# GIRR Model Solutions
# Spring 2023

## 1. Learning Objectives:

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

**Learning Outcomes:**

(2b) Describe the different types of exposures used for conducting actuarial work.
(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, Chapters 12 and 13.

**Commentary on Question:**

*This question tests the candidate's understanding of the earnings of policies with different policy terms, as well as adjusting earned premiums to current rate level for ratemaking purposes.*

**Solution:**

(a) State the two key assumptions of the parallelogram method.

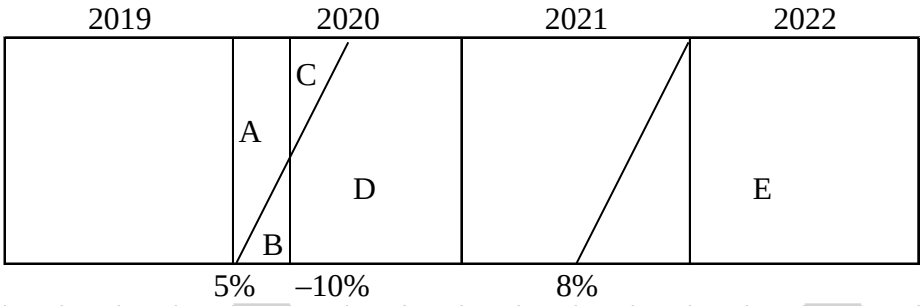
- Policies are written evenly over the experience period
- Exposures are earned evenly over the policy term

## 1. Continued

(b) Calculate the calendar year 2020 on-level premium to be used for a ratemaking analysis.

6-month policies:

- in force premium on Jan 1, 2020: 3,000,000
- annualized premium: 6,000,000



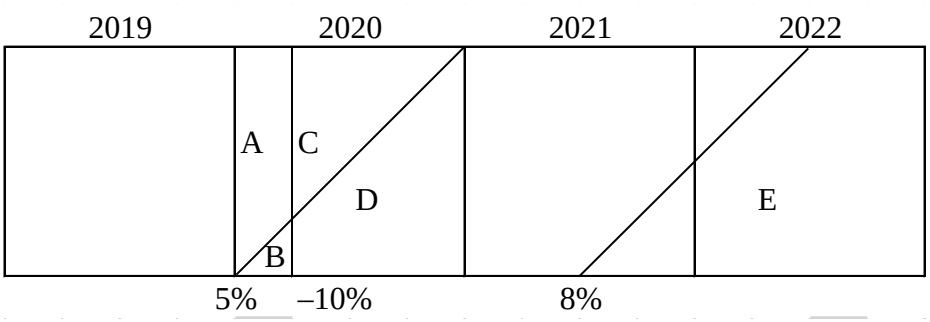

| Section | Rate Level Index | Percent Premium Earned in CY2020 at Rate Level |
|---|---|---|
| A | 1.00000 | 18.75% |
| B | 1.05000 | 6.25% |
| C | 0.90000 | 6.25% |
| D | 0.94500 | 68.75% |
| E | 1.02060 | |
| Average rate level: | | 0.9591 |
| On-level factor: | | 1.0642 |
| On-level earned premium: | | 6,384,985 |

e.g., 1.0642 = 1.0206 / 0.9591

## 1. Continued

12-month policies:

- in force premium on Jan 1, 2020: 9,000,000




| Section | Rate Level Index | Percent Premium Earned in CY2020 at Rate Level |
|---|---|---|
| A | 1.00000 | 21.88% |
| B | 1.05000 | 3.13% |
| C | 0.90000 | 28.13% |
| D | 0.94500 | 46.88% |
| E | 1.02060 | |
| Average rate level: | | 0.9477 |
| On-level factor: | | 1.0770 |
| On-level earned premium: | | 9,692,755 |

Total CY2020 earned premium at current rate level for ratemaking:
= 6,384,985 + 9,692,755 = 16,077,740

(c) Provide two examples of general insurance policies where exposures are not usually earned evenly throughout the policy term.

Any two of the following are acceptable:

- Policies covering seasonal risks
- Warranty
- Financial guarantee
- Property catastrophe and aggregate stop-loss reinsurance
- Retrospectively-rated policies
- Policies with reinstatement premium

## 2. 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:**

(1g) Identify different types of data used for actuarial work.
(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, Chapters 4 and 11.

**Commentary on Question:**

*This question tests the candidate's understanding of the different types of data used for actuarial work, as well as adjusting development triangles of claims and counts from changes in transactions.*

**Solution:**

(a) Provide one advantage and one disadvantage to aggregating claims data by policy year.

Advantage: There is a precise matching of the premiums and the claims arising from those premiums.

Disadvantage: There is a time lag associated with this type of aggregation.

(b) Provide one disadvantage to aggregating claims data by report year.

Disadvantage: It does not capture claims that have been incurred but not yet reported (pure IBNR).

## 2. Continued

(c) Construct new data triangles with corrections for this claim file.

What's in the current data:

| AY | | 12 | 24 | 36 | 48 |
|---|---|---|---|---|---|
| 2019 | Cumulative paid claims | 0 | 1,500 | 2,500 | 60,000 |
| 2019 | Case estimate | 0 | 900,000 | 900,000 | 400,000 |
| 2019 | Reported Claims | 0 | 901,500 | 902,500 | 460,000 |
| 2019 | Reported Counts | 0 | 1 | 1 | 1 |

What should have been in the data:

| AY | | 12 | 24 | 36 | 48 |
|---|---|---|---|---|---|
| 2019 | Cumulative paid claims | 0 | 1,500 | 2,500 | 60,000 |
| 2019 | Case estimate | 90,000 | 90,000 | 90,000 | 40,000 |
| 2019 | Reported Claims | 90,000 | 91,500 | 92,500 | 100,000 |
| 2019 | Reported Counts | 1 | 1 | 1 | 1 |

| Accident | Revised Reported Claims | | | | | |
|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 |
| 2017 | 2,147,785 | 3,025,674 | 3,620,901 | 4,136,684 | 4,362,359 | 4,382,594 |
| 2018 | 2,219,814 | 3,071,925 | 3,876,926 | 4,331,668 | 4,596,920 | |
| *2019* | *2,432,602* | *3,344,013* | *4,112,135* | *4,714,225* | | |
| 2020 | 2,591,328 | 3,398,123 | 4,339,405 | | | |
| 2021 | 2,582,962 | 3,768,518 | | | | |
| 2022 | 2,735,738 | | | | | |

| Accident | Revised Reported Counts | | | | | |
|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 |
| 2017 | 729 | 895 | 998 | 1,082 | 1,119 | 1,122 |
| 2018 | 727 | 900 | 1,019 | 1,089 | 1,130 | |
| *2019* | *744* | *911* | *1,022* | *1,102* | | |
| 2020 | 765 | 902 | 1,042 | | | |
| 2021 | 763 | 939 | | | | |
| 2022 | 767 | | | | | |

There is no change to paid claims and no change to closed counts.

## 2. Continued

(d) Calculate calendar year 2022 reported claims, based on corrected data.

| | |
|---|---|
| Change in reported for accident years 2016 and prior: | 7,200 |
| Sum of latest diagonal of adjusted reported claims triangle: | 24,537,400 |
| Sum of previous diagonal of adjusted reported claims triangle: | 18,787,247 |
| Calendar year 2022 reported claims: | |
| = 24,537,400 – 18,787,247 + 7,200 = | 5,757,353 |

## 3. 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 candidate's understanding of development method for estimating ultimate claims.*

**Solution:**

(a) State the two key assumptions of the development method.

- Historical experience is predictive of future experience.
- Activity observed to date is relevant for projecting future activity.

(b) Describe an advantage of using paid claims instead of reported claims when applying the development method.

Paid development patterns are not influenced by changes in philosophy or processes regarding case estimates.

(c) Describe an advantage of using reported claims instead of paid claims when applying the development method.

Reported claims are often used instead of paid claims as there tends to be less volatility and more credibility associated with the selection of development factors for reported claims.

(d) Describe one way you might account for the presence of large claims in the data when applying the development method.

Remove the large claims from the data triangle so that the development pattern is not distorted by the presence of large claims.

## 3. Continued

(e) Describe two ways you might account for limited credibility of the data when applying the development method.

- When the credibility of the data is more limited, use longer-term averages, which frequently demonstrate greater stability than shorter-term averages.
- Could look to industry data for development patterns.

(f) Calculate projected ultimate claims for all accident years using the paid development method.

| | Paid Claims Age-to-age factors | | | | | | |
|---|---|---|---|---|---|---|---|
| AY | 12-24 | 24-36 | 36-48 | 48-60 | 60-72 | 72-84 | 84-ult |
| 2016 | 2.339 | 1.481 | 1.306 | 1.218 | 1.133 | 1.047 | |
| 2017 | 1.931 | 1.613 | 1.332 | 1.186 | 1.131 | | |
| 2018 | 2.767 | 1.510 | 1.317 | 1.213 | | | |
| 2019 | 2.774 | 1.517 | 1.353 | | | | |
| 2020 | 2.269 | 1.598 | | | | | |
| 2021 | 2.210 | | | | | | |
| 2022 | | | | | | | |
| Simple 3 | 2.418 | 1.542 | 1.334 | 1.206 | 1.132 | 1.047 | |
| Simple All | 2.382 | 1.544 | 1.327 | 1.206 | 1.132 | 1.047 | |
| Vol Wtd 3 | 2.385 | 1.542 | 1.334 | 1.205 | 1.132 | 1.047 | |
| Vol Wtd 5 | 2.352 | 1.544 | 1.328 | 1.205 | 1.132 | 1.047 | |
| Vol Wtd All | 2.350 | 1.544 | 1.328 | 1.205 | 1.132 | 1.047 | |
| Selected: | 2.350 | 1.544 | 1.328 | 1.205 | 1.132 | 1.047 | 1.015 |
| Age-to-Ult. | 6.983 | 2.972 | 1.925 | 1.450 | 1.203 | 1.062 | 1.015 |

Recommend volume-weighted average of all years to address the variability.

*Algebraic Method for Paid Claims Tail Factor:*

| AY | Ultimate Reported Claims | Paid Claims Developed to 84 months | Implied Tail Factor |
|---|---|---|---|
| 2016 | 2,513,084 | 2,487,315 | 1.010 |
| 2017 | 2,665,698 | 2,625,300 | 1.015 |
| 2018 | 2,809,772 | 2,760,204 | 1.018 |
| Average | | | 1.015 |

**3.** **Continued**

| Paid Claims | CDF | Ultimate Paid Claims |
|---|---|---|
| 2,487,315 | 1.015 | 2,523,552 |
| 2,507,208 | 1.062 | 2,663,547 |
| 2,328,436 | 1.203 | 2,800,417 |
| 2,091,115 | 1.450 | 3,031,578 |
| 1,650,625 | 1.925 | 3,177,499 |
| 1,140,537 | 2.972 | 3,389,654 |
| 408,139 | 6.983 | 2,850,185 |
| 12,613,375 | | 20,436,433 |

## 4. 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 different types of expenses required for ratemaking.*

**Solution:**

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

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Calendar Year | Earned Exposures | Direct Written Premium | Direct Earned Premiums | Total Commission Expenses and Premium Taxes | General Expenses |
| 2019 | 8,700 | 7,447,430 | 7,377,050 | 670,269 | 243,420 |
| 2020 | 9,150 | 7,895,360 | 7,846,640 | 710,582 | 253,065 |
| 2021 | 9,340 | 8,112,390 | 8,090,270 | 730,115 | 260,640 |
| 2022 | 9,240 | 8,097,340 | 8,083,570 | 728,761 | 268,436 |
| 2023 Budget | 9,120 | 8,050,000 | 8,048,900 | 724,500 | 285,000 |

| | (6) = (5)×75% | (7) = (6) / (3) | (8) = (4) / (2) |
|---|---|---|---|
| | General Expenses | | Commission and Premium Tax Expense Ratio |
| Calendar Year | Variable | As a % of Earned Premiums | |
| 2019 | 182,565 | 2.47% | 9.00% |
| 2020 | 189,799 | 2.42% | 9.00% |
| 2021 | 195,480 | 2.42% | 9.00% |
| 2022 | 201,327 | 2.49% | 9.00% |
| 2023 Budget | 213,750 | 2.66% | 9.00% |
| Recommended | | 2.66% | 9.00% |

## 4. Continued

Total variable expense ratio = 2.66% + 9.00% = 11.66%

Justification: There is a significant increase expected from budget, so give more consideration to the budget.

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

| | (10) = (5)×25% | (11) = (10)/(1) |
|---|---|---|
| Calendar Year | Fixed General Expense (000) | Fixed General Expense Per Exposure |
| 2019 | 60,855 | 6.99 |
| 2020 | 63,266 | 6.91 |
| 2021 | 65,160 | 6.98 |
| 2022 | 67,109 | 7.26 |
| 2023 Budget | 71,250 | 7.81 |
| | Selection: | 7.81 |

Justification: There is a significant increase expected from budget, so give more consideration to the budget.

Provision for new system = 2,500,000 / 9,120 / 4 = 68.53 (amortized over 4 years)

Total: 7.81 + 68.53 = 76.34

## 5. 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.

**Sources:**

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 27 and 32.

**Commentary on Question:**

*This question tests the candidate's understanding of trending premiums and indicated rate changes using claim ratios.*

**Solution:**

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

**Commentary on Question:**

*The year-to-year change in **average** increased limit factor (ILF) needs to be analyzed for the trend due to shift in policy limits.*

## 5. Continued

| Experience Period | Weighted Average ILF | Annual Trend Due to Shift in ILF |
|---|---|---|
| 2015 | 1.00018 | |
| 2016 | 1.00270 | 0.25% |
| 2017 | 1.00603 | 0.33% |
| 2018 | 1.00877 | 0.27% |
| 2019 | 1.01202 | 0.32% |
| 2020 | 1.01500 | 0.29% |
| 2021 | 1.01769 | 0.27% |
| 2022 | 1.01924 | 0.15% |
| Average: | | 0.27% |
| Average excluding high & low: | | 0.28% |

Recommended trend: 0.28%
Justification: average excluding high and low removes the outliers, especially 2022.

(b) Calculate the indicated rate level change for this line of business using a claims ratio approach. Justify any selection(s).

| | | |
|---|---|---|
| Average earned premium dates in 2022: | Jul. 1, 2022 | |
| Effective date of new rates: | Sep. 1, 2023 | # of months |
| Average earned premium dates in future rating period: | | trending period |
| for 12-month policies | Sep. 1, 2024 | 26 |
| for 6-month policies | Jun. 1, 2024 | 23 |
| Average: | | 25.25 |

Annual premium trend = $(1 + 0.28\%)(1 + -0.1\%) - 1 = 0.180\%$
Annual pure premium trend = $(1 + 6\%)(1 + -1.2\%) - 1 = 4.728\%$

| Accident Year | (1) Earned Premiums | (2) Trending Period (months) | (3) Premium On-Level Factors | (4) = $(1.0018)^{[(2)/12]}$ Premium Trend Factors | (5) = (1)(3)(4) Earned Premiums Trended at Current Rates |
|---|---|---|---|---|---|
| 2018 | 15,804,847 | 73.25 | 1.064 | 1.01102 | 17,001,688 |
| 2019 | 15,333,428 | 61.25 | 1.106 | 1.00921 | 17,114,913 |
| 2020 | 15,526,085 | 49.25 | 1.104 | 1.00740 | 17,267,582 |
| 2021 | 16,625,910 | 37.25 | 1.049 | 1.00559 | 17,538,061 |
| 2022 | 17,102,494 | 25.25 | 1.026 | 1.00379 | 17,613,581 |

| Accident Year | (6) Ultimate Claims | (7) = $(1.04728)^{[(2)/12]}$ Claim Trend Factors | (8) = (6)(7) Trended Ultimate Claims | (9) = (8) / (6) Claim Ratio |
|---|---|---|---|---|
| 2018 | 8,703,669 | 1.32577 | 11,539,025 | 67.87% |
| 2019 | 9,184,011 | 1.26591 | 11,626,161 | 67.93% |
| 2020 | 9,602,493 | 1.20876 | 11,607,137 | 67.22% |
| 2021 | 10,401,614 | 1.15419 | 12,005,466 | 68.45% |
| 2022 | 11,309,041 | 1.10209 | 12,463,536 | 70.76% |
| | | Average: | | 68.45% |
| | | Average latest 3 years: | | 68.81% |

Selected claim ratio = 68.81%
Justification for selected claim ratio: Increasing in most recent years, so give more weight to more recent 3 years.

Indicated rate change: $[0.6881(1 + 0.07) + 0.05]/(1 – 0.23 – 0.04) = 7.71\%$

(c) Describe one reason why an indicated rate change using a pure premium approach may not result in the same result as part (b).

The premium on-level factors are an approximation used to restate historical earned premiums as if they were at the current rate level for the forecast period.

(d) Calculate the profit and contingencies to premium ratio implied by a 3% rate increase using your colleague's indicated rate change.

Claim ratio implied by the 6% rate indication:
$(\text{Claim ratio} + 0.05)/(1 – 0.23 – 0.04) – 1 = 0.06 \rightarrow$ claim ratio = 72.38%

Profit margin implied by a 3% rate change:
$(0.7238 + 0.05)/(1 – 0.23 – Q) – 1 = 0.03$
$\rightarrow Q = 1.87\%$

(e) State two actions the company can take that could help achieve the target profit, given the 3% rate increase.

**Commentary on Question:**
*Other actions are possible.*

- decrease expenses
- decrease claims (e.g., changing mix of business, better risk selection)

## 6. 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 19.

**Commentary on Question:**

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

**Solution:**

(a) Describe why the Cape Cod method may not be appropriate for coverages such as property or automobile collision.

The development factor may be less than 1, which will result in used-up exposures that are greater than the original exposures.

(b) Calculate projected ultimate claims using the Cape Cod method applied to paid claims.

| | (1) | (2) | (3) = 1/(2) | (4) = (1)(3) | (5) |
|---|---|---|---|---|---|
| Accident Year | On-Level Earned Premiums | Paid Cumulative Development Factors | Expected % Paid | Used-Up On-Level Earned Premiums | Actual Paid Claims |
| 2017 | 14,304,922 | 1.048 | 95.42% | 13,649,735 | 8,573,426 |
| 2018 | 14,662,414 | 1.097 | 91.16% | 13,365,920 | 8,699,818 |
| 2019 | 14,826,526 | 1.326 | 75.41% | 11,181,392 | 7,732,920 |
| 2020 | 15,064,165 | 1.847 | 54.14% | 8,156,018 | 5,857,706 |
| 2021 | 15,448,284 | 3.146 | 31.79% | 4,910,453 | 3,561,183 |
| 2022 | 15,630,481 | 9.473 | 10.56% | 1,650,003 | 1,395,852 |
| Total | | | | 52,913,520 | 35,820,905 |

## 6. Continued

| Accident Year | (6) Claim Trend Factors | (7) Tort Reform Factors | (8) = (5)(6)(7) Adjusted Claims | (9) = (A)(1)/[(6)(7)] Expected Claims | (10) = (5) + (9)[1 – (3)] Ultimate Claims |
|---|---|---|---|---|---|
| 2017 | 1.2763 | 0.800 | 8,753,684 | 9,438,074 | 9,005,704 |
| 2018 | 1.2155 | 0.800 | 8,459,747 | 10,157,636 | 9,597,986 |
| 2019 | 1.1576 | 0.800 | 7,161,457 | 10,784,894 | 10,384,410 |
| 2020 | 1.1025 | 0.950 | 6,135,215 | 9,688,961 | 10,300,884 |
| 2021 | 1.0500 | 1.000 | 3,739,242 | 9,911,179 | 10,321,955 |
| 2022 | 1.0000 | 1.000 | 1,395,852 | 10,529,475 | 10,813,802 |
| Total | | | 35,645,197 | 60,510,219 | 60,424,742 |

Adjusted Expected Claim Ratio = 35,645,197 / 52,913,520 = 67.37% (A)

e.g., 2020 tort reform factor: 25%(0.8) + 75%(1.0) = 0.95

(c) Describe two situations that could result in such a difference in Cape Cod projections.

**Commentary on Question:**
*Other situations are possible.*

Any two of the following are acceptable:

- Decrease in the adequacy of case reserves in the latest diagonal
- Change in the settlement rates resulting in higher paid claims than in past
- Unusual payment of large claims where the case is low
- Change in environment (internal or external) that is reflected in case estimates but not yet seen in paid claims that lag the reporting of claims

## 7. Learning Objectives:

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

**Learning Outcomes:**

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

(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, Chapter 21.

**Commentary on Question:**

*This question tests the candidate's understanding of the appropriateness of various methods of estimating ultimate claims under changing conditions.*

**Solution:**

Recommend a different estimation method to use with each of the following four independent books of business. Justify your recommendations.

**Commentary on Question:**

*The Berquist-Sherman adjustments are adjustments to data and not a method. Candidates needed to also recommend the estimation method if they recommended Berquist-Sherman adjustments.*

(i) A long-tailed book where the case estimates were strengthened in 2018.

The paid development is responsive to the case change, but it will be too leveraged for 2022 so avoid this method. Recommend adjusting for the case change using Berquist-Sherman approach and then use the reported development method to estimate ultimate claims.

(ii) A book that has unstable development patterns and experience that has been improving.

Recommend using the frequency-severity method to separately analyze claim counts and average severity. This might give better insights as to what patterns are changing and where the deterioration is coming from (i.e., frequency or severity or both).

## 7. Continued

(iii) A quickly growing book of business that has only been writing business for three years.

***Commentary on Question:***
*The frequency-severity method is also acceptable, but not if already selected in part (ii), as the question asks for a different method for each part.*

Any of expected, Bornhuetter Ferguson or Cape Cod methods for a new line of business and also the significant growth.

(iv) A medium-tailed book of business where the policy limit was increased from 2 million to 3 million, effective January 1, 2019.

The expected method (if the expected method was not chosen in part (iii)) because both the pattern and experience will change at mature (in the tail) periods which will take many years to figure out.

## 8. 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:**

(5a) Identify and describe the influences of portfolio changes on claim frequency and severity.
(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.

**Sources:**

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 26, 27, and 31.

**Commentary on Question:**

*This question tests the candidate's understanding of the loading for catastrophes in ratemaking.*

**Solution:**

(a) Explain why two trend adjustments must be made to the modeled expected earthquake claims to calculate the catastrophe loading for ratemaking.

Past adjustment: modeled catastrophe claims must be trended from February 1, 2022 to July 1, 2022 for exposure trend to reflect in-force exposures as of July 1, 2022
Future adjustment: modeled catastrophe claims must be trended from July 1, 2022 to mid-point of future rating period for severity trend to reflect the cost level in the future rating period

(b) Calculate the catastrophe loading to be used for ratemaking, as a claim ratio.

| | |
|---|---|
| Midpoint of future rating period: | October 1, 2024 |
| Exposure trend period (months): February 1, 2022 to July 1, 2022 | 5 |
| Exposure trend = $1.01^{(5/12)}$ = | 1.00415 |
| Severity trend period (months): July 1, 2022 to October 1, 2024 | 39 |
| Severity trend = $1.06^{(39/12)}$ = | 1.20849 |
| Trended modeled catastrophe claims = 450,000×1.00415×1.20849 = | 546,081.10 |
| Catastrophe loading = 546,081.10 / 15,450,000 = | 3.53% |

## 8. Continued

(c) Describe an additional step or approach that would increase your confidence in the estimate of expected earthquake claims.

Running alternative catastrophe models would increase confidence in the estimate of expected earthquake claims.

(d) Describe how you would consider the effect of a demand surge in the calculation of the catastrophe loading for ratemaking.

Demand surge can result in a trend rate that is higher post-catastrophe than pre-catastrophe. Therefore, could recognize a demand surge by selecting a higher post event claim severity trend rate.

## 9. 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 tests the candidate's understanding of estimating unpaid ULAE.*

**Solution:**

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

The significant inflation in this case will cause a relatively higher increase in the calendar paid ULAE than the calendar paid claims, since inflation can more quickly affect the underlying costs of ULAE, including the salaries of claims adjusters, rent, and utilities. This will overstate the paid ULAE to paid claims ratio, thus overestimating the unpaid ULAE.

## 9. Continued

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

**Commentary on Question:**
*It is recommended to solve this part of the question by displaying the details of the how the expected reported claims for CY 2021 & 2022 are determined to ensure that no report years are excluded.*

First need to calculate the CY2021 & CY2022 expected reported claims:

| | Maturity Age in months | | | | |
|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 60 |
| Reported CDF | 2.306 | 1.479 | 1.137 | 1.023 | 1.000 |
| % Cumulative Reported | 43.4% | 67.6% | 88.0% | 97.8% | 100.0% |
| % Incremental Reported | 43.4% | 24.2% | 20.3% | 9.8% | 2.2% |

e.g., 43.4% = 1/2.306

| Report Year | Selected Ultimate Claims | Expected Reported Claims in Calendar Years 2021 | 2022 |
|---|---|---|---|
| 2017 | 8,297,960 | 186,562 | |
| 2018 | 9,230,643 | 904,692 | 207,532 |
| 2019 | 10,390,684 | 2,113,205 | 1,018,387 |
| 2020 | 11,357,111 | 2,753,886 | 2,309,752 |
| 2021 | 12,811,927 | 5,555,909 | 3,106,651 |
| 2022 | 14,531,428 | | 6,301,573 |
| Total | | 11,514,254 | 12,943,895 |

e.g., for Report Year 2019:
2,133,205 = 10,390,684×20.3%
1,018,387 = 10,390,684×9.8%

| Calendar Year | Paid ULAE | Expected Claims Paid | Expected Claims Reported | Ratio of Paid ULAE to Average of Paid and Reported Claims |
|---|---|---|---|---|
| 2019 | 725,000 | 8,950,624 | 9,323,021 | 7.93% |
| 2020 | 825,176 | 9,921,833 | 10,304,355 | 8.16% |
| 2021 | 935,423 | 11,058,159 | 11,514,254 | 8.29% |
| 2022 | 1,062,610 | 12,393,344 | 12,943,895 | 8.39% |
| Total | 3,548,209 | 42,323,960 | 44,085,525 | 8.21% |

e.g., 8.29% = 935,423 / ((11,058,159+11,514,254)/2)

## 9. Continued

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

Recommended ratio: 8.28%
Justification: using the average of the latest 3 years to reflect the increasing trend and remove the 2019 low outlier value.

(d) Calculate unpaid ULAE as of December 31, 2022 using the recommended ratio from part (c).

Calculated unpaid ULAE = $8.28\% \times 4{,}965{,}557 \times (1 - 0.40) + 8.28\% \times 13{,}974{,}912$
$= 1{,}403{,}552$

## 10. 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:**

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

(4f) Calculate claim liabilities.

**Sources:**

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 22 and 24.

**Commentary on Question:**

*This question tests the candidate's understanding of evaluating and justifying selections of ultimate values based on multiple methods, as well as calculating claim liabilities.*

**Solution:**

(a) Evaluate the appropriateness of each of the following methods for estimating ultimate claims:

**Commentary on Question:**

*Evaluation of the appropriateness of a method requires an explanation why it is or is not appropriate.*

(i) Bornhuetter Ferguson method based on reported claims for AY 2018

- The Bornhuetter Ferguson method is an acceptable method for this line of business.
- It is likely not influenced too much by change in case adequacy in AY2018.
- Therefore, this method is likely appropriate for AY 2018.

(ii) frequency-severity method based on reported claims for AY 2021

- This method is good for more recent periods (i.e., 2021).
- However, since this method is based on reported claims, it could be affected by the change in case adequacy, since there is no indication that the severities have been adjusted for the change in case estimates.
- Therefore, this method is likely not appropriate for AY 2021.

## 10. Continued

(iii) paid development method for AY 2022

- This method is not affected by change in case adequacy.
- Leveraged effect for 2022 = 8,195,915 / 1,312,636 = 6.24. This is too high, therefore there is too much uncertainty with this method.
- Therefore, this method is likely not appropriate for AY 2022.

(b) Recommend the ultimate claims for AY 2020. Justify your recommendation.

**Commentary on Question:**
*Other recommendations based on paid claims methods are acceptable.*

- Reported methods are affected by the change in case adequacy, so these methods should be avoided.
- The data analysis does not support a change in claim settlement patterns, so paid methods are reasonable.
- Leveraged effect for AY 2020 = 7,951,950 / 4,015,114 = 1.98. This is not too high suggesting that methods based on the paid development method are reasonable.
- Therefore, recommend the average of all paid methods, as all paid methods are determined to be reasonable:
  = (7,951,950 + 8,011,083 + 7,939,852 + 7,945,960) / 4 = 7,962,211

(c) Calculate the case estimate and IBNR for AY 2020, based on your recommendation in part (b).

- Unpaid claims = 7,962,211 – 4,015,114 = 3,947,097
- Case estimate = 5,866,764 – 4,015,114 = 1,851,650
- IBNR = 3,947,097 – 1,851,650 = 2,095,447

*Also, IBNR = 7,962,211 – 5,866,764 = 2,095,447*

## 11. 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 20.

**Commentary on Question:**

*This question tests the candidate's understanding of a Berquist-Sherman adjustment for a change in claims settlement.*

**Solution:**

(a) Identify two possible reasons for a delay in claims processing.

Any two of the following are acceptable:

- a recent change in the claims processing system
- an increase in volume that creates a backlog of processing claims
- a change in claims personnel

(b) Calculate the disposal ratio triangle for this line of business.

| Accident | Disposal Ratios (closed counts / ultimate counts) | | | | | |
|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 |
| 2017 | 0.291 | 0.532 | 0.735 | 0.886 | 0.991 | 0.996 |
| 2018 | 0.314 | 0.574 | 0.799 | 0.961 | 0.991 | |
| 2019 | 0.341 | 0.617 | 0.824 | 0.922 | | |
| 2020 | 0.334 | 0.609 | 0.784 | | | |
| 2021 | 0.350 | 0.581 | | | | |
| 2022 | 0.325 | | | | | |

e.g., for AY2020 at 12 months development: 0.334 = 459 / 1,373

## 11. Continued

(c) Interpret the results from part (b).

| Accident | Change in Disposal Ratios | | | | |
|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 |
| 2017-2018 | 7.7% | 7.7% | 8.8% | 8.4% | 0.0% |
| 2018-2019 | 8.9% | 7.5% | 3.1% | –4.0% | |
| 2019-2020 | –2.1% | –1.3% | –4.8% | | |
| 2020-2021 | 4.8% | –4.5% | | | |
| 2021-2022 | –7.3% | | | | |

The ratios down the column should show noticeable decrease if there is a slowing in settlement patterns. There appears to be a noticeable decrease in the most recent diagonal.

(d) Calculate the adjusted paid claims triangle.

Selected disposal ratios (most recent diagonal):

| 12 | 24 | 36 | 48 | 60 | 72 |
|---|---|---|---|---|---|
| 0.325 | 0.581 | 0.784 | 0.922 | 0.991 | 0.996 |

| Accident | Adjusted Closed Counts | | | | | | Ultimate |
|---|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 | Counts |
| 2017 | 445 | 797 | 1,075 | 1,265 | 1,359 | 1,365 | 1,371 |
| 2018 | 432 | 773 | 1,043 | 1,227 | 1,318 | | 1,330 |
| 2019 | 427 | 764 | 1,032 | 1,213 | | | 1,315 |
| 2020 | 446 | 798 | 1,077 | | | | 1,373 |
| 2021 | 462 | 826 | | | | | 1,421 |
| 2022 | 459 | | | | | | 1,413 |

e.g., for AY2020 at 12 months: 446 = 0.325 / 1,373

| Accident | Average Claim Cost | | | | | |
|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 |
| 2017 | 3,448 | 4,443 | 4,997 | 5,426 | 5,714 | 6,125 |
| 2018 | 3,620 | 4,665 | 5,247 | 5,697 | 6,000 | |
| 2019 | 3,801 | 4,898 | 5,510 | 5,982 | | |
| 2020 | 3,991 | 5,143 | 5,785 | | | |
| 2021 | 4,190 | 5,400 | | | | |
| 2022 | 4,400 | | | | | |

e.g., AY2020 at 12 months: $3{,}991 = 4{,}400 \times 1.05^{-2}$

## 11. Continued

| Accident | Adjusted Paid Claims = (Adjusted Closed Counts)(Average Claim Cost) | | | | | |
|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 |
| 2017 | 1,535,374 | 3,540,462 | 5,374,253 | 6,861,836 | 7,763,600 | 8,360,625 |
| 2018 | 1,563,931 | 3,606,313 | 5,474,211 | 6,989,463 | 7,908,000 | |
| 2019 | 1,623,608 | 3,743,923 | 5,683,096 | 7,256,166 | | |
| 2020 | 1,779,980 | 4,104,507 | 6,230,445 | | | |
| 2021 | 1,934,318 | 4,460,400 | | | | |
| 2022 | 2,019,600 | | | | | |

e.g., AY2020 at 12 months: 1,779,980 = 446×3,991

## 12. 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:**

(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 17, 18, and 24.

**Commentary on Question:**

*This question tests the candidate's understanding of the expected method and the Bornhuetter Ferguson method for estimating ultimate claims.*

**Solution:**

(a) Calculate expected claims for each accident year using the expected method.

Claim trend = (1 + 5.5%)(1 – 0.5%) – 1 = 4.9725%

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | Projected Ultimate | | | Premium |
| Accident | Earned | Claims Based on | | Claim Trend at | On-Level |
| Year (AY) | Premiums | Paid | Reported | 4.9725% | Factors |
| 2017 | 7,830,576 | 5,515,481 | 5,396,582 | 1.275 | 1.139 |
| 2018 | 8,092,188 | 5,886,678 | 5,758,999 | 1.214 | 1.133 |
| 2019 | 8,536,126 | 6,187,315 | 6,051,964 | 1.157 | 1.089 |
| 2020 | 8,983,907 | 6,565,775 | 6,448,346 | 1.102 | 1.049 |
| 2021 | 9,288,767 | 7,041,612 | 6,913,772 | 1.050 | 1.034 |
| 2022 | 9,626,289 | 7,648,572 | 7,544,729 | 1.000 | 1.000 |

## 12. Continued

| AY | (6) = (2)(4)/[(1)(5)] Trended On-Level Claim Ratio based on Paid | (7) = (3)(4)/[(1)(5)] Trended On-Level Claim Ratio based on Reported | (8) = (A)(5)/(4) Claim Ratio at Each AY Cost Level | (9) = (1)(8) Expected Claims |
|---|---|---|---|---|
| 2017 | 78.8% | 77.1% | 68.1% | 5,329,615 |
| 2018 | 78.0% | 76.3% | 71.1% | 5,751,085 |
| 2019 | 77.0% | 75.3% | 71.7% | 6,120,941 |
| 2020 | 76.8% | 75.4% | 72.5% | 6,513,970 |
| 2021 | 77.0% | 75.6% | 75.0% | 6,968,819 |
| 2022 | | | 76.2% | 7,331,874 |

| Average trended on-level claim ratio at AY2022 cost and rate level (excl. 2022) | | |
|---|---|---|
| All Years | 77.5% | 75.9% |
| Latest 5 Years | 77.5% | 75.9% |
| Latest 5 Years Excl. High and Low | 77.3% | 75.7% |
| Latest 3 Years | 76.9% | 75.4% |

| | | |
|---|---|---|
| Selected expected claim ratio at AY2022 cost level | 76.17% | (A) |

Rationale: There is no indication of a significant the difference between reported and paid, so use the average of paid and reported. Use the more recent 3 years average to reflect more recent experience.

(b) Calculate projected ultimate claims using the Bornhuetter Ferguson method with reported claims and your results from part (a).

| Accident Year | (10) Reported Claims | (11) = (3)/(10) Cumulative Development Factors | (12) = (10) + (9)[1 – 1/(11)] Projected Ultimate Claims |
|---|---|---|---|
| 2017 | 5,313,155 | 1.0157 | 5,395,547 |
| 2018 | 5,582,317 | 1.0317 | 5,758,756 |
| 2019 | 5,471,143 | 1.1062 | 6,058,584 |
| 2020 | 5,175,067 | 1.2460 | 6,461,304 |
| 2021 | 4,529,697 | 1.5263 | 6,932,754 |
| 2022 | 3,414,718 | 2.2095 | 7,428,211 |

## 12. Continued

(c) Assess the reasonableness of the inputs to the Bornhuetter Ferguson method in part (b).

| | (13) = 1 / (11) | (14) = (9)(13) | (15) = (10) – (14) |
|---|---|---|---|
| Accident Year | Percent Reported | Expected Reported | Actual and Expected Difference |
| 2017 | 98.45% | 5,247,223 | 65,932 |
| 2018 | 96.93% | 5,574,646 | 7,671 |
| 2019 | 90.40% | 5,533,500 | –62,357 |
| 2020 | 80.25% | 5,227,733 | –52,666 |
| 2021 | 65.52% | 4,565,762 | –36,065 |
| 2022 | 45.26% | 3,318,381 | 96,337 |
| | | | 18,853 |

Assessment: overall it appears reasonable, but there are some accident years that might not be reasonable (e.g., 2017, 2019 & 2022) that should be investigated.

(d) Calculate total IBNR using your results from part (b).

| | |
|---|---|
| Total ultimate claims | 38,035,156 |
| Total reported claims | 29,486,097 |
| IBNR = Ultimate Claims – Reported Claims | 8,549,059 |

## 13. 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, Second Edition (2022), Friedland, Chapter 14.

**Commentary on Question:**

*This question tests the candidate's understanding of the types of development triangles that can be used for investigative testing and analyzing development triangles for investigative testing.*

**Solution:**

(a) Analyze this data for evidence of a change in case reserve adequacy, using two different investigative tests. Justify your conclusion.

Change in average case estimates:

| Accident | Average Case Estimates = Case Estimates / Open Counts | | | | | |
|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 |
| 2017 | 4,401 | 5,011 | 5,618 | 6,147 | 9,947 | 0 |
| 2018 | 4,771 | 5,421 | 5,923 | 6,477 | 0 | |
| 2019 | 5,041 | 5,844 | 6,452 | 0 | | |
| 2020 | 5,345 | 6,083 | 7,575 | | | |
| 2021 | 5,636 | 7,466 | | | | |
| 2022 | 6,801 | | | | | |

| Accident | Change in average case estimates: | | | | |
|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 |
| 2017-2018 | 8.4% | 8.2% | 5.4% | 5.4% | n/a |
| 2018-2019 | 5.7% | 7.8% | 8.9% | n/a | |
| 2019-2020 | 6.0% | 4.1% | 17.4% | | |
| 2020-2021 | 5.4% | 22.7% | | | |
| 2021-2022 | 20.7% | | | | |

## 13. Continued

Change in average reported claims:

| Accident | Average Reported Claims | | | | | |
|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 |
| 2017 | 3,764 | 4,448 | 4,801 | 5,094 | 5,204 | 5,231 |
| 2018 | 4,064 | 4,585 | 5,074 | 5,426 | 5,498 | |
| 2019 | 4,163 | 4,878 | 5,333 | 5,642 | | |
| 2020 | 4,601 | 5,152 | 5,836 | | | |
| 2021 | 4,912 | 5,748 | | | | |
| 2022 | 5,436 | | | | | |

| Accident | Change in average reported: | | | | |
|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 |
| 2017-2018 | 8.0% | 3.1% | 5.7% | 6.5% | 5.7% |
| 2018-2019 | 2.4% | 6.4% | 5.1% | 4.0% | |
| 2019-2020 | 10.5% | 5.6% | 9.4% | | |
| 2020-2021 | 6.7% | 11.6% | | | |
| 2021-2022 | 10.7% | | | | |

Based on the significant increase in the most recent diagonal of both triangles, there is an indication of a strengthening of case estimates.

(b) Critique your colleague's conclusion.

The case strengthening could cause the most recent diagonal to increase, but a deterioration in claims experience could also cause the increase.

(c) Describe why an increase in the most recent diagonal of the ratios of paid to reported claims triangle may not give a clear indication of this change.

A decrease in the overall adequacy of case estimates, which would decrease the reported claims, could also be driving the increase in the ratios of paid to reported claims.

## 13. Continued

(d) Analyze this data for evidence of a change in claim settlement patterns, using an investigative test other than the test described in part (c). Justify your conclusion.

Change in ratios of closed to reported counts:

| Accident | Closed to Reported Counts | | | | | |
|---|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 | 72 |
| 2017 | 0.516 | 0.719 | 0.839 | 0.927 | 0.994 | 1.000 |
| 2018 | 0.510 | 0.720 | 0.839 | 0.928 | 1.000 | |
| 2019 | 0.507 | 0.717 | 0.842 | 1.000 | | |
| 2020 | 0.507 | 0.719 | 0.893 | | | |
| 2021 | 0.507 | 0.768 | | | | |
| 2022 | 0.547 | | | | | |

| Accident | Change in ratios of closed to reported counts: | | | | |
|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 |
| 2017-2018 | –1.2% | 0.1% | 0.0% | 0.1% | n/a |
| 2018-2019 | –0.6% | –0.4% | 0.3% | n/a | |
| 2019-2020 | 0.1% | 0.3% | 6.1% | | |
| 2020-2021 | 0.0% | 6.9% | | | |
| 2021-2022 | 7.8% | | | | |

Based on the significant increase in the most recent diagonal there is an indication of an increase in claim settlement patterns.

## 14. 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) Recommend an annual claim frequency trend to use for the development-based frequency-severity method. Justify your recommendation.

| | (1) | (2) | (3) = (2) / (1) | (4) = $(3)_i/(3)_{i-1} - 1$ |
|---|---|---|---|---|
| Accident Year | Earned Exposures | Ultimate Counts Based on Development Method | Indicated Frequency | Year-to-Year Change |
| 2017 | 11,434 | 1,235 | 10.80% | |
| 2018 | 11,635 | 1,247 | 10.72% | –0.773% |
| 2019 | 11,681 | 1,249 | 10.69% | –0.234% |
| 2020 | 11,821 | 1,260 | 10.66% | –0.314% |
| 2021 | 12,044 | 1,256 | 10.43% | –2.163% |
| 2022 | 12,240 | 1,301 | 10.63% | 1.924% |
| Average: | | | | –0.312% |
| Selected frequency trend: | | | | –0.312% |

Justification: The year-to-year changes are quite erratic, with an overall decrease over the period. The average of all years provides a reasonable measure of the overall trend.

## 14. Continued

(b) Estimate ultimate claims for all accident years using the development-based frequency-severity method.

| Accident Year | (5) Frequency Trend @ –0.312% | (6) = (3)(5) Trended Frequency | (7) = 10.59%×(1)/(5) Calculated Ultimate Counts |
|---|---|---|---|
| 2017 | 0.98450 | 10.63% | 1,230 |
| 2018 | 0.98758 | 10.58% | 1,248 |
| 2019 | 0.99067 | 10.59% | 1,249 |
| 2020 | 0.99377 | 10.59% | 1,260 |
| 2021 | 0.99688 | 10.40% | 1,279 |
| 2022 | 1.00000 | 10.63% | 1,296 |
| Average excluding 2022 | | | |
| - all years | | 10.56% | |
| - latest 3 years | | 10.53% | |
| - excl. hi-lo | | 10.59% | |
| Selected freq. at 2022 cost level | | 10.59% | |

Justification: Excluding high and low values excludes the outlier value in 2021.

| Accident Year | (8) Ultimate Severity | (9) Severity Trend @ 7.5% | (10) = (8)(9) Trended Severity | (11) = 5,900.79/(9) Calculated Ultimate Severity | (12) = (7)(11) Projected Ultimate Claims |
|---|---|---|---|---|---|
| 2017 | 4,104 | 1.43563 | 5,891.82 | 4,110.25 | 5,055,292 |
| 2018 | 4,384 | 1.33547 | 5,854.70 | 4,418.52 | 5,512,721 |
| 2019 | 4,751 | 1.24230 | 5,902.15 | 4,749.90 | 5,931,044 |
| 2020 | 5,066 | 1.15563 | 5,854.40 | 5,106.15 | 6,432,161 |
| 2021 | 5,531 | 1.07500 | 5,945.83 | 5,489.11 | 7,023,037 |
| 2022 | 5,897 | 1.00000 | 5,897.00 | 5,900.79 | 7,648,692 |
| Average excluding 2022 | | | | | 37,602,948 |
| - all years | | | 5,889.78 | | |
| - latest 3 years | | | 5,900.79 | | |
| - excl. hi-lo | | | 5,882.89 | | |
| Selected severity at 2022 cost level | | | 5,900.79 | | |

Justification: Latest 3 years gives more consideration to the increasing more recent experience.

## 14. Continued

(c) Describe two scenarios when projections from the frequency-severity method are preferred.

Any two of the following are acceptable:

- For immature periods (i.e., most recent accident years)
- 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