GIRR Model Solutions
Spring 2024

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, Second Edition (2022), J. Friedland, Chapter 2, 12, and 13.

Commentary on Question:

This question tests the candidate's understanding of certain details of individual insurance policies and ability to make correct calculations of earned premium, unearned premium and written premium for various policies. The candidate also needs to understand earned premiums adjusted to current rate level.

Solution:

(a) Calculate the total earned premium for calendar year 2022.

Policy	Period in CY2022	Monthly Premium	# policies	# of months earned in 2022	CY2022 Earned Premium
Block	Jan-March 2022	175.00	1,000	3	525,000
Block	April-Dec 2022	183.75	800	9	1,323,000
100	Mar 1-Dec 31, 2022	250.00	1	10	2,500
200	May 1-Dec 31, 2022	175.00	1	8	1,400
300	July 1-Dec 31, 2022	116.67	1	6	700
400	n/a		1	0	0
Total					1,852,600

1. Continued

(b) Calculate the total unearned premium as of December 31, 2023.

Policy	Monthly Premium	# policies	# of months outstanding on Dec. 31, 2023	Total Unearned Premium
Block	198.45	560	3	333,396
100	262.50	1	2	525
200	175.00	1	4	700
300	116.67	1	0	0
400	200.00	1	2	400
Total				335,021

(c) Calculate the calendar year 2022 earned premium at current rate levels using the extension of exposures method.

Policy	Period	Monthly Premium from Part (a)	Rate change to Current Rate Level	Monthly Premium at Current Rates	# policies	# of months earned in 2022	CY2022 Earned Premium at Current Rate Levels
Block	Jan-March 2022	175.00	13.40%	198.45	1,000	3	595,350
Block	April-Dec 2022	183.75	8.00%	198.45	800	9	1,428,840
100	Mar 1-Dec 31, 2022	250.00	13.40%	283.50	1	10	2,835
200	May 1-Dec 31, 2022	175.00	8.00%	189.00	1	8	1,512
300	July 1-Dec 31, 2022	116.67	8.00%	126.00	1	6	756
400	n/a				1	0	0
Total							2,029,293

(d) State why the parallelogram approach is not as accurate as the extension of exposures method used in part (c).

The exposures are not evenly distributed over time.

2. 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).

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapter 15.

Commentary on Question:

This question tests the development method for estimating ultimate claims where there is seasonality. In addition, it tests the candidate's understanding of expected paid and reported claims for an interim period between actuarial analyses as well as tail factors.

Solution:

(a) Calculate the ultimate claims for accident year 2023 using the development method. Justify your selections.

Accident	Age-to-Age Factors							
Half-Year	6-12	12-18	18-24	24-30	30-36	36-42	42-48	48-Ult
2020-1	1.022	1.049	1.007	1.010	1.005	1.001	1.000	
2020-2	1.053	1.024	1.014	1.011	1.006	1.001		
2021-1	1.027	1.043	1.008	1.012	1.006			
2021-2	1.046	1.028	1.016	1.010				
2022-1	1.025	1.037	1.007					
2022-2	1.055	1.009						
2023-1	1.018							
AHY-1 Avg	1.023	1.043	1.007	1.011				
AHY-2 Avg	1.051	1.020	1.015	1.010				
All years Avg	1.035	1.032	1.010	1.011	1.006	1.001	1.000	
AHY-1 Selected Factors:								
Age-to-age	1.023	1.043	1.007	1.011	1.006	1.001	1.000	1.000
Age-Ult	1.093	*1.069*	1.025	1.017	1.007	1.001	1.000	1.000
AHY-2 Selected Factors:								
Age-to-age	1.051	1.020	1.015	1.011	1.006	1.001	1.000	1.000
Age-Ult	*1.108*	1.054	1.033	1.017	1.007	1.001	1.000	1.000

2. Continued

Accident Year 2023:

Accident Half-Year	Reported Claims	Age-Ultimate Factor	Ultimate Claims
2023-1	2,283,355	1.069	2,439,958
2023-2	2,451,221	1.108	2,715,998
Total			5,155,957

(b) Calculate the accident year 2023 expected reported claims from December 31, 2023 to June 30, 2024.

Accident Half-Year	Reported Claims	Incremental Dev. Factor	Ultimate Claims
2023-1	2,283,355	0.043	97,784
2023-2	2,451,221	0.051	125,554
Total			223,337

(c) Describe one disadvantage of the Bondy method.

Its primary disadvantage is the potential to greatly underestimate the remaining development for long-tail lines.

(d) State one advantage and one disadvantage of Boor's algebraic method.

Advantage: It is based entirely on data in triangles, so no need for additional data.
Disadvantage: Need reliable estimates of ultimate claims for most mature periods, and that is not always available.

3. Learning Objectives:

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

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).
(5e) Calculate trend factors for claims and exposures.

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapter 27.

Commentary on Question:

This question tests the candidate's understanding of premium trend analysis, particularly when the trend rate changes.

Solution:

(a) Explain the purpose of quantifying the effect of shifts in the mix of exposures and rating characteristics on the premium during the experience period.

The purpose is so that the historical premiums can be adjusted to reflect the average premium level that is expected during the forecast period.

(b) Calculate the 2020 premium trend factor to be used to adjust 2020 earned premiums for the ratemaking exercise.

All policies written between July 1, 2019 and December 31, 2020 contribute toward 2020 earned premium. Average written date = Apr. 1, 2020
Past trend period: Apr. 1, 2020 to Jan. 1, 2024 = 45 months, or 3.75 years

New policies effective: Oct. 1, 2024 for 1 year
Average written date in future rating period: Apr. 1, 2025
Future trend period: Jan. 1, 2024 to Apr. 1, 2025 = 15 months, or 1.25 years

2020 premium trend factor = $(1 + 1.5\%)^{3.75}(1 + 3.0\%)^{1.25} = 1.097221$

3. Continued

(c) Explain how the premium trend factors would be affected by the following:.

(i) An increasing proportion of insureds choosing a lower policy limit at the beginning of 2024

(ii) An increasing proportion of insureds choosing a higher deductible at the beginning of 2024

(i) The decreased insured value would decrease the premiums, so the premium trend factors would decrease.

(ii) The higher deductible would decrease the premiums, so the premium trend factor would decrease.

(d) Describe why the trending periods would be different in the part (b) calculation if this trending analysis is done for a self-insurer.

A self-insurer is essentially one policy and not a series of policies written over the period. Therefore, the average written dates would be based on the self-insurer's fiscal year (e.g., fiscal year running from May 1 through April 30 would have an average date of November 1).

4. 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.

(3f) Demonstrate knowledge of good practice related to projecting ultimate values.

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapter 17.

Commentary on Question:

This question tests the candidate's understanding of the expected method of estimating ultimate claims.

Solution:

(a) Provide one reason why the expected method is preferred over the development method when estimating ultimate claims for a new line of business.

The expected method is preferred when there is limited or no historical experience available.

(b) Explain why a pure premium approach is preferred over an expected claim ratio approach when developing expected claims for self-insurers.

A self-insurer does not typically have earned premiums in the same way that an insurer does.

(c) Provide two reasons why the trended on-level claim ratio for accident year 2023 might be excluded when selecting the 2023 cost level expected claim ratio.

Any two of the following are acceptable:

- By definition, a priori is "presupposed by experience" and "formed or conceived beforehand" and therefore would exclude 2023
- Accident year 2023 might provide significantly difference results than the rest of the experience period
- When the cumulative development factors are highly leveraged for the latest years' experience

4. Continued

(d) Explain the steps you would follow to apply the expected method to estimate ultimate salvage received for a collision line of business.

1 Create a triangle of ratios of salvage received to paid claims
2 Develop the ratios to ultimate values using a development method approach
3 Selected an ultimate salvage ratio
4 Multiply the ultimate salvage ratio to the ultimate claims to estimate ultimate salvage

5. Learning Objectives:

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

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:

(2d) Adjust historical earned premiums to current rate levels.
(5b) Identify the time periods associated with trending procedures.
(5e) Calculate trend factors for claims and exposures.
(6f) Explain the requirements for loadings for catastrophes and large claims in ratemaking.
(6g) Calculate loadings for catastrophes and large claims.
(6h) Apply loadings for catastrophes and large claims in ratemaking.
(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, Second Edition (2022), J. Friedland, Chapters 13, 26, 31, and 32.

Commentary on Question:

This question tests the candidate's ability to calculate the indicated average rate, while considering adjustments to earned premium and a loading for non-hurricane weather claims.

Solution:

(a) Calculate the trended ultimate non-hurricane weather excluding hail pure premium per 100 EHY for all years.

Average accident date in future rating period: June 1, 2025 (9 months after start date).

months from 2023 average accident date to June 1, 2025: 23

5. Continued

	Ultimate			Trend Factors	
Accident Year	Frequency per 100 EHY	Severity	Trending Period (months)	Frequency @ –1.0%	Severity @5.0%
2014	2.02	4,100	131	0.8961	1.7034
2015	0.39	3,500	119	0.9051	1.6223
2016	1.99	2,900	107	0.9143	1.5450
2017	0.1	4,400	95	0.9235	1.4715
2018	1.99	2,800	83	0.9328	1.4014
2019	0.8	4,200	71	0.9423	1.3347
2020	0.63	2,600	59	0.9518	1.2711
2021	2.73	3,600	47	0.9614	1.2106
2022	0.56	2,100	35	0.9711	1.1529
2023	1.69	3,100	23	0.9809	1.0980

Trended Ultimate

Accident Year	Frequency per 100 EHY	Severity	Pure Premium per 100 EHY
2014	1.810	6,983.94	12,642
2015	0.353	5,678.00	2,004
2016	1.819	4,480.60	8,152
2017	0.092	6,474.43	598
2018	1.856	3,923.89	7,284
2019	0.754	5,605.56	4,226
2020	0.600	3,304.87	1,982
2021	2.625	4,358.07	11,438
2022	0.544	2,421.15	1,317
2023	1.658	3,403.88	5,643
Average: -all years	1.211	4,663.44	5,529

(b) Recommend the trended ultimate non-hurricane weather excluding hail pure premium per 100 EHY to use in determining a weather loading. Justify your recommendation.

Recommend all years average: 5,529
Justification: should use more years to smooth out fluctuations; no significant trend.

5. Continued

(c) Calculate the non-hurricane weather excluding hail loading percentage to use for ratemaking.

Selected state S PP per 100 EHY	5,529
Credibility-Weighted Pure Premium per 100 EHY	5,069.96
Expected Non-Hurricane Weather Claims	909,095.18
Weather loading as a claim ratio = 909,095/13,089,711 =	6.95%

(d) Identify two considerations when choosing the number of years and/or the weights to assign to each of the years.

Any 2 of the following are acceptable:

- professional judgment
- assessment of the relevance and reliability of the insurer's historical experience
- whether there are regulation requirements
- balance between stability and responsiveness
- management input
- credibility consideration - want enough years for full credibility, if possible
- also acceptable to note that give more weight to recent experience to account for recent changes

(e) Recommend the number of years to include when estimating the weighted average trended claim ratio for the indicated rate change. Justify your recommendation.

AY	Ultimate Counts	Running Total Ultimate Counts
2019	1,070	5,447
2020	1,075	***4,377***
2021	1,074	3,302
2022	1,141	2,228
2023	1,087	1,087

Recommend 4 years.
Justification: Full credibility (3,654) is met by including at least the most recent 4 years.

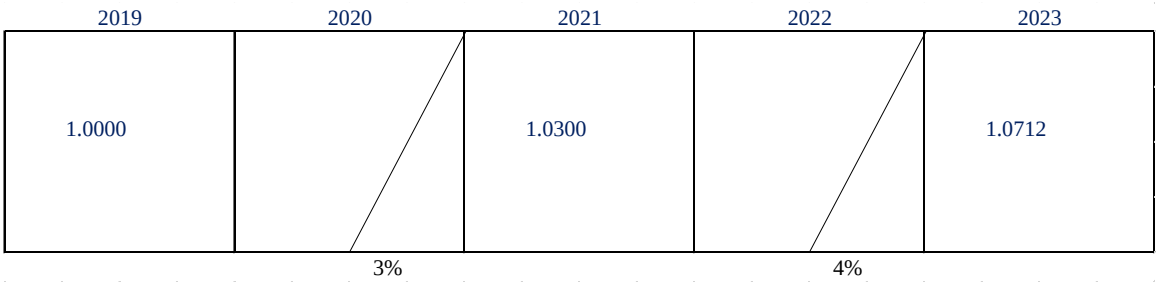
5. Continued

(f) Recommend the weights to assign to each year when estimating the weighted average trended claim ratio for the indicated rate change. Justify your recommendation.

Commentary on Question:
Candidates can also select weights judgmentally, as long as the number of years used matches the number of years recommended in part (e).

		AY Weights		
AY	Earned Exposures	Initial	Limited	Balanced
2020	19,937	27.3%	23.4%	24.4%
2021	17,061	23.4%	23.4%	24.4%
2022	17,992	24.7%	24.6%	25.6%
2023	17,931	24.6%	24.6%	25.6%
	72,921		96.0%	

(g) Calculate the indicated rate change for this line of business.



	Area in CY				
Rate Index	2019	2020	2021	2022	2023
1.0000	100%	75%	0%	0%	0%
1.0300	0%	25%	100%	75%	0%
1.0712	0%	0%	0%	25%	100%
Average rate level:	1.0000	1.0075	1.0300	1.0403	1.0712
On-level factor:	1.0712	1.0632	1.0400	1.0297	1.0000

Claim Ratio Trend: $(1 + -1.0\%)(1 + 5\%) - 1 = 3.95\%$

5. Continued

AY	Earned Premiums	On-Level Factor	On-Level Earned Premiums	Ultimate Claims
2019	13,510,549	1.07120	14,472,500	8,709,600
2020	13,268,660	1.06323	14,107,582	8,673,608
2021	11,739,370	1.04000	12,208,945	7,919,295
2022	12,638,750	1.02970	13,014,158	8,605,528
2023	13,089,711	1.00000	13,089,711	9,489,317

AY	Claim Trend Period (yrs)	Claim Trend Factor	Trended Ult. Claims	Claim Ratio	Weights
2019	5.9167	1.25761	10,953,253	75.68%	0.0%
2020	4.9167	1.20982	10,493,496	74.38%	24.4%
2021	3.9167	1.16385	9,216,849	75.49%	24.4%
2022	2.9167	1.11962	9,634,939	74.03%	25.6%
2023	1.9167	1.07708	10,220,730	78.08%	25.6%
			Weighted:	75.51%	

Weighted Average Trended Claim Ratio (including non-hurricane weather loading):	82.46%
Ratio of ULAE to Claims	5.00%
Weighted Average Trended Claim Ratio including ULAE = 0.8245×(1 + 6.7598) =	86.58%
Fixed Expenses as Ratio to Premiums at Current Rate Level	3.00%
Variable Expenses - Ratio to Premiums	12.00%
Profit and Contingencies Ratio to Premiums	4.00%
Permissible Claim Ratio = (1 – 0.12 – 0.04) / (1 + 0.03/0.8658) =	81.19%
Indicated Rate Change = 0.8658 / 0.8119 – 1 =	6.64%

6. 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, Second Edition (2022), J. Friedland, Chapter 30.

Commentary on Question:

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

Solution:

(a) Describe how you might account for a start-up cost expense.

An annual provision using an appropriate amortization period could be added.

(b) Explain whether a residual market assessment would be considered a fixed or variable expense.

It depends on the assessment.

- If the assessment is a fixed amount (i.e., variable on policy counts), then it should be considered a fixed expense.
- If the assessment is variable on premium, then it should be considered a variable expense.

(c) Describe a possible consequence to an insurer treating fixed expenses as variable expenses when determining rates.

Treating all expenses as variable can lead to inadequate expense provisions for insureds with low premium and excessive expense provisions for insureds with high premium.

(d) Describe two situations where you might cap the percentage of variable expenses in a ratemaking analysis.

- Where regulations limit the amount of expenses
- Where there is an expense that is not expected in the future or expected to be lower in the future.

7. 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:

(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.
(3f) Demonstrate knowledge of good practice related to projecting ultimate values.
(3g) Estimate ultimate values using the methods cited in (3e).
(4f) Calculate claim liabilities.

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 15, 17, 18, and 24.

Commentary on Question:

This question tests the candidate's understanding of the development method, the Bornhuetter Ferguson method, and the Benktander method of estimating IBNR.

Solution:

(a) Calculate the IBNR for each AY as of December 31, 2023 using:

(i) the Development method,

(ii) the Bornhuetter Ferguson method, and

(iii) two iterations of the Benktander method.

(i)

AY	Reported Claims	CDF	Development Method Ultimate Claims	Development Method IBNR
2021	5,613,235	1.2556	7,047,851	1,434,616
2022	4,682,692	1.5958	7,472,822	2,790,130
2023	3,554,432	2.3060	8,196,475	4,642,043

7. Continued

(ii)

AY	Historical Earned Premiums	Claim Trend Factor @6.1%	Premium On-Level Factor	Claim Ratio at Each AY Cost Level	Expected Claims Based on Claim Ratio
2021	10,119,409	1.1257	1.034	69.81%	7,064,127
2022	10,552,425	1.0610	1.020	73.06%	7,709,934
2023	10,850,455	1.0000	1.000	76.00%	8,246,346

AY	Ultimate Claims BF Method	BF Method IBNR
2021	7,051,164	1,437,929
2022	7,561,352	2,878,660
2023	8,224,719	4,670,287

(iii)

	BK Method (Ultimate Claims)		BK Method (IBNR)	
AY	Iteration 1	Iteration 2	Iteration 1	Iteration 2
2021	7,048,525	7,047,988	1,435,290	1,434,753
2022	7,505,877	7,485,164	2,823,185	2,802,472
2023	8,212,471	8,205,534	4,658,039	4,651,102

(b) Explain if this business is performing better or worse than expected for AY 2023 using the methods above.

2023 claim ratio for each method:

Development method	75.5%
BF method	75.8%
BK 2nd iteration	75.6%

Expected claim ratio: 76.0%

Since all claim ratios are lower than the expected claim ratio, all are performing better than expected.

(c) Identify one other weakness of the Benktander method.

There is not a clear sense as to the improvement in the estimation of ultimate claims from additional iterations.

8. Learning Objectives:

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

Learning Outcomes:

(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.

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapter 23.

Commentary on Question:

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) Provide another reason why the classical paid-to-paid method overstates unpaid ULAE, even in a steady state environment.

For most insurance portfolios, the average size of claims remaining open at the valuation date is greater than the average size of claims opened, and claims closed over the prior calendar year. This is the case even where there is no inflation and no growth in the exposure base.

(b) Describe two situations where the Mango and Allen smoothing adjustment is particularly valuable in producing a more reasonable estimate of unpaid ULAE.

Any two of the following are acceptable:

- Long-tail lines of business
- Changing exposure volume
- When large claims result in significant distortions to the calendar year paid and reported claims from year to year
- Where there are few claims paid or reported per year with great variability in the average claim value (i.e., low frequency and highly variable severity)
- Relatively new insurer who does not have a significant volume of credible paid or reported claims
- Sparse or volatile data

8. Continued

(c) Calculate the ULAE ratio for each year using the Mango and Allen smoothing adjustment based on paid and reported claim data.

	Maturity Age in Months				
	12	24	36	48	60
Reported CDF	3.505	2.020	1.765	1.420	1.165
% Cumulative Reported	28.5%	49.5%	56.7%	70.4%	85.8%
% Incremental Reported	28.5%	21.0%	7.2%	13.8%	15.4%

Accident Year	Selected Ultimate Claims	Projected in Calendar Year 2019	2020	2021	2022	2023
Expected Reported Claims						
2019	5,331,195	1,521,026	1,118,180	381,302	733,856	821,770
2020	4,622,596		1,318,858	969,556	330,621	636,315
2021	5,116,924			1,459,893	1,073,238	365,976
2022	5,524,846				1,576,276	1,158,797
2023	6,060,412					1,729,076
Total	26,655,973	1,521,026	2,437,037	2,810,751	3,713,990	4,711,934

ULAE Ratio based on Mango and Allen Smoothing Adjustment:

Calendar Year	Paid ULAE	Expected Claims		Ratio ULAE to Claims
		Paid	Reported	Average of Paid and Reported
2019	278,480	991,462	1,521,026	22.2%
2020	323,800	1,170,742	2,437,037	18.0%
2021	369,200	1,573,118	2,810,751	16.8%
2022	448,080	2,346,706	3,713,990	14.8%
2023	675,994	3,297,712	4,711,934	16.9%
Total	1,817,074	8,388,278	13,673,712	16.5%

(d) Recommend a ULAE ratio to use for this line of business. Justify your recommendation.

Recommendation is to use the average of all years of 16.5%. The justification is to use the average as this is a new line of business and there probably isn't yet the stability in the numbers.

8. Continued

(e) Calculate unpaid ULAE as of December 31, 2023 using the recommended ratio from part (d).

% of ULAE opening a claim file: 30%

IBNR = 5,750,000 – 3,250,000 = 2,500,000

Unpaid ULAE = 16.5%×3,250,000×(1 – 0.30) + 16.5%×2,500,000 = 786,559

9. 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.

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

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 19 and 22.

Commentary on Question:

This question tests the candidate's understanding of the Cape Cod method for estimating ultimate claims.

Solution:

(a) Describe two differences between the Cape Cod method and the Generalized Cape Cod method for estimating ultimate claims.

Any two of the following are acceptable:

- The Generalized Cape Cod (GCC) method uses a judgmentally selected decay factor to assign different weights to each year in the experience period.
- In the Cape Cod method, expected claims for each year in the experience period are derived from the same expected claim ratio. In the GCC method, a distinct expected claim ratio is obtained for each year in the experience period.
- The GCC method takes into account the relationship between the variance and trending, which if not considered could cause excessive weight to be given to years that are out of date.

9. Continued

(b) Describe two major differences between the Bornhuetter Ferguson and Cape Cod methods.

Any two of the following are acceptable:

- The difference between the two methods is in the determination of the expected value input.
- The derivation of the expected value for the Cape Cod method is prescribed by the method itself and is not an independent a priori estimate as in the Bornhuetter Ferguson method.
- Whereas the expected value used with the Bornhuetter Ferguson method can incorporate significant professional judgment, the expected value used in the Cape Cod method is determined by a formula; professional judgment does not typically play a role.

(c) Describe two advantages that blended methods provide when evaluating and selecting estimates of ultimate claims.

Any two of the following are acceptable:

- The Bornhuetter Ferguson and Cape Cod methods are easy to apply and relatively easy to explain to non-actuarial users.
- Blending expected claims with actual claims is intuitively appealing; as a year matures, more weight will be given to actual claims instead of expected claims
- Because future claim emergence is tied to exposures instead of historical claim experience, external information can be readily incorporated into the analysis. For example, rate level changes and trend can be used in blended methods. Even changes in the distribution of business, such as shifts in exposures by class, territory, or limit, could be factored into the analysis.

10. Learning Objectives:

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

Learning Outcomes:

(3d) Analyze development triangles for investigative testing.

(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).

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 14 and 20.

Commentary on Question:

This question tests the candidate's understanding of Berquist-Sherman adjustments when there has been a change in claim settlement patterns.

Solution:

(a) Perform two diagnostic tests to confirm that there was a change in claim settlement patterns in 2023.

Ratio of Paid Claims to Reported Claims:

AY	12	24	36	48	60	72
2018	0.579	0.756	0.866	0.939	0.996	***1.000***
2019	0.601	0.766	0.864	0.938	***0.999***	
2020	0.590	0.764	0.863	***0.977***		
2021	0.591	0.758	***0.942***			
2022	0.569	***0.829***				
2023	***0.628***					

- if there has been a speed up in claim settlement in 2023, expect the latest diagonal to show noticeable increase in the ratios
- there is evidence of a speed up in this case

10. Continued

Ratio of Closed Counts to Reported Counts:

AY	12	24	36	48	60	72
2018	0.648	0.757	0.824	0.869	0.905	***1.000***
2019	0.655	0.760	0.822	0.869	***0.981***	
2020	0.651	0.764	0.822	***0.949***		
2021	0.652	0.758	***0.923***			
2022	0.646	***0.834***				
2023	***0.696***					

- if there has been a speed up in claim settlement in 2023, expect the latest diagonal to show noticeable increase in the ratios
- there is evidence of a speed up in this case

(b) Perform one diagnostic test to determine whether there was a change in case adequacy in 2023.

Change in average case:

Accident Year	Average Case 12	24	36	48	60	72
2018	3,442	3,435	2,880	1,880	185	-
2019	3,652	3,553	2,998	1,966	194	
2020	3,861	3,756	3,231	2,075		
2021	4,062	4,005	3,378			
2022	4,340	4,205				
2023	4,508					

Accident Year	Change in Average Case 12	24	36	48	60	72
2018-2019	6.1%	3.4%	4.1%	4.6%	5.2%	
2019-2020	5.7%	5.7%	7.8%	5.5%		
2020-2021	5.2%	6.6%	4.6%			
2021-2022	6.9%	5.0%				
2022-2023	3.9%					
Average:	5.5%	5.2%	5.5%	5.1%	5.2%	

- evidence of change in case adequacy would show up as a change in one of the diagonals significantly different than 5%
- there is no evidence of a significant change in case adequacy in this situation

10. Continued

(c) Calculate the adjusted paid claims triangle.

Commentary on Question:
Solution needs to use ultimate counts from reported only because reported counts are not affected by the settlement change but closed counts are.

Ratio of Closed Counts to Ultimate Counts:

AY	12	24	36	48	60	72	Ultimate Counts (from reported)
2018	0.387	0.580	0.721	0.815	0.888	0.991	1,485
2019	0.395	0.578	0.702	0.810	0.962		1,492
2020	0.388	0.575	0.711	0.888			1,499
2021	0.395	0.564	0.798				1,503
2022	0.398	0.630					1,474
2023	0.420						1,491
Selected	0.420	0.630	0.798	0.888	0.962	0.991	

Adjusted Closed Counts:

AY	12	24	36	48	60	72	Ultimate Counts (from reported)
2018	623	935	1,185	1,319	1,429	1,471	1,485
2019	626	939	1,190	1,325	1,436		1,492
2020	629	944	1,196	1,331			1,499
2021	631	946	1,199				1,503
2022	619	928					1,474
2023	626						1,491

Adjusted Paid Claims:

AY	12	24	36	48	60	72
2018	2,743,316	4,113,672	5,212,419	5,801,704	6,288,756	6,472,400
2019	2,756,247	4,133,063	5,236,989	5,829,052	6,318,400	
2020	2,769,179	4,152,454	5,261,560	5,856,400		
2021	2,776,568	4,163,534	5,275,600			
2022	2,722,995	4,083,200				
2023	2,754,400					

10. Continued

(d) Describe an alternative approach that could be used for determining ratios of paid claims to cumulative closed counts.

Instead of a fixed ratio that does not vary by accident year and development period, determine a mathematical curve to approximate the relationship between cumulative closed counts and cumulative paid claims.

(e) Describe a possible problem with the alternative approach identified in part (d).

In some situations, a mathematical relationship may not even exist.

(f) Critique your colleague's recommendation.

This line of business did not have a change in case adequacy, so an adjustment for that is not needed. However, adjusting for both a change in case adequacy and a change in claim settlement should not significantly affect the results, as adjusting for the change in case adequacy should have little, if any, effect.

11. Learning Objectives:

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

Learning Outcomes:

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

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapter 21.

Commentary on Question:

This question tests the candidate's understanding of ultimate claims when conditions are changing.

Solution:

(a) Describe how this reform would affect the reported claims development triangle evaluated as of December 31, 2023, assuming the following:

(i) The reform affected only new claims.

(ii) The reform affected new and open claims.

(i) The change affecting all new claims would occur on a row (accident year) basis and would be immediate with the effective date as claim adjusters estimate new claims that occurred after the effective date.

(ii) The change affecting all open claims would occur on a diagonal (or calendar year) basis and would have more of a phased-in effect as all claim estimates get re-evaluated by the claim department over time.

(b) Describe why the expected method could be well-suited to estimate claims under scenario (a)(i) above.

The expected method allows for tort reform adjustments, so would adjust prior accident years to the current benefit level.

11. Continued

(c) Describe why a Berquist-Sherman data adjustment could be well-suited to estimate claims under scenario (a)(ii) above.

The benefit change on a diagonal is similar to the effect of a case adequacy change. The Berquist-Sherman adjustment uses the latest diagonal to restate prior calendar year data (diagonals) consistent with current benefit level.

(d) Describe whether this reform would affect indemnity, ALAE, ULAE, or some combination.

Likely effect is change in indemnity and no change to ALAE and ULAE.

(e) Describe whether this reform would affect paid data, reported data, or both paid and reported data.

Change in claims affects both paid and reported data.

12. Learning Objectives:

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

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).
(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.

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 16 and 26.

Commentary on Question:

This question tests the development-based frequency-severity method for estimating ultimate claims.

Solution:

(a) Describe two options to consider when experience is not fully credible for trending.

Any two of the following are acceptable:

- Rely on industry data for a similar line of business in a similar jurisdiction.
- Combine the insurer's experience in specific states or provinces with the experience of a larger region.
- Combine the insurer's experience with that of other insurers in a group under common ownership.

12. Continued

(b) Recommend the annual claim frequency trend to use for this line of business. Justify your recommendation.

Accident Year	Earned Exposures	Ultimate Counts	Indicated Frequency	Annual Change in Frequency
2018	16,451	1,485	9.027%	
2019	16,557	1,492	9.011%	-0.172%
2020	16,815	1,499	8.915%	-1.072%
2021	16,915	1,503	8.886%	-0.326%
2022	17,147	1,474	8.596%	-3.256%
2023	17,461	1,491	8.539%	-0.666%
Average:				-1.098%
Exponential fitted:				-1.200%
Selected:				-1.200%

Justification: use all years due to erratic changes.

(c) Calculate the ultimate counts using the development-based frequency-severity method with your selected frequency trend from part (b). Justify any selections.

Accident Year	Freq trend @-1.2%	Trended Frequency	F-S Ultimate Counts
2018	0.941431	8.498%	1,498
2019	0.952864	8.587%	1,489
2020	0.964436	8.598%	1,494
2021	0.976148	8.674%	1,485
2022	0.988002	8.493%	1,487
2023	1.000000	8.539%	1,496
Average trended frequency at 2023 cost level excluding 2023			
all years		8.570%	
excluding hi-lo		8.561%	
Selected frequency @ 2023 level:		8.570%	

Justification for selected frequency: No significant trend; no significant outliers

12. Continued

(d) State one other influence that the trend rate should also recognize.

Social influences, (i.e., the impact on insurance costs of societal changes such as changes in claim consciousness, court practices, and legal precedents, as well as in other noneconomic factors).

(e) Calculate the ultimate claims using the development-based frequency-severity method. Justify any selections.

Accident Year	Severity Trend @5.0%	Trended Reported Severity	F-S Ultimate Severity	F-S Ultimate Claims
2018	1.276282	6,022.77	4,966.93	7,438,122
2019	1.215506	6,493.23	5,215.28	7,766,041
2020	1.157625	6,503.54	5,476.05	8,182,046
2021	1.102500	6,457.34	5,749.85	8,538,549
2022	1.050000	6,219.15	6,037.34	8,979,399
2023	1.000000	6,168.00	6,339.21	9,485,828

Average trended severity at 2023 cost level excluding 2023	
all years	6,339.21
excluding hi-lo	6,389.91
Selected severity @ 2023 level:	6,339.21

Justification for selected severity: No significant trend; no significant outliers.

13. Learning Objectives:

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

Learning Outcomes:

(2a) Create development triangles of claims and counts from detailed claim transaction data.

Sources:

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapter 11.

Commentary on Question:

This question tests the constructions of claims data triangles as well as the candidate's ability to recognize inconsistencies with claims data triangles.

Solution:

(a) Verify that the change in case estimates during calendar year 2023 from the industry summary should be 223,240.

Accident Year	Case Estimates					
	12	24	36	48	60	72
2015	786,844	564,811	308,931	160,024	48,442	0
2016	795,613	613,589	329,380	140,620	45,963	0
2017	865,750	653,990	358,166	158,396	55,255	0
2018	971,601	688,324	387,347	163,712	48,728	0
2019	985,138	757,423	408,513	205,511	86,907	
2020	1,069,993	795,296	445,648	300,044		
2021	1,110,968	873,229	457,851			
2022	1,252,106	896,859				
2023	1,306,801					

Calendar Year (CY)	Case Estimates at End of Year	Case Change in CY
2022	2,825,222	
2023	3,048,462	223,240

13. Continued

(b) Identify the value that was reported in error to the industry bureau.

CY	Paid at End of Year	Paid in CY
2022	26,688,847	
2023	28,641,623	1,952,776

The claims paid in CY 2023 was incorrect, which likely caused the error in the change in case in CY 2023.

(c) Construct a *reported* count triangle that reflects the development on these two claim files over time. Make sure to correctly label your triangles.

Claim #4400:
- AY 2021
- Reported in 2021 (12 months)
- Stays a reported count at 24 and 36 months

Accident Year	Reported Counts 12	24	36
2021	1	1	1

Claim #5500:
- AY 2021
- Reported in 2022 (24 months), so zero at 12 and 1 at 24 & 36 months

Accident Year	Reported Counts 12	24	36
2021	0	1	1

13. Continued

(d) Construct a *closed* count triangle that reflects the development on these two claim files over time. Make sure to correctly label your triangles.

Claim #4400:
- closed in 2022, so closed counts should be a 1 at 24 months, reopened in 2023 so remove the 1 at 36 months

Accident	Closed Counts		
Year	12	24	36
2021	0	1	0

Claim #5500:
- deemed invalid claim in 2023, so closed count is 1 at 36 months

Accident	Closed Counts		
Year	12	24	36
2021	0	0	1