

# Exam GIRR

**Date:** Wednesday, May 11, 2022

## INSTRUCTIONS TO CANDIDATES

### General Instructions

1. This examination has 19 questions numbered 1 through 19 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.

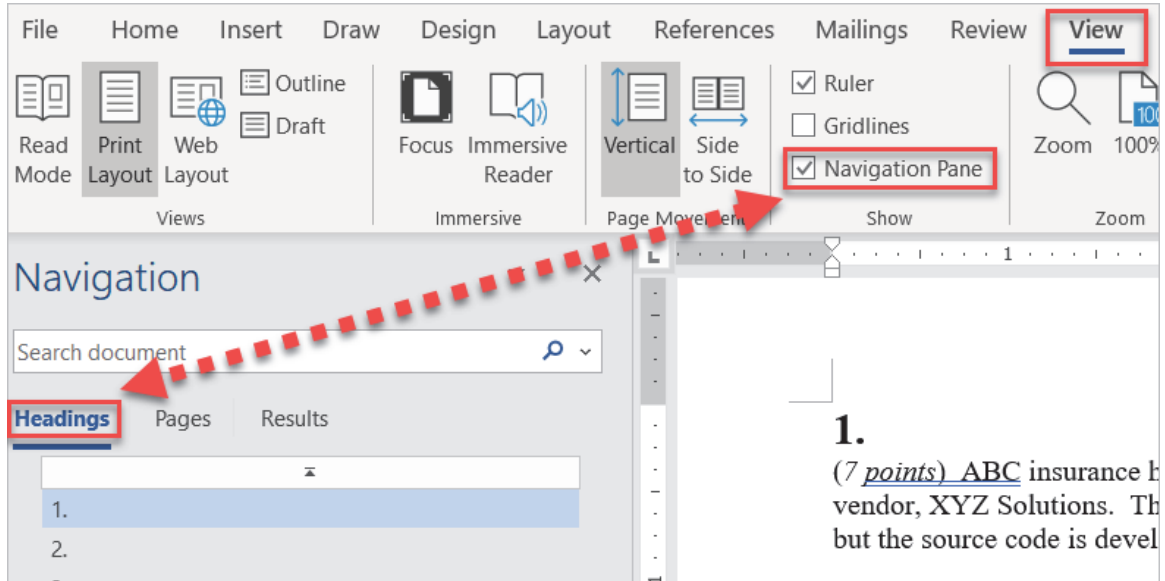
### Written-Answer Instructions

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,  $\beta_1$  can be typed as beta\_1 and  $\sigma^2$  can be typed as sigma^2.
  - b) In the Excel document formulas should be entered. 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.

(6 points) You are given the following information for a single line of business:

<b>Calendar Year</b>	<b>Unearned Premiums at End of Year</b>	<b>Earned Premiums</b>
2017	785,000	778,650
2018	792,500	782,020
2019	801,240	789,880

(a) (0.5 points) Calculate the calendar year 2018 written premiums.

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

You are given the following historical rate changes for this line of business:

<b>Rate Change History</b>	
<b>Effective Date of Rate Change</b>	<b>Overall Rate Change %</b>
Apr. 1, 2016	2.0%
Jul. 1, 2017	4.0%
Oct. 1, 2018	7.0%
Feb. 1, 2020	3.0%

- There have been no additional rate changes after February 1, 2020.
- All policies are written for 12-month terms.
- Premiums are written evenly throughout the year.
- Premiums are earned evenly throughout the policy term.

(b) (2 points) Calculate the 2017, 2018, and 2019 on-level earned premiums, applicable for ratemaking, using the parallelogram method.

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

## 1. Continued

Following an audit of the data for this line of business, it was discovered that the following two policies were not included in the earned premiums given above:

- Policy 1 was written on May 1, 2018, for an annual premium of 5,000.
- Policy 2 was written on November 1, 2018, for an annual premium of 7,000.
- Policies 1 and 2 were subject to the overall rate changes from the table above with no additional rating factors.

- (c) (1.5 points) Calculate the 2018 earned premium adjusted to current rate levels for ratemaking purposes for these two policies using the extension of exposures approach.

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

- (d) (1.5 points) Explain why the answer in part (c) results in a different answer from multiplying the 2018 earned premiums for these two policies by the 2018 on-level factor calculated in part (b).

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

Your co-worker recommends combining the on-level earned premiums from part (b) and part (c) for the total on-level earned premiums to use for ratemaking.

- (e) (0.5 points) Critique this recommendation.

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

## 2.

(7 points) You are given the following claim information evaluated as of December 31, 2021.

Accident Year	Reported Claims (000)			
	12	24	36	48
2018	1,196	1,525	1,638	1,723
2019	1,269	1,607	1,908	
2020	1,294	1,707		
2021	1,451			

Accident Year	Reported Counts			
	12	24	36	48
2018	230	250	260	265
2019	235	255	265	
2020	231	251		
2021	234			

You are also informed that the following six claim transactions were not captured in the triangles due to a system error.

Trans #	Claim ID	Transaction Date	Transaction Description	Occurrence Date	Case Estimate (000)	Indemnity Payment (000)	ALAE Payment (000)
1	1020	May 17, 2019	Open new claim file	Apr. 27, 2018	10	5	
2	1377	Nov. 3, 2019	Open & close new claim file	Sep. 15, 2019		50	25
3	1944	Jan. 2, 2021	Close reported claim file	Sep. 15, 2019	-25	10	5
4	2135	Feb. 28, 2021	Change in case estimate	Jan. 6, 2020	65		
5	2260	Apr. 24, 2021	Open new claim file	Feb. 3, 2018	20		
6	2260	June 5, 2021	Close reported claim file	Feb. 3, 2018	-20		20

- (a) (4 points) Update both development triangles shown above to include the claim transactions not captured due to the system error.

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

- (b) (0.5 points) Determine calendar year 2021 reported claims.

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

Accident year 2021 paid claims and ALAE evaluated as of December 31, 2021, were 800,000.

- (c) (0.5 points) Determine case reserves as of December 31, 2021, for accident year 2021 only.

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

## 2. Continued

You are subsequently given a variety of corrected claim and count triangles and have been asked to conduct investigative tests.

- (d) *(1 point)* Describe the investigative tests you would recommend using for the following independent situations:
- (i) The claim department implemented a new definition of claims to distinguish between reported incidents that are valid claims and incidents not covered under the insurance policy.
  - (ii) The claim department implemented a new initiative to increase their use of partial settlements.

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

During investigative testing, you observe an increase in average reported claims, with changes greater than the rate of trend going down each column (from accident year to accident year). However, the reported counts are stable.

- (e) *(1 point)* Provide two examples of company operational changes that could cause an increase in average reported claims without affecting reported counts.

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

### 3.

(4 points) AV is an architectural consulting firm with the following characteristics:

- Has been in operation for five years without any professional liability insurance
- No reported claims
- One past incident that could give rise to a claim
- Steadily increasing revenue for the last five years with an expectation of increasing revenue in the next few years

AV is considering the purchase of insurance coverage from a professional liability insurer, XYZ.

(a) (1 point) Provide two reasons why AV might decide to purchase coverage.

ANSWER:

(b) (1 point) Recommend two exposure base options for XYZ to consider in providing insurance coverage. Justify your recommendations.

ANSWER:

(c) (1 point) Provide one advantage and one disadvantage to AV in purchasing a *claims-made* policy.

ANSWER:

(d) (1 point) Provide one advantage and one disadvantage to AV in purchasing an *occurrence* policy.

ANSWER:

## 4.

(4 points) Finite risk reinsurance is a form of excess reinsurance.

- (a) (0.5 points) Describe finite risk reinsurance.

ANSWER:

- (b) (0.5 points) Explain why finite risk reinsurance has been controversial.

ANSWER:

Insurer A purchased a traditional per occurrence excess of loss contract from reinsurer B for its general liability portfolio with the following policy terms:

- The policy attaches at 2 million.
- Insurer A and reinsurer B equally share the 2 million to 4 million layer.
- Reinsurer B assumes the full 4 million to 10 million layer.

A policyholder submitted a claim of 8 million to insurer A.

- (c) (1 point) Determine the net amount paid by each company.

- (i) Insurer A  
(ii) Reinsurer B

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

There was an additional 1 million of ALAE associated with the 8 million of indemnity.

- (d) (1 point) Calculate the total net amount paid by each company for this claim with pro-rata treatment of ALAE.

- (i) Insurer A  
(ii) Reinsurer B

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



#### **4. Continued**

The reinsurance contract is subsequently renewed whereby all contract terms remain the same except for ALAE. ALAE will now be considered within the retention instead of pro rata treatment.

A new claim of 12 million has been submitted by a policyholder to insurer A. There is an additional 1 million of ALAE associated with the 12 million of indemnity.

- (e) *(1 point)* Calculate the total net amount paid by each company for this claim when ALAE is considered within the retention for this second claim.
- (i) Insurer A
  - (ii) Reinsurer B

<i>Provide the response for this part in the Excel spreadsheet.</i>
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## 5.

(12 points) You are estimating unpaid claims for a line of business using several different methods, and are given the following information evaluated as of December 31, 2021:

Accident Year	Reported Claims (000)							Ultimate Claims
	12	24	36	48	60	72	84	
2015	26,457	24,686	25,884	32,193	32,398	32,722	32,886	33,051
2016	24,327	23,397	26,233	33,132	34,281	34,555		34,902
2017	29,941	26,497	27,059	35,029	35,972			36,660
2018	27,447	28,164	32,125	35,453				36,950
2019	27,994	28,557	33,927					43,359
2020	28,178	31,041						43,793
2021	34,227							47,706

Accident Year	Paid Claims (000)						
	12	24	36	48	60	72	84
2015	8,658	16,875	22,688	27,108	29,707	31,198	31,530
2016	10,793	18,254	24,319	29,431	31,170	32,966	
2017	9,664	17,663	25,519	30,636	32,690		
2018	10,721	18,976	25,797	32,579			
2019	11,866	20,748	26,519				
2020	13,014	19,889					
2021	12,410						

Calendar/ Accident Year	Earned Premiums	Premium On-Level Factors	Trended On-Level Claim Ratios based on Reported Claims
2015	49,736,108	1.0722	76.8%
2016	52,114,124	1.0681	74.9%
2017	55,021,088	1.0420	73.8%
2018	56,278,147	1.0265	71.2%
2019	58,829,789	1.0182	77.7%
2020	61,195,354	1.0092	73.5%
2021	60,091,505	1.0000	79.4%

- The annual claim severity trend is 5%.
- The annual claim frequency trend is -1.3%.

## 5. Continued

- (a) (4.5 points) Calculate the ultimate claims for all accident years using the development method with paid claims. Justify any selections you make.

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

- (b) (1.5 points) Calculate the trended on-level claim ratios for all accident years using the ultimate claims calculated in part (a).

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

Trended on-level claim ratios derived from reported claims as well as paid claims are considered for the expected claim ratio.

- (c) (1.5 points) Recommend a 2021 cost level expected claim ratio to use for estimating expected claims. Justify your recommendation.

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

- (d) (1 point) Calculate expected claims for all accident years based on the recommendation in part (c).

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

- (e) (1 point) Calculate ultimate claims for all accident years using the Bornhuetter Ferguson method based on paid claims. Use the expected claims from part (d).

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

## 5. Continued

Your appointed actuary has selected the following ultimate claims for this line of business as of December 31, 2021:

<b>Accident Year</b>	<b>Selected Ultimate Claims</b>
2015	33,050,822
2016	34,902,242
2017	36,660,362
2018	37,986,078
2019	41,178,916
2020	42,698,643
2021	45,316,988
<b>Total</b>	<b>271,794,051</b>

- (f) (0.5 points) Calculate the total unpaid claims for this line of business as of December 31, 2021, showing the case estimate and indicated IBNR separately.

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

You are provided with the following additional information:

<b>Accident Year</b>	<b>Reported Claims as of March 31, 2022</b>
2015	32,925,000
2016	34,599,600
2017	36,055,609
2018	36,105,780
2019	35,158,600
2020	32,342,000
2021	33,780,455
<b>Total</b>	<b>240,967,044</b>

- (g) (1.5 points) Calculate the difference between the actual and expected reported claims for this line of business from December 31, 2021 through March 31, 2022 for all accident years, using linear interpolation.

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

- (h) (0.5 points) Provide an interpretation of the results for the actual versus expected analysis derived in part (g).

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

## 6.

(5 points)

(a) (1.5 points) Define the following terms in the context of individual risk rating:

- (i) Prospective experience rating plan
- (ii) Retrospective experience rating plan
- (iii) Expense modification plan

ANSWER:

(b) (0.5 points) Provide one benefit of insurance company reliance on an insured's historical claims to project future claims for a prospective experience rating plan.

ANSWER:

(c) (1 point) Critique the use of a prospective experience rating plan for personal property coverage from an insurance company's perspective.

ANSWER:

An insurer is considering a new prospective experience rating plan with the following characteristics:

- Only the most recent three years of the insured's claims experience is included, and
- Actual claims are segregated into primary claims and excess claims in the experience rating formula.

(d) (1 point) Critique each characteristic in the new plan.

ANSWER:

**6. Continued**

- (e) (1 point) Explain why retrospective experience rating is typically not appropriate for each of the following:
- (i) Insureds with low premium volume
  - (ii) Insureds with poor claims experience

ANSWER:
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## 7.

(5 points) Your company uses only two rating variables for its homeowners insurance policy. One is class (A, B, and C) and the other is territory (1, 2, and 3). Rates are determined as:

$$\text{base rate} \times \text{class factor} \times \text{territory factor.}$$

The exposures for the nine rating combinations are given in the following table:

Exposures			
Class	Territory		
	1	2	3
A	2,700	2,700	2,025
B	1,350	2,025	2,700
C	1,350	675	4,050

- (a) (1.5 points) Determine if there is distributional bias in the exposure data. Support your conclusion.

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

The trended ultimate pure premiums are given in the following table:

Pure Premiums				
Class	Territory			Total
	1	2	3	
A	240.00	200.00	450.00	282.73
B	270.00	250.00	450.00	343.33
C	300.00	260.00	500.00	428.89
Total	262.50	226.25	473.08	<b>346.90</b>

- (b) (1.5 points) Calculate the rebalanced pure premiums using the one-way analysis relativities for each rating variable combination.

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

## 7. Continued

The minimum bias approach is to be used to obtain the final relativities. The process starts with the one-way relativities for territory.

- (c) (1.5 points) Calculate the revised relativities by class that result from a single iteration of the minimum bias method.

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

- (d) (0.5 points) Describe the condition under which the converged results of the minimum bias method will be factors that reproduce all nine observed trended ultimate pure premiums.

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



## 8.

(7 points) You are given the following information:

Accident Year	Reported Claims					
	12	24	36	48	60	72
2016	30,847,710	36,970,980	39,804,500	49,934,760	50,877,310	43,481,120
2017	34,029,400	38,856,540	45,646,070	51,501,360	46,739,030	
2018	38,734,090	40,177,840	47,328,140	47,597,670		
2019	39,000,910	39,002,570	40,849,280			
2020	41,845,080	39,427,380				
2021	42,482,430					

Accident Year	Paid Claims					
	12	24	36	48	60	72
2016	10,450,640	17,578,750	24,478,180	28,746,870	31,182,590	37,359,990
2017	10,463,190	18,205,500	24,401,580	30,144,600	36,751,040	
2018	10,407,100	18,712,370	26,582,760	35,904,160		
2019	10,849,930	20,766,690	33,573,290			
2020	11,502,420	23,964,040				
2021	12,921,930					

Accident Year	Reported Counts					
	12	24	36	48	60	72
2016	3,272	3,548	3,546	3,733	3,726	3,735
2017	3,275	3,513	3,608	3,693	3,722	
2018	3,391	3,470	3,610	3,671		
2019	3,271	3,417	3,576			
2020	3,344	3,477				
2021	3,290					

Accident Year	Closed Counts					
	12	24	36	48	60	72
2016	1,993	2,497	2,881	2,922	3,021	3,548
2017	1,879	2,456	2,726	2,921	3,414	
2018	1,801	2,425	2,796	3,307		
2019	1,780	2,579	3,328			
2020	1,803	2,863				
2021	1,968					

## 8. Continued

Accident Year	Selected Ultimate Counts
2016	3,735
2017	3,731
2018	3,691
2019	3,707
2020	3,707
2021	3,693

- The claims department has noted that starting in 2021, they increased case estimates and increased the rate of claims settlement.
- The annual claim severity trend is 5%.

There are several diagnostic tests that can be used to confirm that the case estimates have increased.

- (a) (1.5 points) Verify that the case estimates have increased for this line of business using one diagnostic test.

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

- (b) (1 point) Describe a different diagnostic test from the test performed in part (a) that may indicate that case estimates have increased for this line of business.

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

The disposal rates can be evaluated to determine if the rate of claims settlement has increased.

- (c) (1.5 points) Evaluate the disposal rates for this line of business to confirm that the rate of claims settlement has increased.

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

- (d) (0.5 points) Recommend disposal rates for each maturity age. Justify your recommendation.

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

- (e) (2.5 points) Calculate the adjusted case estimate triangle for this line of business, adjusting for changes in both case estimates and settlement rates. Justify any selections you make.

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

## 9.

(4 points) You are estimating the IBNR for the layer 900,000 excess of 100,000 and are considering the following two approaches to the development method:

- Using actual development data at different limits, and
- Using Siewart's formula for theoretically-derived development factors at different limits.

(a) (1 point) Explain why the theoretical approach might be the preferred approach.

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

You are given the following information:

Accident Year	Reported Claims (000) as of December 31, 2021	
	Limit 100,000	Limit 1,000,000
2017	2,696	4,328
2018	2,816	4,112
2019	2,492	3,896
2020	3,185	4,784
2021	3,198	4,878

Total Limits – Selected Cumulative Development Factors to Ultimate				
12	24	36	48	60
1.094	1.019	1.011	1.005	1.001

Summary of Severity Relativities ( $R_t$ ) by Maturity					
	12	24	36	48	60
$R_t$ 100,000 to Unlimited	0.646	0.626	0.624	0.623	0.622
$R_t$ 1,000,000 to Unlimited	0.982	0.977	0.973	0.972	0.971

There is no development beyond 72 months.

(b) (3 points) Calculate the IBNR for the layer 900,000 excess of 100,000 as of December 31, 2021 using theoretically-derived development factors at different limits.

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

## 10.

(5 points)

- (a) (2.5 points) Describe the five major categories of expenses that are considered in a ratemaking analysis as defined by U.S. Standards.

ANSWER:

- (b) (1 point) Describe two different ways for an insurer to incorporate non-proportional reinsurance in a ratemaking analysis.

ANSWER:

- (c) (0.5 points) Describe the purpose of a residual market mechanism.

ANSWER:

- (d) (1 point) Describe each of the following as used in U.S. workers compensation ratemaking:

- (i) An expense constant
- (ii) A premium discount plan

ANSWER:

# 11.

(4 points) You are estimating unpaid claims as of December 31, 2021, using a frequency-severity closure method, and are given the following information:

Accident Half-Year	Incremental Closed Counts by Age						Selected Ultimate Counts
	6	12	18	24	30	36	
2019-1	1,985	803	374	398	154	16	3,730
2019-2	1,828	863	445	449	172		3,776
2020-1	2,012	813	363	395			3,751
2020-2	1,767	832	421				3,676
2021-1	1,988	794					3,711
2021-2	1,848						3,811

There is no development beyond 36 months.

- (a) (3 points) Calculate the incremental closed counts for accident half-years 2021-1 and 2021-2 for all maturity ages.

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

You are given the following additional information:

Incremental Paid Severity at 2021-2 Cost Level					
6	12	18	24	30	36
1,500	5,200	7,450	24,500	38,500	42,100

The annual severity trend is 7%.

- (b) (1 point) Calculate the total unpaid claims for accident year 2021 as of December 31, 2021.

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

## 12.

(4 points) You are given the following information for estimating unpaid ULAE as of December 31, 2021.

Calendar Year	Exposures	Paid ULAE	Actual Claims		Expected Claims	
			Paid	Reported	Paid	Reported
2018	575,000	16,172,450	176,261,530	176,998,480	181,712,920	179,693,890
2019	592,250	16,807,540	195,338,130	194,011,760	188,100,130	190,637,250
2020	621,860	17,831,120	187,853,340	199,988,960	195,680,570	206,174,180
2021	652,960	19,284,360	197,358,720	211,828,510	205,582,000	222,977,380
<b>Total</b>	<b>2,442,070</b>	<b>70,095,470</b>	<b>756,811,720</b>	<b>782,827,710</b>	<b>771,075,620</b>	<b>799,482,700</b>

	As of Dec. 31, 2021
Case Reserves	95,171,300
IBNER Reserves	43,591,100
IBNYR Reserves	26,803,900
<b>Total</b>	<b>165,566,300</b>

- Claims for this coverage are typically low-frequency and high-severity.
- Calendar year 2019 includes an unusual large claim of 11 million which has been settled.
- 30% of claim department expenses relate to opening a claim file and 70% relate to maintaining and closing a claim file.

- (a) (1.5 points) Estimate unpaid ULAE as of December 31, 2021, using the classical paid-to-paid method with a simple four-year average of historical experience, and a pure IBNR refinement.

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

- (b) (1.5 points) Estimate unpaid ULAE as of December 31, 2021 using the Kittel refinement with the Mango and Allen smoothing adjustment, a simple four-year average of historical experience, and a pure IBNR refinement.

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

- (c) (1 point) Critique the appropriateness of each result from (a) and (b).

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

## 13.

(4 points) One of the outputs from a catastrophe model is PML. PMLs are stated for a specified return period and may be provided for a single cause of loss or by a combination of causes of loss.

- (a) (1 point) Explain why the 100-year PML for hurricane wind losses and the 100-year PML for tornado wind losses should not be added together to determine the 100-year PML for hurricane and tornado wind losses.

ANSWER:

Many different loss metrics may be computed for an insured property at an individual location using the output from a catastrophe model.

- (b) (1 point) Describe how an insurer could use each of the following loss metrics to understand the risk of an individual insured.
- (i) AAL to TIV ratio
  - (ii) PML to TIV ratio

ANSWER:

- (c) (1 point) Explain how catastrophe models can be used by an insurer for portfolio optimization with respect to risk.

ANSWER:

Various requirements have been established to govern the use of catastrophe models. One such example is that of rating agencies mandating certain model output for their use in evaluating a risk-bearing entity's financial strength.

- (d) (1 point) Provide two other examples of requirements that have been established to govern the use of catastrophe models.

ANSWER:

## 14.

(5 points) You are estimating premium liabilities for a company as of December 31, 2021, and are given the following information:

<b>Calendar/ Accident Half Year</b>	<b>Written Premiums</b>	<b>Earned Premiums</b>	<b>Ultimate Claims including ALAE</b>
2019-1	523,613	518,804	364,784
2019-2	517,408	520,827	232,393
2020-1	500,255	514,671	365,518
2020-2	518,366	509,071	229,396
2021-1	506,720	510,927	366,542
2021-2	518,714	512,630	233,315

- The amounts in the table are before any reinsurance.
- Each year, the company renews quota share reinsurance on its gross business (premiums and claims including ALAE) ceding 25% to a reinsurer.
- The company only writes 12-month fire insurance policies.
- There have been no rate changes since January 1, 2017.
- Policies are written evenly throughout the year.
- ULAE is 5.7% of gross claims (including ALAE).
- The selected general expense ratio is 18% of gross written premiums.
- The proportion of general expenses applicable to unearned premiums is 30%.
- The annual claim trend is 1%.
- Claim frequency is significantly higher in the first half of any year.
- The gross unearned premiums are 515,716 as of December 31, 2021.

(a) (1 point) Verify that the following amounts are consistent with the written premiums provided:

- (i) Calendar half-year 2021-1 gross earned premium of 510,927
- (ii) Year-end 2021 gross unearned premiums of 515,716

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

(b) (2.5 points) Recommend the expected claim ratio to be used in the determination of premium liabilities as of December 31, 2021. Justify your recommendation.

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



## 14. Continued

- (c) (1.5 points) Calculate the premium liabilities as of December 31, 2021, both gross and net of reinsurance.

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

## 15.

(6 points)

- (a) (0.5 points) Describe one situation in which the Cape Cod method might be preferred over the Bornhuetter Ferguson method.

ANSWER:

- (b) (0.5 points) Describe one situation in which the Generalized Cape Cod method might be preferred over the Cape Cod method.

ANSWER:

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

<b>Accident Year</b>	<b>Earned Premiums (000)</b>	<b>Reported Claims as of Dec 31, 2021 (000)</b>	<b>Reported Cumulative Development Factors</b>
2013	29,614	15,795	1.011
2014	27,371	14,119	1.028
2015	27,077	17,998	1.049
2016	28,792	17,630	1.090
2017	30,307	16,178	1.159
2018	29,053	15,699	1.305
2019	26,785	14,231	1.709
2020	25,618	7,963	2.399
2021	27,616	4,910	3.999
<b>Total</b>	<b>252,233</b>	<b>124,522</b>	

- All policies are annual, and they are written and earned evenly throughout the year.
- The annual claim trend is 2%.
- An unusual large claim of 3 million is reported in AY 2019. A similar sized claim is not expected to happen again.
- Rate change history:
  - A rate change of -2% was effective January 1, 2015.
  - A rate change of 4% was effective July 1, 2021.

## 15. Continued

- (c) (2 points) Calculate the adjusted expected claim ratio.

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

- (d) (1.5 points) Calculate projected ultimate claims for all accident years.

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

- (e) (1.5 points) Calculate expected claims for accident year 2021 using the Generalized Cape Cod approach and a decay factor of 80%.

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

## 16.

(5 points) You are calculating the 2021 earned premiums to use in ratemaking for an automobile line of business, and are given the following information:

Vehicle Rate Group	Rating Differentials		Calendar Year Earned Exposures by Group				
	Prior to July 1, 2021	Effective July 1, 2021	2017	2018	2019	2020	2021
1	0.930	0.934	4,605	4,406	4,165	3,888	3,782
2	0.952	0.952	4,974	4,956	4,889	4,772	4,683
3	0.976	0.976	4,421	4,222	4,527	4,772	5,404
4	1.000	1.000	3,500	3,488	3,803	4,242	5,043
5	1.024	1.025	2,947	3,121	3,259	3,535	3,963
6	1.048	1.052	2,026	2,754	2,897	3,181	3,422
7	1.072	1.080	1,289	1,836	1,992	2,297	2,702
8	1.092	1.105	737	918	1,268	1,414	1,801
<b>Total</b>			<b>24,499</b>	<b>25,701</b>	<b>26,800</b>	<b>28,101</b>	<b>30,800</b>

- The 2021 calendar year earned premiums at current rate levels are 25,256,000.
- The new rates will be effective October 1, 2022, for one year.
- Two-thirds of the policies are written for annual terms and one-third of the policies are written for six-month terms.
- All policies are written and earned evenly throughout the year.

- (a) (1 point) Calculate the percentage increase in premiums that occurred from the rating differentials change on July 1, 2021.

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

- (b) (2 points) Recommend the annual premium trend rate to use for ratemaking for this line of business. Justify your recommendation.

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

- (c) (2 points) Calculate the calendar year 2021 earned premiums to use for ratemaking.

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

## 17.

(4 points) You are performing a ratemaking analysis for a homeowners book of business. As part of the analysis, you are including a loading for wildfire claims.

You are given the following information:

Accident Year	Earned Exposures	Ultimate Wildfire Counts	Ultimate Wildfire Claims
2015	11,200	0	0
2016	11,850	0	0
2017	12,500	1	1,500,000
2018	13,750	0	0
2019	15,000	1	1,120,000
2020	16,250	0	0
2021	17,500	1	500,000

- New rates are to be effective September 1, 2022, for one year, with all policies written as 12-month policies.
- The annual wildfire claim severity trend is 3%.
- The credibility assigned to wildfire claims for this homeowners book of business is 20%. The complement of credibility is assigned to the industry figures.
- A study of industry results with data as of year-end 2020 indicates a trended ultimate pure premium for wildfire claims of 50, with an average accident date of July 1, 2020.

- (a) (2.5 points) Calculate the ultimate pure premium for wildfire claims to be used as a loading in the homeowners premiums.

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

## 17. Continued

You are given the following additional information:

- The annual non-wildfire claim severity trend is 4%.
  - The annual premium trend is 2.5%.
  - Variable expenses are 20% of premiums.
  - Fixed expenses are 70 per policy.
  - Profit and contingencies are 5% of premium.
  - The experience claim ratio for non-wildfire claims as of July 1, 2021, is 67%.
  - The calendar year 2021 on-level earned premiums are 21,507,500.
- (b) (1.5 points) Calculate the indicated total premium for the homeowners coverage, including a loading for wildfire claims.

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

## 18.

(4 points) When conditions are changing, actuaries sometimes need to substitute one type of data for another type of data that is not affected by the change.

You currently use accident year claim and count development triangles to estimate ultimate claims. However, other policy and claim data are available.

- (a) (2 points) Describe a data substitution that you would make in your analysis to mitigate the problem for each of the following independent scenarios.
- (i) There is a change in policy limits between successive policy years.
  - (ii) Exposure growth during the past two years has caused a distortion in recent development factors due to significant shifts in the average accident date within each accident year.
  - (iii) A tort reform change two years ago reduced the expected severity of many newly reported claims.
  - (iv) There has been a change in the definition of claim count you typically use for diagnostics.

ANSWER:

The company you are working for has experienced a recent shift in mix of business within its commercial multi-peril line of business. The severity of liability claims is increasing faster than property claims. However, the company only captures aggregate claim data on a combined property/liability basis.

- (b) (1 point) Describe the effect you expect this shift to have on an accident year claim triangle using reported claims.

ANSWER:

- (c) (1 point) Describe an approach to estimating ultimate claims for this business.

ANSWER:

## 19.

(5 points) You are given the following uncensored aggregated information for a line of business:

<b>Indemnity Range</b>	<b>Counts in Interval</b>	<b>Indemnity</b>
0 – 500	2,570	886,650
501 – 1,000	2,860	1,976,260
1,001 – 2,000	2,235	3,256,395
2,001 – unlimited	1,975	6,485,900
<b>Total</b>	<b>9,640</b>	<b>12,605,205</b>

The base deductible is 500.

- (a) (1.5 points) Calculate the indicated deductible factor for a deductible of 1,000.

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

- (b) (2.5 points) Recommend a factor for a deductible of 1,500. Justify your recommendation.

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

- (c) (0.5 points) Describe why you would not be able to use data from policies with a 2,000 deductible to determine the deductible factor for a 1,000 deductible if the data was censored.

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

- (d) (0.5 points) Provide a reason why you would choose to determine deductible factors using a classification ratemaking approach instead of using the elimination ratio approach.

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

**\*\*END OF EXAMINATION\*\***