

Exam GIRR

Date: Wednesday, November 10, 2021

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.

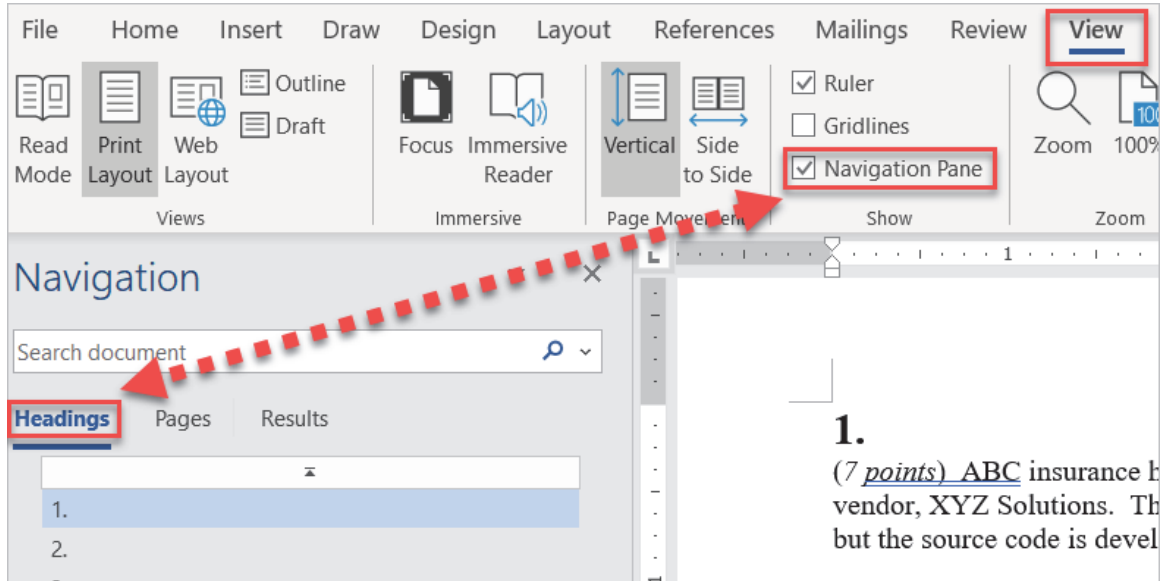
Written-Answer Instructions

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) 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.

(5 points) You are analyzing the following policies:

- Policy #1: 12-month policy first written on November 1, 2019 for a premium of 2,100, renewed in 2020, and in force on December 31, 2020.
- Policy #2: 6-month policy first written on February 1, 2020 for a premium of 720, renewed in 2020, and in force on December 31, 2020.
- Policy #3: 12-month policy first written on April 1, 2020 for a premium of 1,800 and cancelled on November 30, 2020.

There was a premium level increase of 5% for each policy written or renewed after September 1, 2020. All rating characteristics remained the same for each policy at each renewal.

- (a) (1 point) Calculate the 2020 calendar year total written premiums.

Provide the response for this part in the Excel spreadsheet.

- (b) (1.5 points) Calculate the 2020 calendar year total earned premiums.

Provide the response for this part in the Excel spreadsheet.

- (c) (1 point) Calculate the total unearned premiums as of December 31, 2020.

Provide the response for this part in the Excel spreadsheet.

You are calculating 2020 total earned premiums adjusted to the current rate level.

- (d) (1 point) Explain why the parallelogram approach would be inaccurate for this calculation.

Provide the response for this part in the Excel spreadsheet.

- (e) (0.5 points) Calculate the 2020 total earned premiums adjusted to the current rate level.

Provide the response for this part in the Excel spreadsheet.

2.

(7 points)

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

ANSWER:

- (b) (0.5 points) Describe why reinsurers typically use the claim ratio approach to the expected method, rather than the pure premium approach.

ANSWER:

- (c) (0.5 points) Describe why reinsurers often use the expected method rather than the development method.

ANSWER:

The effect of leveraged actuarial factors should be considered when projecting ultimate claims.

- (d) (1 point) Contrast the leveraged nature of cumulative development factors with the leveraged nature of trend factors.

ANSWER:

- (e) (0.5 points) Describe one approach the actuary may consider to moderate the leveraging effect of actuarial factors.

ANSWER:

2. Continued

You are given the following information to estimate ultimate claims as of December 31, 2020.

Report Year	Earned Exposures	Actual Reported Claims	Cumulative Development Factors
2013	12,603	12,974,000	1.042
2014	13,190	13,846,250	1.087
2015	13,631	14,074,250	1.149
2016	13,988	13,332,300	1.235
2017	15,364	14,057,100	1.351
2018	15,949	13,586,400	1.515
2019	16,270	12,601,600	1.754
2020	16,468	10,118,900	2.128
Total	117,464	104,590,800	

The annual claim trend is 3%.

- (f) (2 points) Calculate ultimate claims using the pure premium approach to the expected method.

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

- (g) (1 point) Calculate ultimate claims using the Bornhuetter Ferguson method, where the a priori expected claims are the estimated ultimate claims from the expected method in part (f).

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

- (h) (1 point) Evaluate the reasonableness of the inputs for the Bornhuetter Ferguson method in part (g).

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

3.

(5 points) Insurance policies may include deductibles and limits. Both features are used to reduce the claims paid by insurers with a corresponding adjustment to the premium.

- (a) (0.5 points) Provide two reasons insurers use deductibles, other than to directly reduce the amount of claims paid.

ANSWER:

- (b) (0.5 points) Provide two reasons insurers use limits, other than to directly reduce the amount of claims paid.

ANSWER:

Both increased limits factors and deductible factors may be estimated using either empirical data or a statistical distribution.

- (c) (1 point) Explain why an analysis of increased limits factors is more likely to use a statistical distribution.

ANSWER:

You are given the following information for a deductible analysis using empirical data:

Accident Year	Trended Ultimate Claims, Adjusted to Deductible Level			
	Base Deductible	Optional Deductibles		
	100	250	500	1,000
2015	1,128,906	1,085,419	1,038,175	1,003,976
2016	1,205,190	1,114,475	1,049,455	1,001,738
2017	1,259,261	1,146,143	1,077,875	1,028,878
2018	1,327,281	1,222,920	1,150,421	1,097,933
2019	1,154,561	1,039,514	972,689	925,746
2020	1,479,204	1,371,604	1,296,218	1,241,697

- (d) (2 points) Determine the elimination ratios and deductible factors for each of the deductible options.

Provide the response for this part in the Excel spreadsheet.

3. Continued

- (e) *(1 point)* Evaluate the reasonability of the deductible factors calculated in part (d) using a consistency test.

Provide the response for this part in the Excel spreadsheet.

4.

(4 points) XYZ insurer is thinking of offering an earthquake endorsement to its basic homeowners policy. You are given the following information:

- Using July 1, 2020 in-force policies, expected claims from the earthquake catastrophe model are 225,000 based on an October 1, 2020 cost level.
- Earned house years for accident year 2020 are 15,000.
- The annual exposure trend is 3.5%.
- The annual severity trend is 7%.
- New rates are to be effective July 1, 2022 for one year with all policies written as 12-month policies.

(a) (2 points) Calculate the pure premium for the earthquake endorsement.

Provide the response for this part in the Excel spreadsheet.

You are given the following additional information for the earthquake endorsement:

- The fixed cost per policy is 5.
- The variable expense to premium ratio is 10%.
- The risk load is 25% of premium.

(b) (0.5 points) Calculate the premium for the earthquake endorsement.

Provide the response for this part in the Excel spreadsheet.

You are given the following information for the basic homeowners coverage:

Accident Year	Basic Homeowners (excluding optional earthquake endorsement)	
	On Level Earned Premium	Ultimate Claims
2018	15,500,000	9,000,000
2019	16,250,000	8,000,000
2020	17,000,000	8,200,000

- The current rate level is 1,050.
- The annual premium trend is 2%.
- The permissible claim ratio is 57%.

4. Continued

- (c) *(1 point)* Calculate the indicated rate for the basic homeowners coverage. Justify any selections.

Provide the response for this part in the Excel spreadsheet.

Since the earthquake coverage is an optional endorsement, management proposes that there should not be any fixed and variable expense charged to this optional coverage.

- (d) *(0.5 points)* State whether you agree with management's proposal. Justify your response.

Provide the response for this part in the Excel spreadsheet.

5.

(5 points)

- (a) (1 point) Provide two circumstances in which exposure and premium trend adjustments need to be considered for a ratemaking analysis.

ANSWER:

ABC Insurer has been offering mileage discounts to its automobile insurance policyholders who drive below a certain mileage each year. You are given the following information:

Calendar Year	Earned Proportion of Automobile Policyholders with	
	5% Discount	10% Discount
2016	5.2%	9.3%
2017	5.0%	10.0%
2018	4.5%	11.0%
2019	4.5%	12.0%
2020	6.5%	25.0%

- Policyholders who drive more than 5,000 miles per year and less than 7,500 miles per year qualify for a 5% discount.
 - Policyholders who drive less than 5,000 miles per year qualify for a 10% discount.
 - Due to the pandemic in 2020, there was a significant one-time decrease in the distance driven by many policyholders.
 - Policies are annual and written and earned evenly throughout the year.
- (b) (1.5 points) Calculate and select the annual premium trend due to the change in discount level. Justify your selection.

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

5. Continued

You are conducting a premium trend analysis for rates to be effective on February 1, 2022, for one year and are given the following additional information:

- The annual premium trend due to change in discount level is expected to be -0.2% post 2020.
 - The annual trend due to changes in policy limits is 0.75% .
- (c) (2.5 points) Calculate the premium trend factor to be used for 2018 using earned premium for the trending analysis and incorporating the annual trend selected in part (b).

Provide the response for this part in the Excel spreadsheet.

6.

(4 points)

- (a) (0.5 points) Describe what an *actuarial central estimate* represents according to U.S. ASOPs.

ANSWER:

- (b) (0.5 points) Assess the validity of the following statement:

“Credibility is not utilized in projecting unpaid claims for reserving.”

ANSWER:

You are given the following information as of December 31, 2020 for a general liability line of business:

Accident Year	Earned Premiums	Projected Ultimate Claims Based on Frequency-Severity Method	
		Development Based	Claim Closure
2015	7,770,781	5,053,162	5,053,487
2016	8,054,874	5,508,456	5,506,686
2017	8,669,122	5,901,592	5,867,259
2018	9,068,601	6,242,941	6,305,001
2019	9,896,451	6,826,075	7,055,995
2020	10,833,340	7,153,796	7,378,065

You are also given the following diagnostic results:

Accident Year	Reported Claim Ratios					
	12	24	36	48	60	72
2015	52.7%	58.1%	61.3%	63.3%	64.4%	65.0%
2016	54.7%	60.9%	65.3%	66.4%	67.7%	
2017	54.9%	61.3%	65.7%	66.5%		
2018	56.8%	63.9%	65.8%			
2019	56.1%	63.6%				
2020	55.2%					

6. Continued

- (c) (1 point) Calculate the indicated IBNR as of December 31, 2020 for each of the frequency-severity method projections above.

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

You are given the following IBNR estimates for an auto insurer's bodily injury liability claims:

Accident Year	IBNR Claim Estimates (000)			
	Development Method		Bornhuetter Ferguson	
	Paid	Reported	Paid	Reported
2016	2,852	2,628	2,825	2,650
2017	4,103	4,218	4,185	4,235
2018	4,352	6,318	4,161	5,511
2019	8,072	7,317	7,767	7,467
2020	11,835	10,664	11,409	11,109

- A large claim was reported in accident year 2018.
- The case estimate on the large claim appears adequate.
- The large claim remains unpaid as of December 31, 2020.
- None of the methods have an explicit adjustment for the large claim.

Company management has asked you to recommend an accident year 2018 IBNR reserve as of December 31, 2020.

- (d) (2 points) Critique the appropriateness of each method as a potential IBNR selection for accident year 2018.
- (i) Paid development method
 - (ii) Reported development method
 - (iii) Paid Bornhuetter Ferguson method
 - (iv) Reported Bornhuetter Ferguson method

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

7.

(5 points)

(a) (1 point) Describe the following objectives with respect to risk classification:

- (i) fair or equitable premium rates
- (ii) socially adequate premium rates

ANSWER:

- (i)
- (ii)

(b) (1.5 points) Describe how the objectives in part (a) could be contradictory when rating by age for drivers aged 18, 40, and 80 in automobile insurance.

ANSWER:

(c) (1 point) Assess the validity of the following statement:

“Determining the expected costs for a particular class of risks is the same as predicting the costs for an individual risk in the class.”

ANSWER:

(d) (1.5 points) Describe two operational considerations that affect the *practicality* of designing and maintaining a risk classification system.

ANSWER:

8.

(4 points) You are the appointed actuary for LMN Insurance Company, and you are given the following information:

Underwriting Quarter	Written Premiums During 2020	
	Auto	Homeowners
2020Q1	210,000	320,000
2020Q2	200,500	325,000
2020Q3	197,500	330,000
2020Q4	205,100	322,000

- All policies are written for 12-month policy terms and are written and earned evenly throughout the year.
- Assume each quarter has the same number of days.
- There are no policy cancellations.

- (a) (1 point) Calculate unearned premium by line of business as of December 31, 2020.

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

You are estimating policy liabilities as of December 31, 2020 and are given the following information:

Accident Year 2020 Actual Claim Ratios by Quarter		
	Auto	Homeowners
2020Q1	73.6%	71.2%
2020Q2	71.9%	72.5%
2020Q3	71.5%	77.7%
2020Q4	73.1%	69.8%

Accident Year 2021 Expected Claim Ratios by Quarter		
	Auto	Homeowners
2021Q1	72.0%	70.0%
2021Q2	72.0%	70.0%
2021Q3	72.0%	80.0%
2021Q4	72.0%	70.0%

- The higher expected claim ratio for homeowners in 2021Q3 reflects hurricane season.
- The company does not purchase reinsurance.
- ULAE is 7.5% of claims for automobile and 10% of claims for homeowners.

8. Continued

- Policy acquisition costs are 5% of written premiums.
- The selected general expense ratio is 15% of written premiums.
- One-third of general expenses are associated with ongoing policy administration and maintenance.

- (b) (2.5 points) Calculate the equity in unearned premiums as of December 31, 2020 by line of business.

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

Additionally, a colleague has calculated the equity in the unearned premiums for the general liability line of business and the result is a large negative number. LMN Insurance Company writes no other lines of business besides auto, homeowners, and general liability.

- (c) (0.5 points) Describe two potential implications of this result.

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

9.

(7 points) You are projecting ultimate claims using the Cape Cod method and a pure premium approach.

- (a) (0.5 points) Describe why an exposure base that is not inflation-sensitive is preferred over an exposure base that is inflation-sensitive.

ANSWER:

You are asked to project ultimate claims evaluated as of December 31, 2020 using the Cape Cod method. You are given the following information:

Accident Year	Earned Exposures	Paid Claims as of Dec. 31, 2020 (000)	Reported Claims as of Dec. 31, 2020 (000)	Reported Age-to-Age Factors
2012	8,391	828	1,002	1.008
2013	8,402	831	1,045	1.012
2014	8,788	922	1,216	1.018
2015	9,088	473	664	1.024
2016	9,325	467	710	1.032
2017	9,704	353	593	1.044
2018	10,073	390	739	1.071
2019	10,339	299	632	1.167
2020	10,591	183	448	1.500
Total	84,701	4,746	7,049	

- All policies are annual, and they are written and earned evenly throughout the years.
- The annual pure premium trend is -1% .
- Tort reform resulted in an estimated claim decrease of 5% for all accidents occurring on or after January 1, 2018.

- (b) (2.5 points) Derive a selected adjusted expected pure premium.

Provide the response for this part in the Excel spreadsheet.

- (c) (1.5 points) Derive projected ultimate claims.

Provide the response for this part in the Excel spreadsheet.

9. Continued

- (d) (1 point) Calculate the difference between the expected reported claims underlying the Cape Cod calculations in part (c) and actual reported claims as of December 31, 2020.

Provide the response for this part in the Excel spreadsheet.

Your manager has given you the following actual versus expected results for a *different line of business*. The Cape Cod method was also used to estimate expected reported claims for this business.

Accident Year	Claims (000)		
	Reported Claims as of Dec 31, 2020	Expected Reported Claims	Difference Actual vs. Expected
2012	8,363	7,570	793
2013	8,186	7,331	855
2014	7,047	6,145	902
2015	5,540	4,612	928
2016	6,035	7,629	(1,594)
2017	5,041	7,521	(2,480)
2018	6,282	7,406	(1,124)
2019	5,372	6,233	(861)
2020	3,808	4,465	(657)
Total	55,674	58,912	(3,238)

You have identified an anomaly in these results beginning in accident year 2016. There are several circumstances (business, operational, environmental, etc.) that could cause such an anomaly. One possible circumstance would be that the Cape Cod method uses the same trend rate for all years and if the underlying trend decreased in 2016 the Cape Cod method might overestimate the expected reported claims in recent accident years.

- (e) (1.5 points) Describe two other possible circumstances that could cause an anomaly as shown above.

Provide the response for this part in the Excel spreadsheet.

10.

(4 points)

- (a) (1 point) State one advantage and one disadvantage of claims-made coverage from an insurer's perspective.

ANSWER:

- (b) (1 point) Demonstrate, with a numerical example, a situation in which the claims-made loss cost is greater than the occurrence loss cost.

Provide the response for this part in the Excel spreadsheet.

CM Insurance Company writes claims-made coverage with a 4-year reporting pattern where 40% of the claims incurred in an accident year are reported in the year of occurrence, and 20% are reported in each of the next three years. The annual report year pure premium trend is 0%.

- (c) (1 point) Calculate tail factors for a claims-made policy for the following maturities:
- (i) Second-year
 - (ii) Mature

Provide the response for this part in the Excel spreadsheet.

- (d) (1 point) Calculate CM's earned premium for 2021, 2022 and 2023 for a mature tail policy effective January 1, 2021 with a premium of 25,000.

Provide the response for this part in the Excel spreadsheet.

11.

(4 points) You are given the following information:

Accident Year	Earned Exposures	Reported Claims as of Dec. 31, 2020	Projected Ultimate Based on Development Method	
			Claims	Counts
2014	8,184	10,004,008	10,004,008	347
2015	8,526	10,840,679	10,924,953	364
2016	8,548	11,298,364	11,580,235	367
2017	8,903	12,069,806	12,667,017	384
2018	9,147	12,334,362	13,668,559	399
2019	9,365	11,346,431	14,692,016	407
2020	9,542	5,778,161	16,270,027	436

- For claims occurring prior to 2020, the following trends were observed for this line of business:
 - Annual severity trend of 4.7%
 - Annual frequency trend of 0.5%
- There was a court ruling that expanded policy coverage for claims occurring in 2020. It was expected to increase claim frequency 6% over the trended historical average but have no effect on claim severity beyond the observed annual severity trend.

- (a) (2.5 points) Calculate the ultimate claims for accident year 2020 using the development-based frequency-severity method. Justify any selections.

Provide the response for this part in the Excel spreadsheet.

- (b) (0.5 points) Calculate the percentage growth in accident year 2020 IBNR in changing from the development method to the development-based frequency-severity method.

Provide the response for this part in the Excel spreadsheet.

- (c) (1 point) Explain why the accident year 2020 IBNR calculated using the development-based frequency-severity method is likely to be more appropriate than the IBNR calculated using the development method.

Provide the response for this part in the Excel spreadsheet.

12.

(5 points) Diagnostic reviews can be valuable for actuaries when evaluating projections and selecting ultimate claims.

- (a) (1 point) Describe two diagnostics that can be used to confirm the reasonableness of projected ultimate claims.

ANSWER:

You are analyzing a reported development triangle for a products liability coverage where state-legislated tort reform effective two years ago capped the cost of large claims reported after the effective date of the legislation. All other aspects of the business are in a steady-state environment.

- (b) (1 point) Explain what effect the tort reform is likely to have on reported claim development factors if the data is organized as follows:
- (i) On an accident year basis.
 - (ii) On a report year basis.

ANSWER:

(i)

(ii)

- (c) (1 point) Recommend a preferred approach to estimating ultimate claims for each scenario in part (b). Justify your recommendation.

ANSWER:

(i)

(ii)

12. Continued

You are given the following method results for a line of business:

Accident Year (AY)	Paid CDFs	Reported CDFs	Projected Ultimate Claims			
			Expected Method: Reported Claim Ratio	Development Method: Paid Data	Cape Cod Method: Paid Data	Bornhuetter Ferguson Method: Reported Claim Ratio
2013	1.055	1.007	6,303,396	6,710,368	6,696,546	6,422,916
2014	1.133	1.014	7,212,445	7,610,141	7,586,251	7,274,264
2015	1.181	1.049	7,832,913	8,094,627	8,081,606	7,797,684
2016	1.356	1.117	8,716,621	8,868,690	8,880,447	8,570,436
2017	1.660	1.212	9,846,962	9,461,628	9,703,338	9,719,451
2018	2.223	1.373	10,649,381	10,822,452	10,859,544	10,648,168
2019	4.265	1.862	11,950,431	11,666,839	12,090,525	12,025,016
2020	10.807	3.068	13,289,524	11,985,818	13,441,214	13,235,975
Total			75,801,673	75,220,563	77,339,471	75,693,910

- Based on the results of diagnostic testing for this line of business, the data includes a change in case outstanding adequacy.

You are given four accident year selections as follows:

- (i) AY2013: Bornhuetter Ferguson method using reported claim ratio data
 - (ii) AY2016: Cape Cod method using paid claim data
 - (iii) AY2019: Development method using paid claim data
 - (iv) AY2020: Expected method using reported claim ratio data
- (d) (2 points) Assess the appropriateness of each selection (i) to (iv).

ANSWER:
(i)
(ii)
(iii)
(iv)

13.

(4 points) You are conducting a ratemaking exercise and estimating ultimate claims in the layer 1,000,000 excess of 500,000, and are given the following information:

Claim #	Ground-Up Ultimate Claims
1	495,000
2	525,000
3	1,200,000
4	1,490,000
5	1,800,000
Total	5,510,000

- This table represents a sample of 5 claims from a book of business with 5,000 claim counts.
- The annual claim trend for ground-up ultimate claims is 5%.

(a) (1.5 points) Show that the year-to-year increase in ultimate claims in the layer 1,000,000 excess of 500,000 is 4.3% for this sample.

Provide the response for this part in the Excel spreadsheet.

(b) (1 point) Explain how the annual claim trend for ultimate claims in the layer 1,000,000 excess of 500,000 could be *greater* than 5% for the entire book of business.

Provide the response for this part in the Excel spreadsheet.

13. Continued

You are given the following information for an entire book of business:

Accident year 2020 reported claims at 500,000 limit	6,500,000
Accident year 2020 reported claims at 1,500,000 limit	8,200,000
Annual claim trend at 500,000 limit	3.50%
Annual claim trend at 1,500,000 limit	4.80%
Total limits cumulative development factor at 12 months	1.25

Severity Relativity (R_t) by Months of Development		
	12	96
R_t 500,000 to unlimited	0.78	0.72
R_t 1,500,000 to unlimited	0.95	0.91

- The oldest maturity age in the reported claims triangle is 96 months.
 - The new rates will be effective April 1, 2022 for one year.
 - All policies are written for 12-month policy terms.
- (c) (1.5 points) Calculate the trended ultimate claims in the layer 1,000,000 excess of 500,000 for ratemaking purposes, using theoretically-derived cumulative development factors.

Provide the response for this part in the Excel spreadsheet.

14.

(5 points) You are conducting a diagnostic test for changing levels of case reserve adequacy. You are given the following information:

Accident Year	Reported Claims					
	12	24	36	48	60	72
2015	3,974,890	6,702,782	9,132,258	11,832,714	12,914,233	13,597,939
2016	4,666,298	7,528,464	9,575,863	12,613,332	14,395,391	
2017	4,968,311	8,535,682	10,802,912	13,826,396		
2018	4,670,934	7,385,262	11,327,707			
2019	4,639,868	9,902,568				
2020	6,046,806					

Accident Year	Paid Claims					
	12	24	36	48	60	72
2015	717,685	2,401,770	4,388,457	7,040,802	10,007,312	12,709,286
2016	743,941	2,493,804	4,570,289	7,360,202	10,483,805	
2017	730,304	2,526,958	4,617,900	7,431,111		
2018	742,780	2,522,316	4,554,456			
2019	706,749	2,600,954				
2020	744,428					

Accident Year	Reported Counts					
	12	24	36	48	60	72
2015	1,743	1,941	2,010	2,048	2,048	2,048
2016	1,867	2,043	2,098	2,143	2,143	
2017	1,895	2,063	2,128	2,156		
2018	1,798	1,993	2,097			
2019	1,847	2,094				
2020	1,889					

Accident Year	Closed Counts					
	12	24	36	48	60	72
2015	1,098	1,640	1,845	1,926	1,978	2,008
2016	1,122	1,704	1,931	2,019	2,070	
2017	1,125	1,680	1,935	2,028		
2018	1,111	1,706	1,919			
2019	1,202	1,755				
2020	1,165					

- The annual severity trend is 5.9%.
- There is a tail factor of 2% for development after 72 months.

14. Continued

- (a) (1 point) Calculate the average case estimate triangle.

Provide the response for this part in the Excel spreadsheet.

- (b) (0.5 points) Explain why the average case estimate triangle indicates reducing, increasing or stable case reserve adequacy.

Provide the response for this part in the Excel spreadsheet.

- (c) (3.5 points) Calculate IBNR by accident year using the reported development method, with a Berquist-Sherman adjustment.

Provide the response for this part in the Excel spreadsheet.

15.

(5 points) You are conducting a ratemaking analysis for a line of business for new rates to be effective January 1, 2022, and are given the following information:

Calendar year 2020 earned premium	8,100,000
Calendar year 2020 earned exposures	11,000
Premium on-level factor	1.030
Premium trend factor	1.007
Experience claims ratio trended to the future rating period	78%
ULAE as a percent of claims	9%
Fixed expenses as a percent of premium	5%
Annual fixed expense trend	0%
Variable expenses as a percent of premium	10%
Target profit as a percent of premium	5%

- (a) (1.5 points) Demonstrate that the indicated rate change using the pure premium approach is 5.9%.

Provide the response for this part in the Excel spreadsheet.

You are given the following additional information:

- Management approves a 4% rate increase for this line of business.
- No further rate changes are expected.
- The annual severity trend is 1.5%.
- The annual frequency trend is 0.5%.
- The annual premium trend is 0.4%.

- (b) (3.5 points) Calculate the forecasted profit per policy for policies written in 2022, 2023, 2024 and 2025.

Provide the response for this part in the Excel spreadsheet.

16.

(7 points)

- (a) (0.5 points) Define “maturity age” in the context of a claim development triangle.

ANSWER:

You are given the following claim information.

Claim ID	Incremental Paid Claims					
	2018H1	2018H2	2019H1	2019H2	2020H1	2020H2
Occurrence Year: 2018						
1	0	100	250	0	0	75
2	50					
3				0	55	0
4						
Occurrence Year: 2019						
5			190	0	30	
6				0	0	
7			75	0	0	185
Occurrence Year: 2020						
8					0	0
9					0	100
10					0	175

16. Continued

Claim ID	Case Estimates at the End of Each Half Year					
	2018H1	2018H2	2019H1	2019H2	2020H1	2020H2
Occurrence Year: 2018						
1	150	200	75	75	75	0
2	0					
3				315	260	260
4					75	90
Occurrence Year: 2019						
5			35	35	0	
6				225	0	
7			0	0	225	0
Occurrence Year: 2020						
8					250	65
9					25	0
10					275	0

- (b) (3 points) Construct a development triangle of cumulative reported claims, by accident year, with maturity ages 6, 12, 18, 24, 30 and 36 months.

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

The above claim information provides claims from the following three lines of business:

- Medical malpractice
- Workers' compensation
- Automobile physical damage

- (c) (1.5 points) Select which line of business was the likely source for each of the following claims, providing a justification for each selection:

- (i) Claim 2
- (ii) Claim 3
- (iii) Claim 7

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

16. Continued

You are given the following general liability development triangle for investigative analysis.

Accident Year	Reported Pure Premiums							
	12	24	36	48	60	72	84	96
2013	199	295	394	471	545	586	620	637
2014	196	293	393	469	544	626	618	
2015	170	257	344	419	485	521		
2016	168	258	346	424	494			
2017	178	280	377	468				
2018	190	300	408					
2019	202	321						
2020	271							

- (d) (1 point) Identify two anomalies relating to this triangle.

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

- (e) (1 point) Describe a business, operational, or environmental change that could cause each of the anomalies identified in part (d).

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

17.

(5 points) Primary Insurance is interested in obtaining per occurrence excess of loss reinsurance for the combined perils of hurricane wind (HW) and flood inland (FI). The reinsurance is to cover Primary's insured losses between the 100-year and 500-year PMLs from these two perils.

The proposed reinsurance cover is to be provided in two layers:

- the first layer covering Primary's insured losses between the 100-year and 250-year PMLs, and
- the second layer covering Primary's insured losses between the 250-year and 500-year PMLs.

You are given the following excerpts of catastrophe model output for Primary's portfolio of insurance policies.

Loss Basis	Return Period (Years)	PMLs (000s)		
		HW	FI	HW and FI Combined
Ground up	100	780,971	120,066	830,644
	250	1,242,287	250,762	1,362,121
	500	1,801,316	388,680	2,006,473
Gross	100	624,777	96,053	664,515
	200	993,830	200,609	1,089,697
	500	1,441,053	310,944	1,605,179

Layer (PML basis)	Statistic	AAL and Standard Deviation (SD) (000s)		
		HW	FI	HW and FI Combined
100-year to 250-year	AAL	616	45	661
	SD	6,314	1,280	6,868
250-year to 500-year	AAL	212	21	233
	SD	3,920	1,005	4,374

- (a) (0.5 points) Calculate the probability of reaching an amount of loss that activates reinsurance coverage for each of the reinsurance layers.

Provide the response for this part in the Excel spreadsheet.

17. Continued

Assume that Primary purchased this reinsurance coverage and then experienced the following losses from a single catastrophic event:

- Insured losses from peril HW: 1,098,085,000
- Insured losses from peril FI: 132,325,000

- (b) (1 point) Calculate Primary's reinsurance recoverables from this catastrophic event for each of the two layers.

Provide the response for this part in the Excel spreadsheet.

Historically, Primary has received reinsurance premium quotes that reflect an expense load of 24% and a risk load equal to the 85% of the SD.

- (c) (2 points) Estimate Primary's reinsurance premium for each layer of coverage.

Provide the response for this part in the Excel spreadsheet.

Primary is also considering inclusion of the peril flood storm surge (FSS) for its reinsurance coverage. Primary has separate PMLs, AALs and SDs for FSS but does not have the amounts on a HW, FI and FSS combined basis. An underwriter has recommended that Primary should calculate the total reinsurance premium by estimating a premium for FSS coverage in the reinsurance layers and then adding it to the premiums estimated in part (c).

- (d) (1.5 points) Provide two reasons why Primary should not calculate the total reinsurance premium using the underwriter's recommendation.

Provide the response for this part in the Excel spreadsheet.

18.

(6 points) You are projecting ultimate claims as of December 31, 2020 using the paid development method and are given the following data:

Accident Year	Paid Claims (000)							
	12	24	36	48	60	72	84	96
2013	162	517	866	1,171	1,402	1,573	1,716	1,824
2014	171	523	875	1,142	1,372	1,565	1,712	
2015	182	518	876	1,169	1,424	1,610		
2016	190	543	923	1,219	1,460			
2017	198	540	1,082	1,391				
2018	205	560	968					
2019	211	573						
2020	224							

Accident Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96
2013	3.191	1.675	1.352	1.197	1.122	1.091	1.063
2014	3.058	1.673	1.305	1.201	1.141	1.094	
2015	2.846	1.691	1.334	1.218	1.131		
2016	2.858	1.700	1.321	1.198			
2017	2.727	2.004	1.286				
2018	2.732	1.729					
2019	2.716						

Accident year 2017 includes a large claim of 150,000 paid and closed on March 15, 2019. The claim was unusual, and a similar claim is not likely to occur.

- (a) (1 point) Select age-to-age development factors for all periods excluding the tail factor. Justify your selections.

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

18. Continued

You are given the following additional information:

Accident Year	Projected Ultimate Claims from Reported Development Method (000)
2013	1,975
2014	1,974
2015	2,032
2016	2,078
2017	2,234
2018	2,216
2019	2,261
2020	2,295
Total	17,065

- (b) (1.5 points) Derive a paid tail factor using Boor's algebraic method.

Provide the response for this part in the Excel spreadsheet.

Subsequently, the Chief Actuary provides you with an alternative tail factor of 1.072 based on industry benchmark data.

- (c) (1 point) Calculate ultimate claims using the paid development method and the tail factor of 1.072.

Provide the response for this part in the Excel spreadsheet.

You are given the following additional information for estimating ULAE:

- Selected ultimate claims for each accident year are based on the results from the reported development method shown above (and not the paid development method).
 - Actual reported claims as of December 31, 2020 are 14,660,000.
 - The selected ratio of calendar year paid unallocated loss adjustment expenses (ULAE) to paid claims is 8%.
- (d) (1 point) Calculate the unpaid ULAE as of December 31, 2020 using the classical paid-to-paid method and a multiplier of 50%.

Provide the response for this part in the Excel spreadsheet.

18. Continued

- (e) (1 point) Describe the Kittel refinement to the classical paid-to-paid method and the weakness it is designed to address.

Provide the response for this part in the Excel spreadsheet.

- (f) (0.5 points) Describe the Mango and Allen smoothing adjustment.

Provide the response for this part in the Excel spreadsheet.

19.

(5 points) You are given the following information on all policies written for a homeowners line of business:

Policy #	Renewal Date Each Year	Territory	Class
1	April 1	3	1
2	June 1	See note below	2
3	October 1	2	1

- All policies are 12-month policy terms.
- All policies were first written prior to 2018, have been renewed each year and are still in-force.
- Policy #2 was originally rated as territory 2 and was changed to territory 1 at their 2019 renewal.
- The risk characteristics for policies #1 and #3 have remained the same since each policy was first written.

You are given the following historical rate changes since 2018:

Effective Date	Base Rate
Jul. 1, 2018	780
Jul. 1, 2019	795
Jul. 1, 2020	805

Effective Date	Territory Rating Factors		
	Territory 1	Territory 2	Territory 3
Jul. 1, 2018	1.00	1.25	0.97
Jul. 1, 2019	1.00	1.22	0.95
Jul. 1, 2020	1.00	1.30	0.94

Effective Date	Class Rating Factors	
	Class 1	Class 2
Jul. 1, 2018	1.15	1.00
Jul. 1, 2019	1.12	1.00
Jul. 1, 2020	1.18	1.00

Premiums are the product of base rate and the rating factors.

19. Continued

- (a) (2 points) Calculate the calendar year 2019 total earned premiums at current rate levels using the extension of exposures method.

Provide the response for this part in the Excel spreadsheet.

- (b) (1 point) Calculate the total in-force premiums as of July 1, 2019 using the July 1, 2018 rates.

Provide the response for this part in the Excel spreadsheet.

- (c) (1 point) Calculate the total in-force premiums as of July 1, 2019 using the July 1, 2019 rates.

Provide the response for this part in the Excel spreadsheet.

- (d) (0.5 points) Calculate the overall premium change for the July 1, 2019 rate changes.

Provide the response for this part in the Excel spreadsheet.

- (e) (0.5 points) Explain why the July 1, 2019 increase in the base rate is not equal to the overall premium change calculated in part (d).

Provide the response for this part in the Excel spreadsheet.

20.

(4 points) You are conducting a ratemaking analysis and are given the following information:

Calendar Year	Earned Exposures	Direct Written Premium	Direct Earned Premiums	Total Commission Expenses and Premium Taxes	General Expenses
2018	32,500	8,800,000	8,700,000	1,400,000	1,355,000
2019	33,700	9,600,000	9,400,000	1,520,000	1,450,000
2020	35,100	10,200,000	9,900,000	1,620,000	1,490,000

- 25% of general expenses are fixed expenses.
- Unallocated loss adjustment expenses have been 6% of claims for each of the past three years and are expected to increase to 8% for the next five years due to a system update that will cost 1,200,000 to implement.
- The earned exposures in the future rating period are projected to be 37,000.

(a) (1.5 points) Calculate the total variable expense ratio for each calendar year.

Provide the response for this part in the Excel spreadsheet.

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

Provide the response for this part in the Excel spreadsheet.

(c) (1.5 points) Recommend the fixed expense per exposure to use in ratemaking. Justify your recommendation.

Provide the response for this part in the Excel spreadsheet.

****END OF EXAMINATION****