SOCIETY OF ACTUARIES

Ratemaking & Reserving

Exam GIRR

MORNING SESSION

Date: Tuesday, April 28, 2020
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 13 questions numbered 1 through 13.

   b) The afternoon session consists of 8 questions numbered 14 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 GIRR.

6. Be sure your written-answer envelope is signed because if it is not, your examination will not be graded.

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Schaumburg, IL 60173-2226

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

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

1. (*5 points*) Assess the validity of each of the following statements.

(a) (*1 point*) The development triangle is an important tool for analyzing historical relationships and for projecting similar relationships into the future.

(b) (*1 point*) It is not appropriate to combine indemnity and ALAE payments in the same development method triangle if they have different development patterns.

(c) (*1 point*) Credibility of the data is typically not considered when selecting age-to-age factors in the development method.

(d) (*1 point*) It is appropriate to assume that policies are earned evenly throughout the year when conducting a ratemaking analysis on aggregate stop-loss coverage.

(e) (*1 point*) Given the same experience period, the claim trend period for reserving with the expected method is generally not the same as the claim trend period for ratemaking.

2. (*6 points*) XYZ Insurance acquired a liability book of business, effective January 1, 2017. You are given the following information:

- All policies are 12-month policies.
- Policies are written and earned uniformly throughout the year.
- At the time of acquisition, there were 900 policies in force, with
  - An average expiration date of June 30, 2017, and
  - An average premium of 500.

(a) (*0.5 points*) Calculate the unearned premium as of December 31, 2016.

You are given the following additional information for the policies written after acquisition:

Calendar Year	Written Policies	Rate Change
2017	2,000	0%
2018	2,200	3%
2019	2,500	5%

Rate changes are effective on July 1 each year.

(b) (*2 points*) Calculate the earned premium for:

(i) Calendar year 2017, and

(ii) Calendar year 2018.

You are estimating unpaid claims as of December 31, 2019 using the expected method.

(c) (*2 points*) Calculate the on-level earned premium at the 2019 average rate level for the purpose of projecting expected claim ratios for reserving, for:

(i) Calendar year 2017, and

(ii) Calendar year 2018.

2. Continued

You are also given the following information:

Accident Year	Paid Claims	Age-to-Ultimate Development Factors
2017	360,000	1.20
2018	450,000	1.50
2019	410,000	1.80

- Calendar year 2019 earned premium is 1,214,172.
- The annual claim trend is 3%.

(d) (*1.5 points*) Calculate the 2019 cost level expected claim ratio, using the average of all years.

3. (*4 points*) You are analyzing the following data triangles for the purpose of investigative testing:

Data Triangle	
A	Ratios of paid claims to reported claims
B	Average reported claims
C	Average paid claims
D	Ratios of closed counts to reported counts
E	Average case estimates

(a) (*1 point*) Describe the expected pattern in a stable environment for each of:

(i) Data triangle A

(ii) Data triangle B

(b) (*1 point*) Describe a limitation when analyzing data triangle A.

(c) (*0.5 points*) Explain why it is preferable to use paid claims on closed counts when analyzing data triangle C.

You have analyzed data triangles A and D, and neither are showing stable patterns.

(d) (*1 point*) Describe what an unstable pattern could indicate for each of:

(i) Data triangle A

(ii) Data triangle D

In reviewing data triangle E, you have noticed a material increase in the averages for a recent accident year.

(e) (*0.5 points*) Describe one possible cause of this anomaly in data triangle E.

4. (*4 points*) You are estimating collision unpaid claims for XYZ Insurance. You are given the following information:

Accident Year	Earned Vehicles	Earned Premiums (000)	Cumulative Paid Claims (000) as of December 31, 2019
2014	76,000	21,700	10,900
2015	76,000	22,600	11,400
2016	81,000	23,500	12,100
2017	81,000	24,600	12,700
2018	85,000	25,100	11,000
2019	89,000	26,500	2,200

Months	12	24	36	48
% Claims Paid	17%	88%	100%	100%

- Beginning in 2018 there was a restructuring of the finance team causing a significant delay in paying claims.
- The annual claim trend is 1.5%.

(a) (*0.5 points*) State a key assumption of the development method which is not fulfilled for XYZ Insurance.

You decide to use the expected method to estimate unpaid claims as of December 31, 2019.

(b) (*0.5 points*) Describe why earned vehicles are a better exposure base than earned premiums for XYZ Insurance.

(c) (*2.5 points*) Calculate expected claims for accident years 2018 and 2019.

(d) (*0.5 points*) Calculate the total unpaid claims as of December 31, 2019.

5. (*5 points*) You are considering several methods for estimating ultimate claims.

(a) (*0.5 points*) Compare the application of professional judgment in the Cape Cod method and the Bornhuetter Ferguson method.

(b) (*0.5 points*) Provide one situation where the Generalized Cape Cod method is preferred over the Cape Cod method.

(c) (*0.5 points*) Provide one situation where the frequency-severity method is preferred over the Cape Cod method.

You are given the following information for the Generalized Cape Cod method:

Accident Year	Earned Premiums (000)	Actual Reported Claims (000) as of Dec. 31, 2019	Expected % Reported
2017	1,460	800	72.0%
2018	1,390	630	60.0%
2019	1,500	410	34.0%

Accident Year	2017	2018	2019
Premium On-Level Factor	1.037	1.018	1.000

The annual claim trend is 1.5%.

(d) (*2.5 points*) Calculate the accident year 2018 expected claims using the Generalized Cape Cod method and a decay factor of 90%.

(e) (*0.5 points*) Calculate the accident year 2018 ultimate claims using the result from part (d).

(f) (*0.5 points*) Re-calculate the accident year 2018 ultimate claims using a decay factor of 0%

6. (*4 points*)

(a) (*1.5 points*) State three reasons why a reinsurer often experiences greater variability in claims than a primary insurer.

An annual aggregate deductible (AAD) is a reinsurance contract provision that can result in ceded claims that vary based on experience.

(b) (*1 point*) Describe one other reinsurance contract provision that can result in ceded claims that vary based on experience.

Primary insurer PPP purchases a per risk, excess of loss reinsurance contract from Reinsurer RRR with a 5 million excess 1 million limit and a 10 million AAD. PPP experiences the following claims covered by the policy:

Claim #	Ultimate Claims
1	1,000,000
2	5,000,000
3	6,000,000
4	12,000,000
5	5,000,000
6	1,000,000

(c) (*1.5 points*) Calculate the amount paid by PPP and RRR for each claim.

7. (*5 points*) You are given the following information for reserving claims excess of a 500,000 limit:

	Reported Claims Excess of Limit (000)							
Accident Year	**12**	**24**	**36**	**48**	**60**	**72**	**84**	**96**
2012	450	2,200	2,030	2,200	2,250	2,280	2,280	2,280
2013	30	900	1,210	1,220	1,230	1,250	1,250	
2014	200	710	1,190	1,910	2,270	2,300		
2015	340	1,100	1,230	1,340	1,480			
2016	40	630	1,080	1,240				
2017	430	820	1,380					
2018	140	650						
2019	400							

	Age-to-Age Factors Excess of Limit							
Accident Year	**12-24**	**24-36**	**36-48**	**48-60**	**60-72**	**72-84**	**84-96**	**96-ult**
2012	4.889	0.923	1.084	1.023	1.013	1.000	1.000	
2013	30.000	1.344	1.008	1.008	1.016	1.000		
2014	3.550	1.676	1.605	1.188	1.013			
2015	3.235	1.118	1.089					
2016	15.750	1.714	1.148					
2017	1.907	1.683						
2018	4.643							
Volume Wtd All	4.301	1.277	1.174	1.084	1.014	1.000	1.000	1.000
Selected LDFs	4.301	1.277	1.174	1.084	1.014	1.000	1.000	1.000
CDFs xs Limit	7.084	1.647	1.290	1.099	1.014	1.000	1.000	1.000

	Total Limits Reported Claims - Selected CDFs							
	12	**24**	**36**	**48**	**60**	**72**	**84**	**96**
CDFs Unlimited	1.889	1.121	1.059	1.024	1.003	1.000	1.000	1.000

	Severity Relativities (R) by Maturity Age							
	12	**24**	**36**	**48**	**60**	**72**	**84**	**96**
R_t	0.950	0.910	0.870	0.845	0.832	0.830	0.830	0.830

7. Continued

You are given the following additional information:

- Accident Year (AY) 2019 estimated ultimate claims limited to 500,000 are 10,360,000.
- The annual claim trend is 0%.
- Pricing actuaries have selected an increased limit factor of 1.185 for claims excess of 500,000, for annual policies effective July 1, 2021.

(a) (*4 points*) Calculate AY 2019 IBNR for claims excess of 500,000 as of December 31, 2019 using the following approaches:

(i) Development method applied to excess claims

(ii) Theoretically-derived development approach using Siewert's severity relativity formulas

(iii) The increased limits factor

(b) (*1 point*) Recommend an AY 2019 IBNR reserve for claims excess of 500,000 as of December 31, 2019 using your results from part (a). Justify your recommendation.

8. (*5 points*) ABC Insurance is a new insurer that started writing business in 2015 with the following incremental paid claims experience for all lines combined:

Accident Year	Incremental Paid Claims at Maturity Ages (millions)				
	12	**24**	**36**	**48**	**60**
2015	51	121	90	38	24
2016	54	129	95	41	
2017	59	138	106		
2018	62	151			
2019	64				

In addition, the following payments for all lines combined were made over the past three calendar years:

Loss Adjustment Expenses (millions)	**2017**	**2018**	**2019**
Salaries and benefits of claims personnel	15	21	24
Rent and utility costs of claims department	17	18	20
External defense and litigation costs	69	115	138

(a) (*2 points*) Determine the ULAE ratio using the classical paid-to-paid method.

ABC Insurance started writing automobile business in 2018. You are given the following information evaluated as of December 31, 2019:

Accident Year	Counts		Claims (000)	
	Reported	**Closed**	**Paid**	**Selected Ultimate**
2018	1,132	1,085	8,473	12,130
2019	1,079	766	7,215	13,866

Selected Disposal Ratio by Maturity Age			
12	**24**	**36**	**48**
0.587	0.864	0.929	1.000

A more refined approach to the paid-to-paid method involves separating the IBNR into pure IBNR and development on case estimates. You have decided to estimate pure IBNR using a Berquist-Sherman frequency-severity approach.

(b) (*1 point*) Estimate the pure IBNR *counts* as of December 31, 2019 for the automobile business.

(c) (*1 point*) Estimate the pure IBNR *claims* as of December 31, 2019 for the automobile business.

8. Continued

(d) (*1 point*) Estimate unpaid ULAE for the automobile business as of December 31, 2019 using the ULAE ratio determined in part (a), a multiplier of 50%, and the pure IBNR claims from part (c).

9. (*5 points*) Actuaries may rely on historical expense data for projecting future expenses used in ratemaking. However, future expenses may differ from historical expenses due to inflationary influences or expense control measures.

(a) (*1 point*) Describe two approaches an actuary may take to address potential misestimation from using historical expenses for ratemaking purposes.

(b) (*1 point*) Describe two ways an actuary can assess the reasonableness of the future expenses used in ratemaking.

U.S. Standards indicate that expenses should be split into fixed and variable components for ratemaking purposes. Historically, many actuaries priced general insurance products as if all expenses were variable.

(c) (*0.5 points*) Describe a situation that would result in an inadequate expense provision when all expenses are treated as variable.

You are given the following information:

Calendar Year	Written Premiums	Trended Earned Premiums at Current Rate Level	Commissions	Operational Expenses
2017	12,900	12,250	300	850
2018	14,350	13,930	375	975
2019	15,500	15,000	325	1,050

- The annual trend for fixed expenses is 2%.
- Rates will be effective July 1, 2020 for one year.
- All policies are written for 12-month policy terms.

(d) (*1 point*) Calculate the commission expense ratio. Justify your approach.

(e) (*1.5 points*) Calculate the operational expense ratio. Justify your approach.

10. (*4 points*)

(a) (*1 point*) State two advantages of using catastrophe models in ratemaking.

You are conducting a ratemaking analysis for a property line of business in a state which is exposed to tornado and earthquake perils. You are including a catastrophe loading in the ratemaking analysis. You are given the following information:

Peril	In-Force Date Reflected in Cat Model	Modeled Expected Claims as of July 1, 2020
Tornado	Nov 1, 2019	36,000
Earthquake	Nov 1, 2019	141,000

- Rates will be effective January 1, 2021 for one year.
- All policies are written for 12-month policy terms.
- The annual exposure trend is 1%.
- The annual severity trend for tornado claims is 2%.
- The annual severity trend for earthquake claims is 6%.
- The calendar year 2020 trended earned premium at current rate level is 11,291,000.

(b) (*2 points*) Calculate the catastrophe loading expressed as a claim ratio, based on catastrophe model results.

As part of your analysis, you also conducted a review based on 10 years of your company's claims experience in this state and developed a catastrophe loading of 0.5%, expressed as a claim ratio.

(c) (*1 point*) Recommend an approach for selecting the catastrophe load. Justify your recommendation.

11. (*4 points*) You are given the following information:

Accident Year	Earned Vehicles	Ultimate Counts	Trended Ultimate Pure Premium
2015	65,000	1,422	225
2016	62,000	1,525	215
2017	58,000	1,460	255
2018	67,000	1,490	220
2019	64,000	1,550	240

- The full credibility standard is 4,331 ultimate counts.
- Fixed expenses per vehicle are 45.
- The ratio of non-premium related expenses to claims is 5%.
- The permissible claim ratio is 75%.

(a) (*1 point*) Recommend the number of years to include in the weighted average pure premium for the ratemaking analysis. Justify your recommendation.

(b) (*1 point*) Calculate the weighted average pure premium.

(c) (*1 point*) Calculate the indicated rate.

The current rate per unit of exposure adjusted for trend and premium changes is 325.

(d) (*1 point*) Calculate the experience claim ratio.

12. (*5 points*)

(a) (*0.5 points*) State two ways a deductible can reduce the claims paid by insurers.

The deductible level chosen by an insured can affect an insurer's claim severity. You are given the following two claims before the application of any deductible:

Claim Number	Claim Amount
1	200
2	1,000

(b) (*0.5 points*) Determine a deductible amount that will *decrease* the insurer's claim severity.

(c) (*0.5 points*) Determine a deductible amount that will *increase* the insurer's claim severity.

You are given the following claim information for a property line of business:

Claim Range	Counts in Interval	Claims
0 - 1,000	600	300,000
1,001 - 2000	280	400,000
2,001 - 4,000	100	300,000
> 4,000	20	500,000
Total	**1,000**	**1,500,000**

The base deductible is 1,000.

(d) (*2 points*) Calculate the indicated deductible factors for deductibles of 2,000 and 4,000 relative to the base deductible.

(e) (*1.5 points*) Recommend a factor for a deductible of 3,000. Justify your recommendation.

13. (*4 points*) Roburns Insurance Company provides claims-made professional liability insurance to ABC Services. You have the following information:

- Report year 2020 expected ultimate claims are 60,000 with:
  - 50% from accident year lag 0,
  - 30% from accident year lag 1, and
  - 20% from accident year lag 2.
- The annual claim trend is 10%.
- The fixed expenses for report year 2020 are expected to be 5,000.
- The annual trend in fixed expenses is 2%.
- Variable expenses are 18% of premium.
- The profit margin is 4% of premium.

(a) (*0.5 points*) Calculate the premium for a report year 2020 mature claims-made policy effective January 1, 2020.

(b) (*2 points*) Calculate the tail factor following the mature claims-made coverage from part (a).

ABC Services decides to switch to an occurrence policy for the renewal on January 1, 2021.

(c) (*1 point*) Calculate the premium for the 2021 occurrence policy.

(d) (*0.5 points*) Explain whether or not ABC Services would need a tail policy.

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

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