,000.

(iii) Expanding the perils covered for a particular line of business.

(b) (*1 point*) Describe the overlap fallacy as it relates to development factors and trend factors.

You are provided with the following information regarding REV Insurance Company and the industry:

- Changes in deductibles, coverages and mix of business for REV policies are consistent with the industry.
- Limits on REV policies are significantly different from the industry.
- Tort reform occurred at the end of accident year 2008.
- Industry historical experience has not been adjusted to reflect the reform; REV historical experience has been adjusted to reflect the reform.

			Frequency		Severity	
Time Period		Earned Vehicles	Annual Trend	R^2	Annual Trend	R^2
REV Insurance	2004-2013	75,000	0.4%	0.22	4.5%	0.68
	2009-2013	43,000	0.9%	0.35	4.8%	0.81
Industry	2004-2013	750,000	0.5%	0.91	3.2%	0.62
	2009-2013	390,000	0.6%	0.94	4.0%	0.89

(c) (*1.5 points*) Recommend the annual frequency trend and severity trend for REV to use. Justify your answers.

REV is revising its rates for all policies written on or after January 1, 2015. All policies are 6-month policies and the rates will be in effect for 12 months.

(d) (*1 point*) Calculate the pure premium trend factor that will be applied to 2012 experience for the ratemaking analysis.

12. (*5 points*) You have been asked to develop projected ultimate claims using the Cape Cod method and have been given the following information:

Accident Year	Earned Premiums	Premium On-Level Factor
2011	20,000	1.035
2012	22,000	1.020
2013	23,000	1.000

Accident Year	Age-to-Ultimate Development Factor	Claims Paid as of Dec. 31, 2013	Claim Adjustment Factors	
			Trend	Tort Reform
2011	4.550	4,100	1.051	0.9
2012	8.750	1,900	1.025	1
2013	25.500	1,200	1.000	1

(a) (*1 point*) Calculate the used-up on-level earned premiums for each accident year shown.

(b) (*1 point*) Calculate the adjusted expected claims ratio.

(c) (*1 point*) Calculate the expected claims for each accident year.

(d) (*1 point*) Calculate the projected ultimate claims for each accident year.

(e) (*1 point*) Explain the challenge reinsurance actuaries face when using the Cape Cod method to estimate ultimate claims.

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

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