Exam GIRR

Date: Wednesday, November 9, 2022

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 20 questions numbered 1 through 20 with a total of 100 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:
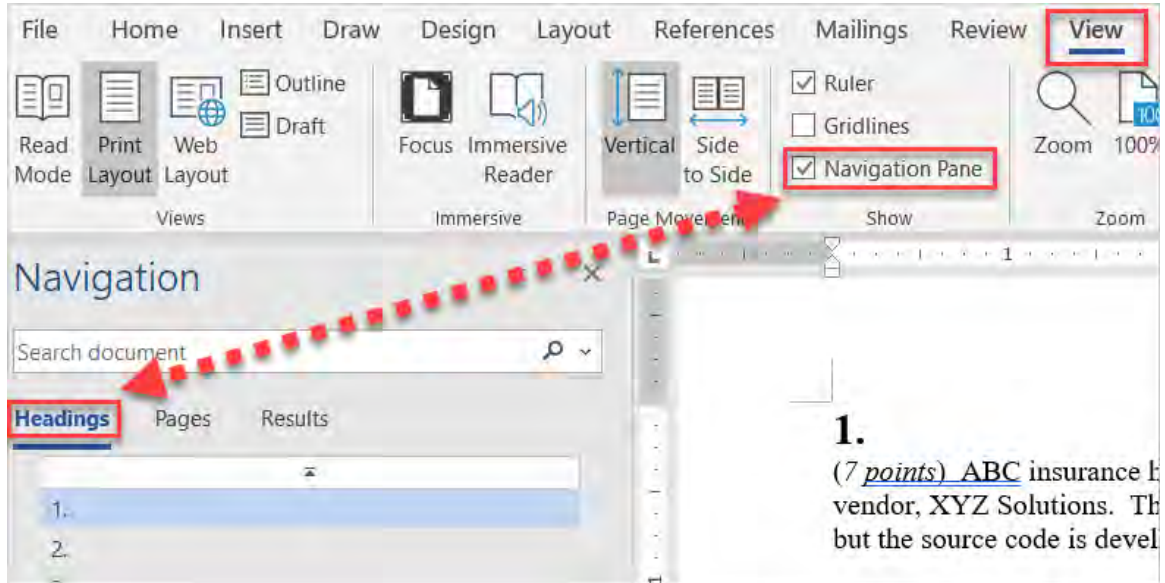
1.

(*4 points*) A suburban city flooded, damaging 80 vehicles parked in an underground garage. The garage's owner is liable to each vehicle owner for 1,000 in property liability damage. The garage owner maintains a large deductible policy which includes property damage liability coverage.

(a) (*1.5 points*) Calculate the losses retained by the garage owner under each of the following deductible scenarios:

   (i)   Straight deductible of 500 per vehicle

   (ii)   Deductible of 20% of the garage owner's liability

   (iii) Diminishing deductible per event where:

   - The garage owner would fully retain any losses less than 50,000,
   - The insurer would pay the total value of any covered loss greater than 100,000, and
   - Losses with a total value between 50,000 and 100,000 would be proportionately shared between the garage owner and the insurer.

   Provide the response for this part in the Excel spreadsheet.

(b) (*0.5 points*) State one advantage of a deductible from an insurer's perspective.

   Provide the response for this part in the Excel spreadsheet.

1. Continued

The garage facility was also damaged with losses of 450,000. The garage is valued at 800,000. There is no deductible on the coverage for the facility.

(c)   (*1.5 points*) Calculate the claims paid by the insurer under each of the following scenarios:

   (i)   The insured purchased coverage of 200,000 with a 50% coinsurance requirement.

   (ii)   The insured purchased coverage of 500,000 with an 80% coinsurance requirement.

   (iii)   The insured purchased coverage of 750,000 with a 90% coinsurance requirement.

   Provide the response for this part in the Excel spreadsheet.

(d)   (*0.5 points*) State one reason why insurers favor including a coinsurance requirement in property policies.

   Provide the response for this part in the Excel spreadsheet.

2.

(*4 points*) You are conducting a ratemaking analysis for a personal automobile line of business. You are given the following information:

The following rate changes have occurred since 2017:

Effective Date	Rate Change
July 1, 2017	5.0%
September 1, 2018	–2.0%
February 1, 2020	7.0%
October 1, 2021	3.0%

- There was a regulatory change where all premiums in force on May 1, 2019 were reduced by 10%.
- All policies are written for twelve-month policy terms.
- All policies are assumed to be written uniformly throughout a calendar year.
- New rates will be effective January 1, 2023.
- Calendar year 2019 earned premium is 1,400,000.

(a) (*2 points*) Calculate the 2019 earned premium adjusted to current rate levels for ratemaking purposes.

> *Provide the response for this part in the Excel spreadsheet.*

(b) (*1 point*) Explain why the answer to part (a) would be higher if all policies were six-month policies instead of twelve-month policies.

> *Provide the response for this part in the Excel spreadsheet.*

The regulator is considering an increase to the state-mandated minimum policy limits effective January 1, 2023. Premiums will change to reflect this policy limits change.

(c) (*1 point*) Explain what affect this change would have on the on-level calculation from part (a).

> *Provide the response for this part in the Excel spreadsheet.*

3.

(*5 points*)

(a) (*1.5 points*) Describe three reasons why an insurer might purchase reinsurance coverage.

ANSWER:

(b) (*1.5 points*) Demonstrate how a reinsurance agreement with a 80% to 90% loss ratio corridor would operate.

ANSWER:

Insurer I purchases a per risk excess of loss reinsurance contract from Reinsurer R with a 5 million excess of 3 million limit. The reinsurance contract also includes a 10 million annual aggregate deductible.

Insurer I experiences the following claims covered by the policy:

Claim Number	Ultimate Claims
1	5,500,000
2	2,000,000
3	4,500,000
4	7,000,000
5	4,000,000

(c) (*2 points*) Calculate the amount paid by I and R for each claim.

Provide the response for this part in the Excel spreadsheet.

4.

(*4 points*) You are estimating accident year (AY) 2021 ultimate claims by layer for a liability line of business. You are given the following information evaluated as of December 31, 2021:

Selected Age-to-Age Factors for Reported Claims at Alternative Limits					
Limit	12-24	24-36	36-48	48-60	60-72
2,000,000	1.735	1.158	1.112	1.063	1.045
1,000,000	1.728	1.153	1.090	1.049	1.034
500,000	1.716	1.149	1.086	1.041	1.031

Severity Relativity (R_t) to 2 Million Limit						
Limit	12	24	36	48	60	72
1,000,000	0.952	0.948	0.945	0.942	0.884	0.850
500,000	0.895	0.890	0.886	0.880	0.810	0.765

Limit	AY 2021 Reported Claims at Alternative Limits
2,000,000	4,912,320
1,000,000	4,614,775
500,000	4,520,083

Limit	Industry-Based Increased Limit Factor (ILF)
2,000,000	1.225
1,000,000	1.075
500,000	1.000

- No claim for this line of business can exceed 2,000,000.
- There is no claim development beyond 72 months.
- The industry-based ILFs are applicable to claims.

4. Continued

(a)   (*3 points*) Calculate the ultimate claims for AY 2021 in the layer 500,000 excess of 500,000 using each of the following approaches:

   (i)   Selected development factors

   (ii)   Theoretical development factors based upon Siewert's formulas

   (iii)   Industry ILFs

   > *Provide the response for this part in the Excel spreadsheet.*

(b)   (*1 point*) Calculate ILFs for 2,000,000 and 1,000,000, assuming a basic limit of 500,000, using each of the following approaches:

   (i)   Selected development factors

   (ii)   Theoretical development factors based upon Siewert's formulas

   > *Provide the response for this part in the Excel spreadsheet.*

5.

(*4 points*) You are conducting an expense analysis to be used in ratemaking for a line of business, and are given the following information:

Calendar Year	Earned Premiums	Earned Premiums at Current Rate Level	Fixed Expenses
2016	13,525,260	17,480,000	543,630
2017	14,287,260	18,239,240	586,640
2018	15,646,150	19,120,010	634,770
2019	16,642,150	19,993,320	684,470
2020	18,527,760	20,826,540	734,250
2021	20,737,090	21,816,000	792,360

(a)   (*1 point*) Calculate the historical annual trend in fixed expenses.

> *The response for this part is to be provided in the Excel spreadsheet.*

(b)   (*0.5 points*) Recommend the annual fixed expense trend. Justify your recommendation.

> *The response for this part is to be provided in the Excel spreadsheet.*

You are given the following additional information:

- New rates will be effective June 1, 2023 for one year.
- All policies are written as 12-month policies.
- The annual premium trend is 1%.

(c)   (*2.5 points*) Calculate the fixed expense ratio to be used in ratemaking, using a simple average from calendar years 2019, 2020 and 2021.

> *The response for this part is to be provided in the Excel spreadsheet.*

6.

(*12 points*) You are estimating ultimate claims for a long-tailed line of business, and are given the following information:

Accident Year	Earned Exposures	Projected Ultimate Based on Reported Claims Development Method		
		Counts	Claims	Severity
2015	11,090	1,230	5,348,724	4,349
2016	11,250	1,270	5,926,222	4,666
2017	11,460	1,305	6,528,246	5,002
2018	11,770	1,349	7,227,370	5,358
2019	12,070	1,381	8,120,976	5,881
2020	12,360	1,447	9,136,918	6,314
2021	12,480	1,480	9,678,673	6,540
Total	**82,480**	**9,462**	**51,967,129**	

- The annual claim frequency trend is 1%.
- The annual claim severity trend is 6.5%.

(a)   (*3 points*) Calculate ultimate claims using the development-based frequency-severity method.

> *Provide the response for this part in the Excel spreadsheet.*

Diagnostic testing revealed that this line of business has had strengthening of case estimates in calendar year 2021. You are provided with the following additional information:

Accident Year	Reported Claims						
	12	24	36	48	60	72	84
2015	1,906,608	2,666,402	3,459,325	4,177,978	4,782,824	5,202,046	5,274,875
2016	2,023,029	2,921,757	3,795,342	4,577,229	5,158,981	5,763,708	
2017	2,207,357	3,082,180	4,057,723	4,924,637	5,759,272		
2018	2,389,192	3,427,092	4,397,500	5,558,325			
2019	2,550,446	3,683,042	5,107,412				
2020	2,695,059	4,364,690					
2021	3,175,077						

6. **Continued**

Accident	Paid Claims						
Year	12	24	36	48	60	72	84
2015	734,782	1,253,583	1,905,611	2,640,076	3,434,180	4,178,154	4,637,751
2016	767,982	1,372,261	2,087,061	2,927,979	3,704,517	4,546,408	
2017	799,315	1,350,784	2,259,191	3,126,494	4,007,167		
2018	899,087	1,635,498	2,443,217	3,379,326			
2019	968,418	1,736,844	2,639,562				
2020	1,026,656	1,937,498					
2021	1,082,487						

Accident	Reported Counts						
Year	12	24	36	48	60	72	84
2015	732	865	996	1,095	1,166	1,214	1,222
2016	752	902	1,023	1,125	1,200	1,253	
2017	780	921	1,041	1,167	1,235		
2018	804	961	1,083	1,201			
2019	813	975	1,110				
2020	835	1,024					
2021	875						

Accident	Closed Counts						
Year	12	24	36	48	60	72	84
2015	336	545	730	879	998	1,094	1,138
2016	346	575	747	902	1,027	1,129	
2017	356	575	760	936	1,056		
2018	368	611	794	964			
2019	369	618	807				
2020	380	648					
2021	400						

(b)   (*2 points*) Construct the reported claims triangle adjusted for the change in case adequacy.

Provide the response for this part in the Excel spreadsheet.

6. Continued

You are provided with the following average ultimate reported severities, adjusted for the change in case adequacy:

Accident Year	Ultimate Reported Severities
2015	4,316.59
2016	4,561.67
2017	4,813.61
2018	5,066.25
2019	5,441.62
2020	5,802.31
2021	5,990.39

(c) (*1.5 points*) Recommend the revised annual claim severity trend. Justify your recommendation.

Provide the response for this part in the Excel spreadsheet.

(d) (*1 point*) Explain why you might expect the answer to part (c) to be lower than the original annual severity trend of 6.5%.

Provide the response for this part in the Excel spreadsheet.

(e) (*0.5 points*) Calculate ultimate claims using the ultimate counts provided and ultimate reported severities adjusted for the change in case adequacy.

Provide the response for this part in the Excel spreadsheet.

(f) (*2 points*) Calculate expected claims for all accident years using the expected method and your recommended annual claim severity trend from part (c). Justify any selections.

Provide the response for this part in the Excel spreadsheet.

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

Provide the response for this part in the Excel spreadsheet.

6. **Continued**

You projected ultimate claims using several methods above.

(h)   (*1 point*) Recommend the selected ultimate claims for accident year 2021 for this line of business. Justify your recommendation.

> *Provide the response for this part in the Excel spreadsheet.*

7.

(*4 points*) You are given the following information for an investigative analysis:

Accident Year	Reported Claim Frequency							
	12	**24**	**36**	**48**	**60**	**72**	**84**	**96**
2014	0.017	0.018	0.019	0.019	0.019	0.019	0.019	0.019
2015	0.018	0.019	0.019	0.019	0.019	0.018	0.018	
2016	0.017	0.018	0.018	0.018	0.018	0.018		
2017	0.018	0.019	0.020	0.020	0.019			
2018	0.015	0.016	0.017	0.018				
2019	0.015	0.015	0.016					
2020	0.014	0.015						
2021	0.013							

You noticed that the claim frequency has been decreasing since accident year 2018.

(a)   (*1 point*) Describe two operational changes that could have caused this decrease.

ANSWER:

(b)   (*0.5 points*) Describe one external environmental change that could have caused this decrease.

ANSWER:

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

Accident Year	Ratios of Paid Claims to Reported Claims							
	12	**24**	**36**	**48**	**60**	**72**	**84**	**96**
2014	0.205	0.363	0.454	0.575	0.670	0.829	0.902	0.960
2015	0.187	0.357	0.425	0.570	0.667	0.813	0.868	
2016	0.213	0.367	0.442	0.559	0.656	0.772		
2017	0.198	0.359	0.438	0.551	0.614			
2018	0.196	0.373	0.447	0.490				
2019	0.190	0.365	0.375					
2020	0.203	0.295						
2021	0.150							

7. Continued

(c)   (*0.5 points*) Identify a change in pattern in this triangle.

ANSWER:

(d)   (*1 point*) Describe two possible operational changes that could have caused the pattern change identified in part (b).

ANSWER:

(e)   (*1 point*) Describe an additional test to further investigate the change in pattern identified in part (b).

ANSWER:

8.

(*6 points*) DSI provides insurance that covers the replacement of an electric vehicle's battery when it is damaged in an accident. You are given the following DSI claims experience for this product:

Age Group	Sex	Number of Vehicles	Estimated Ultimate Claims
25 and over	Male	480	52,000
	Female	160	8,000
Under 25	Male	240	38,000
	Female	120	12,000
Total		**1,000**	**110,000**

The company is using an underlying pure premium of 100 per year for every vehicle in the rating plan. Your colleague recommends increasing the pure premium to 110 for all vehicles.

(a)   (*1 point*) Critique your colleague's recommendation.

> *Provide the response for this part in the Excel spreadsheet.*

Another colleague proposes a single variable risk classification analysis for each of the variables, age group and sex. The new premium for each combination of age group and sex is determined as $P_{ij} = \mu A_i S_j$, where

- μ is the overall average pure premium underlying the experience of all insureds with given risk characteristics,
- A_i is the relativity for an insured in risk class i, age group,
  ($i = 1$ for 25 and over, $i = 2$ for under 25)
- S_j is the relativity for an insured in risk class j, sex.
  ($j = 1$ for male, $j = 2$ for female)

(b)   (*1.5 points*) Calculate A_2, S_2, and μ with the single variable risk classification analysis, by setting the base class as "25 and over", "male."

> *Provide the response for this part in the Excel spreadsheet.*

(c)   (*1.5 points*) Describe two possible issues, in general, with the use of a single variable risk classification analysis.

> *Provide the response for this part in the Excel spreadsheet.*

8. **Continued**

    (d)   (*1.5 points*) Describe two approaches that address the issues identified in part (c).

        Provide the response for this part in the Excel spreadsheet.

Credibility and homogeneity frequently present conflicting objectives in the actuarial work supporting risk classification systems.

    (e)   (*0.5 points*) Describe this conflict.

        Provide the response for this part in the Excel spreadsheet.

9.

(*4 points*) You are calculating premium liabilities as of December 31, 2021 for ABC Insurance. You are given the following information:

Gross Unearned Premium	5,000,000
Selected Ultimate Claims Ratio, including ALAE	60%

- Policies are annual and are written uniformly throughout the year.
- The only reinsurance in force during 2021 was a 20% quota share treaty covering policies written in 2021.
- Reinsurance does not cover ULAE or general expenses.
- ULAE is estimated at 10% of gross claims including ALAE.
- The general expense ratio is 20% of gross premium.
- The proportion of general expense applicable to unearned premium is 25%.

A new catastrophe excess of loss reinsurance policy will be added effective January 1, 2022. This will cover claims incurred in 2022 and apply after the quota share treaty. The cost of the catastrophe reinsurance will be 5% of net earned premium. The impact on the claim ratio is expected to be negligible.

(a)   (*3 points*) Calculate the premium deficiency reserve or equity in the unearned premium as of December 31, 2021.

> *Provide the response for this part in the Excel spreadsheet.*

Recent legislative changes will increase the cost of all claims incurred after December 31, 2021 by 50%.

(b)   (*1 point*) Recalculate the premium deficiency reserve or equity in the unearned premium as of December 31, 2021, incorporating this legislative change.

> *Provide the response for this part in the Excel spreadsheet.*

10.

(*4 points*) You are the reserving actuary for a workers' compensation book of business with the following characteristics:

- Exposures have decreased over the last ten years.
- Pure premiums have increased in recent years. Rates have not kept up with these increases.
- The frequency trend is stable.
- A new claims department manager was hired July 1, 2021. An initiative to strengthen case adjuster claim estimates was implemented by the new manager.

You are estimating ultimate claims by accident year evaluated as of December 31, 2021. You are considering several different methods for projecting ultimate claims for the two most recent accident years.

(a)   (*3 points*) Describe two weaknesses in selecting each of the following methods to estimate ultimate claims for these accident years.

     (i)   Development Method using reported data.

     (ii)   Generalized Cape Cod Method using reported data.

> ANSWER:

(b)   (*1 point*) Evaluate the appropriateness of selecting the Expected Method using reported pure premium data to estimate ultimate claims for the two most recent accident years.

> ANSWER:

11.

(*5 points*) You are given the following information for two policies with exposures that are earned evenly throughout the policy period:

- Policy number 101 is a semi-annual policy written on November 1, 2021.
- Policy number 102 is a two-year policy written on July 15, 2021.

(a)   (*1 point*) Describe the option(s) for recognizing written exposures on each policy.

> *Provide the response for this part in the Excel spreadsheet.*

(b)   (*0.5 points*) Calculate the percentage premium *earned* on December 31, 2021 for policy number 101.

> *Provide the response for this part in the Excel spreadsheet.*

(c)   (*0.5 points*) Calculate the percentage premium *unearned* on December 31, 2021 for policy number 102.

> *Provide the response for this part in the Excel spreadsheet.*

For some lines of general insurance, written exposures are not earned evenly throughout the policy term.

(d)   (*1.5 points*) Explain why a warranty policy is not likely to have exposures earned evenly throughout the policy term.

> *Provide the response for this part in the Excel spreadsheet.*

(e)   (*1.5 points*) Describe three types of coverages or policies, other than a warranty policy, where it may not be appropriate to assume premiums are earned evenly throughout the policy term.

> *Provide the response for this part in the Excel spreadsheet.*

12.

(*5 points*) You are estimating unpaid unallocated loss adjustment expenses (ULAE) as of December 31, 2021 using the Wendy Johnson count-based method, and are given the following weights for three different claim types:

Newly Reported Counts	25%
Open Counts	55%
Closed Counts	20%

Selected claim count weights are typically based on special studies.

(a)   (*0.5 points*) Describe one such special study.

Provide the response for this part in the Excel spreadsheet.

You are given the following additional information:

Accident	Incremental Reported Counts					
Year	12	24	36	48	60	72
2016	1,033	28	26	1	0	0
2017	1,081	32	16	0	0	
2018	1,122	59	8	0		
2019	828	41	25			
2020	799	34				
2021	806					

Accident	Incremental Closed Counts					
Year	12	24	36	48	60	72
2016	636	210	87	21	4	1
2017	650	263	64	10	0	
2018	694	274	71	12		
2019	521	222	69			
2020	511	210				
2021	530					

Calendar Year	Paid ULAE
2018	718,960
2019	738,400
2020	746,800
2021	787,600

12. **Continued**

- The annual claim trend is 2%.

(b) (*3 points*) Recommend an average ULAE per weighted count. Justify your recommendation.

Provide the response for this part in the Excel spreadsheet.

You are given the following projected reported and closed claim counts as of December 31, 2021:

Calendar Year	Newly Reported Counts	Closed Counts
2022	208	528
2023	69	350
2024	5	150
2025	0	108
2026	0	25

(c) (*1.5 points*) Calculate estimated unpaid ULAE as of December 31, 2021.

Provide the response for this part in the Excel spreadsheet.

13.

(*4 points*) You are analyzing the reported development triangle for a liability line of business. The business consists of policies from country Alpha and country Beta. The claims development patterns are assumed to be similar for both countries. Claim amounts from country Beta policies are converted from country Beta currency to country Alpha currency. The analysis is on a combined basis from the two countries because there is an insufficient volume of data for stable development factors from country Beta. The reported triangle used in the analysis includes accident years (AYs) 2014 to 2021. Also, the company's financial reporting is entirely in Alpha currency.

The currency exchange rate is generally fixed and adjusted infrequently. The following table shows the currency exchange rates:

Date	Beta Currency (= 1.00 Alpha Currency)
Jan. 1, 2013 to Dec. 31, 2018	1.02
Jan. 1, 2019 to Dec. 31, 2020	1.15
Jan. 1, 2021 to present	1.30

- Claim payments are converted at the rate in effect when the payment is made.
- Case estimates are converted at the rate in effect at each calendar year-end.
- Premiums are converted at the rate in effect when the policy is written or renewed.

You are given the following additional information:

	Country Alpha	Country Beta
Policy distribution	90%	10%
Expected claims ratio	65%	60%

- The policy distribution is relatively stable over time.
- The claim frequency is similar in both countries.
- The claim frequency trend is zero in both countries.
- Claim severity and severity trend is higher in country Beta than in country Alpha.
- Premium trend is assumed to match claim trend in each country.

You are applying the following projection methods with no special adjustments:

- Development method on reported claims
- Bornhuetter Ferguson method on reported claims with an expected claim ratio of 64.5%

13. Continued

(a) (*1.5 points*) Critique each of the two methods used for the analysis. Your critique should indicate any potential bias in the methods.

ANSWER:

(b) (*1.5 points*) Propose an alternative approach or method for analyzing this data that should produce more accurate results. Justify your proposal.

ANSWER:

(c) (*1 point*) Describe how your responses to parts (a) and (b) would be affected if this were a short-tail line rather than a liability line.

ANSWER:

14.

(*6 points*) You are performing a ratemaking analysis of a homeowners book of business for State Q. As part of the analysis, you are reviewing loadings for catastrophes and large claims.

(a)   (*0.5 points*) Describe one way that large claims are differentiated from catastrophe claims when insurers are estimating loadings for ratemaking purposes.

You are given the following State Q ultimate pure premium for non-hurricane weather excluding hail (referred to as weather claims below) per 100 earned house years (EHY):

Accident Year	Pure Premium per 100 EHY
2010	5,280
2011	5,770
2012	6,330
2013	6,200
2014	6,920
2015	7,140
2016	7,560
2017	8,300
2018	8,460
2019	8,850
2020	9,400
2021	9,940

- The new rates are to be effective August 1, 2023 for one year.
- All policies are written for 12-month policy terms.

(b)   (*1 point*) Recommend the annual pure premium trend for weather claims. Justify your recommendation.

> *Provide the response for this part in the Excel spreadsheet.*

(c)   (*1.5 points*) Recommend the trended ultimate pure premium for weather claims per 100 EHY to use in ratemaking. Justify your recommendation.

> *Provide the response for this part in the Excel spreadsheet.*

14. Continued

You are given the following additional information:

	State Q Property excluding Weather Claims					
Accident Year	Earned House Years	Earned Premiums	Earned Premiums at Current Rate Level	Trended Earned Premiums at Current Rate Level	Trended Ultimate Claims	Accident Year Weights
2019	16,080	10,537,200	11,064,120	12,545,160	7,130,200	25%
2020	16,560	11,330,400	11,606,760	12,777,120	7,449,200	30%
2021	16,860	11,802,000	11,802,000	12,613,560	6,824,400	45%
Total	**49,500**	**33,669,600**	**34,472,880**	**37,935,840**	**21,403,800**	**100%**

- The full credibility standard is 80,000 EHY.
- The square root rule is used for partial credibility.
- The trended adjusted country-wide ultimate claim ratio (including ULAE) is 70%.
- The ULAE to claim ratio is 12%.
- The selected fixed expenses are 5% of premiums.
- The selected variable expenses are 15% of premiums.
- The selected profit and contingencies are 4% of premiums.

(d)   (*3 points*) Calculate the indicated rate level change, including a loading for weather claims.

Provide the response for this part in the Excel spreadsheet.

15.

(*6 points*) You are analyzing ultimate claims for a long-tailed line of business, and are given the following information:

Accident Year	Earned Exposures
2014	15,262
2015	15,567
2016	15,878
2017	16,354
2018	16,845
2019	17,687
2020	19,456
2021	24,320

Accident Year	Cumulative Paid Claims							
	12	24	36	48	60	72	84	96
2014	311,663	795,722	1,524,180	1,990,256	2,519,542	2,855,100	3,024,598	3,150,859
2015	352,341	930,301	1,580,111	2,104,607	2,700,873	3,066,239	3,334,361	
2016	328,658	1,005,033	1,875,126	2,382,118	2,941,424	3,340,680		
2017	365,949	1,062,531	1,891,013	2,706,041	3,211,463			
2018	484,892	1,196,440	2,104,325	3,005,560				
2019	520,095	1,227,907	2,385,228					
2020	535,233	1,491,676						
2021	766,038							

Accident Year	Paid Claims Age-to-Age Development Factors							
	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-Ult.
2014	2.553	1.915	1.306	1.266	1.133	1.059	1.042	
2015	2.640	1.698	1.332	1.283	1.135	1.087		
2016	3.058	1.866	1.270	1.235	1.136			
2017	2.903	1.780	1.431	1.187				
2018	2.467	1.759	1.428					
2019	2.361	1.943						
2020	2.787							
Selected	**2.681**	**1.827**	**1.353**	**1.243**	**1.135**	**1.073**	**1.042**	**1.000**

15. Continued

The selected age-to-age development factors were recommended by your colleague as the simple average of all years.

(a)   (*0.5 points*) Estimate ultimate claims using paid claims and your colleague's selected age-to-age factors.

> *Provide the response for this part in the Excel spreadsheet.*

(b)   (*0.5 points*) State two concerns with your colleague's selected age-to-age factors.

> *Provide the response for this part in the Excel spreadsheet.*

(c)   (*1 point*) Explain your rationale for each of the concerns identified in part (b).

> *Provide the response for this part in the Excel spreadsheet.*

(d)   (*1 point*) Recommend alternative selected age-to-age factors for the following. Justify your recommendations.

   (i)   12-24

   (ii)   36-48

> *Provide the response for this part in the Excel spreadsheet.*

You are given the following additional information, where the selected age-to-age development factors were also recommended by your colleague as the simple average of all years.

| Accident | Reported Claims | | | | | | | |
Year	12	24	36	48	60	72	84	96
2014	1,088,401	1,741,208	2,337,117	2,631,768	2,873,302	3,049,220	3,131,069	3,161,268
2015	1,161,528	1,901,037	2,526,912	2,874,782	3,135,434	3,337,066	3,454,115	
2016	1,274,210	2,056,524	2,786,565	3,137,931	3,421,518	3,684,648		
2017	1,351,653	2,242,800	3,042,803	3,409,629	3,787,476			
2018	1,545,679	2,512,220	3,394,929	3,878,344				
2019	1,785,869	2,834,493	3,997,935					
2020	2,050,810	3,596,409						
2021	3,028,985							

15. **Continued**

Accident Year	Reported Claims Age-to-Age Development Factors							
	12-24	**24-36**	**36-48**	**48-60**	**60-72**	**72-84**	**84-96**	**96-Ult.**
2014	1.600	1.342	1.126	1.092	1.061	1.027	1.010	
2015	1.637	1.329	1.138	1.091	1.064	1.035		
2016	1.614	1.355	1.126	1.090	1.077			
2017	1.659	1.357	1.121	1.111				
2018	1.625	1.351	1.142					
2019	1.587	1.410						
2020	1.754							
Selected	**1.639**	**1.357**	**1.131**	**1.096**	**1.067**	**1.031**	**1.010**	**1.010**

(e)   (*0.5 points*) Estimate ultimate claims using reported claims and your colleague's selected age-to-age factors.

Provide the response for this part in the Excel spreadsheet.

(f)   (*1 point*) Provide two reasons why the ultimate claims from part (e) are higher than the ultimate claims from part (a).

Provide the response for this part in the Excel spreadsheet.

Your colleague has noted that the latest diagonal of the reported age-to-age development factors triangle has increased significantly and has concluded that there has been an increase in the rate of claim settlement.

(g)   (*1.5 points*) Evaluate your colleague's conclusion.

Provide the response for this part in the Excel spreadsheet.

16.

(*4 points*) You are analyzing premium trend to use in a ratemaking analysis based on the following quarterly exposure and premium data:

Experience Period Calendar Quarter Ending	Written Exposures	Actual Written Premiums	On-Level Written Premiums
2018-1	5,229	2,443,276	2,700,678
2018-2	5,354	2,549,138	2,817,692
2018-3	5,568	2,676,306	2,958,258
2018-4	5,754	2,775,206	3,067,577
2019-1	5,931	2,918,640	3,234,297
2019-2	6,065	2,965,409	3,286,125
2019-3	6,327	3,177,321	3,520,955
2019-4	6,450	3,239,327	3,589,668
2020-1	6,697	3,502,765	3,738,994
2020-2	6,904	3,653,803	3,900,218
2020-3	7,119	3,858,738	4,118,974
2020-4	7,224	3,903,207	4,166,442
2021-1	7,520	4,255,243	4,432,677
2021-2	7,709	4,416,103	4,600,245
2021-3	7,920	4,555,392	4,745,342
2021-4	8,205	4,772,726	4,971,738
2022-1	8,422	5,114,877	5,140,873
2022-2	8,757	5,411,129	5,438,630

(a)   (*2 points*) Calculate the quarterly change in average written premiums using:

(i)   Change in quarter-to-quarter averages

(ii)   Change in rolling 4-quarter volume-weighted averages

> *Provide the response for this part in the Excel spreadsheet.*

(b)   (*1 point*) Recommend the annual premium trend. Justify your recommendation.

> *Provide the response for this part in the Excel spreadsheet.*

16. Continued

You are given the following additional information:

- First quarter 2022 on-level earned premiums are 5,136,000.
- New rates will be effective April 1, 2023, for one year.
- All policies are written for annual terms and are written and earned evenly throughout the year.

(c)   (*1 point*) Calculate the first quarter 2022 on-level earned premiums trended to the future rating period.

> *Provide the response for this part in the Excel spreadsheet.*

17.

(*7 points*)

(a)   (*0.5 points*) Provide two reasons an actuary may want to estimate ultimate ALAE separate from ultimate indemnity.

> *Provide the response for this part in the Excel spreadsheet.*

You are asked to project ultimate ALAE evaluated as of December 31, 2021 using the Cape Cod method. You are given the following information:

Accident Year	Earned Exposures	Reported ALAE as of Dec. 31, 2021	Reported ALAE Cumulative Development Factors
2014	24,282	3,617	1.000
2015	25,414	4,159	1.011
2016	26,264	2,256	1.053
2017	26,950	2,410	1.114
2018	28,044	2,051	1.234
2019	29,110	2,672	1.411
2020	29,880	4,900	1.922
2021	30,606	2,699	3.574
Total	**220,550**	**24,764**	

- The annual frequency trend is –1.5%.
- The annual severity trend is 4.0%.
- Tort reform resulted in an estimated claim decrease of 10% for all claims occurring on or after July 1, 2019.

(b)   (*2.5 points*) Calculate the adjusted expected pure premium for ALAE (i.e., ALAE cost per exposure) by accident year and in total using the Cape Cod method.

> *Provide the response for this part in the Excel spreadsheet.*

(c)   (*0.5 points*) Comment on whether or not the results from part (b) are consistent with the key assumption of the Cape Cod method.

> *Provide the response for this part in the Excel spreadsheet.*

17. Continued

(d)   (*1.5 points*) Calculate the projected ultimate ALAE by accident year using the Cape Cod method.

> *Provide the response for this part in the Excel spreadsheet.*

(e)   (*1 point*) Compare actual ALAE as of December 31, 2021 to expected ALAE from the Cape Cod method.

> *Provide the response for this part in the Excel spreadsheet.*

(f)   (*0.5 points*) Assess the actual versus expected results from part (e).

> *Provide the response for this part in the Excel spreadsheet.*

(g)   (*0.5 points*) Describe a scenario where an actuary would likely choose to apply the Generalized Cape Cod method over the Cape Cod method.

> *Provide the response for this part in the Excel spreadsheet.*

18.

(*5 points*) You are given the following claims-made data for Nurses Professional Liability coverage from the claims department.

Report Year	Nurses - Professional Liability Incremental Paid Claims (000) During Calendar Year						
	2015	2016	2017	2018	2019	2020	2021
2015	330	1,380	1,315	577	118	21	5
2016		351	1,855	1,479	428	91	8
2017			436	1,489	1,252	933	168
2018				423	1,592	1,182	670
2019					449	1,675	1,540
2020						354	1,709
2021							584

Report Year	Case Estimates (000) at Evaluation Date						
	Dec. 31, 2015	Dec. 31, 2016	Dec. 31, 2017	Dec. 31, 2018	Dec. 31, 2019	Dec. 31, 2020	Dec. 31, 2021
2015	1,169	1,368	362	116	21	5	0
2016		1,321	1,348	222	94	23	16
2017			1,456	1,378	689	177	18
2018				1,404	1,349	520	203
2019					1,247	1,701	553
2020						1,543	1,711
2021							1,350

(a)   (*1 point*) Construct a cumulative reported claim development triangle by report year.

> *Provide the response for this part in the Excel spreadsheet.*

(b)   (*0.5 points*) Calculate the calendar year 2020 reported claims for the coverage above.

> *Provide the response for this part in the Excel spreadsheet.*

18. **Continued**

You are subsequently informed that the following six claim transactions were not captured in the previous dataset.

Trans. #	Transaction Date	Transaction Description	Occurrence Date	Report Date	Change in Case Estimate (000)	Indemnity Payment (000)
1	Aug. 5, 2019	subrogation recovery	May 6, 2017	July 2, 2018		−15
2	Dec. 19, 2019	payment on reported claim file	Mar. 1, 2016	Aug. 27, 2017	−45	45
3	Dec. 28, 2019	open and close new claim file	Oct. 17, 2018	Dec. 23, 2019		10
4	Jan. 28, 2020	payment & change in case estimate	Aug. 1, 2015	Nov. 28, 2016	−20	15
5	Feb. 4, 2021	open new claim file	Sept. 12, 2020	Feb. 3, 2021	30	
6	May 11, 2021	payment on reported claim file with no change in case estimate	June 14, 2017	Apr. 19, 2020		5

(c)   (*3 points*) Update the reported claim development triangle from part (a) to include the missing claim transactions.

> *Provide the response for this part in the Excel spreadsheet.*

You are given the following carried IBNR reserves for the Nurses coverage above:

IBNR Reserves (000)	
December 31, 2020	3,900
December 31, 2021	4,100

(d)   (*0.5 points*) Calculate the calendar year 2021 incurred claims.

> *Provide the response for this part in the Excel spreadsheet.*

19.

(*3 points*) You are calculating the experience rating modification for a commercial general liability policy. You are given the following information:

| Policy Year | Claim ID | Reported Claims as of July 1, 2022 | |
		Total Limits Indemnity	ALAE
July 1, 2019 – June 30, 2020	1	14,000	35,000
	2	32,000	20,000
July 1, 2020 – June 30, 2021	3	22,000	16,000
	4	10,000	3,000

Policy Year	Basic Limits Premiums Subject to Experience Rating	Percentage of Claims Expected to be Unreported as of July 1, 2022
July 1, 2019 – June 30, 2020	88,600	16%
July 1, 2020 – June 30, 2021	92,200	38%

- The basic limit for indemnity is 20,000.
- The Maximum Single Limit (MSL) is 45,000.
- The Adjusted Expected Loss Ratio (AELR) is 0.67.
- Partial credibility is assigned to claims using *basic limits premiums subject to experience rating*, the square root rule and a full credibility standard of 2,000,000.

Calculate the experience rating modification.

Provide the response for this part in the Excel spreadsheet.

20.

(*4 points*) Your catastrophe model produces the following annual probabilities of hurricane events and expected loss for a portfolio of policies in a zip code in Florida:

Event #	Annual Probability of Hurricane (*p*)	Expected Loss (*L*) Per $1,000 of Building Coverage
1	1.00%	$50
2	0.20%	$100
3	0.40%	$125
4	0.60%	$150
5	0.09%	$25
6	0.50%	$200
7	0.45%	$225
8	0.50%	$250
9	1.10%	$200
10	1.20%	$100

(a) (*0.5 points*) Calculate the expected Average Annual Loss (AAL) per $1,000 of building coverage.

> *Provide the response for this part in the Excel spreadsheet.*

You are given the following additional information:

- The annual expense load is 25%.
- The average building coverage limit is $200,000

(b) (*2 points*) Calculate Hurricane Wind Premium for the average building in the zip code using the method described in the American Academy of Actuaries monograph, Uses of Catastrophe Model Output.

> *Provide the response for this part in the Excel spreadsheet.*

Hurricane insurance costs can vary significantly by location within a state.

(c) (*0.5 points*) Describe why hurricane deductibles tend to be larger in inland areas compared to coastal regions.

> *Provide the response for this part in the Excel spreadsheet.*

20. Continued

You are given the expected AAL and Probable Maximum Losses (PML) for hurricane events for two different zip codes in Florida.

Zip Code	AAL	250-year PML
A	$22.86	$2,426.10
B	$26.16	$2,025.55

(d) (*1 point*) Identify which zip code has the highest potential for loss from hurricane events. Justify your selection.

Provide the response for this part in the Excel spreadsheet.

END OF EXAMINATION