SOCIETY OF ACTUARIES

General Insurance
Ratemaking & Reserving

Exam GIRR

Date: Thursday, November 5, 2020

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 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. The Word and Excel files that contain your answers must be uploaded before time expires.

1. (*4 points*) You are given the following information for a line of business that started in 2016:

Accident Year	Reported Claims (000)			
	12	**24**	**36**	**48**
2016	12,800	16,380	18,350	19,080
2017	13,700	17,810	19,590	
2018	15,200	19,150		
2019	14,800			

Accident Year	Paid Claims (000)			
	12	**24**	**36**	**48**
2016	9,730	14,580	17,430	18,300
2017	9,450	15,320	18,410	
2018	10,940	16,090		
2019	11,100			

Accident Year	Case Estimates (000)			
	12	**24**	**36**	**48**
2016	3,070	1,800	920	380
2017	4,250	2,490	1,140	
2018	4,260	2,980		
2019	3,620			

(a) (*1 point*) Identify the inconsistencies in the data triangles.

The response for part (a) is to be provided in the Excel spreadsheet.

(b) (*0.5 points*) Provide one potential cause for the data issue identified in part (a).

ANSWER:

1. Continued

You are provided with the following additional transactions from a single claim that occurred on March 1, 2017 and was not included in the above data:

	Transaction Description	Transaction Date	Case Estimate	Indemnity Payment	ALAE Payment
1	Open new claim file	May 1, 2017	42,000	0	0
2	Payment on reported claim file	Dec. 1, 2017	30,000	10,000	1,000
3	Payment on reported claim file	Jun. 1, 2018	20,000	12,000	2,000

(c) (*1.5 points*) Construct revised paid claims and case estimates triangles incorporating this additional information.

The response for part (c) is to be provided in the Excel spreadsheet.

(d) (*1 point*) Calculate the calendar year 2018 reported claims using the revised triangles from part (c).

The response for part (d) is to be provided in the Excel spreadsheet.

2. (*4 points*) You are estimating ultimate claims as of December 31, 2019 using the Bornhuetter Ferguson method, and are given the following information:

Accident Year	Actual Claims as of Dec. 31, 2019		Ultimate Claims from Development Method on		Expected Claims
	Paid	Reported	Paid	Reported	
2016	889,190	898,170	916,755	916,133	889,488
2017	916,340	964,570	1,014,895	1,003,537	998,479
2018	824,940	959,230	1,065,872	1,077,820	1,113,814
2019	586,850	838,362	1,140,237	1,139,829	1,142,919

(a) (*1 point*) Calculate the total ultimate claims using the Bornhuetter Ferguson method applied to the following two claim amounts:

(i) Paid claims

(ii) Reported claims

The response for part (a) is to be provided in the Excel spreadsheet.

(b) (*1.5 points*) Evaluate the reasonableness of the inputs for the Bornhuetter Ferguson method in part (a) by comparing the following two amounts:

(i) Actual paid claims to expected paid claims

(ii) Actual reported claims to expected reported claims

The response for part (b) is to be provided in the Excel spreadsheet.

(c) (*0.5 points*) Identify two reasons that might cause the differences shown in part (b).

ANSWER:

You have decided to estimate ultimate claims as of December 31, 2019 using the Benktander method.

(d) (*0.5 points*) Describe a reason why the Benktander method might be preferred to estimate ultimate claims.

ANSWER:

2. Continued

(e) (*0.5 points*) Calculate the total ultimate claims applied to paid claims using one iteration of the Benktander method.

The response for part (e) is to be provided in the Excel spreadsheet.

3. (*4 points*)

(a) (*0.5 points*) Describe why the risk of reserve inadequacy is greatly reduced for claims-made policies compared to occurrence policies.

ANSWER:

You are given the following accident year lag by report year matrix:

Reported Claims								
Accident Year Lag	**Report Year**							
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
0	160	168	176	185	194	204	214	225
1	240	252	265	278	292	306	322	338
2	240	252	265	278	292	306	322	338
3	160	168	176	185	194	204	214	225

(b) (*1.5 points*) Calculate the total reported claims for each of the following:

(i) A first-year claims-made policy effective January 1, 2013

(ii) A third-year claims-made policy effective January 1, 2015

(iii) A tail policy purchased after the third-year claims-made policy from part (b)(ii)

The response for part (b) is to be provided in the Excel spreadsheet.

You are conducting a ratemaking analysis for a professional liability coverage with the following information:

- The total reported claims for accident year 1 are 800.
- There is a four-year reporting pattern of equal percentages each year.
- There is 10% annual pure premium trend in accident year claims.

(c) (*2 points*) Calculate each of the following factors for this coverage:

(i) A second-year claims-made step factor

(ii) A mature claims-made tail factor

The response for part (c) is to be provided in the Excel spreadsheet.

4. (*5 points*) You are given the following information for estimating ultimate claims excess of a 500,000 limit:

Accident Year	Reported Claims at Total Limits (000)				
	12	**24**	**36**	**48**	**60**
2015	8,758	15,885	16,378	16,672	16,711
2016	9,907	14,079	15,231	16,493	
2017	9,569	15,032	15,500		
2018	8,881	15,952			
2019	9,934				

Accident Year	Reported Claims at 500,000 Limit (000)				
	12	**24**	**36**	**48**	**60**
2015	8,706	14,507	14,367	14,714	14,854
2016	9,600	12,981	13,407	13,558	
2017	9,052	13,342	13,612		
2018	8,881	14,977			
2019	9,267				

Age-to-Age Development Factors (All-Years Volume-Weighted Average)					
	12-24	**24-36**	**36-48**	**48-60**	**60-Ult**
Total Limits	1.642	1.047	1.049	1.002	1.000
500,000 Limit	1.543	1.014	1.018	1.010	1.000

(a) (*1.5 points*) Calculate the ultimate claims for the layer of claims excess 500,000 using the development method with all-years volume-weighted average development factors.

The response for part (a) is to be provided in the Excel spreadsheet.

(b) (*1 point*) Calculate the ultimate claims for the layer of claims excess 500,000 as the difference between ultimate total limits claims and ultimate 500,000 limit claims.

The response for part (b) is to be provided in the Excel spreadsheet.

(c) (*1 point*) Recommend the ultimate claims for the layer of claims excess of 500,000. Justify your recommendation.

ANSWER:

4. Continued

You are also evaluating the ultimate claims excess of 500,000 using the expected method and are given the following information:

- The selected expected claim ratio at the 2019 cost level is 12%.
- The claim ratio trend is 5%.
- The earned premiums at current rate levels for calendar years 2018 and 2019 are 30,500,000 and 31,800,000, respectively.

(d) (*1 point*) Calculate the ultimate claims for the layer of claims excess 500,000 for accident years 2018 and 2019, using the expected method.

The response for part (d) is to be provided in the Excel spreadsheet.

(e) (*0.5 points*) Describe when the expected method is appropriate to use for determining ultimate claims for excess limits.

ANSWER:

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
2014	4,526,480	5,850,000	172,580
2015	4,830,080	6,166,130	186,220
2016	5,279,580	6,451,780	200,650
2017	5,542,320	6,658,360	214,400
2018	6,139,740	6,901,520	231,200
2019	6,873,650	7,231,270	253,090

This line of business has historically used an annual fixed expense trend of 3%, which has been based on a publicly-available cost index.

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

The response for part (a) is to be provided in the Excel spreadsheet.

(b) (*0.5 points*) Assess the reasonableness of using the publicly-available cost index for this line of business in comparison to using the historical trend in fixed expenses.

ANSWER:

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

ANSWER:

You are given the following additional information:

- New rates will be effective April 1, 2021 for one year.
- All policies are written as 12-month policies.
- The annual premium trend is 0%.

(d) (*2 points*) Calculate the fixed expense ratio to be used in ratemaking, using a simple average from calendar years 2017, 2018 and 2019.

The response for part (d) is to be provided in the Excel spreadsheet.

6. (*7 points*) You are given the following information:

Accident Year	Paid Claims					
	12	**24**	**36**	**48**	**60**	**72**
2014	375,550	784,660	1,201,110	1,448,160	1,779,630	2,052,790
2015	364,560	783,060	1,208,490	1,461,210	1,786,040	
2016	322,630	685,250	1,041,620	1,268,040		
2017	321,440	697,160	1,032,020			
2018	264,920	586,100				
2019	345,800					

Accident Year	Closed Counts					
	12	**24**	**36**	**48**	**60**	**72**
2014	583	713	754	772	792	813
2015	539	665	709	728	757	
2016	450	549	582	596		
2017	427	522	544			
2018	332	414				
2019	405					

(a) (*2 points*) Calculate the ultimate paid severity for each accident year using the development method.

The response for part (a) is to be provided in the Excel spreadsheet.

(b) (*1 point*) State two considerations for deciding how many data points to include when selecting an annual trend.

ANSWER:

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

The response for part (c) is to be provided in the Excel spreadsheet.

6. Continued

You are estimating ultimate claims using a frequency-severity claim closure method and are given the following information:

Accident Year	Ultimate Counts
2014	813
2015	798
2016	649
2017	606
2018	488
2019	586

(d) (*1.5 points*) Calculate the proportion of closed counts for development months 36 through 72 using a simple average of all years.

The response for part (d) is to be provided in the Excel spreadsheet.

You are given the following additional information:

Selected Incremental Paid Severity at 2019 Cost Level by Development Month					
12	**24**	**36**	**48**	**60**	**72**
851	4,273	11,153	13,605	12,107	8,704

(e) (*1 point*) Calculate the accident year 2018 unpaid claims, using the results from parts (c) and (d).

The response for part (e) is to be provided in the Excel spreadsheet.

7. (*4 points*) You are given the following characteristics for two different lines of business:

Line of Business A:

- Twenty years of data available for claims and counts
- Long-tailed coverage
- Volatile claim experience
- Significant annual claim ratio (pure premium) trend of 9%
- Increasing claim frequency over the most recent 10 years
- Policy limits have increased over time

Line of Business B:

- Newer growing line of business with six years of claim data available, but count data is unreliable due to change in definition of a claim count
- Short-tailed coverage
- Relatively stable experience for reported claims except for occasional large claims
- Paid claim experience includes a decrease in claim settlement patterns due to the strain of a growing business

Recommend two methods for projecting ultimate claims that are appropriate <u>for each</u> line of business without repeating any methods. Justify your recommendations for all four methods.

ANSWER:

8. (*5 points*)

(a) (*1 point*) Describe the difference between claim liabilities and premium liabilities.

ANSWER:

The two main approaches for determining the central estimate of premium liabilities are the premium approach and the claims approach.

(b) (*1 point*) Describe each of these approaches.

ANSWER:

(c) (*0.5 points*) Provide one challenge with the premium approach.

ANSWER:

You are estimating the policy liabilities for an insurer that started writing business on March 1, 2020. You have decided to use the claims approach and are given the following additional information:

Line of Business	Gross Written Premium (000)	Gross Expected Claim Ratios including ALAE
Property	1,305	82%
General Liability	1,539	56%
Automobile	1,244	79%

- All policies were written on March 1, 2020 and are for 12-month terms.
- There is a 25% quota share reinsurance treaty.
- ULAE is 12.9% of gross claims (including ALAE).
- General expenses are 16% of gross written premiums.
- 30% of general expenses are associated with ongoing maintenance for unexpired risks.
- Incentive commissions are 3.2% of gross premiums.

(d) (*2.5 points*) Calculate the equity in unearned premiums as of June 30, 2020, net of reinsurance.

The response for part (d) is to be provided in the Excel spreadsheet.

9. (*8 points*)

(a) (*0.5 points*) Describe why premium on-level factors are typically used in the Cape Cod method but not in the Bornhuetter Ferguson method.

ANSWER:

(b) (*0.5 points*) Describe a situation in which an actuary may choose to derive an adjusted expected pure premium instead of an adjusted expected claim ratio when using the Cape Cod method.

ANSWER:

In selecting a decay factor for the Generalized Cape Cod method, actuaries should consider their confidence in the development method.

(c) (*1 point*) Explain why confidence in the development method is a consideration in selecting the decay factor.

ANSWER:

9. Continued

You have been asked to project ultimate claims using the Cape Cod method and have been given the following information as of December 31, 2019:

Accident Year	Earned Premiums (000)	Actual Reported Claims (000)	Reported Cumulative Development Factors
2015	16,100	11,150	1.030
2016	17,600	11,380	1.055
2017	18,300	11,190	1.100
2018	19,800	11,470	1.300
2019	21,600	9,040	1.700

- All policies are written for 12-month policy terms.
- The following rate changes have occurred:
  - 6% effective January 1, 2016
  - 5% effective July 1, 2018
- The annual claim ratio trend is 5%.
- Tort reform resulted in a claim decrease of 10% for all accidents occurring on or after July 1, 2016.
- Accident year 2018 includes one unusually large claim of 600,000 which has been recorded as a case estimate.

(d) (*2 points*) Calculate premium on-level factors for each accident year, to use in the Cape Cod method as of December 31, 2019.

The response for part (d) is to be provided in the Excel spreadsheet.

(e) (*4 points*) Calculate the projected ultimate claims for each accident year using the Cape Cod method.

The response for part (e) is to be provided in the Excel spreadsheet.

10. (*4 points*) Experience rating plans are generally designed to recognize both the frequency and severity inherent in an insured's actual claims.

(a) (*0.5 points*) Describe how the NCCI split rating experience rating plan differentiates between the frequency and severity of an insured's experience.

ANSWER:

(b) (*0.5 points*) Provide another way that an experience rating formula can differentiate between frequency and severity, other than the approach identified in part (a).

ANSWER:

You are given the following information:

Claims ID	Actual Reported Claims
# 2	15,000
# 4	40,000
# 7	5,000
Claims less than 1,000	20,000

Classification Code	Payroll	Expected Loss Rate (per 100 of payroll)	D-ratio
A	1,400,000	0.10	0.5
B	1,600,000	2.00	0.4
C	1,000,000	1.50	0.3

- The primary threshold for reported claims, for rating purposes, is 10,000.

(c) (*1.5 points*) Calculate the following:

(i) Total actual excess claims

(ii) Total expected primary claims

(iii) Expected excess claims for Classification Code C

The response for part (c) is to be provided in the Excel spreadsheet.

10. Continued

The formula for the NCCI experience rating modification factor is given as follows:

$$M = \frac{A_P + (1-W) \times E_{XS} + B + W \times A_{XS}}{E_P + (1-W) \times E_{XS} + B + W \times E_{XS}}$$

(d) (*0.5 points*) Calculate the NCCI experience rating modification factor using W = 0.5 and B = 50,000.

The response for part (d) is to be provided in the Excel spreadsheet.

(e) (*1 point*) Recommend two ways to increase responsiveness of this experience rating plan.

ANSWER:

11. (*6 points*) You are conducting an analysis of deductible factors for ratemaking using empirical individual claims data.

(a) (*0.5 points*) Describe a potential issue related to the absence of complete data when using reported claim data from recent years.

ANSWER:

(b) (*1 point*) Describe a potential issue related to claim development when using individual reported claim data from recent years.

ANSWER:

You are given the following information:

Claim #	Date of Claim	Ground Up Ultimate Claims
1	January 1, 2017	7,500
2	July 1, 2017	800
3	July 1, 2017	1,600
4	January 1, 2018	2,400
5	January 1, 2018	6,700
6	July 1, 2018	2,300
7	January 1, 2019	700
8	July 1, 2019	300
9	July 1, 2019	1,100
10	July 1, 2019	4,500

- New rates are to be effective March 1, 2021 for one year.
- All policies are written as 12-month policies.
- The annual claim severity trend is 5%.

(c) (*2.5 points*) Calculate the indicated deductible factors for deductibles of 500 and 1,000 relative to a base deductible of zero.

The response for part (c) is to be provided in the Excel spreadsheet.

11. Continued

(d) (*1 point*) Explain why the deductible factors would be higher if an annual severity trend greater than 5% is used in part (c).

ANSWER:

(e) (*1 point*) Evaluate the reasonability of the deductible factors calculated in part (c) by performing a consistency test.

The response for part (e) is to be provided in the Excel spreadsheet.

12. (*4 points*)

(a) (*1 point*) State four applications of catastrophe modeling for insurance.

ANSWER:

You insure a small book of property portfolios in the state of Florida. You receive two new requests (portfolio X and portfolio Y) for pricing quotes and you decide to add only one of these portfolios to the book.

You are given the following information:

	Average Annual Loss (AAL)	**100-Year Probable Maximum Loss (PML)**
Current Book	50,000	750,000
Current Book + Portfolio X	50,000 + 5,000	850,000
Current Book + Portfolio Y	50,000 + 6,000	770,000

(b) (*1 point*) Recommend which portfolio you would add to the book. Justify your recommendation.

ANSWER:

Management decided to write the portfolio you didn't recommend in part (b). The risk potential of the portfolio could be reduced by 13.7% if hurricane shutters are installed as a risk mitigation strategy. The expense load factor is 27%. The selected risk load is 440.

(c) (*1 point*) Calculate the premium for this other portfolio assuming hurricane shutters are installed on all properties in the portfolio.

The response for part (c) is to be provided in the Excel spreadsheet.

(d) (*0.5 points*) Provide a consideration in the selection of a risk load in this situation.

ANSWER:

12. Continued

You are concerned about the close geographical proximity of your existing book of business to the portfolio that management wants to add.

(e) (*0.5 points*) Recommend a way this risk could be managed.

ANSWER:

13. (*5 points*) You are determining a loading for large claims on a homeowners line of business.

(a) (*0.5 points*) Explain why actuaries typically conduct separate analyses of property and liability claims for homeowners insurance when determining a loading for large claims.

ANSWER:

You are estimating ultimate property claims to be used in a ratemaking analysis for State Q, and are given the following information:

Accident Year	Selected Ultimate Claims at 1 Million Limit (000)	Selected Ultimate Claims at Total Limits (000)
2016	7,420	7,950
2017	7,800	8,150
2018	8,500	8,690
2019	9,150	9,320

Selections	1 Million Limit	Total Limits
State Q Severity Trend	4.0%	5.0%
State Q Credibility	60%	50%
Countrywide Severity Trend	5.0%	6.0%

- The claims experience of State Q is not fully credible for calculating trend.
- Rates are effective April 1, 2021 for one year.
- All policies are written for 12-month policy terms.

You are given the following loadings for large claims for the 500,000 to 1 million limit:

Accident Year	500,000 to 1 Million Limit
2016	1.182
2017	1.185
2018	1.270
2019	1.285

(b) (*3 points*) Calculate the loadings for 500,000 to total limits for each accident year.

The response for part (b) is to be provided in the Excel spreadsheet.

13. Continued

(c) (*0.5 points*) Recommend a loading for 500,000 to total limits for ratemaking purposes. Justify your recommendation.

ANSWER:

(d) (*1 point*) Explain why severity trend is used for the part (b) calculation instead of pure premium trend.

ANSWER:

14. (*6 points*) You are given the following information as of December 31, 2019:

Accident Year	Reported Claims (000)						Ultimate Claims (000)
	12	24	36	48	60	72	
2014	3,013	4,401	5,552	6,159	6,509	6,557	6,557
2015	3,401	4,902	6,078	6,747	7,242		7,293
2016	3,559	5,374	6,744	7,544			8,087
2017	3,189	4,604	5,988				7,150
2018	3.292	5,018					7,572
2019	3,537						7,875

- Estimated ultimate claims were based on the development method applied to reported claims.

You are also given the following actual reported claims evaluated as of September 30, 2020.

Accident Year	Reported Claims as of September 30, 2020 (000)
2014	6,557
2015	7,283
2016	7,923
2017	6,572
2018	6,335
2019	5,129

(a) (*1.5 points*) Calculate the difference between the actual and expected reported claims from December 31, 2019 through September 30, 2020 for all accident years, using a linear interpolation of the development pattern.

The response for part (a) is to be provided in the Excel spreadsheet.

(b) (*0.5 points*) Provide an interpretation of the results for the actual versus expected analysis derived in part (a).

ANSWER:

14. Continued

You are told that the claim department outsourced a portion of its claim handling effective March 2019. There are concerns that operational changes may have affected development patterns in immature accident periods.

You are given the following additional information for the same line of business to perform diagnostic testing.

Accident Year	Paid Claims (000)					
	12	24	36	48	60	72
2014	1,377	2,616	3,958	4,809	5,675	6,010
2015	1,553	2,928	4,381	5,275	6,221	
2016	1,692	3,238	4,860	5,887		
2017	1,446	2,749	4,152			
2018	1,496	2,849				
2019	1,448					

Accident Year	Closed Counts					
	12	24	36	48	60	72
2014	477	666	727	753	781	796
2015	487	697	762	786	806	
2016	521	736	802	827		
2017	457	640	697			
2018	452	641				
2019	447					

Accident Year	Open Counts					
	12	24	36	48	60	72
2014	297	176	126	100	72	57
2015	320	186	128	104	84	
2016	309	191	136	111		
2017	277	157	111			
2018	272	158				
2019	267					

(c) (*2.5 points*) Evaluate if the data indicates a possible change in case reserve adequacy using two different diagnostic tests.

The response for part (c) is to be provided in the Excel spreadsheet.

(d) (*1.5 point*) Evaluate if the data indicates a possible change in case settlement rates using a diagnostic test different than either of the two tests from part (c).

The response for part (d) is to be provided in the Excel spreadsheet.

15. (*4 points*) You are estimating unpaid ULAE.

(a) (*0.5 points*) Describe one way a reinsurer might assess the reasonableness of an estimate of unpaid ULAE.

ANSWER:

You are given the following information for an insurance company:

Calendar Year	Earned Exposures	Paid ULAE	Ratio of ULAE to Claims	
			Classical Paid	Kittel Refinement
2017	7,430	810,000	7.4%	7.5%
2018	7,890	850,000	7.5%	7.3%
2019	8,310	880,000	7.6%	7.1%

- The Kittel refinement reflects the average of actual paid and reported claims.

(b) (*0.5 points*) Recommend one of the two approaches from the table above to use in estimating unpaid ULAE. Justify your recommendation.

ANSWER:

You are given the following additional information:

	As of December 31, 2019
Case Estimates	3,510,000
IBNR	1,600,000

- Approximately 80% of IBNR is a provision for development on known claims.
- Approximately 25% of claim department expenses relate to opening a claim file and 75% relate to maintaining and closing a claim file.

(c) (*1.5 points*) Estimate unpaid ULAE as of December 31, 2019 using the approach you selected in part (b).

The response for part (c) is to be provided in the Excel spreadsheet.

15. Continued

Unpaid ULAE as of December 31, 2018 was 270,000.

(d) (*0.5 points*) Determine calendar year 2019 incurred ULAE.

The response for part (d) is to be provided in the Excel spreadsheet.

You work for an insurance company that writes only auto insurance. The company's practice is to set up zero case estimates for ALAE because ALAE for the company is relatively small and stable.

Your colleague recommends estimating unpaid ALAE using the same paid-to-paid approach as ULAE because there are no ALAE case estimates, the experience is stable, and auto insurance is the only line of business.

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

ANSWER:

16. (*7 points*) You are conducting a ratemaking analysis for an automobile line of business and are given the following information:

Rate Change History	
Effective Date of Rate Change	**Rate Change %**
July 1, 2015	8.0%
January 1, 2017	10.0%
January 1, 2019	5.0%

- Premiums are written and earned evenly throughout the year.
- All policies are written for 12-month policy terms.
- In addition to the above rate changes, there was a regulation change where all premiums in force on July 1, 2017 were required to be reduced by 20%.

(a) (*2 points*) Calculate premium on-level factors for accident years 2015-2019 to use for ratemaking purposes.

The response for part (a) is to be provided in the Excel spreadsheet.

You are given the following additional information:

Accident Year	Earned Premiums	Ultimate Claims
2015	11,755,570	8,130,150
2016	11,864,520	7,970,110
2017	12,406,530	7,781,380
2018	12,492,860	8,001,680
2019	12,394,530	7,995,960

- The annual premium trend is 1%.
- The annual pure premium trend is 4%.
- The new rates will be effective November 1, 2020 through October 31, 2021.
- The historical data is considered fully credible for ratemaking purposes.
- The regulation change which reduced premiums also reduced claim costs by 20% for all accidents occurring on or after July 1, 2017.

(b) (*2.5 points*) Calculate the trended on-level claim ratios for each accident year.

The response for part (b) is to be provided in the Excel spreadsheet.

16. Continued

(c) (*1 point*) Recommend a trended claim ratio to use for ratemaking. Justify your recommendation.

The response for part (c) is to be provided in the Excel spreadsheet.

You are given the following additional information:

- The ratio of ULAE to claims is 10%.
- The ratio of fixed expenses to premiums at current rates is 6%.
- The ratio of variable expenses to premiums is 19%.
- The ratio of profit and contingencies to premiums is 5%.

(d) (*0.5 points*) Calculate the indicated rate change.

The response for part (d) is to be provided in the Excel spreadsheet.

The purpose of the legislative change effective July 1, 2017 was to reduce increases in premiums arising from poor industry claims experience. As a result, management questions your required increase of 5% in 2019.

(e) (*1 point*) Explain why an indicated rate increase of 5% is not necessarily indicative of deteriorating experience.

ANSWER:

17. (*3 points*)

(a) (*0.5 points*) Provide two different examples of changing conditions that are likely to decrease the latest diagonal of a reported claim triangle.

ANSWER:

(b) (*0.5 points*) Describe how an increase in attachment point for an excess of loss reinsurer could affect a reported claim triangle.

ANSWER:

You are analyzing a reported development triangle for a line of business where the ultimate claim ratio is increasing unexpectedly apparently due to inadequate price increases. All other aspects of the business are in a steady-state environment.

(c) (*1 point*) Explain what affect the claim ratio deterioration is likely to have on reported claim development factors.

ANSWER:

(d) (*1 point*) Explain which of the following two methods is likely to produce a more accurate estimate of ultimate claims in recent accident years in this scenario:

(i) the development method applied to reported claims, or

(ii) the Bornhuetter Ferguson method applied to reported claims.

ANSWER:

18 (*7 points*)

(a) (*1 point*) Contrast a treaty reinsurance arrangement with a facultative reinsurance arrangement.

ANSWER:

Since 2014, XYZ Re has reinsured Primary Insurance's auto book of business under a quota share treaty. The quota share percentage for accident years 2014-2016 was 50%. The quota share percentage for accident years 2017 and subsequent is 30%.

You are given the following information evaluated as of December 31, 2019:

XYZ Re Premiums and Claims Assumed from Primary Insurance							
Accident Year (AY)	**On Level Earned Premiums (000)**	**Incremental Reported Claims (000)**					
		12	**24**	**36**	**48**	**60**	**72**
2014	14,251	6,138	602	404	236	125	75
2015	14,662	6,605	674	509	234	160	
2016	15,105	7,086	730	438	289		
2017	9,320	4,572	448	291			
2018	9,517	4,898	910				
2019	9,750	5,251					

- The annual claim severity trend is 4%.
- The annual claim frequency trend is 1%.
- The development factor for 72 months to ultimate is 1.005.

(b) (*1.5 points*) Calculate Primary Insurance's ultimate claims gross of reinsurance for all accident years, using the development method and 3-year volume-weighted average.

The response for part (b) is to be provided in the Excel spreadsheet.

You are using the expected method to estimate ultimate claims.

(c) (*2 points*) Calculate the trended on-level claim ratio at AY 2019 cost and rate level gross of reinsurance, using an all-years simple average.

The response for part (c) is to be provided in the Excel spreadsheet.

18. Continued

(d) (*1 point*) Calculate the total ultimate claims for XYZ Re's share of all accident years as of December 31, 2019.

The response for part (d) is to be provided in the Excel spreadsheet.

Primary Insurance has provided a budgeted gross earned premium of 33,000,000 for AY 2020. You expect the claim severity trend, claim frequency trend, and quota share percentage to remain unchanged.

(e) (*0.5 points*) Estimate XYZ Re's AY 2020 expected claims.

The response for part (e) is to be provided in the Excel spreadsheet.

You are given the following additional information:

- Due to the COVID-19 outbreak and the associated lockdown measures, expected claim frequency in AY 2020 will decrease by 20% from AY 2019, partially offset by an increase in severity of 10%.
- In response to reduced vehicle usage, Primary Insurance has processed premium refunds which reduced AY 2020 earned premium by 15%.

(f) (*1 point*) Estimate the total impact on XYZ Re's AY 2020 expected claims.

The response for part (f) is to be provided in the Excel spreadsheet.

19. (*4 points*) You are estimating ultimate claims for a line of business and need to apply a Berquist-Sherman adjustment for a change in settlement rates. You are given the following information:

Accident Year	Closed Counts excluding Large Claim Counts				
	12	24	36	48	60
2015	618	860	1,042	1,187	1,256
2016	801	1,035	1,273	1,426	
2017	627	882	1,082		
2018	606	929			
2019	699				

Selected Disposal Ratios by Maturity Age				
12	24	36	48	60
0.449	0.688	0.844	0.945	1.000

(a) (*1 point*) Calculate the triangle of adjusted closed counts.

The response for part (a) is to be provided in the Excel spreadsheet.

You are given the following additional information:

Accident Year	Paid Claims Excluding Large Claims				
	12	24	36	48	60
2015	756,000	2,101,000	4,562,000	6,689,000	7,213,000
2016	865,000	2,250,000	5,230,000	8,044,000	
2017	696,000	1,967,000	4,601,000		
2018	699,000	2,145,000			
2019	832,000				

Accident Year	Large Claims as of December 31, 2019	
	Paid	Reported
2016	615,000	801,000
2018	297,000	923,000

- A 3-year volume-weighted average is used to select age-to-age development factors.
- There is no development after 60 months.

19. Continued

An exponential curve of the form $y = ae^{bx}$ can be used to approximate the relationship between cumulative closed counts (x) and cumulative paid claims (y). You are given the following values for a and b:

Accident Year	Parameter "*a*" Values			
	12&24	**24&36**	**36&48**	**48&60**
2015	55,580	53,863	291,585	1,827,615
2016	32,800	57,432	145,499	
2017	54,100	46,377		
2018	85,287			

Accident Year	Parameter "*b*" Values			
	12&24	**24&36**	**36&48**	**48&60**
2015	0.00422	0.00426	0.00264	0.00109
2016	0.00409	0.00354	0.00281	
2017	0.00407	0.00425		
2018	0.00347			

(b) (*2.5 points*) Calculate total unpaid claims using the development method applied to paid claims, adjusted for changes in settlement rates.

The response for part (b) is to be provided in the Excel spreadsheet.

(c) (*0.5 points*) Assess the appropriateness of relying on the accident year 2019 ultimate claims from part (b) when selecting ultimate claims.

ANSWER:

20. (*5 points*) You are trending earned premiums for ratemaking purposes and are given the following information:

Experience Period	Earned Exposures by Policy Limit			
	500,000	**1,000,000**	**1,500,000**	**2,000,000**
2014	5,056	4,424	3,476	2,844
2015	5,010	4,843	3,841	3,006
2016	4,816	4,816	4,128	3,440
2017	4,200	4,872	4,032	3,696
2018	3,588	4,524	3,900	3,588
2019	3,108	4,292	3,848	3,552

	Increased Limits Factors by Policy Limit			
	500,000	**1,000,000**	**1,500,000**	**2,000,000**
In effect prior to Nov. 1, 2020	0.82	1.00	1.15	1.27
In effect starting Nov. 1, 2020	0.85	1.00	1.13	1.24

(a) (*1.5 points*) Calculate the annual premium trend due to the shift in policy limits for each year.

The response for part (a) is to be provided in the Excel spreadsheet.

(b) (*1 point*) Recommend the annual premium trend due to the shift in policy limits to use for ratemaking. Justify your recommendation.

The response for part (b) is to be provided in the Excel spreadsheet.

A deductible analysis resulted in an annual trend of –0.4% due to a shift in deductibles.

(c) (*1.5 points*) Explain why the annual premium trend due to a shift in policy limits tends to be positive while the annual premium trend due to a shift in deductibles tends to be negative.

ANSWER:

20. Continued

You are given the following additional information:

- Calendar year 2017 on-level earned premium is 17,808,000.
- The new rates will be effective March 1, 2021 through February 28, 2022.
- All policies are written for 6-month policy terms.

(d) (*1 point*) Calculate the calendar year 2017 on-level earned premium trended for ratemaking purposes.

The response for part (d) is to be provided in the Excel spreadsheet.

****END OF EXAMINATION****