SOCIETY OF ACTUARIES

General Insurance
Ratemaking & Reserving

Exam GIRR

Date: Wednesday, May 7, 2025

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 14 questions numbered 1 through 14 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.

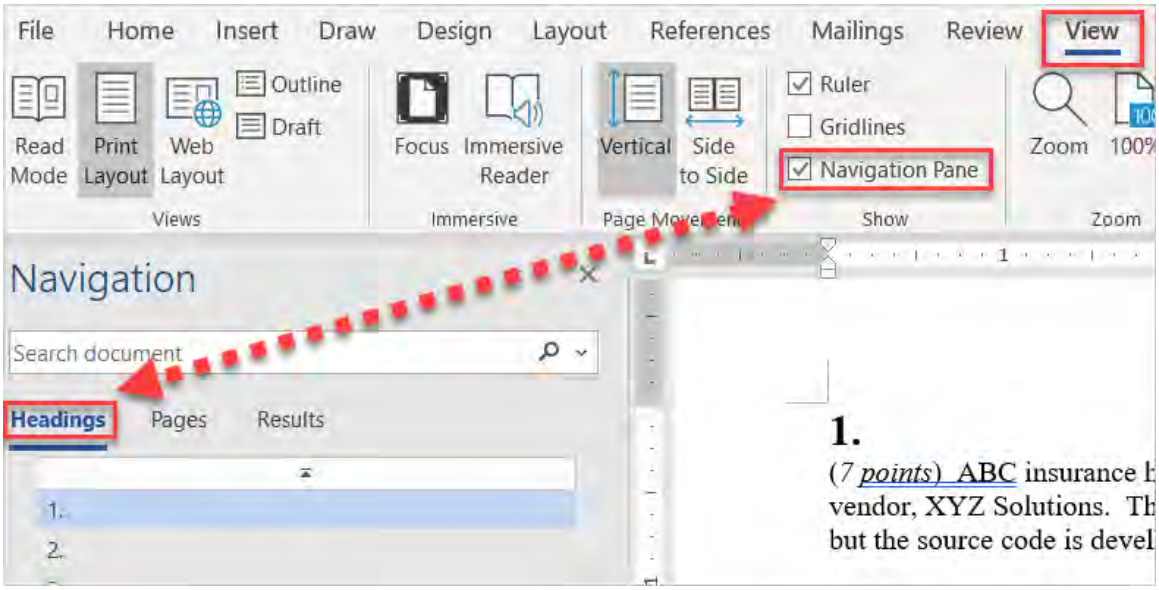
4. The Word and Excel files that contain your answers must be uploaded before the five-minute upload period expires.

8770 W. Bryn Mawr Avenue Suite 1000
Chicago, IL 60631

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.

(*5 points*) You are analyzing development triangles for investigative testing purposes.

(a) (*1 point*) State two purposes for conducting investigative testing with development triangles.

You are given:

Accident Year	Ratio of Paid Claims to Reported Claims				
	12	24	36	48	60
2020	0.498	0.705	0.839	0.923	0.989
2021	0.502	0.710	0.835	0.913	
2022	0.514	0.705	0.812		
2023	0.499	0.655			
2024	0.462				

Accident Year	Ratio of Closed Counts to Reported Counts				
	12	24	36	48	60
2020	0.581	0.710	0.792	0.848	0.889
2021	0.591	0.716	0.789	0.847	
2022	0.576	0.709	0.790		
2023	0.587	0.715			
2024	0.581				

- The annual claim severity trend is 5%.

(b) (*1 point*) Describe the pattern (row or column) you would expect to observe in each of these triangles if the line of business is in a stable environment.

(c) (*2 points*) Evaluate each triangle to determine if this line of business likely does or does not represent a stable line of business.

(d) (*0.5 points*) State what a triangle of ratios of closed counts with no payments to total closed counts would help identify.

1. Continued

You are also analyzing a triangle of average paid claims, which is calculated as paid claims divided by closed counts.

(e) (*0.5 points*) Describe a data adjustment needed to ensure this test would provide consistency between the payments in the numerator and the counts in the denominator.

2.

Provide the response for this question in the Excel spreadsheet.

(*8 points*) You are given:

Accident Year	Cumulative Paid Claims						
	12	**24**	**36**	**48**	**60**	**72**	**84**
2018	1,379,364	2,782,417	4,430,621	5,902,221	7,307,442	8,616,782	9,269,896
2019	1,436,979	3,158,601	4,719,732	6,462,499	7,837,333	8,885,445	
2020	1,566,440	3,241,372	5,104,234	6,755,984	8,106,189		
2021	1,621,033	3,468,672	5,345,638	7,217,780			
2022	2,012,287	3,648,224	5,583,814				
2023	1,851,044	4,117,247					
2024	2,078,097						

Accident Year	Reported Claims						
	12	**24**	**36**	**48**	**60**	**72**	**84**
2018	3,132,659	4,422,985	5,875,165	7,086,391	8,162,156	9,097,359	9,391,874
2019	3,205,344	4,837,781	6,238,525	7,702,789	8,746,908	9,423,176	
2020	3,470,580	5,088,185	6,751,756	8,119,190	9,086,519		
2021	3,790,273	5,523,899	7,115,668	8,653,058			
2022	4,045,586	5,725,217	7,498,246				
2023	4,185,696	6,281,172					
2024	4,585,964						

(a) (*2 points*) Calculate the following:

(i) Total claims paid in calendar year (CY) 2024

(ii) Total change in case estimates in CY 2024

(b) (*0.5 points*) Describe one reason why the change in case estimates is expected to be negative for each accident year prior to 2024.

(c) (*1 point*) Describe one reason why a change in case estimates could be positive for any accident year prior to 2024.

2. Continued

You are also given:

Accident Year	Projected Ultimate Claims using Reported Claims
2018	9,695,924
2019	10,043,178
2020	10,613,552
2021	11,476,774
2022	12,081,976
2023	13,243,526
2024	14,117,878

(d) (*4.5 points*) Calculate projected ultimate claims using cumulative paid claims. Justify ***all*** selections and use the algebraic method for the tail factor.

3.

Provide the response for this question in the Excel spreadsheet.

(*3 points*) You are conducting an analysis of expenses used in a ratemaking analysis and are given:

Calendar Year	Earned Exposures	Direct Written Premiums	Direct Earned Premiums	Total Commission Expenses and Premium Taxes	General Expenses
2021	4,974	6,035,090	5,953,290	663,860	243,420
2022	4,842	5,929,640	5,858,330	652,260	253,065
2023	4,872	5,783,010	5,703,650	636,131	260,640
2024	4,859	6,070,980	5,989,490	667,808	268,436
2025 Budget	4,616	5,829,940	5,755,190	582,994	285,000

- 30% of general expenses are fixed expenses.

Your co-worker has recommended the following:

- The variable expense ratio should be based on the average of calendar years 2021 through 2024.
- The variable expense ratio from the 2025 budget should not be included in the consideration of the selected variable expense ratio because it is an outlier.

Critique your co-worker's recommendation.

4.

Provide the response for this question in the Excel spreadsheet.

(*6 points*) You are estimating allocated loss adjustment expense (ALAE) liabilities as of December 31, 2024.

(a) (*1 point*) State two situations where ultimate indemnity and ultimate ALAE should be estimated separately.

You are given:

Accident Year (AY)	Earned Exposures	Projected Ultimate ALAE Based on Reported Development Method
2020	8,433	1,086,216
2021	8,637	1,123,621
2022	8,570	1,213,024
2023	8,728	1,281,322
2024	8,808	1,380,962

The annual claim trend is 5.5%.

(b) (*1.5 points*) Calculate the projected AY 2024 ultimate ALAE using the expected method.

You are also given the following information:

- AY 2024 reported claims are 3,318,135.
- AY 2024 expected ultimate claims are 13,809,620.
- AY 2024 reported ALAE to reported claim ratio is 0.095.
- The 12-month cumulative development factor for the ratio of reported ALAE to reported claims is 1.020.
- Reported and ultimate claims exclude ALAE.

(c) (*1.5 points*) Calculate the projected AY 2024 ratio of ultimate ALAE to ultimate claims using the Bornhuetter Ferguson method and your results from part (b).

(d) (*1 point*) Evaluate the reasonableness of the inputs for the Bornhuetter Ferguson method in part (c) by comparing the actual reported ALAE ratio to the expected ALAE ratio.

(e) (*1 point*) Calculate the AY 2024 IBNR for ALAE using your results from part (c).

5.

Provide the response for this question in the Excel spreadsheet.

(*7 points*) You are given:

Policies written on or before December 31, 2022:

- All policies were written for 6-month policy terms.
- As of December 31, 2022, there were 4,200 policies in force.
- Every policy had an annualized premium of 1,200 as of December 31, 2022.
- 90% of the policies in force on December 31, 2022 renewed in 2023.
- The unearned premiums as of December 31, 2022 were 1,260,000.

Policies written or renewed after December 31, 2022:

- All policies written or renewed after December 31, 2022 were written for 12-month policy terms.
- 1,560 new policies were written in 2023.

The following rate changes were made:

Effective Date of Rate Change	Overall Rate Change %
July 1, 2023	5%
July 1, 2024	2%

- No other rate changes have been made after July 1, 2024.

All policies are written uniformly throughout the year and earned uniformly through the policy period.

(a) (*1.5 points*) Calculate the CY 2023 written premiums for the policies that renewed in 2023.

(b) (*1 point*) Calculate the CY 2023 earned premiums for the policies that renewed in 2023.

(c) (*1.5 points*) Calculate the CY 2023 earned premiums for the *new* policies written in CY 2023.

(d) (*1.5 points*) Calculate the total unearned premiums as of December 31, 2023.

(e) (*1.5 points*) Calculate the CY 2023 earned premiums at current rate levels.

6.

(*4 points*) You are analyzing a line of business for possible changing conditions. Berquist and Sherman offer four suggestions for choosing data that are relatively unaffected by specific changing conditions.

(a) (*0.5 points*) State which data should be chosen when the rate of growth of earned exposures changes markedly within the year.

ANSWER:

(b) (*0.5 points*) Describe the data distortion that could occur when the rate of growth of earned exposures changes markedly within the year.

ANSWER:

(c) (*1 point*) Describe two potential scenarios, *that do not involve actions of the insurer,* which could cause the changing condition of a shift in policy limits.

ANSWER:

You are reviewing ultimate claims estimates for a line of business and are given the following estimates of ultimate claims:

Accident Year	Development Method Based on		Development Based Frequency Severity Method	Expected Method
	Paid Claims	Reported Claims		
2020	11,494,928	10,980,216	11,322,767	11,246,658
2021	12,168,792	11,505,522	11,957,036	11,978,249
2022	13,113,884	12,239,603	12,894,023	12,752,727
2023	14,354,650	12,837,979	13,741,168	13,439,865
2024	14,987,039	12,927,485	14,325,080	14,436,370
Total	**66,119,293**	**60,490,805**	**64,240,074**	**63,853,869**

- The adequacy of case estimates was significantly reduced in the latest calendar year.
- All development factors are selected using the average of all years.

6. Continued

(d) (*1 point*) Explain how the estimated ultimate claims from the development method based on reported claims will be affected by the case adequacy change.

ANSWER:

(e) (*0.5 points*) Describe why the frequency-severity method could be a reasonable approach for this line of business.

ANSWER:

(f) (*0.5 points*) Describe how the expected method could be affected by the case adequacy change in this situation.

ANSWER:

7.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You are estimating unpaid unallocated loss adjustment expenses (ULAE) as of December 31, 2024 and are given:

Calendar Year	Paid ULAE	Paid Claims
2021	538,680	5,670,300
2022	579,220	5,669,000
2023	622,000	6,282,800
2024	732,130	7,108,100

As of Dec. 31, 2024	
Paid claims	34,514,400
Reported claims	36,861,900
Ultimate claims	42,514,600
IBNYR	1,243,600

Based on discussions with claim department management, you have learned the following:

- Calendar year 2022 paid ULAE included a one-time charge of 52,000 related to implementation of a new system. This expense is not expected to occur again.
- Approximately 40% of claim department expenses relate to opening a claim file and 60% relate to maintaining and closing a claim file.

(a) (*3 points*) Estimate unpaid ULAE as of December 31, 2024 using the classical paid-to-paid method.

(b) (*0.5 points*) Identify the weakness in the classical paid-to-paid method according to Kittel.

(c) (*0.5 points*) Explain why the weakness identified in part (b) occurs.

(d) (*1 point*) State two circumstances where the Mango and Allen smoothing adjustment is particularly valuable.

8.

Provide the response for this question in the Excel spreadsheet.

(*3 points*) You are using catastrophe models to price an earthquake endorsement for your company.

(a) (*0.5 points*) State one way that noninsurance data can be used in catastrophe models.

(b) (*0.5 points*) State one reason why catastrophe claims might trend at a rate materially different than non-catastrophe claims.

You are given:

- In-force exposures as of November 1, 2024 are 19,700.
- Using November 1, 2024 in-force policies, expected claims from the earthquake catastrophe model are 2,112,000 based on a March 1, 2025 cost level.
- The annual exposure trend is 2%.
- The annual severity trend is 10%.
- New rates are to be effective September 1, 2025 for one year with all policies written as 12-month policies.

(c) (*2 points*) Calculate the pure premium for the earthquake endorsement effective September 1, 2025.

9.

Provide the response for this question in the Excel spreadsheet.

(*8 points*) You are estimating ultimate claims using a frequency-severity closure method for line of business A (LOB A) in state X which your company started writing in 2022.

(a) (*1 point*) Describe two alternative sources for trend, other than industry data, if an insurer's own claim experience in LOB A for state X is not sufficiently credible.

You are given paid severity data from the industry for LOB A.

Accident Year	Industry Projected Ultimate Severity
2019	5,030
2020	5,467
2021	5,718
2022	6,098
2023	6,620
2024	6,789

(b) (*1 point*) Recommend a severity trend based on the industry data. Justify your recommendation.

The industry data above was adjusted to a basic policy limit of 500,000.

(c) (*1 point*) Assess whether your company's severity trend for LOB A is expected to be lower, equal, or higher than the industry severity trend if the company's policy limit for LOB A is 300,000.

9. Continued

You are also given:

Accident Year	Industry Incremental Paid Severity					
	12	24	36	48	60	72
2019	2,662	4,830	5,873	6,281	6,375	7,193
2020	2,897	4,949	6,637	6,969	7,049	
2021	3,222	5,111	6,996	7,006		
2022	3,413	5,868	6,787			
2023	3,494	6,187				
2024	3,653					

- Both the industry data and the company data have been adjusted to a basic policy limit of 500,000.
- The industry data is considered a reasonable basis for determining projections for LOB A.

(d) (*1.5 points*) Calculate the incremental severity at the 2024 cost level for all development ages 12 through 72 using a simple all year's average and your recommended severity trend from part (b).

You are also given:

Industry Proportion of Closed Counts						
12	24	36	48	60	72	84
0.251	0.304	0.371	0.616	0.738	0.652	1.000

Industry Age-to-Ultimate Development Factors for Closed Counts	
Age	Factor
72-ult	1.026
60-ult	1.053
48-ult	1.211
36-ult	1.499
24-ult	2.105
12-ult	4.004

9. Continued

Accident Year	Company Incremental Closed Counts for LOB A		
	12	**24**	**36**
2022	60	54	48
2023	145	130	
2024	203		

- The industry proportion of closed counts and age-to-ultimate factors are used to estimate future closed counts for the company.
- The industry incremental severities at the 2024 cost level from part (d) are used to estimate future incremental paid severities for the company.
- The incremental severity at the 2024 cost level for development age 84 is assumed to be the same as the severity at development age 72.

(e) (*3.5 points*) Calculate the company's total unpaid claims estimate as of December 31, 2024 for LOB A using the frequency-severity closure method.

10.

(*3 points*) You are estimating ultimate claims for a line of business where there has been a change in the adequacy of the case estimates in the latest calendar year.

(a) (*0.5 points*) Describe your general approach to estimating ultimate claims based on the frequency-severity method applied to reported claims. (You do not need to outline specific steps).

ANSWER:

You are given the following for a different line of business:

- A triangle of case estimates
- A triangle of paid claims
- Several large open claims
- A change in the adequacy of case estimates

(b) (*1.5 points*) Describe the steps to follow when adjusting reported claims for both large claims and the change in the adequacy of case estimates.

ANSWER:

One challenge faced by actuaries when applying the Berquist-Sherman adjustment for changes in the adequacy of case estimates is the selection of an adjusted tail factor.

(c) (*1 point*) Provide two approaches for selecting a tail factor in such a situation.

ANSWER:

11.

Provide the response for this question in the Excel spreadsheet.

(*6 points*) You are estimating ultimate claims as of December 31, 2024.

(a) (*1 point*) State two desirable characteristics of an exposure base.

You are given:

Accident Year	Earned Exposures	Reported Claims as of Dec. 31, 2024	Cumulative Development Factors
2018	24,036	9,304,916	1.055
2019	24,429	9,343,805	1.114
2020	24,934	9,119,571	1.224
2021	25,042	8,456,780	1.421
2022	25,370	7,273,955	1.752
2023	25,914	5,693,605	2.357
2024	26,312	3,976,374	3.661

- The exposures for this line of business are inflation sensitive.
- The annual claim severity trend is 6.3%.
- The annual claim frequency trend is –0.6%.
- The annual exposure trend is 1.4%.

(b) (*3 points*) Calculate projected ultimate claims for all accident years using the Cape Cod method with a pure premium based on an experience period of 2018 through 2024.

(c) (*2 points*) Calculate projected ultimate claims for all accident years using the Cape Cod method with a pure premium based on an experience period of 2021 through 2024.

12.

Provide the response for this question in the Excel spreadsheet.

(*6 points*) Your company is forecasting future experience for several lines of business (LOB) for planning purposes.

You are given the following for LOB A:

Calendar Year (CY)	Forecasted Earned Exposures
2025	9,500
2026	9,250
2027	9,180

2024 average earned premium at current rate level	1,600
Annual premium trend	1%
2024 cost level claim and ALAE ratio	69%
Annual frequency trend	–1%
Annual severity trend	6%
Fixed expense per exposure	75
Annual fixed expense trend	0%
Variable expense ratio as a percent of premium	15%
ULAE as a percent of claims plus ALAE	7%

The base forecast scenario assumes no rate changes over the 2025-2027 forecast period.

(a) (*3 points*) Calculate the forecasted profit for CY 2027 for LOB A.

12. Continued

You are given the following LOB B forecast information for 2027, before any rate adjustment:

Projected earned premiums	7,500,000
Projected claims plus LAE	6,190,000
Projected fixed expenses	475,000
Projected variable expenses	975,000

- To increase the projected profit for CY 2027, a 5% rate increase is planned to be effective for all policies written or renewed on or after September 1, 2026.
- Premiums are written evenly throughout the year.
- All policies were written for 12-month terms.

(b) (*2.5 points*) Calculate the forecasted profit for CY 2027 for LOB B.

Your colleague has proposed reducing exposures in 2027 to reduce the combined ratio and underwriting loss.

(c) (*0.5 points*) Critique your colleague's proposal.

13.

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

Accident Year (AY)	Paid Claims (000)	Reported Claims (000)
2018	9,358	9,476
2019	8,896	9,438
2020	8,370	9,350
2021	7,061	9,446
2022	5,475	7,191
2023	3,583	5,547
2024	1,805	3,804
Total	**44,548**	**54,252**

Accident Year (AY)	Projected Ultimate Claims (000)				
	Development Method		Expected Method	Bornhuetter Ferguson	
	Paid	Reported		Paid	Reported
2018	10,197	9,947	9,900	10,173	9,945
2019	10,562	10,399	10,775	10,596	10,434
2020	11,605	11,501	11,709	11,634	11,540
2021	*12,487*	*13,515*	12,553	12,515	13,527
2022	13,695	13,867	13,586	13,630	13,670
2023	14,509	15,102	14,568	*14,554*	14,660
2024	15,719	17,079	*15,916*	15,893	16,040
Total	**88,774**	**91,410**	**89,007**	**88,995**	**89,816**

- A large claim occurred and was reported in accident year 2021. The case estimate was set at the policy limit and remains unpaid as of December 31, 2024. No payments have been made on this claim as of December 31, 2024.
- The adequacy of case estimates was increased in calendar year 2024.
- Development factor selections are based on a simple all year average with one exception: accident year 2021 reported data is excluded from the averages due to the one large, reported claim.
- The a priori expected claim ratio is constant for all accident years.

13. Continued

Critique the appropriateness of each of the following estimates as a potential selection of ultimate claims:

(i) Paid development method for AY 2021

(ii) Reported development method for AY 2021

(iii) Paid Bornhuetter Ferguson method for AY 2023

(iv) Expected method for AY 2024

ANSWER:

14.

Provide the response for this question in the Excel spreadsheet.

(*3 points*) You are calculating premium trend factors for a 15% discount that some policyholders have received, and are given:

Calendar Half-Year	Proportion of Policyholders with 15% Discount
2020-1	14.50%
2020-2	15.16%
2021-1	15.80%
2021-2	16.45%
2022-1	18.79%
2022-2	19.85%
2023-1	20.86%
2023-2	21.95%
2024-1	23.01%
2024-2	24.02%

(a) (*1.5 points*) Recommend a semi-annual premium trend to account for changes in the proportion of policyholders with the 15% discount. Justify your recommendation.

You are conducting a premium trend analysis for rates to be effective September 1, 2025 for one year.

(b) (*1.5 points*) Calculate the premium trend factor to use for 2022, using written premiums for the trending analysis and the trend recommended in part (a).

****END OF EXAMINATION****