

Exam GIRR

Date: Wednesday, May 8, 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.

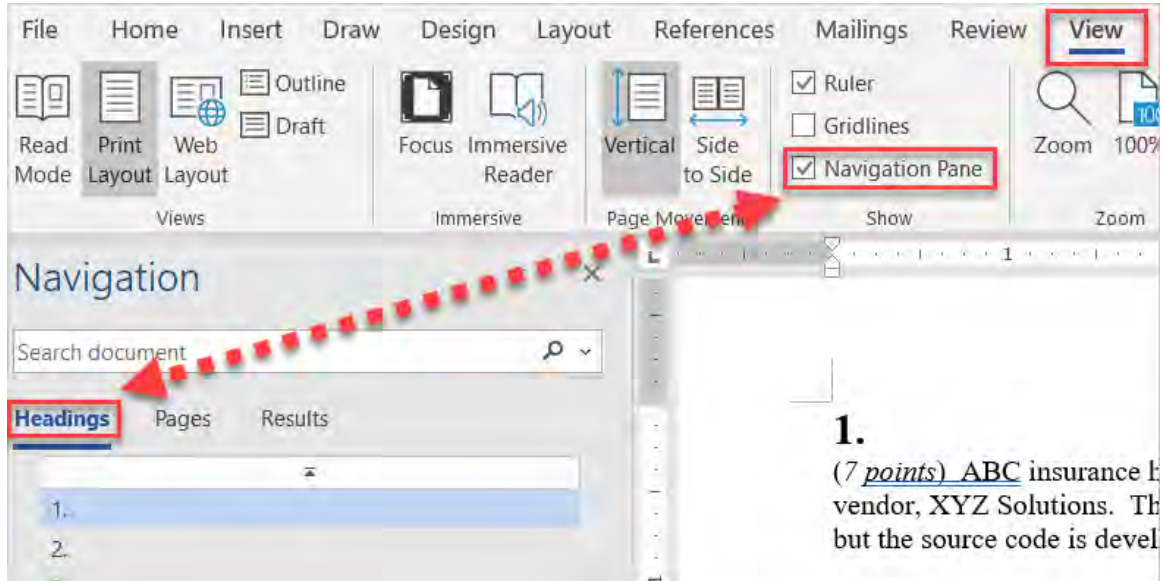
Written-Answer Instructions

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 five-digit candidate number in the filename.
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) ABC Insurance has a book of business with the following information:

- There were 1,000 annual policies in force on January 1, 2022, each with an annual premium of 2,100, and a renewal date of April 1.
- These policies had a renewal rate of 80% on April 1, 2022, and a renewal rate of 70% on April 1, 2023.
- The following four other policies have been written:

Policy Number	Effective Date	Policy Term (months)	Written Premium
100	Mar. 1, 2022	12	3,000
200	May 1, 2022	24	4,200
300	Jul. 1, 2022	18	2,100
400	Sep. 1, 2023	6	1,200

- Policy 100 was renewed on March 1, 2023.
- Policy 300 was cancelled on October 1, 2023.
- Policies 100, 200, and 400 were still in force on December 31, 2023.
- Premiums for all policies written or renewed on or after April 1, 2022, were increased by 5%.
- Premiums for all policies written or renewed on or after April 1, 2023, were increased by 8%.
- ABC earns premium evenly throughout the year.

- (a) (2 points) Calculate the total earned premium for calendar year 2022.
- (b) (2 points) Calculate the total unearned premium as of December 31, 2023.

ABC is conducting a ratemaking analysis with new rates to be effective April 1, 2024.

- (c) (1.5 points) Calculate the calendar year 2022 earned premium at current rate levels using the extension of exposures method.
- (d) (0.5 points) State why the parallelogram approach is not as accurate as the extension of exposures method used in part (c).

2.

Provide the response for this question in the Excel spreadsheet.

(5 points) You are estimating ultimate claims as of December 31, 2023 for a line of business that has seasonality.

Accident Half-Year	Reported Claims							
	6	12	18	24	30	36	42	48
2020-1	1,778,236	1,817,664	1,906,195	1,918,947	1,938,911	1,949,451	1,951,269	1,951,269
2020-2	1,801,831	1,896,710	1,942,431	1,969,627	1,990,982	2,002,627	2,004,998	
2021-1	1,930,879	1,983,793	2,069,155	2,084,933	2,109,125	2,121,231		
2021-2	1,944,003	2,034,385	2,091,282	2,125,691	2,146,588			
2022-1	2,075,131	2,126,932	2,205,071	2,220,455				
2022-2	2,137,034	2,253,530	2,273,987					
2023-1	2,243,409	2,283,355						
2023-2	2,451,221							

There is no development after 48 months.

- (a) (2.5 points) Calculate the ultimate claims for accident year 2023 using the development method. Justify your selections.
- (b) (1 point) Calculate the accident year 2023 expected reported claims from December 31, 2023 to June 30, 2024.

Some lines of business require a tail factor.

- (c) (0.5 points) Describe one disadvantage of the Bondy method.
- (d) (1 point) State one advantage and one disadvantage of Boor’s algebraic method.

3.

Provide the response for this question in the Excel spreadsheet.

(4 points) You are analyzing premium trend on a large book of business for a ratemaking exercise.

- (a) (0.5 points) Explain the purpose of quantifying the effect of shifts in the mix of exposures and rating characteristics on the premium during the experience period.

Based on an analysis of the historical premium for this book of business, the annual premium trend has been 1.5% prior to January 1, 2024. You are expecting a significant change in the economic environment and have therefore selected an annual trend of 3.0% for all policies written on or after January 1, 2024. All policies are six-month policies, written evenly throughout each year. The new rates will be in effect starting October 1, 2024 for one year.

- (b) (1.5 points) Calculate the 2020 premium trend factor to be used to adjust 2020 earned premiums for the ratemaking exercise.
- (c) (1 point) Explain how the premium trend factors would be affected by the following:
- (i) An increasing proportion of insureds choosing a lower policy limit at the beginning of 2024
 - (ii) An increasing proportion of insureds choosing a higher deductible at the beginning of 2024
- (d) (1 point) Describe why the trending periods would be different in the part (b) calculation if this trending analysis is done for a self-insurer.

4.

(4 points)

- (a) (0.5 points) Provide one reason why the expected method is preferred over the development method when estimating ultimate claims for a new line of business.

ANSWER:

- (b) (0.5 points) Explain why a pure premium approach is preferred over an expected claim ratio approach when developing expected claims for self-insurers.

ANSWER:

You are estimating ultimate claims as of December 31, 2023, using the expected method. You have estimated trended on-level claim ratios at 2023 cost levels for all accident years.

- (c) (1 point) Provide two reasons why the trended on-level claim ratio for accident year 2023 might be excluded when selecting the 2023 cost level expected claim ratio.

ANSWER:

- (d) (2 points) Explain the steps you would follow to apply the expected method to estimate ultimate salvage received for a collision line of business.

ANSWER:

5.

Provide the response for this question in the Excel spreadsheet.

(11 points) You are conducting a ratemaking analysis for a line of business in state S with the following information:

- The new rates are to be effective September 1, 2024, through August 31, 2025.
- All policies are written for 6-month policy terms.
- The annual frequency trend is -1% .
- The annual severity trend is 5% .

You are also given the following state S claims data for non-hurricane weather excluding hail:

Accident Year	Ultimate	
	Frequency per 100 earned house years (EHY)	Severity
2014	2.02	4,100
2015	0.39	3,500
2016	1.99	2,900
2017	0.10	4,400
2018	1.99	2,800
2019	0.80	4,200
2020	0.63	2,600
2021	2.73	3,600
2022	0.56	2,100
2023	1.69	3,100

- (a) (2 points) Calculate the trended ultimate non-hurricane weather excluding hail pure premium per 100 EHY for all years.
- (b) (0.5 points) Recommend the trended ultimate non-hurricane weather excluding hail pure premium per 100 EHY to use in determining a weather loading. Justify your recommendation.

5. Continued

You are given the following additional information:

- Calendar year 2023 earned premiums at current rate level are 13,089,711.
 - Calendar year 2023 EHY are 17,931.
 - State S is part of region R.
 - The trended ultimate pure premium per 100 EHY for region R is 4,000.
 - The credibility that relates to the non-hurricane weather excluding hail loading for state S is 70%.
- (c) (1 point) Calculate the non-hurricane weather excluding hail loading percentage to use for ratemaking.

Actuaries can have flexibility in choosing the number of years to include in the experience period for ratemaking purposes.

- (d) (1 point) Identify two considerations when choosing the number of years and/or the weights to assign to each of the years.

You are given the following data:

Accident Year	Earned Exposures	Ultimate Counts	Historical Earned Premiums	Ultimate Claims
2019	20,675	1,070	13,510,549	8,709,600
2020	19,937	1,075	13,268,660	8,673,608
2021	17,061	1,074	11,739,370	7,919,295
2022	17,992	1,141	12,638,750	8,605,528
2023	17,931	1,087	13,089,711	9,489,317

The full credibility standard is 3,654 ultimate counts.

- (e) (1 point) Recommend the number of years to include when estimating the weighted average trended claim ratio for the indicated rate change. Justify your recommendation.

5. Continued

- (f) (1 point) Recommend the weights to assign to each year when estimating the weighted average trended claim ratio for the indicated rate change. Justify your recommendation.

You are given the following additional information:

- Rate change history:
 - A rate change of +3% was effective July 1, 2020
 - A rate change of +4% was effective July 1, 2022
 - Premiums are written and earned evenly throughout the year.
 - The annual premium trend is 0%.
 - The ratio of ULAE to claims is 5%.
 - The ratio of fixed expenses to premiums at current rates is 3%.
 - The ratio of variable expenses to premiums is 12%.
 - The ratio of profit and contingencies to premiums is 4%.
- (g) (4.5 points) Calculate the indicated rate change for this line of business.

6.

(3 points) You are conducting an expense analysis to be used in ratemaking.

- (a) (0.5 points) Describe how you might account for a start-up cost expense.

ANSWER:

- (b) (1 point) Explain whether a residual market assessment would be considered a fixed or variable expense.

ANSWER:

- (c) (0.5 points) Describe a possible consequence to an insurer treating fixed expenses as variable expenses when determining rates.

ANSWER:

- (d) (1 point) Describe two situations where you might cap the percentage of variable expenses in a ratemaking analysis.

ANSWER:

7.

Provide the response for this question in the Excel spreadsheet.

(5 points) You are estimating IBNR for a line of business using the following information:

Accident Year (AY)	Historical Earned Premiums	Premium On-Level Factor	Cumulative Paid Claims	Case Estimates
2021	10,119,409	1.034	5,155,384	457,851
2022	10,552,425	1.020	3,785,833	896,859
2023	10,850,455	1.000	2,247,631	1,306,801

Reported Claim Development Factors by Development Months					
12-24	24-36	36-48	48-60	60-72	72-Ult.
1.445	1.271	1.154	1.073	1.014	1.000

- The expected claim ratio at the 2023 cost level is 76.0%.
- The annual claim ratio trend is 6.1%.
- The annual premium trend is 0%.

- (a) (3.5 points) Calculate the IBNR for each AY as of December 31, 2023 using:
- (i) the Development method,
 - (ii) the Bornhuetter Ferguson method, and
 - (iii) two iterations of the Benktander method.
- (b) (1 point) Explain if this business is performing better or worse than expected for AY 2023 using the methods above.

One of the weaknesses of the Benktander method is that there is no clear guidance with respect to the appropriate number of iterations to perform.

- (c) (0.5 points) Identify one other weakness of the Benktander method.

8.

Provide the response for this question in the Excel spreadsheet.

(6 points) According to Mango and Allen, one reason the classical paid-to-paid method produces a conservative estimate of unpaid ULAE is that the cost of ULAE per thousand dollars of claims is a decreasing function of the average claim size.

- (a) (1 point) Provide another reason why the classical paid-to-paid method overstates unpaid ULAE, even in a steady state environment.
- (b) (1 point) Describe two situations where the Mango and Allen smoothing adjustment is particularly valuable in producing a more reasonable estimate of unpaid ULAE.

Insurer STL started writing Professional Liability business on January 1, 2019.

You are given the following:

Report Year	Estimated Ultimate Claims
2019	5,331,195
2020	4,622,596
2021	5,116,924
2022	5,524,846
2023	6,060,412

Maturity Age in Months	Reported Age-to-Ultimate Factors
12	3.505
24	2.020
36	1.765
48	1.420
60	1.165

8. Continued

Calendar Year	Paid ULAE	Expected Paid Claims
2019	278,480	991,462
2020	323,800	1,170,742
2021	369,200	1,573,118
2022	448,080	2,346,706
2023	675,994	3,297,712

- (c) (3 points) Calculate the ULAE ratio for each year using the Mango and Allen smoothing adjustment based on paid and reported claim data.
- (d) (0.5 points) Recommend a ULAE ratio to use for this line of business. Justify your recommendation.

You are provided with the following additional information:

- 30% of ULAE is associated with opening a claim file, while 70% relates to maintaining and closing a claim file
 - Total claim liabilities are 5,750,000
 - Case estimates for existing reported claims are 3,250,000
- (e) (0.5 points) Calculate unpaid ULAE as of December 31, 2023 using the recommended ratio from part (d).

9.

(3 points)

- (a) (1 point) Describe two differences between the Cape Cod method and the Generalized Cape Cod method for estimating ultimate claims.

ANSWER:

The Cape Cod method is similar to the Bornhuetter Ferguson method in that it is a blend of the development and expected methods.

- (b) (1 point) Describe two major differences between the Bornhuetter Ferguson and Cape Cod methods.

ANSWER:

- (c) (1 point) Describe two advantages that blended methods provide when evaluating and selecting estimates of ultimate claims.

ANSWER:

10.

Provide the response for this question in the Excel spreadsheet.

(7 points) You are estimating ultimate claims for a line of business as of December 31, 2023. Your reserving software produces the following preliminary estimates based on age-to-age development factors.

Accident Year	Reported Claims						Ultimate Claims
	12	24	36	48	60	72	
2018	2,547,815	3,882,690	4,892,823	5,569,866	5,949,436	6,457,536	7,009,030
2019	2,838,865	4,127,622	5,006,184	5,807,333	6,766,801		7,971,966
2020	2,937,668	4,227,315	5,435,742	6,403,965			8,424,818
2021	3,135,121	4,466,810	5,821,531				8,875,100
2022	3,231,963	4,537,564					8,754,568
2023	3,311,902						9,259,675

Accident Year	Cumulative Paid Claims						Ultimate Claims
	12	24	36	48	60	72	
2018	1,473,977	2,934,650	4,236,143	5,227,761	5,923,948	6,457,536	7,039,187
2019	1,706,744	3,161,169	4,325,672	5,447,559	6,761,362		8,034,251
2020	1,733,016	3,228,227	4,689,331	6,256,636			8,826,037
2021	1,851,625	3,385,403	5,483,690				9,869,855
2022	1,838,698	3,759,628					9,954,417
2023	2,081,240						10,557,046

Accident Year	Reported Counts						Ultimate Counts
	12	24	36	48	60	72	
2018	886	1,138	1,298	1,392	1,457	1,471	1,485
2019	899	1,134	1,275	1,392	1,464		1,492
2020	893	1,128	1,297	1,402			1,499
2021	909	1,117	1,299				1,503
2022	908	1,113					1,474
2023	899						1,491

Accident Year	Closed Counts						Ultimate Counts
	12	24	36	48	60	72	
2018	574	862	1,070	1,210	1,319	1,471	1,641
2019	589	862	1,048	1,209	1,436		1,786
2020	581	862	1,066	1,331			1,885
2021	593	847	1,199				2,000
2022	587	928					1,977
2023	626						1,990

- This line of business was stable prior to 2023.
- New procedures for processing and settling claims were introduced in 2023.
- Ultimate estimates shown above are based on simple development methods.

10. Continued

- (a) (2 points) Perform two diagnostic tests to confirm that there was a change in claim settlement patterns in 2023.

The annual claim severity trend is 5%.

- (b) (1 point) Perform one diagnostic test to determine whether there was a change in case adequacy in 2023.

You have decided to use Berquist-Sherman adjustments to allow for changes in the claim settlement rates. Your analysis indicates that there is a simple relationship between cumulative paid claims and cumulative closed counts for all accident and development years. The ratio of cumulative paid claims to cumulative closed counts is 4,400.

- (c) (2 points) Calculate the adjusted paid claims triangle.
- (d) (0.5 points) Describe an alternative approach that could be used for determining ratios of paid claims to cumulative closed counts.
- (e) (0.5 points) Describe a possible problem with the alternative approach identified in part (d).

Your colleague recommends using the Berquist-Sherman approach that adjusts for both a change in case adequacy and a change in claim settlement patterns for this line of business.

- (f) (1 point) Critique your colleague's recommendation.

11.

(4 points) You are estimating unpaid claims for lines of business where conditions have been changing.

A legislative reform limiting claim payments was implemented effective July 1, 2020.

- (a) (1 point) Describe how this reform would affect the reported claims development triangle evaluated as of December 31, 2023, assuming the following:
- (i) The reform affected only new claims.
 - (ii) The reform affected new and open claims.

ANSWER:

- (b) (1 point) Describe why the expected method could be well-suited to estimate claims under scenario (a)(i) above.

ANSWER:

- (c) (1 point) Describe why a Berquist-Sherman data adjustment could be well-suited to estimate claims under scenario (a)(ii) above.

ANSWER:

- (d) (0.5 points) Describe whether this reform would affect indemnity, ALAE, ULAE, or some combination.

ANSWER:

- (e) (0.5 points) Describe whether this reform would affect paid data, reported data, or both paid and reported data.

ANSWER:

12.

Provide the response for this question in the Excel spreadsheet.

(7 points) You are estimating ultimate claims for a line of business as of December 31, 2023 using the development-based frequency-severity method.

- (a) (1 point) Describe two options to consider when experience is not fully credible for trending.

You are given the following additional information:

Accident Year	Earned Exposures	Projected Ultimate Counts Based on	
		Closed Counts	Reported Counts
2018	16,451	1,641	1,485
2019	16,557	1,786	1,492
2020	16,815	1,885	1,499
2021	16,915	2,000	1,503
2022	17,147	1,977	1,474
2023	17,461	1,990	1,491

- This line of business was stable prior to 2023, when new claims processing and settlement policies were introduced in 2023.
 - Ultimate estimates shown above are based on simple development methods.
- (b) (1.5 points) Recommend the annual claim frequency trend to use for this line of business. Justify your recommendation.
- (c) (1.5 points) Calculate the ultimate counts using the development-based frequency-severity method with your selected frequency trend from part (b). Justify any selections.

12. Continued

You are given the following additional information:

Accident Year	Projected Ultimate Severity Based on	
	Paid Severity	Reported Severity
2018	4,390	4,719
2019	4,602	5,342
2020	4,789	5,618
2021	5,085	5,857
2022	5,196	5,923
2023	5,456	6,168

The annual claim severity trend is 5%. The selected trend rate should recognize economic trend.

- (d) (0.5 points) State one other influence that the trend rate should also recognize.
- (e) (2.5 points) Calculate the ultimate claims using the development-based frequency-severity method. Justify any selections.

13.

Provide the response for this question in the Excel spreadsheet.

(5 points) You are given the following data for a line of business from your company's internal data source:

Accident Year	Reported Claims from Internal Data Source					
	12	24	36	48	60	72
2015	2,073,186	2,977,355	3,689,430	4,344,924	4,635,919	4,691,541
2016	2,214,894	3,167,365	4,021,756	4,613,081	4,945,867	5,014,244
2017	2,339,966	3,357,699	4,299,159	4,992,272	5,303,741	5,364,852
2018	2,442,143	3,577,869	4,576,972	5,228,180	5,653,369	5,760,949
2019	2,592,402	3,757,301	4,853,532	5,625,219	6,054,505	
2020	2,817,613	4,182,588	5,212,351	6,024,272		
2021	3,075,951	4,425,866	5,613,235			
2022	3,232,412	4,682,692				
2023	3,554,432					

Accident Year	Cumulative Paid Claims from Internal Data Source					
	12	24	36	48	60	72
2015	1,286,342	2,412,544	3,380,499	4,184,900	4,587,477	4,691,541
2016	1,419,281	2,553,776	3,692,376	4,472,461	4,899,904	5,014,244
2017	1,474,216	2,703,709	3,940,993	4,833,876	5,248,486	5,364,852
2018	1,470,542	2,889,545	4,189,625	5,064,468	5,604,641	5,760,949
2019	1,607,264	2,999,878	4,445,019	5,419,708	5,967,598	
2020	1,747,620	3,387,292	4,766,703	5,724,228		
2021	1,964,983	3,552,637	5,155,384			
2022	1,980,306	3,785,833				
2023	2,247,631					

There is no development beyond 72 months.

13. Continued

Your company reports its data to an industry bureau that aggregates industry data. The industry bureau provided the following summary of the information they received from your company:

Calendar Year (CY)	Claims Paid During CY	Change in Case Estimates During CY
2021	1,762,048	114,622
2022	1,564,355	291,478
2023	2,332,776	-156,760

- (a) (1.5 points) Verify that the change in case estimates during calendar year 2023 from the industry summary should be 223,240.

An investigation into the difference in the numbers found that it was due to an incorrect value reported to the industry bureau.

- (b) (1.5 points) Identify the value that was reported in error to the industry bureau.

You are given the following claims information regarding two claims for a different line of business:

- Claim #4400 is a claim file from an accident that occurred on March 1, 2021 and was reported to the insurer on October 1, 2021. The claim file originally closed in 2022 but was later reopened in 2023. The company does not treat such claims as a new claim, but as reopening the original claim file.
 - Claim #5500 is a claim file from an accident that occurred on July 1, 2021 and was reported to the insurer on February 1, 2022. The adjuster set an initial case estimate of 12,000. Upon further investigation, on February 1, 2023 this claim was found to not be covered under the insurance policy purchased by the insured, and the claim file was closed with no claim payments made.
- (c) (1 point) Construct a *reported* count triangle that reflects the development on these two claim files over time. Make sure to correctly label your triangles.
- (d) (1 point) Construct a *closed* count triangle that reflects the development on these two claim files over time. Make sure to correctly label your triangles.

****END OF EXAMINATION****