
SOCIETY OF ACTUARIES
Introduction to Ratemaking & Reserving

Exam GIIRR

MORNING SESSION

Date: Wednesday, November 1, 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 8 questions numbered 13 through 20.

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.

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

1. (5 points)

ABC Insurance Company has written the following general liability policies:

Effective Date	Policy Term	Premium
Apr. 1, 2014	2-year	4,000
Jan. 1, 2015	1-year	7,000
Apr. 1, 2015	2-year	8,000
Oct. 1, 2015	6-month	6,000
Feb. 1, 2016	1-year	6,000

- ABC does not treat multi-year policies as multiple annual policies.
 - Policies do not renew upon expiry.
- (a) (1.5 points) Calculate written premium for calendar years 2015 and 2016.
- (b) (1.5 points) Calculate earned premium for calendar years 2015 and 2016.
- (c) (1 point) Calculate the unearned premium at December 31, 2016.
- (d) (0.5 points) Calculate the in-force premiums at January 1, 2016.
- (e) (0.5 points) Explain why earned premium might be different if ABC wrote motorcycle policies in a winter climate instead of general liability policies.

2. (5 points) Deductibles can decrease the claims paid by insurers by reducing morale hazard and encouraging risk control.

- (a) (0.5 points) Define the following terms:
 - (i) Morale Hazard
 - (ii) Risk Control
- (b) (0.5 points) State how a deductible can limit losses to an insurer for each term in part (a).
- (c) (0.5 points) State two other ways in which a deductible can limit loss exposure to an insurer.

An owner of four restaurants in neighboring regions has an insurance policy that covers property damage losses to each restaurant. Hurricane Julian makes landfall and produces a series of tornados in the regions where the restaurants are located.

The restaurants each incur 50,000 of damages and the policy has a 10,000 deductible.

- (d) (1 point) Explain two alternative deductible applications for a 10,000 per claim deductible.
- (e) (1 point) Calculate the losses retained by the insured and the insurer's claims for each deductible shown below, stating any assumptions.
 - (i) 10,000 per occurrence
 - (ii) 10,000 per location
- (f) (0.5 points) Explain why aggregate deductibles are more common for commercial insureds than for individual insureds.
- (g) (0.5 points) Describe how each of the following typically affect policy limits:
 - (i) A large deductible
 - (ii) A self-insured retention (SIR)

2. Continued

The restaurant owner also has a General Liability (GL) policy with a 1 million policy limit. The insured sustains a 1.1 million covered loss.

- (h) *(0.5 points)* Calculate the amount retained by the insured and the insurer's claims for each of the following:
- (i) Large deductible of 100,000
 - (ii) SIR of 100,000

3. (5 points)

- (a) (1 point) Explain the difference between inputs to the Bornhuetter Ferguson method and the Cape Cod method.

You are estimating ultimate claims as of December 31, 2016 and are given the following information:

Accident Year	On-Level Earned Premium	Reported Claims	Reported Cumulative Development Factors
2014	16,700	8,200	1.400
2015	16,200	5,700	2.000
2016	15,800	2,500	4.500

- The annual claim trend is 2%.
 - Tort reform resulted in an estimated claim decrease of 5% for all accidents on or after January 1, 2016.
- (b) (3.5 points) Calculate the projected ultimate claims for all accident years using the Cape Cod method.
- (c) (0.5 points) Calculate the accident year 2016 IBNR using the Generalized Cape Cod method and a decay factor of 0%.

4. (5 points) RockThirty Insurance Company (R30) provides only hurricane coverage.

(a) (1 point) State three alternatives to reinsurance that R30 might consider to improve its risk/return profile.

R30 has employed a catastrophe model that has produced the following set of possible losses and probabilities:

Loss (millions)	Probability
Various losses less than 100 that average 25	0.80
130	0.08
160	0.06
220	0.04
350	0.02

R30 is considering various reinsurance schemes offered by MEB Re and will examine the risk and return trade-off to make a decision as to which, if any, offered reinsurance scheme to purchase. The following symbols are used:

- L_{R30} = the random loss incurred by R30, net of any reinsurance
- L_{MEB} = the random loss incurred by MEB Re
- P_{R30} = 100 million, the total premium collected by R30
- $P_{MEB} = 1.3E(L_{MEB})$ the premium charged by the reinsurer

R30 uses the following measures of risk and return:

- Risk = $\text{Prob}[(L_{R30} + P_{MEB}) > 150 \text{ million}]$
- Return = $P_{R30} - P_{MEB} - E(L_{R30})$

With no reinsurance, the risk is 0.12 and the return is 44.2 million.

MEB Re has offered two reinsurance schemes:

- MEB Re pays 50% of losses in excess of 100 million.
- MEB Re pays 100% of losses in excess of 200 million.

(b) (3 points) Calculate the risk and return measures for both of the reinsurance schemes.

(c) (1 point) Determine, using an efficient-frontier approach, which, if either, of the two reinsurance schemes present viable options for R30.

5. (5 points)

- (a) (0.5 points) Describe why unallocated loss adjustment expenses (ULAE) are usually analyzed on a calendar year basis.
- (b) (0.5 points) Describe an approach you would use to estimate unpaid ULAE if you believed that carried claim reserves might be low or inadequate.

You are estimating unpaid ULAE as of December 31, 2016 for Realty Insurance Company (RIC) and are given the following information:

Calendar Year	Paid ULAE	Ratio of Paid ULAE to Claims	
		Gross Paid Claims	Gross Reported Claims
2014	1,900	14.4%	13.2%
2015	1,800	10.7%	11.8%
2016	1,600	11.3%	9.8%
Total	5,300	12.0%	11.5%

Unpaid Claims as of December 31, 2016		
	Gross	Net
Case Estimates	15,300	10,710
Selected IBNER (development on case estimates)	10,000	7,000
Selected IBNYR (pure IBNR)	2,500	1,750

- RIC is writing professional liability insurance in an inflationary environment.
 - Exposures are increasing each calendar year.
 - RIC implemented new systems and operational procedures during 2014 in an effort to reduce claim-related expenses.
 - Approximately 40% of claim department expenses relate to opening a claim file, and 60% relate to maintaining and closing a claim file.
 - A quota share reinsurance contract is in place such that 30% of loss and allocated loss adjustment expenses (ALAE) are ceded to a reinsurer.
- (c) (0.5 points) Provide two disadvantages of using a classical paid-to-paid method to estimate unpaid ULAE for RIC.
- (d) (2 points) Calculate unpaid ULAE as of December 31, 2016 using the Kittel refinement to the classical paid-to-paid method.

5. Continued

An actuarial colleague has suggested that you use the Mango and Allen smoothing adjustment rather than the Kittel refinement method to estimate unpaid ULAE.

- (e) *(0.5 points)* Describe the input for the Mango and Allen smoothing adjustment.
- (f) *(1 point)* Provide two reasons to justify using a Mango and Allen smoothing adjustment in this case.

6. (5 points) You are conducting an expense analysis to be used in ratemaking for a line of business written in State X.

(a) (1 point) Explain how a premium-based expense ratio analysis may be distorted if countrywide expense ratios are used to project fixed expenses for State X.

You are given the following information:

Calendar Year	Fixed Expenses	Earned Premium	Earned Premium at Current Rates
2013	50,000	1,090,000	1,190,000
2014	50,000	1,020,000	1,092,000
2015	50,000	962,000	1,010,000
2016	50,000	907,000	929,000

This line of business has historically used an annual fixed expense trend of 3%, which has been based on a publicly available cost index.

- (b) (1.5 points) Assess the reasonableness of using the publicly available cost index for this line of business by comparing it with the historical trend in fixed expenses.
- (c) (0.5 points) Recommend the annual fixed expense trend. Justify your recommendation.

New rates will be effective April 1, 2018 for one year. All policies are written as six-month policies.

(d) (2 points) Calculate the fixed expense ratio to be used in ratemaking, based on the average of 2015 and 2016.

7. (5 points) You are reviewing the ultimate claims estimates for Old Co Insurance as of December 31, 2016.

You are given the following information:

- Ultimate claims have historically been estimated as the average of the following three methods:
 - Expected method
 - Reported development method
 - Reported Bornhuetter Ferguson method
 - The expected claim ratio used in 2016 and prior calculations was 60%.

 - Old Co's portfolio has been stable for several years, but has recently been subject to the following changes:
 - A 10% deterioration in claim ratio to 66%,
 - A 50% increase in exposure, and
 - A 30% slowdown in claims reported by the end of the first year.
- (a) (3 points) Explain how each of the following methods is likely to be affected by each of the recent changes at Old Co:
- (i) Expected method
 - (ii) Reported development method
 - (iii) Reported Bornhuetter Ferguson method

An actuarial student has suggested replacing the average of the three methods with a single method, the reported Cape Cod method.

- (b) (0.5 points) Provide two reasons why actuaries use multiple methods to estimate ultimate claims.
- (c) (1.5 points) Explain whether or not the reported Cape Cod method is likely to produce a more accurate estimate than the reported Bornhuetter Ferguson based on the recent changes at Old Co.

8. (6 points) You are estimating IBNR reserves for Big Hat Insurance Company. You are given the following information:

Accident Year	Cumulative Reported Claims		
	12	24	36
2014	63,000	84,000	110,300
2015	87,800	108,000	
2016	85,200		

Accident Year	Cumulative Paid Claims		
	12	24	36
2014	31,500	52,500	94,500
2015	33,800	74,300	
2016	36,500		

Accident Year	Outstanding Counts		
	12	24	36
2014	190	170	100
2015	200	180	
2016	210		

Accident Year	Average Case Estimate		
	12	24	36
2014	166	185	158
2015	270	187	
2016	232		

- The expected annual severity trend is 6%.
- Ultimate claim estimates are based on the reported development method with simple all-year average development factors.

Discussions with the claims manager provide the following information:

- There was an unexpected class action suit in calendar year 2015.
- All claims from the class action suit were settled and paid in calendar year 2016.
- The settlement amounts were fully reserved for as of December 31, 2015 by a 50% increase in all case reserves from accident years 2014 and 2015.
- The suit and settlement are not expected to change any future claims development patterns.
- Despite this, the claims manager suspects that claims staff have become more conservative in setting reserves because of the high claims ratios in the 2015 financial year.

8. Continued

- (a) (2 points) Recalculate the average case estimate triangle, eliminating the effects of the settlement.
- (b) (0.5 points) Explain whether the recalculated average case estimate triangle provides any evidence for or against the claims manager's suspicion.

You have decided to use a Berquist Sherman adjustment to allow for changing case estimate adequacy.

- (c) (2 points) Calculate the adjusted reported claims triangle, excluding the effects of the settlement.

You have decided to use a 5% tail factor for reported development beyond 36 months.

- (d) (1.5 points) Calculate the indicated IBNR for accident years 2014 through 2016 using the reported development method and the adjusted reported claims triangle from part (c).

9. (5 points) You are given the following information to estimate claim and allocated loss adjustment expense (ALAE) liabilities as of December 31, 2016:

Report Year (RY)	Earned Exposures	Projected Ultimate ALAE Based on Reported Development Method
2013	480	26,000
2014	500	28,500
2015	520	32,000
2016	550	28,000

The annual claim trend is 3.0%.

- (a) (1.5 points) Calculate the projected RY 2016 ultimate ALAE using the expected method.

You are also given the following information:

- RY 2016 reported claims are 420,000.
 - RY 2016 expected ultimate claims are 516,040.
 - RY 2016 reported ALAE to reported claim ratio is 0.067.
 - The 12-month cumulative development factor for the ratio of reported ALAE to reported claims is 0.922.
- (b) (1.5 points) Calculate the projected RY 2016 ratio of ultimate ALAE to ultimate claims using the Bornhuetter Ferguson method and your results from part (a).
- (c) (1 point) Evaluate the reasonableness of the inputs for the Bornhuetter Ferguson method in part (b) by comparing the actual reported ALAE ratio to the expected ALAE ratio.
- (d) (1 point) Calculate the RY 2016 IBNR for ALAE using your results from part (b).

10. (5 points) You are given the following information:

Accident Year	Ultimate Claims Based on Development Method	Ultimate Counts Based on Development Method	Earned Exposures
2012	1,602,000	172	2,200
2013	1,745,000	179	2,300
2014	1,828,000	185	2,400
2015	1,940,000	188	2,400
2016	2,302,000	203	2,600

- The annual frequency trend is 0%.
 - The earned exposures are not inflation-sensitive.
- (a) (1 point) Calculate the annual change in severity for each year.
- (b) (1 point) Recommend an annual severity trend to use for the frequency-severity method. Justify your recommendation.
- (c) (3 points) Calculate the ultimate claims for accident year 2015 using the development based frequency-severity method.

- 11.** (5 points) You are estimating ultimate claims for a book of business using the expected method and are given the following information:

Accident Year	Earned Premiums	Projected Ultimate Claims from Development Method	Premium On-Level Factors at 2016 Level
2013	12,000	11,000	1.10
2014	15,000	10,000	1.06
2015	14,000	9,000	1.04
2016	11,000	8,000	1.00

- The annual claim trend is 2.5%.
 - A tort reform was effective January 1, 2014 with the effect that claim severities were reduced by 25%.
 - The cumulative development factors are highly leveraged.
- (a) (3 points) Recommend the 2016 cost and rate level expected claim ratio to be used to estimate expected claims. Justify your recommendation.
- (b) (1 point) Calculate the accident year 2015 expected claims.

Under certain situations, development factors and trend factors can each have highly leveraged projections.

- (c) (0.5 points) Explain how a development factor can highly leverage a projection.
- (d) (0.5 points) Explain how a trend factor can highly leverage a projection.

12. (4 points)

- (a) (0.5 points) State two reasons why an insurer would want to encourage insureds to increase their deductibles.

You are conducting a premium trend analysis due to deductible changes as part of a ratemaking analysis, and are given the following information:

Deductible	Current Differentials	% Earned Exposures by Deductible				
		2012	2013	2014	2015	2016
200	1.10	50%	45%	20%	18%	15%
500	1.00	30%	32%	55%	52%	50%
1,000	0.90	20%	23%	25%	30%	35%
Total		100%	100%	100%	100%	100%

- All policies are annual and they are written and earned evenly throughout the year.
 - Calendar year 2012 earned premium adjusted to current rate level is 240,000.
 - There was a one-time initiative in calendar year 2014 to encourage insureds to increase their deductibles from 200 to 500.
 - The new rates will be effective September 1, 2017 for one year.
- (b) (1.5 points) Calculate the annual change in premium for each year.
- (c) (0.5 points) Recommend the annual premium trend rate to use in adjusting from calendar year 2016 to the future rating period. Justify your recommendation.
- (d) (1.5 points) Calculate the calendar year 2012 earned premium to use for ratemaking.

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

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