GIRR Model Solutions
Spring 2021

1. **Learning Objectives:**

2. The candidate will demonstrate the ability to prepare claims and exposure data for general insurance actuarial work.

Learning Outcomes:

(2c) Calculate written, earned, in-force and unearned premiums for portfolios of policies with various policy terms and earnings patterns.

(2d) Adjust historical earned premiums to current rate levels.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 11 & 12.

Commentary on Question:

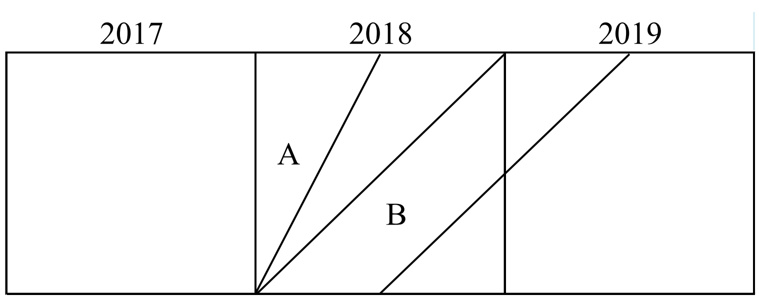
This question tests the candidate's understanding of earned premiums and adjusting earned premiums to current rate levels for ratemaking purposes.

Solution:

(a) Calculate the 2018 earned premium.

Commentary on Question:

Candidates who made use of the diagram did better on this question.



1. Policies in force as of Dec. 31, 2017:

   A: These are the policies that are in force as of Dec. 31, 2017 and expire in 2018

   Area = 1/2 × 1 × 1/2 = 25%

   Earned premium = 2,500 × 750 × 0.25 = 468,750

   B: These are the policies from 2017 that expired in 2018 and then renewed

   Area = 1/2 – 1/8 = 37.5%

   Earned premium = 2,500 × 750 × 0.375 × 0.80 × (1 + 0.04) = 585,000

1. Continued

2. Policies written new from July 1, 2018:
   Earned premium = 2,750 × 780 × 0.50 = 1,072,500
   Total 2018 earned premium = 468,750 + 585,000 + 1,072,500 = 2,126,250.

(b) Calculate the 2018 on-level earned premium to use for ratemaking.

Commentary on Question:
The parallelogram approximation approach is not accurate for this question due to the different terms of the policies during the year.

1 A: This area needs to reflect both rate changes to be on-level:
On-level earned premium (OLEP) = 468,750 × (1 + 0.04) × (1 + 0.05) = 511,875

1 B: This needs only needs to reflect the 2020 rate change:
OLEP = 585,000 × (1 + 0.05) = 614,250

2. This needs only needs to reflect the 2020 rate change:
OLEP = 1,072,500 × (1 + 0.05) = 1,072,500

Total 2018 on-level earned premium = 511,875 + 614,250 + 1,072,500 = 2,198,625.

2. Learning Objectives:

3. The candidate will know how to calculate and evaluate projected ultimate values.

Learning Outcomes:

(3c) Identify the types of development triangles that can be used for investigative testing.

(3d) Analyze development triangles for investigative testing.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 13.

Commentary on Question:

This question tests investigative analysis of various development triangles.

Solution:

(a) Provide one possible interpretation of this anomaly. Justify your interpretation.

A large claim may have been reported between 24 and 36 months (which remains unpaid). Justification:

- A large reported claim would explain the increase in average reported claims for accident year 2014 only, with no change in average paid claims.
- A large reported but unpaid claim would explain the decrease in the ratios for paid to reported claims for accident year 2014 only beginning at 36 months.
- A single large claim would not have a material effect on counts.

(b) Identify another anomaly from the diagnostics.

- Latest 2 diagonals (i.e., calendar years 2019-2020) for ratios of paid to reported claims is low

OR

- Latest 2 diagonals (i.e., calendar years 2019-2020) for ratios of closed to reported counts is low

(c) Provide one possible interpretation of the anomaly you identified in part (b). Justify your interpretation.

This appears to be a slow-down in settlement patterns. Justification:

- Changes on the diagonal often relate to settlement changes or case reserve adequacy changes.
- Either paid claims have decreased or reported claims have increased.
- Closed counts and paid claims have both decreased.
- Since average reported claims didn't change, this does not appear to be a change in case adequacy.

3. Learning Objectives:

3. The candidate will know how to calculate and evaluate projected ultimate values.

4. The candidate will understand financial reporting of claim liabilities and premium liabilities.

5. The candidate will understand trending procedures as applied to ultimate claims, exposures and premiums.

Learning Outcomes:

(3g) Estimate ultimate values using the methods cited in (3e).
(4a) Describe the key assumptions underlying ratio and count-based methods for estimating unpaid unallocated loss adjustment expenses.
(4b) Estimate unpaid unallocated loss adjustment expenses using ratio and count-based methods.
(4c) Evaluate and justify selections of unpaid unallocated loss adjustment expenses based on ratio and count-based methods.
(5b) Identify the time periods associated with trending procedures.
(5c) Analyze and evaluate trend for claims (including frequency, severity, and pure premium) and exposures (including inflation-sensitive exposures and premiums).
(5d) Choose trend rates for claims (frequency, severity, and pure premium) and exposures.
(5e) Calculate trend factors for claims and exposures.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 15, 22, and 25.

Commentary on Question:

This question tests the candidate's understanding of claims trend analysis and selection as well as estimating ultimate claims using the development-based frequency-severity method. This question also tests the candidate's understanding of estimating unpaid ULAE using the classical paid-to-paid method with the Mango-Allen smoothing adjustment.

Solution:

(a) Explain why this may happen when using the development-based frequency-severity method.

For the development-based frequency-severity method, the severity would be developed to an ultimate value separately, which might not equal the developed ultimate claims divided by the developed ultimate counts.

3. Continued

(b) Recommend a claim frequency at the accident year 2020 cost level. Justify your recommendation.

	(1)	(2)	(3)	(4)
		Projected Ultimate Based on Development Method		
Accident Year	Earned Exposures	Counts	Claims	Severity
2015	25,200	2,088	9,028,629	4,324
2016	26,700	2,194	9,779,132	4,458
2017	25,300	2,063	9,477,056	4,594
2018	24,500	1,983	9,375,491	4,733
2019	23,900	1,933	8,987,726	4,724
2020	24,200	1,709	7,810,473	4,749
Total	149,800	11,970	54,458,507	

	(5) = (2)/(1)	$(6)_t = (5)_t / (5)_{t-1}$	(7)	(8) = (5)(7)
Accident Year	Indicated Frequency	Year-to-year Change	Frequency Trend @ −0.78%	Trended Frequency
2015	0.082857		0.961604	0.079676
2016	0.082172	−0.008266	0.969163	0.079638
2017	0.081542	−0.007676	0.976782	0.079648
2018	0.080939	−0.007392	0.984461	0.079681
2019	0.080879	−0.000743	0.992200	0.080248
2020	0.070620	−0.126842	1.000000	0.070620

Frequency trend selection: (column 6): Average of 2016-2018 = −0.78%
(2019 & 2020 are outliers)

Recommended 2020 cost level frequency (column 8): average excluding 2020
= 0.0798
(all other years are stable and 2020 is an outlier)

3. Continued

(c) Calculate ultimate claims using the development-based frequency-severity method and the recommended claim frequency from part (b).

	(4)	$(9)_t = (4)_t / (4)_{t-1}$	(10)	(11) = (4)(10)
Accident Year	Indicated Severity	Year-to-year Change	Severity Trend @ 3.06%	Trended Severity
2015	4,324		1.162655	5,027.32
2016	4,458	0.030990	1.128134	5,029.22
2017	4,594	0.030507	1.094638	5,028.77
2018	4,733	0.030257	1.062136	5,027.09
2019	4,724	−0.001902	1.030600	4,868.55
2020	4,749	0.005292	1.000000	4,749.00

Severity trend selection: (column 9): Average of 2016-2018 = 3.06%
(2019 & 2020 are outliers)

Recommended 2020 cost level frequency (column 11): Average of 2016-2018 = 5,028.10
(2019 & 2020 are outliers)

	(12) = (1)×0.0798/(7)	(13) = 5.028.10/(10)	(14) = (12)(13)
Accident Year	Ultimate Counts	Ultimate Severity	Ultimate Claims
2015	2,090.83	4,324.67	9,042,137
2016	2,198.00	4,457.01	9,796,505
2017	2,066.50	4,593.39	9,492,263
2018	1,985.55	4,733.95	9,399,499
2019	1,921.82	4,878.81	9,376,179
2020	1,930.76	5,028.10	9,708,066
Total			56,814,649

3. Continued

(d) Calculate the expected claims paid for calendar years 2017 through 2020.

	12	**24**	**36**	**48**	**60**	**72**
Cumulative paid claims development factors by maturity age (CDF)	11.245	2.017	1.228	1.063	1.010	1.000
% Cumulative Paid (1/CDF)	8.9%	49.6%	81.4%	94.1%	99.0%	100.0%
% Incremental Paid	8.9%	40.7%	31.9%	12.6%	4.9%	1.0%

e.g., % incremental paid at 24 months = 40.7% = 49.6% - 8.9%

		Projected in Calendar Year			
Accident Year	Ultimate Claims from Part (c)	2017	2018	2019	2020
2015	9,042,137	2,880,340	1,142,940	446,367	89,526
2016	9,796,505	3,985,781	3,120,642	1,238,293	483,607
2017	9,492,263	844,132	***3,861,998***	3,023,727	1,199,837
2018	9,399,499		835,883	3,824,256	2,994,177
2019	9,376,179			833,809	3,814,768
2020	9,708,066				863,323
Total		7,710,253	8,961,462	9,366,451	9,445,237

e.g., Accident year 2017 expected paid claims in calendar year 2018
= 0.407×9,492,263 = ***3,861,998***

(e) Recommend a ULAE ratio using the classical paid-to-paid method with the Mango-Allen smoothing adjustment. Justify your recommendation.

Calendar Year	Paid ULAE	Expected Claims from Part (d)	Ratio ULAE to Claims
2017	738,905	7,710,253	9.58%
2018	851,350	8,961,462	9.50%
2019	883,245	9,366,451	9.43%
2020	879,224	9,445,237	9.31%
Total	3,352,724	35,483,403	9.45%

Recommended ULAE ratio = total of all years = 9.45%, as there are no significant outliers.

Commentary on Question:
Candidates could also recommend a ULAE ratio that considered the downward trend.

3. Continued

(f) Calculate the unpaid ULAE.

Calculated unpaid ULAE = $9.45\% \times 4{,}351{,}459 \times (1 - 0.25) + 9.45\% \times 11{,}117{,}813$
$= 1{,}358{,}858$.

4. Learning Objectives:

3. The candidate will know how to calculate and evaluate projected ultimate values.

4. The candidate will understand financial reporting of claim liabilities and premium liabilities.

Learning Outcomes:

(3i) Assess the appropriateness of the projection methods cited in (e) in varying circumstances.

(4a) Describe the key assumptions underlying ratio and count-based methods for estimating unpaid unallocated loss adjustment expenses.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 21 and 22.

Commentary on Question:

This question tests the candidate's ability to evaluate and justify selections of ultimate values based on various methods. In addition, this question tests the candidate's understanding of estimating unpaid unallocated loss adjustment expenses.

Solution:

(a) Explain why the development method may not be appropriate for estimating unpaid claims for this coverage.

Commentary on Question:

Any two of the following are acceptable.

- The development method is not appropriate for immature experience periods (i.e., the data is less than five years).
- The development method is not appropriate when limited or no historical experience is available.
- The development method is not appropriate when conditions are changing (i.e., tort reform will distort development).

(b) Recommend an appropriate method for estimating unpaid claims for this coverage. Justify your recommendation.

Commentary on Question:

Although the Cape Cod method is the most appropriate recommendation, other methods are acceptable if the justification is appropriate for the circumstances. Justification should include at least three explanations.

4. **Continued**

The Cape Cod method is recommended. Justification:

- Good for immature experience periods
- Good when limited or no historical experience is available
- Good for long-tailed coverages
- Allows for explicit trend adjustment
- Allows for explicit tort reform adjustment
- Industry development (experience) can be used to supplement company development (which is limited to five years)
- Cape Cod method uses actual experience
- Cape Cod method adds stability
- Can be applied to paid and/or reported data

(c) Explain why the classical paid-to-paid method may not be appropriate for estimating unpaid ULAE for this coverage.

Commentary on Question:
Any two of the following are acceptable.

- Tort reform may change the relationship between payments for ULAE and payments for claims.
- Experience period has not reached a steady-state (only five years but coverage is long-tailed).
- Classical paid-to-paid method is not appropriate if significant changes in exposure are occurring (growth in this case).

(d) Recommend an appropriate method for estimating unpaid ULAE for this coverage. Justify your recommendation.

Commentary on Question:
Although the Mango & Allen smoothing adjustment is the most appropriate recommendation, other methods are acceptable if the justification is appropriate for the circumstances. Justification should include at least two explanations.

The Mango & Allen smoothing adjustment is recommended. Justification:

- Appropriate for long-tail coverages
- Appropriate for changing exposure volume
- Appropriate for relatively new insurer/coverage

5. Learning Objectives:

1. The candidate will understand the key considerations for and key concepts underlying general insurance actuarial work.

2. The candidate will demonstrate the ability to prepare claims and exposure data for general insurance actuarial work.

Learning Outcomes:

(1q) Understand the types of reinsurance and key reinsurance terms.
(1s) Analyze and describe the types of reinsurance.
(2a) Create development triangles of claims and counts from detailed claim transaction data.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 10.

Fundamentals of General Insurance Actuarial Analysis 2019 Supplement, J. Friedland, Appendix H.

Commentary on Question:

This question tests the constructions of claims data triangles as well as the candidate's understanding of claims net of reinsurance.

Solution:

Construct the accident year 2017 row as of December 31, 2020 of ABC's cumulative reported claims and ALAE for each of the following development triangles:

(i) Gross of reinsurance

(ii) Net of reinsurance with pro rata treatment of ALAE

(iii) Net of reinsurance with ALAE included in the insurer's retention and the reinsurer's limit

5. Continued

Claim	Transaction Date (m/y)	Indemnity Change in Case Estimate	Indemnity Payment	ALAE Change in Case Estimate	ALAE Payment	Notes
1	03/2018	600,000	0	30,000	0	Claim reported to ABC
1	05/2018	175,000	0	15,000	5,000	Claim activity
1	04/2019	–150,000	150,000	–22,000	22,000	Claim activity
1	07/2020	–625,000	597,000	–23,000	24,000	Claim settled and closed
2	03/2018	90,000	0	10,000	0	Claim reported to ABC
2	05/2019	–90,000	110,000	–10,000	15,000	Claim settled and closed
3	11/2017	400,000	0	60,000	0	Claim reported to ABC
3	08/2018	–75,000	0	–10,000	35,000	Claim activity
3	10/2019	–325,000	300,000	–50,000	35,000	Claim settled and closed
4	03/2018	600,000	0	30,000	0	Claim reported to ABC
4	02/2020	100,000	0	12,000	19,000	Claim activity

Claim	Date (m/y)	Calendar Year	Development Months	Indemnity	ALAE	Occurrence
1	03-2018	2018	24	600,000	30,000	A
1	05-2018	2018	24	175,000	20,000	A
1	04-2019	2019	36	0	0	A
1	07-2020	2020	48	–28,000	1,000	A
2	03-2018	2018	24	90,000	10,000	A
2	05-2019	2019	36	20,000	5,000	A
3	11-2017	2017	12	400,000	60,000	B
3	08-2018	2018	24	–75,000	25,000	B
3	10-2019	2019	36	–25,000	–15,000	B
4	03-2018	2018	24	600,000	30,000	C
4	02-2020	2020	48	100,000	31,000	C

5. Continued

(i) Claims gross of reinsurance by development month:

Occurrence		12	24	36	48
A	Indemnity	0	865,000	885,000	857,000
A	ALAE	0	60,000	65,000	66,000
B	Indemnity	400,000	325,000	300,000	300,000
B	ALAE	60,000	85,000	70,000	70,000
C	Indemnity	0	600,000	600,000	700,000
C	ALAE	0	30,000	30,000	61,000
Total		460,000	1,965,000	1,950,000	2,054,000

e.g., Occurrence A, Indemnity at 24 months = 865,000 = 600,000 + 175,000 + 90,000

(ii) Net of reinsurance with pro rata treatment of ALAE

Ceded reinsurance with pro rata treatment of ALAE, by development month:

Occurrence		12	24	36	48
A	Indemnity	0	600,000	600,000	600,000
A	ALAE	0	41,618	44,068	46,208
B	Indemnity	200,000	125,000	100,000	100,000
B	ALAE	30,000	32,692	23,333	23,333
C	Indemnity	0	400,000	400,000	500,000
C	ALAE	0	20,000	20,000	43,571
Total		230,000	1,219,311	1,187,401	1,313,112

e.g., Occurrence A, Indemnity at 24 months = 600,000
= Min[(865,000 – 200,000), 600,000]

Occurrence A, ALAE at 24 months = 41,618 = 60,000×600,000/865,000

Net of reinsurance with pro rata treatment of ALAE = (i) – Ceded reinsurance with pro rata treatment of ALAE:

	12	24	36	48
Total	230,000	745,689	762,599	740,888

5. **Continued**

(iii) Net of reinsurance with ALAE included in the insurer's retention and the reinsurer's limit

Ceded reinsurance with ALAE included in the insurer's retention and the reinsurer's limit, by development month:

Occurrence		12	24	36	48
A	Indemnity + ALAE	0	600,000	600,000	600,000
B	Indemnity + ALAE	260,000	210,000	170,000	170,000
C	Indemnity + ALAE	0	430,000	430,000	561,000
Total		260,000	1,240,000	1,200,000	1,331,000

e.g., Occurrence A, Indemnity + ALAE at 24 months = 600,000
= Min[{(860,000 + 60,000) – 200,000}, 600,000]

Net of reinsurance with ALAE included in the insurer's retention and the reinsurer's limit = (i) – Ceded reinsurance with ALAE included in the insurer's retention and the reinsurer's limit:

	12	24	36	48
Total	200,000	725,000	750,000	723,000

6.

Learning Objectives:

6. The candidate will understand how to apply the fundamental ratemaking techniques of general insurance.

Learning Outcomes:

(6l) Calculate risk classification changes.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 32.

Commentary on Question:

This question tests the candidate's understanding of risk classification.

Solution:

(a) Describe why grouping risks into more homogeneous classes can improve the effectiveness of a risk classification system.

By grouping together risks into relatively homogeneous classes, the risk classification system reduces the adverse selection that occurs when high-risk and low-risk participants are offered identical coverage at the same price.

(b) Describe how an effective risk classification system can contribute to availability of coverage.

If Auto Insurer was aware of the different costs underlying its portfolio of risks but was not allowed to differentiate its price based on the expected costs, there would be no incentive to provide coverage to risks that have higher than average expected costs.

(c) Evaluate each of the following risk characteristics for use in a risk classification system for automobile insurance:

(i) Gender

(ii) Credit score

(iii) Age

(iv) Telematics data

6. Continued

(i) Gender is easy to measure and not subject to manipulation, so it satisfies the objectivity. However, use of gender for risk classification is prohibited in some jurisdictions.

(ii) Credit score has been known to have positive correlation with claim experience, but it is difficult to show the causality. Also, the possibility of using credit score as a rating factor depends on a jurisdiction.

(iii) Age is easy to measure and not subject to manipulation, so it satisfies the objectivity. It has been shown that age of the primary driver has strong relationship with the claim behavior.

(iv) Telematics data is objective, and it can be used to measure the exposure of an insurance contract more precisely. However, one should be careful since use of telematics data might require additional managerial support such as IT, human resources, and financial requirements.

(d) Describe two problems encountered with a one-way analysis of a risk classification system.

Inability to adjust for distributional bias between risk classes, which occurs when there are differences in the distribution of exposures by risk characteristic between risk classes.

Inability to adjust for dependence between risk classes, which occurs when knowing the risk class of an insured within one risk characteristic changes the true relativities for the risk classes in another risk characteristic from what they would be without that knowledge.

7. Learning Objectives:

4. The candidate will understand financial reporting of claim liabilities and premium liabilities.

Learning Outcomes:

(4h) Evaluate premium liabilities.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 24.

Commentary on Question:

This question tests the candidate's understanding of premium liabilities.

Solution:

(a) Verify the calculation of ultimate claim ratios.

Earned Premiums

	Property		Liability	
Calendar Year	Gross	Net	Gross	Net
2017	1,025	760	1,950	1,803
2018	1,050	774	2,550	2,274
2019	1,150	849	4,000	3,446
2020	1,250	922	5,450	4,543

Earned premiums $(EP)_y$ = Unearned premiums $(UEP)_{y-1}$
+ Written premiums $(WP)_y - UEP_y$

e.g., Property, Gross: $EP_{2018} = UEP_{2017} + WP_{2018} - UEP_{2018}$
$= 500 + 1{,}100 - 550 = 1{,}050$

Ultimate Claim Ratios including ALAE

	Property		Liability	
Accident Year	Gross	Net	Gross	Net
2017	45%	39%	55%	46%
2018	46%	40%	60%	52%
2019	44%	39%	65%	59%
2020	47%	41%	70%	66%

e.g., Property, Gross, AY2018 = 46% = 480 / 1,050

7. Continued

(b) Recommend expected claim ratios for each line of business, gross and net of reinsurance, that will be used in the determination of premium liabilities as of December 31, 2020. Justify each recommendation.

	Property		Liability	
	Gross	Net	Gross	Net
Recommended claim ratios	45.5%	39.9%	70.1%	65.6%

Justification:

- Property gross and net are stable with little discernible trend, so the average used.
- Liability has rising trend, so recommend using the latest year. [Could even project out a year].

(c) Calculate the premium liabilities, both gross and net of reinsurance.

		Property		Liability		Total	
		Gross	Net	Gross	Net	Gross	Net
(1)	Unearned premiums	650.00	514.00	3,000.00	2,460.00	3,650.00	2,974.00
(2)	Selected claim ratios	46%	40%	70%	66%		
(4)	Expected claims = (1)(2)	295.98	205.10	2,102.75	1,613.65	2,398.73	1,818.75
(5)	ULAE = 2,398.73×10%					239.87	239.87
(6)	General expenses = 3,650.00×15%×25%					136.88	136.88
(7)	Incentive commissions = 3,650.00×3%					109.50	109.50
(8)	Premium liabilities = sum[(4),(5),(6),(7)]					2,884.98	2,304.99

(d) Determine the equity in unearned premiums.

Equity in unearned premiums = UEP_{net} – Premium liabilities_{net}
= 2,974.00 – 2,304.99 = 669.01.

8. **Learning Objectives:**

9. The candidate will understand the nature and application of catastrophe models used to manage risks from natural disasters.

Learning Outcomes:

(9b) Apply catastrophe modeling results in ratemaking, loss mitigation, risk selection, and reinsurance.

(9c) Describe the advantages and limitations of catastrophe models.

Sources:

Uses of Catastrophe Model Output, American Academy of Actuaries, July 2018.

Commentary on Question:

This question tests the candidate's understanding of catastrophe modeling.

Solution:

(a) Describe four limitations of relying on historical data to analyze catastrophe events.

Any four of the following are acceptable:

- Traditional actuarial methods rely on incurred historical data to derive indications.
- Frequency and severity of catastrophe activity has not been constant over time.
- The attributes of historical events may be quite different from future events.
- Geographical patterns and physical characteristics of the historical record do not reflect the full range of possible catastrophe events.
- Property distributions and characteristics have changed.
- Many important property characteristics are not available in historical records.
- Claim payment records may be limited or inaccurate and claim practice may have changed over time.
- Information related to older events is not always reliable.

(b) Explain how catastrophe model output can be used to evaluate alternative loss mitigation strategies.

Any of the following is acceptable:

- The impact of the loss mitigation features can be evaluated by seeing how AALs and other measures react to the presence or absence of these features.
- Cost/Benefit tradeoffs can be evaluated.
- Strategies to encourage desired choices can be tied to potential loss dollar changes.

8. Continued

(c) Calculate the hurricane wind premium by county for a 207,500 Coverage A limit.

Commentary on Question:
The risk load needs to be included in the Hurricane Wind Premium Per $1,000 Coverage A before multiplying by the average Coverage A limit.

County	(1) Modeled Gross Hurricane Wind Loss Per 1,000 Coverage A	(2) Selected Risk Load (Standard Deviation)	(3) = [(1)+(2)]/[1 – 0.27] – [(1)+(2)] Expense Load	(4) = (1)+(2)+(3) Hurricane Wind Premium Per 1,000 Coverage A	(5) = (4)×207,500/1,000 Hurricane Wind Premium for 207.5K Coverage A Limit
Monroe	13.82	27.65	15.34	56.81	11,788
Broward	5.54	11.08	6.15	22.77	4,724
Palm Beach	5.26	10.51	5.83	21.60	4,483
Miami-Dade	7.60	15.21	8.44	31.25	6,484
Hillsborough	0.75	1.51	0.84	3.10	642
Orange	0.36	0.72	0.40	1.48	307
Okeechobee	1.91	3.81	2.12	7.84	1,626
Duval	0.25	0.49	0.27	1.01	210
Sarasota	1.74	3.48	1.93	7.15	1,484

9. Learning Objectives:

3. The candidate will know how to calculate and evaluate projected ultimate values.

Learning Outcomes:

(3d) Analyze development triangles for investigative testing.
(3f) Demonstrate knowledge of good practice related to projecting ultimate values.
(3g) Estimate ultimate values using the methods cited in (3e).

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 13 and 19.

Commentary on Question:

This question tests the candidate's understanding of Berquist-Sherman adjustments when there has been a change in case estimate adequacy.

Solution:

(a) Calculate the average case estimate triangle.

Accident	Case Estimates = Reported Claims – Paid Claims				
Year	12	24	36	48	60
2016	7,600	11,200	3,800	5,240	3,600
2017	8,862	12,699	4,047	4,815	
2018	7,923	12,072	6,036		
2019	8,996	16,680			
2020	13,301				

Accident	Open Counts = Reported Counts – Closed Counts				
Year	12	24	36	48	60
2016	248	228	196	148	60
2017	253	232	200	151	
2018	265	244	210		
2019	260	239			
2020	271				

Accident	Average Case = Case Estimates / Open Counts				
Year	12	24	36	48	60
2016	30.65	49.12	19.39	35.41	60.00
2017	35.03	54.74	20.24	31.89	
2018	29.90	49.48	28.74		
2019	34.60	69.79			
2020	49.08				

9. Continued

(b) Evaluate whether the average case estimate triangle indicates either decreasing, increasing or stable case reserve adequacy.

Changes in Average Case Estimates	12	24	36	48
2016-2017	14.3%	11.4%	4.4%	–9.9%
2017-2018	–14.6%	–9.6%	42.0%	
2018-2019	15.7%	41.1%		
2019-2020	41.9%			

There is some instability down each column. The last diagonal shows significant increases, suggesting a significant increase in case reserve adequacy.

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

Adjusted Average Case = Last Diagonal from part (a), trended to each AY at 5%:

AY	12	24	36	48	60
2016	40.38	60.29	26.07	30.37	60.00
2017	42.40	63.30	27.37	31.89	
2018	44.52	66.47	28.74		
2019	46.74	69.79			
2020	49.08				

e.g., 46.74 = 49.08 / 1.05

Adjusted Case Estimates = Adjusted Average Case Estimate × Open Counts:

AY	12	24	36	48	60
2016	10,014	13,746	5,110	4,495	3,600
2017	10,727	14,686	5,475	4,815	
2018	11,797	16,218	6,036		
2019	12,153	16,680			
2020	13,301				

e.g., 12,153 = 46.74 × 260

9. Continued

Adjusted Reported Claims = Paid Claims + Adjusted Case Estimates

AY	12	24	36	48	60
2016	34,414	56,546	62,710	69,495	76,000
2017	36,692	60,257	66,816	74,040	
2018	39,872	65,494	72,363		
2019	40,977	67,306			
2020	44,192				

Development Factors:

AY	12 to 24	24 to 36	36 to 48	48 to 60	60 to Ult
2016	1.643	1.109	1.108	1.094	
2017	1.642	1.109	1.108		
2018	1.643	1.105			
2019	1.643				
2020					
Average	1.643	1.108	1.108	1.094	1.000
Age-to-Ultimate	2.205	1.342	1.212	1.094	1.000

	(1)	(2)	(3) = (1)(2)	(4) = (3) – (1)
AY	Reported Claims	Age-to-Ultimate Development Factor	Ultimate Claims	IBNR
2016	76,000	1.000	76,000	0
2017	74,040	1.094	80,971	6,931
2018	72,363	1.212	87,696	15,333
2019	67,306	1.342	90,343	23,037
2020	44,192	2.205	97,436	53,244
Total			432,445	98,544

(d) Explain why the reported development method without a Berquist-Sherman adjustment would have overstated the IBNR.

Case estimates without the adjustment are lower, which would yield higher development factors.

10. Learning Objectives:

6. The candidate will understand how to apply the fundamental ratemaking techniques of general insurance.

Learning Outcomes:

(6m) Describe key considerations in the analysis of deductible factors and increased limits factors.
(6n) Calculate deductible factors and increased limits factors.
(6o) Explain coinsurance and coinsurance penalties.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 33.

Commentary on Question:

This question tests the candidate's understanding of coinsurance in property policies, deductible factors, and increased limits factors.

Solution:

(a) Explain the effect of a straight per-event deductible on each of the following:

(i) An insurer's claim frequency

(ii) An insurer's claim severity

Commentary on Question:

Candidates need to explain how deductibles can either increase or decrease severity. Simply stating that deductibles can increase or decrease severity is insufficient.

(i) Deductibles reduce an insurer's claim frequency because claims below the deductible are no longer the insurer's responsibility which reduces claim counts.

(ii) Deductibles can increase or decrease claim severity. An increase can occur when small claims are eliminated leaving larger claims with higher average severity. A decrease can occur when claims exceed the deductible amount. A portion of these claims is eliminated making each claim smaller which lowers average severity.

10. Continued

(b) Describe the reason for a coinsurance clause in a property insurance policy.

Coinsurance is used to motivate insureds to purchase the appropriate amount of insurance and to penalize those that do not. If the insured chooses to insure the property for a lesser amount than that required by coinsurance, then any payments for claims arising from insured events would be reduced in direct relationship with the ratio of the insured value, selected by the insured, to the property's required insurable value, determined by the insurer's rating rules.

(c) Calculate the claims paid by the insurer under the following scenarios:

(i) Loss amount is 800,000 and the deductible is 10,000

(ii) Loss amount is 900,000 and the deductible is 0

Coinsurance penalty percentage = 1 – 500,000/(1,000,000×0.8) = 0.375

(i) Paid by the insurer = min[(1 – 0.375)×800,000, 500,000] – 10,000
= 490,000

(ii) Paid by the insurer = min[(1 – 0.375)×900,000, 500,000] – 0
= 500,000

(d) Calculate the elimination ratio to be used for pricing a deductible option of 1,000.

Claims eliminated by 1,000 deductible:

Indemnity Range	Claims Eliminated
0 – 1,000	1,049,000
Over 1,000	1,000×10,620 = 10,620,000
Total	11,669,000

Elimination ratio = 11,669,000 / 60,459,000 = 0.193.

(e) Calculate a rate for the 1,000 deductible option using results from part (d).

Commentary on Question:
Applying the elimination ratio directly to the rate did not get full credit since it does not account for expenses properly.

Reduce claims for claims eliminated by deductible:
110×0.7×(1 – 0.193) = 62.138 = P×CR
Using the premium equation, P = P×CR + P×V + F, solve for P:
P = 62.138 + P×0.2 + 110×0.1
P = 91.42.

10. Continued

(f) Calculate the increased limits factors relative to a basic limit of 10,000 for:

(i) 20,000 limit, and

(ii) 100,000 limit.

Claims limited to 10,000 = 35,000,000 + 10,000×(1,500 + 500) = 55,000,000

(i) Claims limited to 20,000 = 35,000,000 + 25,000,000 + 20,000×500
= 70,000,000
Therefore, increased limits factor for 20,000 limit:
= 70,000,000 / 55,000,000 = 1.273

(ii) Claims limited to 100,000 = 75,000,000
Therefore, increased limits factor for 100,000 limit:
= 75,000,000 / 55,000,000 = 1.364.

11. **Learning Objectives:**

1. The candidate will understand the key considerations for and key concepts underlying general insurance actuarial work.

3. The candidate will know how to calculate and evaluate projected ultimate values.

Learning Outcomes:

(1g) Identify different types of data used for actuarial work.

(3e) Describe the key assumptions underlying the following projection methods: development method, frequency-severity methods, expected method, Bornhuetter Ferguson method, Benktander method, Cape Cod method, Generalized Cape Cod, and Berquist-Sherman adjustments to the development method.

(3l) Understand the differences in development patterns and trends for various claim layers.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 4, 14, 17, and 18.

Fundamentals of General Insurance Actuarial Analysis 2019 Supplement, J. Friedland, Appendix I.

Commentary on Question:

This question tests the candidate's understanding of the appropriate use of various methods of estimating ultimate claims, including how circumstances such as seasonality, actual versus expected analysis, dealing with limited and immature data, ALAE, and claims by layer affect the estimation of ultimate claims.

Solution:

(a) Provide two reasons for not using the Cape Cod method for projecting ultimate claims for auto collision coverage.

Any two of the following are acceptable:

- Collision is a very fast-reporting and fast-settling coverage; the Cape Cod (CC) method is for better for medium to long-tail coverages.
- Used-up exposures will result in exposures greater than the original exposures for all year where development is less than 1.
- The CC method is useful to add stability to assumptions. Collision coverage isn't usually that volatile.
- The CC is a special type of Bornhuetter Ferguson (BF) method and actuaries disagree on appropriateness of method when development is less than 1.

11. Continued

(b) Describe two approaches for testing potential seasonality in claims data.

- Analyze development factors by accident quarter rather than accident year to see if there are any patterns showing higher or lower quarters.

- Analyze average severity (or frequency) by accident quarter to see if there is any pattern showing higher or lower quarters.

(c) Describe the purpose of this test.

Evaluating reasonableness of input assumptions.

(d) Describe two next steps you could perform after reviewing these results.

Any two of the following are acceptable:

- Ask claim department if any operational changes occurred
- Check the data
- Ask claim department if they noticed any anomalies
- Modify input assumptions
- Investigate further

(e) Describe the problem with estimating ultimate claims in each of these two situations:

(i) Immature experience

(ii) Limited experience

(i) Claim experience at immature development ages is often volatile which could lead to volatile projections.

(ii) Limited experience refers to the amount of data in the experience period. For example, 5 years of data would be inadequate for estimating claims under a long-tail coverage.

11. Continued

(f) Describe your considerations for each data grouping in determining your selection.

A.
- Is historical experience predictive of future experience?
- Is activity observed to date relevant for projecting future activity?
- Is ALAE volume a significant component of total claims?
- Are case estimates separately available for ALAE (vs. indemnity)?

B.
- Are reporting patterns similar for indemnity and ALAE?
- Do indemnity and ALAE have a consistent relationship over time, even if their patterns are different?
- If indemnity and ALAE payments and case estimates cannot be separated.

C.
- Is ALAE data (or volume or experience) volatile (or limited), so expressing ALAE as a ratio to claims adds stability?

(g) Critique your colleague's recommendations.

- Development method is appropriate for projecting aggregate ultimate values for a portfolio of claims, not individual claims.
- Development factors are derived from an aggregation of open and closed claims, therefore, they need to apply to both open and closed claims to derive an appropriate ultimate values in the aggregate. (Otherwise, the aggregate ultimate will fall short).

12. **Learning Objectives:**

5. The candidate will understand trending procedures as applied to ultimate claims, exposures and premiums.

6. The candidate will understand how to apply the fundamental ratemaking techniques of general insurance.

Learning Outcomes:

(5b) Identify the time periods associated with trending procedures.
(5c) Analyze and evaluate trend for claims (including frequency, severity, and pure premium) and exposures (including inflation-sensitive exposures and premiums).
(5d) Choose trend rates for claims (frequency, severity, and pure premium) and exposures.
(5e) Calculate trend factors for claims and exposures.
(6j) Calculate indicated rates and indicated rate changes using the claim ratio and pure premium methods.
(6k) Demonstrate the use of credibility in ratemaking.

Sources:
Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 16 & 31.

Commentary on Question:
This question tests the candidate's understanding of premium trend. This question also tests basic ratemaking using a claim ratio approach incorporating the complement of credibility.

Solution:

(a) Recommend the annual premium trend to use for ratemaking. Justify your recommendation.

Commentary on Question:
Change in annual written premium is needed to analyze the trend.

12. Continued

Calendar Year	Average On-Level Written Premium (OLWP)	Year-to-Year Change in Average OLWP
2011	540.00	
2012	546.48	1.20%
2013	552.71	1.14%
2014	560.01	1.32%
2015	572.21	2.18%
2016	579.54	1.28%
2017	587.30	1.34%
2018	593.65	1.08%
2019	601.07	1.25%
2020	608.52	1.24%
Average all years		1.34%
Average excluding 2015 outlier		1.23%

Recommended annual trend = 1.23%.
Justification: Annual trend is reasonably stable except for 2015, which appears to be an outlier.

(b) Calculate the trended claim ratio for each accident year.

Average earned premium date in the future rating period = 9 months after August 1, 2021 = May 1, 2022

Accident Year	Average Earned Premium Date: Experience Period	Average Earned Premium Date: Forecast Period	Trending Period (months)	Trended On-Level Earned Premium @1.23%	Trended Claim Ratios
2016	2016-07-01	2022-05-01	70	9,065,912.50	75.42%
2017	2017-07-01	2022-05-01	58	8,888,948.54	72.76%
2018	2018-07-01	2022-05-01	46	8,419,705.00	69.45%
2019	2019-07-01	2022-05-01	34	8,166,989.29	70.21%
2020	2020-07-01	2022-05-01	22	8,435,636.28	67.27%
			All year average:		71.02%
			Excluding high/low:		70.81%
			Average (2018-2020):		68.98%

12. **Continued**

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

Commentary on Question:
Other recommendations acceptable as long as the justification matches the data.

Selected weighted average trended experience claim ratio: 70.81%.

Justification: Exclude high and low years to smooth the erratic values. No clear trend.

(d) Calculate the claim ratio to use for the complement of credibility.

Indicated rate change for policies effective January 1, 2021 through June 30, 2021	4%
Approved rate change for policies effective January 1, 2021 through June 30, 2021	2%
Permissible claim ratio for policies effective January 1, 2021 through June 30, 2021	55%
Pure premium trend	5.0%
Premium trend	1.23%
Average accident date of prior filing	01-Apr-21
Average accident date of forecast period	01-May-22
Trending period in months	13
Complement of credibility claim ratio = $1.04/1.02 \times 0.55 \times (1.05/1.0123)^{(13/12)}$	58.34%

(e) Calculate the indicated rate change.

Selected trended claim ratio	70.81%
Credibility assigned to the experience claim ratio	77.00%
Complement of credibility	58.34%
Credibility weighed claim ratio	67.94%
Indicated rate change = (67.94% + 15%)/(1 – 11% – 4%) – 1 =	–2.42%

13. **Learning Objectives:**

6. The candidate will understand how to apply the fundamental ratemaking techniques of general insurance.

Learning Outcomes:

(6q) Distinguish occurrence-based and claims-made based coverage.

(6r) Calculate rates for claims-made coverage as well as claims-made maturity and tail factors.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 34.

Commentary on Question:

This question tests the candidate's understanding of claims-made ratemaking.

Solution:

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

Claims-made policies incur no pure IBNR claims as only claims reported during the policy year are covered.

(b) Explain how a coverage gap can be created when the insured switches:

(i) From claims-made to occurrence coverage

(ii) From occurrence to claims-made coverage

(i) Claims-made to occurrence: tail of claims-made is not covered by occurrence unless purchased separately.

(ii) Occurrence to claims-made: usually no issue, unless there is a timing issue between expiration date of the old policy and effective date of new policy.

13. Continued

(c) Construct a numerical example demonstrating this principle.

Commentary on Question:
Any example that properly demonstrates the principle is acceptable.

Assume 3 year reported, 100 reported each year, annual trend of 10%:

AY Lag	AY Lag by Report Year Matrix 1	2	3	4
0	*100*	110	121	133.1
1	*100*	*110*	121	133.1
2	*100*	110	*121*	133.1

Report year 1 claims-made policy = 100 + 100 + 100 =	300
Report year 1 occurrence policy = 100 + 110 + 121 =	331

(d) Construct a numerical example demonstrating this principle.

Commentary on Question:
Any example that properly demonstrates the principle is acceptable.

Use same example as part (c), except with a trend after reported year 1 of 20%.

AY Lag	AY Lag by Report Year Matrix 1	2	3	4
0	100	120	144	172.8
1	100	120	144	172.8
2	100	120	144	172.8

	RY2 @10% Trend	RY2 @20% Trend
RY2 Claims-made policy:	330.00	360.00
RY2 Occurrence policy:	364.10	436.80

Change in claims-made = 360 / 330 – 1 =	9.1%
Change in occurrence = 436.80 / 364.10 – 1 =	20.0%

14. **Learning Objectives:**

2. The candidate will demonstrate the ability to prepare claims and exposure data for general insurance actuarial work.

3. The candidate will know how to calculate and evaluate projected ultimate values.

Learning Outcomes:

(2d) Adjust historical earned premiums to current rate levels.

(3g) Estimate ultimate values using the methods cited in (3e).

Sources:

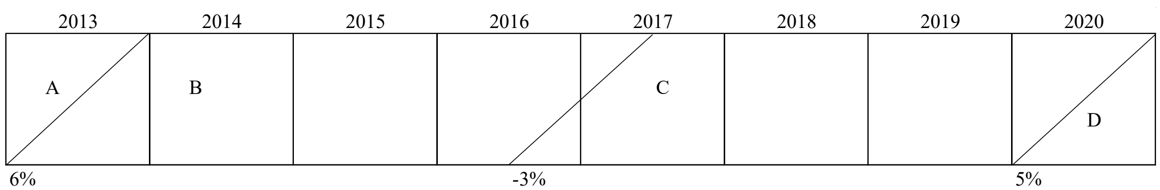
Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 12, 16, and 18.

Commentary on Question:

This question tests the candidate's understanding of adjusting earned premiums to current rate levels as well as estimating ultimate claims using the expected method and the Cape Cod method.

Solution:

(a) Calculate premium on-level factors for all accident years for projecting claim ratios as of December 31, 2020.



Rate Change History			Percent Premium Earned in Each CY at Rate Level				
Effective Date of Rate Change	Rate Change %	Rate Level Index	2011	2012	2013	2014	2015
Initial		1.00000	100.00%	100.00%	50.00%	-	-
Jan. 1, 2013	6.0%	1.06000	-	-	50.00%	100.00%	100.00%
Jul. 1, 2016	–3.0%	1.02820	-	-	-	-	-
Jan. 1, 2020	5.0%	1.07961	-	-	-	-	-
Average Rate Level in each CY:			1.00000	1.00000	1.03000	1.06000	1.06000
On-Level Factors for reserving:			1.05391	1.05391	1.02321	0.99425	0.99425

14. Continued

Rate Change History							
Effective Date	Rate	Rate Level	Percent Premium Earned in Each CY at Rate Level				
of Rate Change	Change %	Index	2016	2017	2018	2019	2020
Initial		1.00000	-	-	-	-	-
Jan. 1, 2013	6.0%	1.06000	87.50%	12.50%	-	-	-
Jul. 1, 2016	–3.0%	1.02820	12.50%	87.50%	100.00%	100.00%	50.00%
Jan. 1, 2020	5.0%	1.07961	-	-	-	-	50.00%
Average Rate Level in each CY:			1.05603	1.03218	1.02820	1.02820	1.05391
On-Level Factors for reserving:			0.99799	1.02105	1.02500	1.02500	1.00000

e.g., 2016 $1.05603 = (1.06 \times 0.875) + (1.0282 \times 0.125)$
$0.99799 = 1.05391 / 1.05603$

(b) Calculate projected ultimate claims for all accident years using the expected method.

	(1)	(2)	(3)	(4)	(5)
Accident Year (AY)	On-Level Factors	Tort Reform	Trended On-Level Claim Ratio	Claim Ratio at Cost Level of Each AY	Projected Ultimate Claims
2011	1.05391	0.80	67.0%	84.5%	4,889,698
2012	1.05391	0.80	66.5%	84.5%	4,456,640
2013	1.02321	0.80	53.7%	82.0%	3,999,255
2014	0.99425	0.90	68.8%	70.8%	3,417,196
2015	0.99425	1.00	68.3%	63.8%	3,270,117
2016	0.99799	1.00	59.6%	64.0%	3,455,112
2017	1.02105	1.00	66.8%	65.5%	3,388,744
2018	1.02500	1.00	64.5%	65.7%	3,136,239
2019	1.02500	1.00	62.1%	65.7%	2,999,591
2020	1.00000	1.00		64.1%	3,154,776
Total			64.1%		36,167,367

Notes: (3) = [(Projected ultimate claims from development method)(2) / [(Earned premiums)(1)]
$(3)_{\text{Total}}$ = Average of AY2011 through AY2019
(4) = 64.1%×(1)/(2)
(5) = (4)(Earned premiums)

14. **Continued**

(c) Calculate projected ultimate claims for all accident years using the Cape Cod method.

	(6)	(7)	(8) = (6)(7)	(9)	(10)
Accident Year (AY)	On-Level Earned Premium	Expected % Paid	Used-Up On-Level Earned Premium	Adjusted Paid Claims at Dec. 31, 2020	Expected Claims
2011	6,099,959	96.5%	5,887,991	3,944,320	4,918,179
2012	5,559,714	92.5%	5,143,121	3,418,400	4,482,598
2013	4,989,120	86.5%	4,315,848	2,316,800	4,022,549
2014	4,795,868	78.2%	3,749,702	2,578,140	3,437,100
2015	5,099,389	70.2%	3,581,032	2,447,000	3,289,164
2016	5,387,869	55.5%	2,988,280	1,780,460	3,475,237
2017	5,284,375	39.5%	2,088,686	1,395,000	3,408,482
2018	4,890,621	26.3%	1,286,667	829,600	3,154,507
2019	4,677,534	13.7%	639,357	396,900	3,017,063
2020	4,919,527	4.5%	221,920	180,900	3,173,151
Total			29,902,603	19,287,520	36,378,030
		Adjusted Expected Claim Ratio:		64.5%	

Notes: (6) = (1)(Earned Premiums)
(7) = 1 / (Cumulative Development Factors)
(9) = (2)(Paid Claims as of December 31, 2020)
Adjusted Expected Claim Ratio = 19,287,520 / 29,902,603
(10) = 64.5%×(6)/(2)

14. Continued

Accident Year (AY)	(11) = 1 – (7) Expected % Unpaid	(12) = (10)(11) Expected Unpaid Claims	(13) Projected Ultimate Claims
2011	3.5%	170,902	5,101,302
2012	7.5%	335,884	4,608,884
2013	13.5%	542,835	3,438,835
2014	21.8%	749,766	3,614,366
2015	29.8%	979,358	3,426,358
2016	44.5%	1,547,762	3,328,222
2017	60.5%	2,061,256	3,456,256
2018	73.7%	2,324,592	3,154,192
2019	86.3%	2,604,671	3,001,571
2020	95.5%	3,030,010	3,210,910
Total		14,347,036	36,340,896

Notes: (13) = (12) + (Paid Claims as of December 31, 2020)

15. **Learning Objectives:**

3. The candidate will know how to calculate and evaluate projected ultimate values.

Learning Outcomes:

(3h) Explain the effect of changing conditions on the projection methods cited in (3e).

(3i) Assess the appropriateness of the projection methods cited in (3e) in varying circumstances.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 20.

Commentary on Question:

This question tests the candidate's understanding of how estimates of ultimate claims are affected by various changing conditions and the appropriateness of various methods of estimating ultimate claims under changing conditions.

Solution:

(a) Explain how the changes occurring to book of business 1 might influence the estimates of ultimate claims under each of the following methods:

(i) The Bornhuetter Ferguson method

(ii) The frequency-severity method

(i) Historical development factors will be understated when applied to recent accident years. However, the a priori expected claim ratios will be correct if they come from pricing actuaries.

(ii) Historical development factors (for counts and average values) will be understated when applied to recent accident years. However, identifying the trend and possibly adjusting for it should be easier if frequency is analyzed separately from severity.

15. **Continued**

(b) Explain how the changes occurring to book of business 2 might influence the estimates of ultimate claims under each of the following methods:

(i) The development method applied to reported claims

(ii) The Cape Cod method applied to reported claims

(i) The development method should not be affected by the change in claim frequency. However, this method could be over-responsive to the large claim in the recent accident year and will likely overstate the estimate in this year only.

(ii) Because the expected ratio is based on historical averages, this method may understate claim frequency deterioration in the recent two accident years if it is not reflected in the trend selection. Development should not be affected by the change in claim frequency. The large claim will be appropriately reflected in the estimate without being over-responsive because the Cape Cod method uses expected unreported and does not apply development to actual claims reported.

16. Learning Objectives:

6. The candidate will understand how to apply the fundamental ratemaking techniques of general insurance.

Learning Outcomes:

(6f) Explain the requirements for loadings for catastrophes and large claims in ratemaking.

(6g) Calculate loadings for catastrophes and large claims.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 25 and 30.

Commentary on Question:

This question tests the candidate's understanding of loadings for large claims for ratemaking.

Solution:

(a) Demonstrate that the all-years simple average of the loadings for large claims were calculated correctly in the table above.

Average earned date in rating period is 12 months following the effective date of the rates, or February 1, 2023.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Selected Ultimate Claims at Alternative Limits (000)			Trend Period	Severity Trend at		
Accident Year	250,000	500,000	Total Limits	(years)	4.5%	5.0%	5.7%
2013	3,990	4,560	4,560	115	1.525	1.596	1.701
2014	3,988	3,988	3,988	103	1.459	1.520	1.609
2015	3,846	5,198	5,370	91	1.396	1.448	1.523
2016	4,301	6,367	6,829	79	1.336	1.379	1.440
2017	4,545	6,489	6,489	67	1.279	1.313	1.363
2018	4,256	4,256	4,256	55	1.224	1.251	1.289
2019	4,840	7,164	7,779	43	1.171	1.191	1.220
2020	5,038	7,349	7,349	31	1.120	1.134	1.154

Notes: (4) = average earned date in each year (i.e., July 1), to February 1, 2023.
(5): e.g., $1.171 = 1.045^{(43/12)}$

16. Continued

	(8) = (1)(5)	(9) = (2)(6)	(10) = (3)(7)	(11) = (9)/(8)	(12) = (10)/(8)	(13) = (10)/(9)
	Trended Ultimate Claims at Limit			Loading for Large Claims		
Accident Year	250,000	500,000	Total Limits	250,000 to 500,000	250,000 to Total Limits	500,000 to Total Limits
2013	6,084	7,278	7,757	1.196	1.275	1.066
2014	5,819	6,062	6,418	1.042	1.103	1.059
2015	5,370	7,525	8,176	1.401	1.523	1.086
2016	5,747	8,779	9,837	1.528	1.712	1.121
2017	5,811	8,521	8,843	1.466	1.522	1.038
2018	5,207	5,323	5,487	1.022	1.054	1.031
2019	5,667	8,533	9,488	1.506	1.674	1.112
2020	5,645	8,336	8,481	1.477	1.502	1.017
Average				1.330	1.421	1.066

Therefore, the loadings provided were not calculated correctly.

(b) Calculate the ultimate claims at total limits for each accident year from 2016 to 2020, using selected ultimate claims at the following limits:

(i) 250,000

(ii) 500,000

Commentary on Question:
Candidates can use either the loadings for large claims provided or the correct loadings calculated in part (a). The model solution shown here uses the loadings as provided in the question. Both solutions are shown in the Excel file.

	Loading for Large Claims		
	250,000 to 500,000	250,000 to Total Limits	500,000 to Total Limits
Loadings for large claims	1.323	1.404	1.059
Countrywide	1.530		1.050
State X credibility	50.0%		20.0%
Credibility-weighted loading for large claims	1.42650	1.50039	1.05180

e.g., 1.05180 = 1.059×0.2 + 1.05×0.8
1.50039 = 1.42650×1.05180

16. Continued

	(14) = (7)/(5)	(15) = (7)/(6)	(16) = 1.50039/(14)	(17) = 1.0518/(15)	(18) = (1)(16)	(19) = (2)(17)
	Trend Factor for Large Claim Loading		Large Claim Loading adjusted for cost level		Indicated Ultimate Claims at Total Limits based on projections at Alternative Limits (000)	
Accident Year	250,000 to Total Limits	500,000 to Total Limits	250,000 to Total Limits	500,000 to Total Limits	250,000	500,000
2016	1.078	1.045	1.392	1.007	5,986	6,410
2017	1.066	1.038	1.408	1.013	6,398	6,577
2018	1.054	1.031	1.424	1.020	6,060	4,342
2019	1.042	1.024	1.440	1.027	6,971	7,358
2020	1.030	1.017	1.457	1.034	7,339	7,598
Total					32,754	32,285

(c) Explain why a loading for catastrophe claims might still be appropriate for the State X property business ratemaking despite including a loading for large claims.

Large claims and catastrophe claims are different. A large claim typically affects one policyholder for one insurer, whereas a catastrophe involves numerous claims involving many insurers. Ratemaking data may not include any catastrophe claims but exposure does exist and should be accounted for.

17. **Learning Objectives:**

6. The candidate will understand how to apply the fundamental ratemaking techniques of general insurance.

Learning Outcomes:

(6s) Explain the premise of experience rating.

(6t) Describe the types of experience rating used with general insurance.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 35.

Commentary on Question:

This question tests the candidate's understanding of individual risk rating.

Solution:

(a) Evaluate the suitability of each of the following individual risk rating programs for LMN:

(i) Schedule rating

(ii) Prospective experience rating

(iii) Retrospective experience rating

(i) Schedule rating
- Schedule rating should still be used as only 1 year of experience would reflect the new safety system.
- However, something less than 10% is recommended as only some of the past experience would reflect the new safety program.

(ii) Prospective experience rating
- This is a good option as LMNs future premiums can be based on its claim experience.
- Experience rating would help with fluctuations as it would hold LMN accountable for their claims.
- Experience rating should include the schedule rating adjustment.

(iii) Retrospective experience rating
- This is not a very large risk, so it is not ideal for retrospective rating.
- There are significant fluctuations, which suggests this is likely not an ideal candidate for retrospective rating.
- A company with strong financials is normally a good candidate for retrospective rating.

17. Continued

(b) Explain how this principle can be considered in the design of LMN’s prospective experience rating program.

- Actual claims should be capped and/or split into primary and excess components.
- Primary claims are expected to be more predictable because they are typically less volatile and have a shorter period of development than excess claims.

18. **Learning Objectives:**

6. The candidate will understand how to apply the fundamental ratemaking techniques of general insurance.

Learning Outcomes:

(6d) Quantify different types of expenses required for ratemaking including expense trending procedures.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 29.

Commentary on Question:

This question tests the candidate's understanding of expenses used in ratemaking.

Solution:

(a) Recommend a fixed and a variable expense ratio to use for ratemaking. Justify your recommendation.

Commentary on Question:

Justification for recommendations is required for full credit.

Calendar Year	General and Other Acquisition Expenses Ratio	Commission Expenses	Premium Taxes and Licenses
2017	9.8%	12.0%	2.8%
2018	10.1%	12.0%	2.8%
2019	9.7%	12.0%	2.8%
2020	9.2%	12.0%	2.8%
Budgeted ratio:	10.0%		
Average:		12.0%	2.8%

Notes: General and other acquisition expenses are a percent of earned premiums Commission expenses and premium taxes and licenses are a percent of written premiums.

Recommended general and other acquisition expense ratio is 10%.
Justification: Budget is similar to all other prior years except 2020, so budget appears to be a reasonable ratio. Also, 2020 may be an outlier due to premium growth in excess premium growth exhibited in prior years.

Fixed expense ratio = 10%×30% = 3%
Variable expense ratio for general and other acquisition expenses = 10%×70% = 7%
Total variable expense ratio = 7.0% + 12.0% + 2.8% = 21.8%

18. Continued

(b) Identify a potential distortion to a ratemaking analysis when selecting a fixed expense percentage that is applied to a projected average premium.

Any one of the following is acceptable:

1. Recent rate changes can result in differences in the relationship between the fixed expenses and premium during the experience period.
2. Differences between the average premiums of the experience period and the forecast period that arise because of shifts in the mix of business may lead to inadequate or excessive expenses.
3. A premium-based fixed expense ratio analysis may be distorted if countrywide expense ratios are used to project fixed expenses for a specific jurisdiction.

(c) Recommend a solution to the potential distortion identified in part (b).

Commentary on Question:
The recommended solution must match the distortion identified in part (b).

1. Use premiums adjusted to on level.
2. Trend premiums.
3. Track fixed expenses by state and calculate fixed expense ratios for each state.

19. **Learning Objectives:**

3. The candidate will know how to calculate and evaluate projected ultimate values.

Learning Outcomes:

(3e) Describe the key assumptions underlying the following projection methods: development method, frequency-severity methods, expected method, Bornhuetter Ferguson method, Benktander method, Cape Cod method, Generalized Cape Cod, and Berquist-Sherman adjustments to the development method.

(3g) Estimate ultimate values using the methods cited in (3e).

(3j) Evaluate and justify selections of ultimate values based on the methods cited in (3e).

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 14, 17, and 21.

Commentary on Question:

This question tests the calculation of ultimate claims and unpaid claims using the development method and the Bornhuetter Ferguson method.

Solution:

(a) Describe two situations when the Bornhuetter Ferguson method may be preferable to the development method.

Any two of the following situations are acceptable:

- For immature experience periods
- Following the introduction of new GI products when limited or no historical experience is available
- Following entry into a new geographical area for which limited or no historical data exists
- If there have been wide-ranging changes, either internally at the insurer or in the external environment, such that historical relationships and development patterns are not a reliable guide to the future

19. **Continued**

(b) Select age-to-age development factors to be used in applying the development method.

AY	12:24	24:36	36:48	48:60	60:72	Tail
2015	1.678	1.310	1.154	1.073	1.044	
2016	1.671	1.307	1.147	1.072		
2017	1.589	1.299	1.143			
2018	1.582	1.292				
2019	1.561					
Simple average:	1.616	1.302	1.148	1.073	1.044	
Latest 3 years:	1.577	1.299	1.148	1.073	1.044	
Selection:	1.577	1.299	1.148	1.073	1.044	1.100

Justification: Use the most recent 3 years to give consideration to the decreasing ratios down the columns.

(c) Estimate ultimate claim ratios as of December 31, 2020 for all accident years using the development method and selections from part (b).

	12-Ult.	24-Ult.	36-Ult.	48-Ult.	60-Ult.	72-Ult.
Calculated CDFs	2.897	1.837	1.414	1.231	1.148	1.100

e.g., 1.231 = 1.073×1.044×1.100

AY	Paid Claims	CDF	Ultimate Claims	Ultimate Claim Ratios
2015	14,520	1.100	15,972	68.5%
2016	14,071	1.148	16,155	71.9%
2017	12,825	1.231	15,793	70.1%
2018	11,822	1.414	16,712	77.1%
2019	7,968	1.837	14,634	70.6%
2020	3,370	2.897	9,764	54.7%
Total	64,576		89,030	

e.g., 16,712 = 11,822×1.414; 77.1% = 16,712 / 21,688

19. Continued

(d) Estimate ultimate claim ratios as of December 31, 2020 for all accident years using the Bornhuetter Ferguson method.

AY	Earned Premiums	Paid Claims	CDF	% Unpaid	A Priori Claim Ratio	Ultimate Claims	Ultimate Claim Ratios
2015	23,313	14,520	1.100	9%	65%	15,898	68.2%
2016	22,459	14,071	1.148	13%	65%	15,954	71.0%
2017	22,525	12,825	1.231	19%	65%	15,577	69.2%
2018	21,688	11,822	1.414	29%	65%	15,947	73.5%
2019	20,743	7,968	1.837	46%	65%	14,110	68.0%
2020	17,850	3,370	2.897	65%	60%	10,383	58.2%
Total		64,576				87,868	

e.g., 15,947 = 11,822 + 21,688×0.65×(1 – 1/1.414)
73.5% = 15,947 / 21,688

(e) Recommend unpaid claims by accident year as of December 31, 2020. Justify your recommendations.

AY	Ultimate Claim Ratio from Part (c)	Ultimate Claim Ratio from Part (d)	Selected Ultimate Claim Ratio	Ultimate Claims	Unpaid Claims
2015	68.5%	68.2%	68.5%	15,972	1,452
2016	71.9%	71.0%	71.9%	16,155	2,084
2017	70.1%	69.2%	70.1%	15,793	2,968
2018	77.1%	73.5%	77.1%	16,712	4,890
2019	70.6%	68.0%	70.6%	14,634	6,666
2020	54.7%	58.2%	58.2%	10,383	7,013
Total				89,649	25,073

e.g., 16,712 = 0.771×21,688
4,890 = 16,712 – 11,822

Justification: Recommend the development method for AYs 2019 and prior, and the Bornhuetter Ferguson (BF) method for AY 2020. The development method is used for older years to reflect actual experience. The BF is better for immature periods and more than half of ultimate claims for AY 2020 are unpaid. Also, BF method allows incorporation of expected change from COVID in the a priori claim ratio for AY 2020.