SOCIETY OF ACTUARIES

General Insurance
Ratemaking & Reserving

Exam GIRR

Date: Wednesday, November 6, 2024

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 13 questions numbered 1 through 13 with a total of 70 points.

   The points for each question are indicated at the beginning of the question.

2. 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 provided in this document.

Written-Answer Instructions

1. Each question part or subpart should be answered either in the Word document or the Excel file as directed. Graders will only look at work in the indicated file.

   a) In the Word document, answers should be entered in the box marked ANSWER. The box will expand as lines of text are added. There is no need to use special characters or subscripts (though they may be used). For example, β_1 can be typed as beta_1 and σ^2 can be typed as sigma^2.

   b) Calculations should be done in Excel and entered as formulas. Performing calculations on scratch paper or with a calculator and then entering the answer in the cell will not earn full credit. Formatting of cells or rounding is not required for credit. Rows can be inserted to the answer input area as required to provide space for your answer.

   c) Individual exams may provide additional directions that apply throughout the exam or to individual items.

2. The answer should be confined to the question as set.

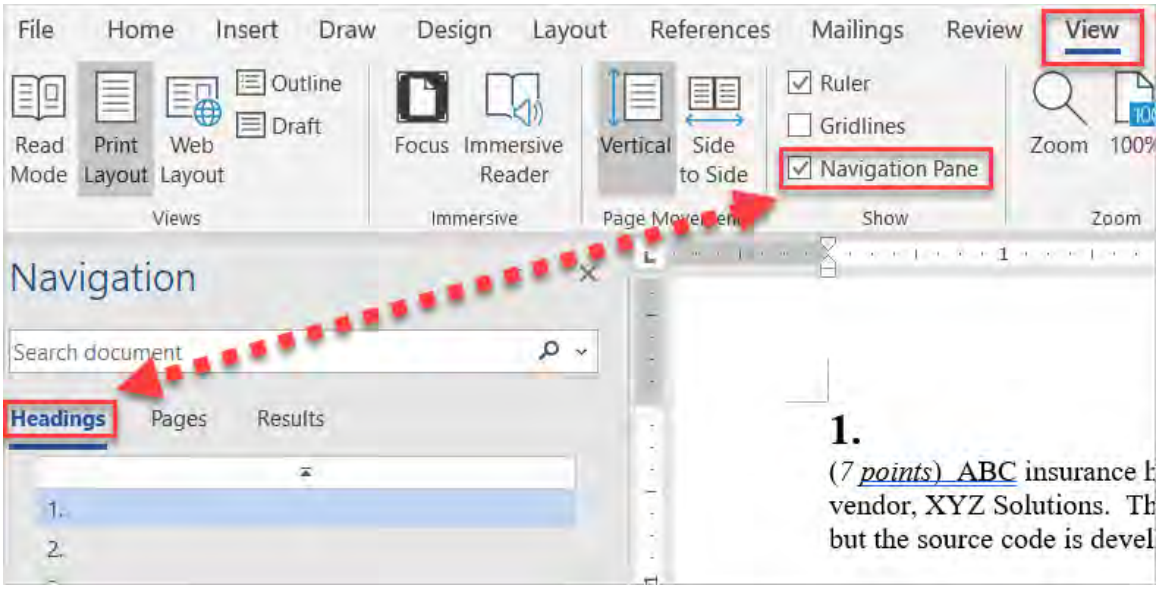
3. Prior to uploading your Word and Excel files, each file should be saved and renamed with your candidate number in the filename. To maintain anonymity, please refrain from using your name and instead use your candidate number.

4. The Word and Excel files that contain your answers must be uploaded before the .five-minute upload period expires.

Navigation Instructions

Open the Navigation Pane to jump to questions.

Press Ctrl+F, or click View > Navigation Pane:



1.

Provide the response for this question in the Excel spreadsheet.

(*6 points*) You are given:

Accident Year	Reported Claims			
	12	**24**	**36**	**48**
2020	10,000,000	15,000,000	16,500,000	17,236,120
2021	11,280,000	17,482,000	19,204,718	
2022	13,500,000	20,808,951		
2023	16,723,013			

Accident Year	Cumulative Paid Claims			
	12	**24**	**36**	**48**
2020	5,000,000	12,000,000	15,600,000	16,991,500
2021	5,775,000	13,860,000	18,023,071	
2022	6,680,000	16,008,300		
2023	7,715,400			

Accident Year	Reported Claim Counts			
	12	**24**	**36**	**48**
2020	1,500	1,650	1,700	1,720
2021	1,650	1,815	1,870	
2022	1,815	1,997		
2023	1,997			

Accident Year	Closed Claim Counts			
	12	**24**	**36**	**48**
2020	850	1,445	1,615	1,700
2021	935	1,590	1,777	
2022	1,030	1,749		
2023	1,133			

- There are no partial payments.
- There is no reported development after 48 months.
- The annual severity trend is 5%.

1. Continued

(a) (*2 points*) Verify that the adequacy of case estimates has increased using two diagnostic tests.

(b) (*1 point*) Verify that a change in claim settlement pattern has not occurred using one diagnostic test.

(c) (*3 points*) Calculate the IBNR for accident year 2023 using the reported development method with a Berquist-Sherman adjustment.

2.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You are estimating ultimate claims as of December 31, 2023 using the expected method.

(a) (*0.5 points*) Describe one advantage of using the pure premium approach rather than the claim ratio approach when using the expected method.

You are given:

Accident Year	Earned Exposures	Earned Premiums	Premium On-Level Factors	Actual Paid Claims as of Dec. 31, 2023	Cumulative Paid Development Factors
2017	78,945	52,155,000	1.067	25,428,000	1.565
2018	78,248	53,621,000	1.029	22,854,000	1.701
2019	77,701	53,900,000	1.016	20,810,000	1.927
2020	75,377	54,236,000	0.980	18,966,000	2.262
2021	77,739	55,984,000	0.999	15,127,000	2.809
2022	76,371	56,409,000	1.025	11,397,000	3.831
2023	75,070	56,834,000	1.000	7,237,000	6.369
Total	**539,452**	**383,139,000**		**121,819,000**	

- The annual claim ratio trend is 3%.

(b) (*0.5 points*) Provide one reason why the expected method might be preferred over the development method in this scenario for analyzing accident year 2023 claims.

(c) (*3 points*) Calculate the expected claims for accident year 2023 using the expected method with the following approaches:

(i) Claim ratio

(ii) Pure premium

(d) (*1 point*) Estimate accident year 2023 claims expected to be paid between December 31, 2023 and December 31, 2024 using your results from part (c)(ii).

3.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) Credibility procedures often require the actuary to exercise professional judgment as the assignment of a credibility value is frequently not a precise mathematical exercise. One consideration in assigning credibility is the volume of claims in the experience set of data.

(a) (*1 point*) Identify two other considerations in assigning credibility to an experience set of data.

You are estimating ultimate property claims for ratemaking purposes for State Z. The claims experience of State Z is not fully credible for calculating trend. You are given the following:

Accident Year	Selected Ultimate Claims at 1,000,000 Limit	Selected Ultimate Claims at Total Limits
2021	4,298,400	4,483,200
2022	4,368,900	4,607,900
2023	4,890,200	5,097,900

Selections	1,000,000 Limit	Total Limits
Severity Trend State Z	7.0%	8.6%
Pure Premium Trend State Z	5.5%	6.0%
Credibility State Z	70%	50%
Countrywide Severity Trend	6.0%	7.0%
Countrywide Pure Premium Trend	4.0%	5.0%

- The claim trend period for accident year 2023 is 32 months.

You are given the following loadings for large claims for the 500,000 to 1 million limit:

Accident Year	500,000 to 1 Million Limit
2021	1.196
2022	1.165
2023	1.185

(b) (*3 points*) Calculate the loadings for 500,000 to total limits for each accident year.

3. Continued

(c) (*1 point*) Recommend a loading for 500,000 to total limits for ratemaking purposes. Justify your recommendation.

4.

Provide the response for this question in the Excel spreadsheet.

(*6 points*) ABC Insurance is a new insurer that started writing business in 2021. You are given:

- One policy was written on the first day of each month from April 2021 to March 2024, for a total of 36 policies.
- Each policy is a two-year policy.
- The two-year premium of 120 per policy is recorded on the effective date of each policy.
- There are no cancellations or changes to policies.
- None of the policies were renewed upon expiration.
- Policies are earned evenly through the policy term.
- The earned premiums are:

Calendar Year	Earned Premiums
2021	225
2022	930
2023	1,425

(a) (*2 points*) Verify the earned premiums for calendar years 2021, 2022, and 2023.

(b) (*1 point*) Calculate the unearned premiums as of each year-end for 2021, 2022, and 2023.

(c) (*0.5 points*) Calculate in-force premiums as of December 31, 2023.

DEF Insurance is another insurer. DEF's total in-force premiums are 50% of ABC's total in-force premiums. A market analyst is comparing total in-force premiums and concludes that DEF has lower written premium volume than ABC Insurance.

(d) (*0.5 points*) Describe a scenario where the market analyst's conclusion would be incorrect.

4. Continued

The following claim development triangle is given for ABC Insurance:

Accident Year	Reported Claims		
	12	**24**	**36**
2021	68	108	135
2022	279	446	
2023	428		

(e) (*1 point*) Calculate the reported claim ratios for each of calendar years 2022 and 2023.

You are also given:

- There is no development beyond 36 months.
- Ultimate claim ratios for accident years 2022 and 2023 are the same as accident year 2021.

(f) (*1 point*) Calculate IBNR for accident years 2022 and 2023.

5.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You are conducting a ratemaking exercise and are given:

Accident Year	Earned Exposures	Earned Premiums	Trended Earned Premiums at Current Rate Levels	Ultimate Claims	Trended Ultimate Claims
2019	18,640	13,086,213	14,390,080	8,091,546	10,866,820
2020	18,240	13,193,295	14,154,240	7,568,826	9,735,481
2021	17,061	12,668,001	13,341,702	7,496,606	9,235,310
2022	17,992	13,202,396	13,835,848	8,275,177	9,763,870
2023	17,931	13,491,867	13,878,594	9,018,480	10,191,450

- The ULAE to claim ratio is 8%.
- The selected fixed expenses are 7.5% of premiums.
- The selected variable expenses are 15% of premiums.
- The selected profit and contingency ratio is 5% of premiums.
- The average claim ratio and the average pure premium are calculated using a simple average of all years.
- The indicated rate change using the claim ratio approach is 5.91%.

The pure premium and claim ratio approaches typically provide similar indicated rate changes.

(a) (*2.5 points*) Demonstrate that the indicated rate change using the pure premium approach is similar to that using the claim ratio approach (i.e., ±0.5% of 5.91%).

In general, there are two reasons why there can be a slight difference between indicated rate changes from the claim ratio approach versus the pure premium approach.

(b) (*0.5 point*) Describe one such reason.

Your company's management decides to increase rates by 2%, instead of the 5.91% rate indication from the claim ratio approach.

(c) (*1 point*) Calculate the profit and contingencies ratio implied by increasing the rates by 2%.

5. Continued

Implementing a lower rate change than indicated will result in higher rate indications for the next rate review, all other things being equal.

(d) (*1 point*) Explain how implementing a lower rate change than indicated will result in higher rate indications for the next rate review using the claim ratio approach.

6.

Provide the response for this question in the Excel spreadsheet.

(*4 points*) You are conducting a ratemaking exercise and are given:

Calendar Year	Earned Exposures	Direct Written Premium	Direct Earned Premiums	Total Commission Expenses and Premium Taxes	General Expenses
2019	25,800	19,350,000	18,990,120	2,515,500	1,450,000
2020	24,500	19,042,510	18,724,770	2,475,500	1,420,000
2021	23,100	18,507,860	18,240,290	2,313,500	1,440,000
2022	21,900	18,094,650	17,753,030	2,171,400	1,420,000
2023	20,750	17,771,250	17,447,750	2,132,600	1,390,000

- Fixed expenses are 40% of general expenses.
- The annual trend for fixed expenses is 2%.
- Fixed expenses are incurred at the time of writing each policy.
- Premiums are written evenly throughout the year.
- All policies were written for 6-month terms.
- New rates will be effective July 1, 2025 for one year.

(a) (*1 point*) Calculate the total variable expense ratio for each of calendar years 2019 to 2023.

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

(c) (*2 points*) Recommend the fixed expense per exposure to use in ratemaking. Justify your recommendation.

7.

(*4 points*)

(a) (*0.5 points*) Provide two reasons why actuaries use multiple methods to estimate ultimate claims.

ANSWER:

(b) (*0.5 points*) Provide two areas in which an actuary can exercise professional judgement in estimating ultimate claims, other than the selection of methods.

ANSWER:

You are reviewing the ultimate claims estimates for XYZ Insurance as of December 31, 2023.

XYZ's portfolio had been stable for several years, but experienced the following changes in recent years, which will affect actual ultimate claims:

- An improvement in claim ratio from the historical average of 70% to 65%,
- A 30% decrease in exposures, and
- A 20% acceleration in claims reported by the end of the first year.

(c) (*3 points*) Explain how effective each of the following projection methods will be in responding to the recent changes at XYZ:

(i) Paid development method

(ii) Expected method

(iii) Reported Bornhuetter Ferguson method

ANSWER: (i) (ii) (iii)

8.

Provide the response for this question in the Excel spreadsheet.

(*4 points*) You are estimating claim trend by fitting historical data using exponential regression.

(a) (*0.5 points*) Describe one reason for relying on a longer period of time when trending a long-tailed line of business.

(b) (*0.5 points*) Provide an example where a longer period of time may not be appropriate for trending a long-tailed line of business.

(c) (*1 point*) State two considerations when selecting which data points to include in trending procedures.

You are given the following for a ratemaking exercise:

- 40% of all written policies are expected to be twelve-month policies.
- 60% of all written policies are expected to be six-month policies.
- The accident year 2022 trend period for 12-month policies is 45 months.
- The exponential regression best fit lines, where *t* is half years:
    - Claim severity: $s = 42,000e^{0.045t}$
    - Claim frequency: $f = 0.015e^{-0.007t}$

(d) (*2 points*) Calculate the pure premium trend factor for accident year 2022.

9.

Provide the response for this question in the Excel spreadsheet.

(*7 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 a weakness of the classical paid-to-paid method that the Kittel refinement is intended to address.

Count-based ULAE methods resolve two major drawbacks of ratio-based ULAE methods.

(c) (*1 point*) Describe these two major drawbacks.

You are given the following information for estimating unpaid ULAE as of December 31, 2023:

Calendar Year	Paid Claims	Paid ULAE
2021	30,400,000	1,489,600
2022	31,698,113	1,680,000
2023	28,000,000	1,596,000

	As of Dec. 31, 2023
Case Estimates	19,507,585
IBNER	7,861,668
IBNYR	4,812,040

- Approximately 25% of claim department expenses relate to opening a claim file and 75% relate to maintaining and closing a claim file.

(d) (*1.5 points*) Estimate unpaid ULAE as of December 31, 2023 using the classical paid-to-paid method.

9. Continued

You are given the following additional information to estimate unpaid ULAE using the Wendy Johnson count-based method.

Calendar Year	Historical ULAE Counts		
	Newly Reported	Open	Closed
2021	2,325	1,336	2,370
2022	2,550	1,391	2,495
2023	2,528	1,402	2,517

Calendar Year	Projected ULAE Counts		
	Newly Reported	Open	Closed
2024	1,067	1,044	1,425
2025	122	323	843
2026	-	-	323

	Claim Count Weights
Newly reported counts	30%
Open counts	50%
Closed counts	20%

- Historical annual expense trend through 2023 has been 0%.
- Prospective annual expense trend after 2023 is expected to be 2%.

(e) (*1 point*) Demonstrate that the projected open counts for calendar years 2024, 2025, and 2026 are calculated correctly based on newly reported claims and closed claims.

(f) (*2.5 points*) Estimate unpaid ULAE as of December 31, 2023 using the Wendy Johnson method.

10.

Provide the response for this question in the Excel spreadsheet.

(*7 points*) General liability claims may have a long lag between the occurrence date and the report date.

(a) (*0.5 points*) Provide an example of another line of business that often has a long lag between the occurrence date and the report date.

(b) (*0.5 points*) Provide an example of a line of business where claim files are commonly reopened.

You are given:

Accident Year	Cumulative Paid Claims					
	12	24	36	48	60	72
2018	1,518,006	3,284,534	4,838,338	6,146,551	6,945,034	7,149,672
2019	1,582,770	3,552,084	5,075,462	6,140,083	7,043,201	
2020	1,573,601	3,607,985	4,923,578	6,208,567		
2021	1,608,502	3,404,322	4,897,059			
2022	1,448,977	3,339,496				
2023	1,791,306					

A legislative change became effective July 1, 2021, reducing claim costs 20% for all claims paid on or after this date.

(c) (*2 points*) Construct a revised cumulative paid claims triangle adjusted for the legislative change.

10. Continued

You are given:

Accident Year	Projected Earned Exposures	Projected Ultimate Claims
2024	10,600	7,105,054
2025	10,710	7,694,043

- The annual claim frequency trend is expected to be –0.3%.
- The annual claim severity trend is expected to be 7.5%.
- The 2023 cost level claim frequency is 10.6%.
- The 2023 cost level severity is 5,900.

(d) (*1 point*) Verify the projected ultimate claims for accident years 2024 and 2025.

The ultimate claims for all accident years are estimated as:

Accident Year	Projected Ultimate Claims
2018	7,149,672
2019	7,289,724
2020	7,484,846
2021	7,571,028
2022	7,534,985
2023	9,222,361
2024	7,105,054
2025	7,694,043

(e) (*3 points*) Calculate the claims expected to be paid in calendar years 2024 and 2025, using the results from part (c).

11.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) Your company started writing a new line of business on March 1, 2022. You are conducting a ratemaking analysis for this line of business and are given the following:

Historical Rate Changes Since March 1, 2022	
Effective Date of Rate Change	**Rate Change**
September 1, 2022	5%
January 1, 2024	7%

- The first policy was issued March 1, 2022.
- Premiums are written evenly throughout the year.
- Premiums are earned evenly throughout the policy term.
- All policies were written for 12-month terms.
- There have been no rate changes since January 1, 2024.
- New rates will be effective April 1, 2025, for one year.
- The annual premium trend is –0.5%.

You are adjusting historical earned premiums to the future rating period.

(a) (*3 points*) Calculate the on-level premium factors for calendar year 2022 and 2023.

(b) (*2 points*) Calculate premium trend factors for calendar year 2022 and 2023.

12.

Provide the response for this question in the Excel spreadsheet.

(*7 points*) You are given the following information for estimating ultimate claims:

Accident Year	Reported Claims				
	12	**24**	**36**	**48**	**60**
2019	540,061	575,731	648,087	683,622	702,734
2020	554,275	591,019	665,056	701,405	
2021	567,907	656,134	731,837		
2022	581,936	621,002			
2023	596,836				

Calendar Year	Earned Premiums
2019	1,000,000
2020	1,040,000
2021	1,082,000
2022	1,125,000
2023	1,170,000

- This was a new book of business in 2019.
- A rate change of –5% was effective January 1, 2022. There were no other rate changes.
- The annual claim ratio trend is –2%.
- An unusual large claim of 50,000 occurred in accident year 2021. The claim was first reported in September 2022 and the claim estimate has not changed.
- The original Bondy method is used to estimate a tail factor at 60 months.
- The expected claim ratio based on industry data is 65% for all accident years. However, management is uncertain that industry data is representative of this book of business.

(a) (*1.5 points*) Calculate projected ultimate claims for all accident years using the development method.

(b) (*0.5 points*) Critique the appropriateness of selecting the development method for this line of business.

(c) (*1 point*) Calculate projected ultimate claims for all accident years using the Bornhuetter Ferguson method.

12. Continued

(d) (*0.5 points*) Critique the appropriateness of selecting the Bornhuetter Ferguson method for this line of business.

(e) (*3 points*) Calculate projected ultimate claims for all accident years using the Cape Cod method.

(f) (*0.5 points*) Critique the appropriateness of selecting the Cape Cod method for this line of business.

13.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You are estimating ultimate claims using a frequency-severity method, and are given:

Accident Year	Earned Exposures	Reported Claims as of Dec. 31, 2023	Projected Ultimate Based on Development Method	
			Claims	Counts
2017	4,082	5,002,004	5,002,004	174
2018	4,248	5,420,340	5,451,477	182
2019	4,274	5,649,182	5,729,118	184
2020	4,437	6,034,903	6,218,509	192
2021	4,438	6,167,181	6,510,280	193
2022	4,668	5,673,216	7,159,008	204
2023	4,706	2,889,081	7,850,014	217

- The annual severity trend is 4.0%.
- A court ruling expanded policy coverage for claims occurring on or after January 1, 2023.
- The court ruling increased claim frequency by 5% but had no effect on claim severity.
- The earned exposures are not sensitive to inflation.

(a) (*1 point*) Recommend an annual claim frequency trend.

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

Other projection methods use triangles of closed count ratios.

(c) (*0.5 points*) Describe how to calculate the *proportion of closed counts* triangle when using the frequency-severity closure method.

(d) (*0.5 points*) Describe how to calculate the triangle of *disposal ratios* when using the Berquist-Sherman adjustment for changing settlement rates.

****END OF EXAMINATION****