# GI101 Model Solutions
# March 2026

## 1.

**Learning Objectives:**

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

**Learning Outcomes:**

(6a) Quantify different types of expenses required for ratemaking including expense trending procedures
(6f) Describe the claim ratio and pure premium methods of ratemaking
(6g) Calculate indicated rates and indicated rate changes using the claim ratio and pure premium methods
(6h) Demonstrate the use of credibility in ratemaking

**Sources:**

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 30 and 32.

**Commentary on Question:**

*This question tests the candidate's understanding of ratemaking that incorporates credibility.*

**Solution:**

(a) Define contingency margins.

A contingency margin is an explicit provision in the premium (or funding) for adverse deviation and uncertainty in expected costs, claims, and expenses, reflecting the risk that actual experience may be worse than estimated.

(b) Describe two situations where the pure premium approach might be preferred to the claim ratio approach.

Any two of the following are acceptable:

- When earned premiums are distorted by rate level changes or mix of business shifts that make the claim ratio unreliable.
- When exposure data are more stable and credible than premium data, such that projecting claims per exposure produces a more accurate indication than relying on premium-based loss ratios.
- When premium trend is not available and cannot calculate trended earned premium.

## 1. Continued

- When developing new products or when entering a new geographical area.
- When earned premium data is not available, e.g., self-insurer.

(c) Describe how the fixed expense provision is calculated when you are given the fixed expenses to premium ratio.

We are given the fixed expense to premium ratio (i.e., $F / R_C$), or more technically $(F \times E) / (E \times R_C)$; and want to know F to use the PP method.

F = fixed expenses per exposure projected for the forecast period
$R_C$ = current rate per unit of exposure adjusted for trend and premium changes
E = trended earned exposures for the experience period

Therefore, multiply by $R_C$.

(d) Calculate the indicated rate using partial credibility.

| | |
|---|---|
| Indicated rate assuming full credibility: | |
| (1,000 + 50)/(1 – 0.05 – 0.03) | 1,141.30 |
| Current rate: 1,141.30 / 1.07 | 1,066.64 |
| Partial credibility (Z): squareroot(600/1,082) | 74.47% |
| New rate considering credibility: | |
| 1,141.30×0.7447 + 1,066.64×(1 – 0.7447) | 1,122.24 |

*Alternatively,*

| | |
|---|---|
| Indicated rate change with partial credibility: | |
| 1.07×0.7447 + 1×(1 – 0.7447) | 1.0521 |
| New rate considering credibility: | |
| 1,066.64×1.0521 | 1,122.24 |

## 2. 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:**

(1d) Understand the components of ultimate values
(3g) Estimate ultimate values using the methods cited in (e)

**Sources:**

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 3 and 15.

**Commentary on Question:**

*This question tests the candidate's understanding of estimating IBNR using the development with a large claim adjustment.*

**Solution:**

(a) Describe the effect of the large claim on the AY 2023 reported development factors.

The development factor for 12-24 months will increase.
The development factor for 24-26 months will decrease.

(b) Calculate the IBNR for AY 2023 as of December 31, 2025.

| Accident | Reported Claims as of (months) with adjustment | | | | |
|---|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 | 60 |
| 2021 | 400,558 | 603,545 | 779,688 | 852,668 | 881,497 |
| 2022 | 418,143 | 626,463 | 812,172 | 893,525 | |
| 2023 | 441,674 | ***659,929*** | ***853,725*** | | |
| 2024 | 465,005 | 698,840 | | | |
| 2025 | 489,816 | | | | |

| Accident | Age-to-Age factors for reported claims with adjustment | | | | |
|---|---|---|---|---|---|
| Year | 12 to 24 | 24 to 36 | 36 to 48 | 48 to 60 | 60 to Ult |
| 2021 | 1.507 | 1.292 | 1.094 | 1.034 | |
| 2022 | 1.498 | 1.296 | 1.100 | | |
| 2023 | ***1.494*** | ***1.294*** | | | |
| 2024 | 1.503 | | | | |
| Age-to-age factors: | 1.500 | 1.294 | 1.097 | 1.034 | 1.034 |
| Age-to-ult. factors: | 2.2762 | 1.5169 | 1.1723 | 1.0688 | 1.0338 |

## 2. Continued

Simple average used as there is little variation.
Bondy method chosen for tail factor.

| | |
|---|---|
| AY2023 reported claims @ 36 months (excluding large claim): | 853,725 |
| Age-to-ultimate factor: | 1.1723 |
| Ultimate claims (excluding large claim): | 1,000,831 |
| IBNR | 147,106 |

(c) Provide one scenario where estimating the IBNR for accident year 2023 using a paid claims development method might not be an appropriate alternative.

***Commentary on Question:***
*Candidates need to provide a specific scenario for full credit, not a generic statement.*

Any of the following answers is acceptable:

- If there was a material change in claim settlement patterns such that pattern is unstable/not reliable.
- A scenario where the large claim has not had any payments and therefore would not be reflected in the triangle.
- A scenario where the paid development factors have significant leverage.
- A scenario where past activity is not predictive of future activity.

## 3. 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) Calculate the calendar year 2025 expected reported claims.

| Maturity Age in Months | (1) Reported Age-to-Ultimate Development Factors | (2) = 1 / (1) % Cumulative Reported | (3) = $(2)_m - (2)_{m-1}$ % Incremental Reported |
|---|---|---|---|
| 12 | 2.565 | 38.99% | 38.99% |
| 24 | 1.582 | 63.21% | 24.22% |
| 36 | 1.187 | 84.25% | 21.03% |
| 48 | 1.068 | 93.63% | 9.39% |
| 60 | 1.000 | 100.00% | 6.37% |

| Report Year | (4) Estimated Ultimate Claims | (5) Reported Period (months) | (6): from (3) % Incremental Reported | (7) = (4)(6) Expected Reported Claims in Calendar Year 2025 |
|---|---|---|---|---|
| 2020 | 4,148,980 | | | |
| 2021 | 4,615,322 | 49-60 | 6.37% | 293,859 |
| 2022 | 5,195,342 | 37-48 | 9.39% | 487,685 |
| 2023 | 5,678,556 | 25-36 | 21.03% | 1,194,477 |
| 2024 | 6,405,964 | 13-24 | 24.22% | 1,551,830 |
| 2025 | 7,265,714 | 0-12 | 38.99% | 2,832,637 |
| Total | | | | 6,360,488 |

## 3. Continued

(b) Recommend a ULAE ratio to use for this line of business using the Kittel refinement with the Mango and Allen smoothing adjustment to the classical paid-to-paid method. Justify your recommendation.

| | (8) | (9) | (10) | (11) = (8)/avg[(9),(10)] |
|---|---|---|---|---|
| Calendar Year | Paid ULAE | Expected Paid Claims | Expected Reported Claims | Ratio of Paid ULAE to Average of Paid and Reported Claims |
| 2022 | 362,500 | 4,475,312 | 4,661,511 | 7.93% |
| 2023 | 412,588 | 4,960,917 | 5,152,178 | 8.16% |
| 2024 | 467,712 | 5,529,080 | 5,663,308 | 8.36% |
| 2025 | 531,305 | 6,196,672 | ***6,360,488*** | 8.46% |
| Total | 1,774,105 | 21,161,981 | 21,837,485 | 8.25% |
| Avg 2023-2025: | | | | 8.33% |
| Recommended ratio: | | | | 8.33% |

(c) Calculate unpaid ULAE as of December 31, 2025 using the recommended ratio from part (b).

Unpaid ULAE as of December 31, 2025:

$$767{,}861 = 8.33\% \times 6{,}987{,}456 + 75\% \times 8.33\% \times 2{,}979{,}334$$

(d) Explain why the calculation in part (c) would overstate the estimate of unpaid ULAE compared to the more correct application of the paid-to-paid method.

**Commentary on Question:**
*Candidates need to explain <u>why</u> the calculation in part (c) would overstate the unpaid ULAE and not simply describe how the formula does the calculation. In other words, part (c) overstates the calculation because of the treatment of IBNER as described below, and not because the formula uses a different ratio.*

- IBNR includes both pure IBNR and IBNER (development on case).
- Since IBNER claims have already been reported and opened, there is less work needed for these claims.
- So IBNER should not receive the full ULAE ratio, but rather the portion representing closure only.
- If the full ULAE ratio is applied to IBNER, then the ULAE will be overstated.

## 4. Learning Objectives:

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

**Learning Outcomes:**

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

(6e) Apply loadings for catastrophes and large claims in ratemaking

**Sources:**

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapter 31.

**Commentary on Question:**

*This question tests the candidate's understanding of loadings for catastrophes and large claims for a ratemaking analysis.*

**Solution:**

(a) Describe how a hailstorm event could decrease claims severity.

Hailstorms could result in a large number of claims without an offsetting increase in claim sizes, thereby decreasing severity.

OR

Hailstorms could result in small claim amounts such as comprehensive claims on auto insurance.

(b) Provide two reasons why catastrophe claims cause delays in settlement.

Any two of the following are acceptable:

- Difficult for adjusters to enter catastrophe areas which can cause delays.
- Adjusters get backlogged with handling too many claims at the same time.
- Contractors get backlogged with many repairs at the same time.
- Higher potential for fraudulent claims.
- Catastrophe claims involve more complex claims that take longer to settle.
- There could be a delay in reporting claims.

## 4. Continued

(c) Describe a reason to include a loading for large claims when the historical data does not reflect any large claims.

Incidents may have occurred that are either not yet reported or have not yet developed to be above the large claim threshold.

OR

Because no large claims have been reported to date does not necessarily mean that incidents have not occurred that could result in large claims in the future.

(d) Describe two approaches to account for the effect of large claims in a ratemaking analysis.

1. Cap all claims at a selected threshold; then the values above the threshold are considered separately for the development of a loading for large claims.
2. Conduct a separate analysis for claims that are less than a selected threshold and claims that are greater than the threshold.

## 5. 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, Chapters 12 and 13.

**Commentary on Question:**

*This question tests the candidate's understanding of earning premiums and adjusting premiums to current rate levels.*

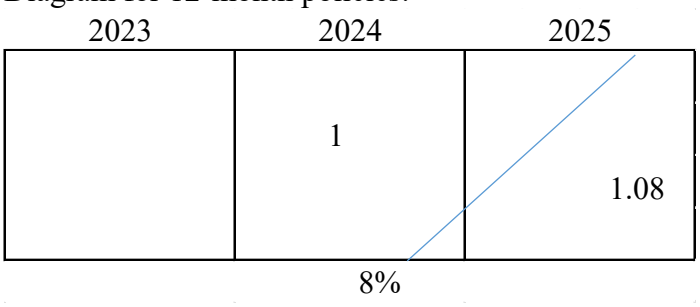
**Solution:**

(a) Calculate the homeowners CY 2024 *earned* premiums for all policies written or renewed on or after July 1, 2024.

| | |
|---|---|
| 50% of policies were 12 month: written premiums = | 170,000 |
| % of these policies earned in 2024 | 25% |
| Earned premiums | 42,500 |
| | |
| 50% of policies were 6 month: written premiums = | 170,000 |
| % of these policies earned in 2024 | 50% |
| Earned premiums | 85,000 |
| | |
| Total earned premiums | 127,500 |

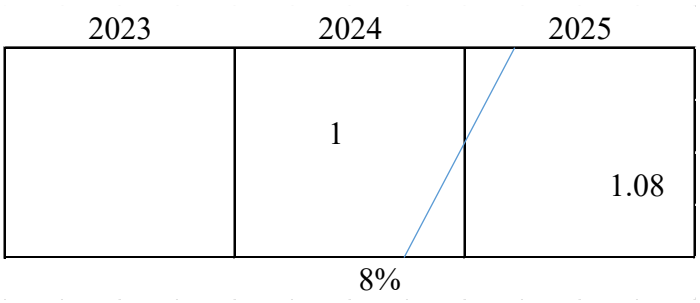
(b) Calculate the automobile CY 2024 earned premiums at current rate levels for a *ratemaking* analysis.

Diagram for 12-month policies:



## 5. Continued

Diagram for 6-month policies:




# of months remaining in 2024 = 4, or 33.33% remaining in 2024

| | % Earned in 2024 | | |
|---|---|---|---|
| Rate Level Index | 12-month policies | 6-month policies | |
| 1.00 | 94.444% | 88.889% | |
| 1.08 | 5.556% | 11.111% | |
| Average Rate Level in 2024 | 1.00444 | 1.00889 | |
| On Level factor | 1.07522 | 1.07048 | |
| | | | Total |
| On Level Earned Premiums | 1,451,549 | 899,207 | 2,350,756 |

e.g., $5.556\% = 1/2\times(4/12)\times(4/12)$
$11.111\% = 1/2\times(4/12)\times(8/12)$

(c) Calculate the automobile CY 2024 earned premiums at current rate levels for *projecting ultimate claims* as of December 31, 2025.

**Commentary on Question:**
*Some candidates confused the part (b) and part (c) calculations.*

For projecting ultimate claims, the average rate level for 2025 is needed. The diagrams in part (b) can be helpful for the determination of the percent of premiums earned at each rate level.

**5.** **Continued**

| | % Earned in 2025 | | |
|---|---|---|---|
| Rate Level Index | 12-month policies | 6-month policies | |
| 1.00 | 22.222% | 2.778% | |
| 1.08 | 77.778% | 97.222% | |
| Average Rate Level in 2025 | 1.06222 | 1.07778 | |
| Average Rate Level from (b) | 1.00444 | 1.00889 | |
| On Level factor | 1.05752 | 1.06828 | |
| | | | Total |
| On Level Earned Premiums | 1,427,655 | 897,357 | 2,325,012 |

e.g., $22.222\% = 1/2\times(8/12)\times(8/12)$
$2.778\% = 1/2\times(2/12)\times(4/12)$

## 6. 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 (e)
(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, Second Edition (2022), J. Friedland, Chapters 16 and 26.

**Commentary on Question:**

*This question tests the candidate's understanding of development-based frequency-severity method of estimating ultimate claims, including evaluating and recommending severity trend.*

**Solution:**

(a) Recommend an annual severity trend to use for the frequency-severity method. Justify your recommendation.

| Accident Year | (1) Claim Severity | (2) Tort Reform Adjustment Factor | (3) = (1)(2) Adjusted Severity | (4) = $(3)_y/(3)_{y-1}$ Annual Change in Severity |
|---|---|---|---|---|
| 2019 | 16,422 | 0.70 | 11,495.41 | |
| 2020 | 17,188 | 0.70 | 12,031.54 | 4.66% |
| 2021 | 14,908 | 0.85 | 12,672.01 | 5.32% |
| 2022 | 13,808 | 1.00 | 13,807.87 | 8.96% |
| 2023 | 14,575 | 1.00 | 14,575.02 | 5.56% |
| 2024 | 15,716 | 1.00 | 15,716.01 | 7.83% |
| 2025 | 16,960 | 1.00 | 16,959.83 | 7.91% |
| | Averages: | All years | | 6.71% |
| | | Excl. hi-lo | | 6.66% |
| | | Fitted exponential: | | 6.80% |
| | | Selected: | | 6.80% |

## 6. Continued

Justification: Fitted exponential was selected to consider all years and smooth out the variation.

(b) Recommend the 2025 cost level severity to use with the development-based frequency-severity method, using your recommendation from part (a).

| Accident Year | (5) Adjusted Severity | (6) Severity Trend @6.80% | (7) = (5)(6) Trended Adjusted Severity |
|---|---|---|---|
| 2019 | 11,495.41 | 1.48361 | 17,054.75 |
| 2020 | 12,031.54 | 1.38921 | 16,714.31 |
| 2021 | 12,672.01 | 1.30081 | 16,483.89 |
| 2022 | 13,807.87 | 1.21804 | 16,818.50 |
| 2023 | 14,575.02 | 1.14053 | 16,623.26 |
| 2024 | 15,716.01 | 1.06796 | 16,784.02 |
| 2025 | 16,959.83 | 1.00000 | 16,959.83 |
| Average trended severities at 2025 cost level excluding 2025 | | | |
| | | All years | 16,746.46 |
| | | Excl. hi-lo | 16,735.02 |
| | Selected Severity at 2025 cost level | | 16,735.02 (A) |

Justification: Removed highest and lowest values to smooth out variation.

(c) Calculate the ultimate claims as of December 31, 2025 for all accident years using the development-based frequency-severity method.

| Accident Year | (8) = (A) / [(2)(6)] Calculated Ultimate Severity | (9) Ultimate Counts | (10) = (7)(8) Ultimate Claims |
|---|---|---|---|
| 2019 | 16,114.15 | 817 | 13,165,258 |
| 2020 | 17,209.21 | 829 | 14,266,431 |
| 2021 | 15,135.38 | 840 | 12,713,722 |
| 2022 | 13,739.34 | 833 | 11,444,870 |
| 2023 | 14,673.01 | 841 | 12,340,005 |
| 2024 | 15,670.14 | 844 | 13,225,597 |
| 2025 | 16,735.02 | 843 | 14,107,625 |
| | | | 91,263,509 |

## 7. 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

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

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

**Sources:**

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 17, 18, 19, 21, and 22.

**Commentary on Question:**

*This question tests the candidate's understanding of the Bornhuetter Ferguson, Cape Cod, and Generalized Cape Cod methods. This question also tests the candidate's understanding of expected claims at dates between year-end dates.*

**Solution:**

(a) Explain how the Bornhuetter Ferguson method and the Cape Cod method each reflect a change in claim experience.

In the BF method, expected claims are based on a prior estimate, which does not change (unless the actuary deliberately makes a change).
{*Alternative acceptable answer: In the BF method, the development factors reflect a change in claim experience.*}

The Cape Cod method is more responsive to a change in claim experience because the actual reported claims of all years enters the calculation of expected claims.

(b) Describe another advantage the GCC method has over each of the following methods:

(i) the Bornhuetter Ferguson method

(ii) the Cape Cod method

## 7. Continued

(i) Any one of the following answers is acceptable:

- GCC method uses information from all accident years in estimating any one year, thereby eliminating the need to arbitrarily determine how to select the a priori claim ratio.
- GCC method uses historical experience to derive expected claim ratio rather than an a priori estimate.
- GCC method is more responsive to changes in experience than BF since expected claim ratio is based on experience.
- GCC method allows the actuary to systematically reflect internal or external changes, such as trend, coverage changes, underwriting changes, etc., through exposure base adjustments.

(ii) Any one of the following answers is acceptable:

- GCC method gives more weight to surrounding years in determining a particular year's expected claim.
- GCC method applies a distinct pure premium (or claim cost) to each year versus CC which applies a constant pure premium (or claim cost) to each year.
- GCC method assigns different weights and different claim ratios for each year.
- GCC method gives less weight to immature years and low volume years, reducing the prediction error.
- The GCC a priori claim ratio estimate is optimal (i.e., produces the minimum bias linear estimate) under certain conditions.
- GCC method is a generalized case of the development and traditional CC methods. These other methods can be handled within the GCC framework.

(c) Compare actual reported claims with expected reported claims as of March 31, 2026.

Cumulative % reported at 15 months = 45% + (0.25 × 35%)
Expected reported claims at 18 months = 2,340,000 × 66% × 53.75%

(d) Calculate the ultimate pure premiums as of March 31, 2026 for:

(i) the expected method

(ii) the Bornhuetter Ferguson method

## 7. Continued

(i) Ultimate pure premium from expected method = (2,340,000 × 66%) / 13,160 = 117.36

(ii) BF IBNR factor at 18 months = 100% – 53.75% from part (c)
Ultimate claims using BF method = 875,000 + (46.25% × 2,340,000 × 66%) = 1,589,285
Ultimate pure premium from BF method = 1,589,285 / 13,160 = 120.77

(e) Calculate the IBNR reserves as of December 31, 2026 using the Bornhuetter Ferguson method.

BF IBNR factor at 24 months = 100% – (45% + 35%) = 20%
IBNR at 24 months = 20% × 2,340,000 × 66% = 308,880

(f) Calculate the AY 2025 ultimate claims as of March 31, 2026 using the Cape Cod method.

| | (1) | (2) | (3) = (1)(2) | (4) | (5) | (6) = (4)(5) |
|---|---|---|---|---|---|---|
| AY | EE | Expected % Reported | Used-Up EE | Reported Claims as of March 31, 2026 | PP Trend Factors | Adjusted Claims as of March 31, 2026 |
| 2022 | 11,648 | 100.0% | 11,648.00 | 1,150,000 | 1.12486 | 1,293,594 |
| 2023 | 11,872 | 96.3% | 11,426.80 | 1,240,000 | 1.08160 | 1,341,184 |
| 2024 | 12,544 | 83.8% | 10,505.60 | 1,280,000 | 1.04000 | 1,331,200 |
| 2025 | 13,160 | 53.8% | 7,073.50 | 875,000 | 1.00000 | 875,000 |
| Total | | | 40,653.90 | | | 4,840,978 |
| | | | Adjusted expected pure premium: 4,840,978 / 40,653.90 | | | 119.078 |

- AY2025 Expected claims = 119.078×13,160 = 1,567,064
- AY2025 % Unreported = 1 – 53.8% = 46.3%
- AY2025 Ultimate Claims = 870,000 + 46.3%×1,567,064 = 1,599,767

## 8. 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.

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

**Learning Outcomes:**

(1k) Understand the sources of data and information for actuarial work
(2a) Create development triangles of claims and counts from detailed claim transaction data
(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
(3f) Demonstrate knowledge of good practice related to projecting ultimate values

**Sources:**
Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 4, 11, 14, and 20.

**Commentary on Question:**
*This question tests the candidate's understanding of development triangles, investigative tests on development triangles, and Berquist-Sherman adjustments when there is a change in case adequacy.*

**Solution:**

(a) Calculate the calendar year 2025 reported claims as of December 31, 2025.

Complete cumulative paid & case estimate triangles:

| | Cumulative Paid Claims | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 1,897,000 | 1,726,000 | 3,313,000 | 4,563,000 |
| 2023 | 3,169,000 | 4,580,000 | *5,610,000* | |
| 2024 | 3,680,000 | *5,220,000* | | |
| 2025 | 3,750,000 | | | |

e.g., 5,220,000 = 3,680,000 + 1,540,000
5,610,000 = 4,580,000 + 980,000 + 50,000

## 8. Continued

| | Case Estimates | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 2,135,000 | 1,033,000 | 495,000 | 146,000 |
| 2023 | 3,560,000 | 2,750,000 | *985,000* | |
| 2024 | 4,150,000 | *3,525,000* | | |
| 2025 | *4,325,000* | | | |

e.g., 3,525,000 = 3,275,000 + 250,000

CY2025 reported claims = Paid in 2025 + Case estimate as of Dec. 31, 2025 – Case estimate as of Dec. 31, 2024

| | |
|---|---|
| Paid in CY 2015 | 7,570,000 |
| Case estimate as of Dec. 31, 2025 | 8,981,000 |
| Case estimate as of Dec. 31, 2024 | 7,395,000 |
| CY 2025 reported claims | 9,156,000 |

*Alternative approach directly from reported claims triangle:*

| | Reported Claims = (Cumulative Paid Claims + Case Estimates) | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 4,032,000 | 2,759,000 | 3,808,000 | 4,709,000 |
| 2023 | 6,729,000 | 7,330,000 | *6,595,000* | |
| 2024 | 7,830,000 | *8,745,000* | | |
| 2025 | *8,075,000* | | | |

CY2025 reported claims = 4,709,000 – 3,808,000 + 6,595,000 – 7,330,000 + 8,745,000 – 7,830,000 + 8,075,000 = 9,156,000

(b) Construct the triangle of average case estimates as of December 31, 2025.

How the 3 claims affect open counts:
1. AY2024 @ 24 months: add 1 open count for newly reported claim #1.
2. AY2023 @ 36 months: remove 1 open count for closed claim #2.
3. AY2025 @ 12 months: add 1 open count for reopened claim #3.

**8.** **Continued**

| | Revised Open Counts | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 980 | 450 | 202 | 55 |
| 2023 | 1,570 | 1,152 | *384* | |
| 2024 | 1,750 | *1,351* | | |
| 2025 | *1,681* | | | |

| | Average Case Estimates = (Case Estimates) / (Open Counts) | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 2,179 | 2,296 | 2,450 | 2,655 |
| 2023 | 2,268 | 2,387 | 2,565 | |
| 2024 | 2,371 | 2,609 | | |
| 2025 | 2,573 | | | |

(c) Assess whether the triangle of average case estimates indicates any significant change in case adequacy.

Change in average case down each column:

| Year-to-Year | 12 | 24 | 36 |
|---|---|---|---|
| 2022-2023 | 4.1% | 4.0% | 4.7% |
| 2023-2024 | 4.6% | 9.3% | |
| 2024-2025 | 8.5% | | |

Due to the increase along the most recent diagonal for 12 and 24 months, there is a possible change in case adequacy.

(d) Construct the triangle of paid to reported ratios as of December 31, 2025.

| | Paid Claims to Reported Claims Ratios | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 0.470 | 0.626 | 0.870 | 0.969 |
| 2023 | 0.471 | 0.625 | 0.851 | |
| 2024 | 0.470 | 0.597 | | |
| 2025 | 0.464 | | | |

## 8. Continued

(e) Assess whether the triangle of paid to reported ratios indicates any significant change in case adequacy.

Change in average case down each column:

| Year-to-Year | 12 | 24 | 36 |
|---|---|---|---|
| 2022-2023 | 0.1% | –0.1% | –2.2% |
| 2023-2024 | –0.2% | –4.5% | |
| 2024-2025 | –1.2% | | |

- Consistent pattern down each column would suggest a stable line of business.
- A significant change in case adequacy would show up as a significant change in one of the diagonals.
- Conclusion: possible change as there is a slight decrease, but not a drastic change.

(f) Calculate the adjusted reported claims triangle.

| | Adjusted Average Case Estimates | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 2,287 | 2,412 | 2,466 | *2,655* |
| 2023 | 2,379 | 2,509 | *2,565* | |
| 2024 | 2,474 | *2,609* | | |
| 2025 | *2,573* | | | |

e.g., AY2022 @ 24 months: $2{,}412 = 2{,}609 \times 1.04^{-2}$

| | Adjusted Reported Claims | | | |
|---|---|---|---|---|
| AY | 12 | 24 | 36 | 48 |
| 2022 | 4,138,529 | 2,811,549 | 3,811,222 | *4,709,000* |
| 2023 | 6,903,663 | 7,470,167 | *6,595,000* | |
| 2024 | 8,009,354 | *8,745,000* | | |
| 2025 | *8,075,000* | | | |

e.g., AY2022 @ 24 months: $2{,}811{,}549 = 2{,}412 \times 450$

(Note: Rounded values are shown here. Refer to the Excel solution file for unrounded values that result in the 2,811,549.)

## 8. Continued

(g) Critique your colleague's recommendation for this line of business by describing one positive aspect and one negative aspect of the recommendation.

Positive aspect: Since this is a new line of business, industry data should provide a more stable development pattern.

Negative aspect: It may not be applicable to the line of business due to something such as a difference in how counts are determined or claims management.

## 9. 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)
(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, Second Edition (2022), J. Friedland, Chapter 27.

**Commentary on Question:**
*This question tests premium trending due to vehicle rate group drift.*

**Solution:**
(a) Calculate the annual change in premium for each year.

| | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|
| Average Differential: | 1.04690 | 1.05465 | 1.06330 | 1.07375 |
| Change in Differential: | | 0.74% | 0.82% | 0.98% |

(b) Recommend an annual premium trend rate to adjust from calendar year 2022 to the future rating period. Justify your recommendation.

**Commentary on Question:**
*Alternative recommendation with appropriate justification is possible.*

Selection: 0.90% (average of 2024 and 2025)

Justification: Selecting average of the latest two years to give consideration towards the increasing trend.

(c) Calculate the calendar year 2022 earned premiums for ratemaking.

Average earned date in CY 2022 Jul. 1, 2022
Average earned date in future rating period: Sep. 1, 2027
Trending period (years): 62 months (5.167 years)

CY 2022 earned premiums for ratemaking: $13,093,018 = 12,500,000 \times 1.009^{5.167}$

## 10. 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 (e)

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

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

**Sources:**

Fundamentals of General Insurance Actuarial Analysis, Second Edition (2022), J. Friedland, Chapters 21 and 22.

**Commentary on Question:**

*This question tests the evaluation of the reasonableness of the various methods of projecting ultimate claims under specific circumstances as well as under changing conditions.*

**Solution:**

(a) Describe how this policy limit change is likely to affect the following:

(i) Frequency and severity of claim data

(ii) Development pattern for paid claims

(i) No effect on claim frequency is expected. Claim severity will likely increase. However, overall increase may be small since this change affects only a portion of policyholders, i.e., those that purchase minimum limits.

(ii) Development pattern could lengthen because claim severity is higher, and larger claims tend to be more complex with longer settlement periods. However, overall effect could be small because policy limit change affects only a portion of policyholders.

(b) Recommend an approach to estimating ultimate claims for accident year 2025.

**Commentary on Question:**

*The question asks to recommend an approach to estimating ultimate claims and not simply state a method to use.*

The actuary would need to incorporate appropriate modifications (or data adjustments) to the analysis. Such modifications may include an adjustment factor similar to the reform factor discussed in Chapter 17 for regulatory change to the automobile product. Essentially, the actuary is attempting to modify historical experience to the same state as the current portfolio.

## 10. Continued

(c) Explain which of these two methods is a more accurate projection method under this scenario, when no explicit adjustments are made to the method or data. Justify your selection.

- The Bornhuetter Ferguson (BF) method is more accurate under this scenario because this is a timing change and not a true change in claim experience.
- The BF method does not incorporate changes in claim experience unless there is an explicit adjustment. Therefore, the only distortion will be in the development pattern itself, not the a priori expected claims.
- The Cape Cod method will over-respond to the pattern change in both the calculation of expected claims and the development pattern.

(d) Critique your colleague's recommendation.

**Commentary on Question:**
*Some candidates did not understand that the verb critique is an analysis that covers both strengths and weaknesses, or in this case, agree or disagree with the colleague's recommendation.*

Agree:
IBNR is generally not negative for lines of business that do not have salvage or subrogation, so negative IBNR methods should be disregarded.

Disagree:
Negative IBNR can be reasonable for LOB with salvage or subrogation (or conservative reserving), so depending on the LOB negative IBNR might be reasonable.

## 11. Learning Objectives:

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

**Learning Outcomes:**

(3a) Identify considerations for selecting methods for estimating ultimate claims
(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 (e)
(3j) Evaluate and justify selections of ultimate values based on the methods cited in (e)

**Sources:**

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

**Commentary on Question:**

*This question tests the candidate's understanding of the pure premium approach to the expected method and ability to account for leveraged ultimate projections in selecting expected ultimate claims.*

**Solution:**

(a) Explain an advantage of using the pure premium approach instead of the claim ratio approach.

One advantage of using the pure premium approach is that no adjustment is required for premium rate changes, which may be difficult to calculate or unavailable (e.g., for a self-insurer).

(b) Describe how development factors can highly leverage projections.

Development factors in the most recent periods will be large when the majority of the development is in future periods, leading to uncertainty in ultimate projections.

(c) Describe how trend factors can highly leverage projections.

Trend factors on older years could be highly leveraged due to the longer projection period for trending.

## 11. Continued

(d) Describe one way you could account for development leverage and one way you could account for trend leverage when selecting a pure premium with the expected method.

*Either one of the following is acceptable:*

- Consider excluding the most recent accident periods to mitigate development leverage.
- Consider excluding the oldest accident periods to mitigate with trend leverage.

(e) Calculate the 2025 cost level pure premiums for all accident years based on paid claims and also based on reported claims.

| | (1) | (2) | (3) | (4) | (5) = (2)(4)/(1) | (6) = (3)(5)/(1) |
|---|---|---|---|---|---|---|
| | | Projected Ultimate Claims Based on | | Claim | Trended PP Based on | |
| AY | Earned Exposures | Paid Claims | Reported Claims | Trend @5% | Paid Claims | Reported Claims |
| 2019 | 23,378 | 9,714,851 | 9,692,414 | 1.3401 | 556.88 | 555.60 |
| 2020 | 23,579 | 10,013,897 | 10,045,106 | 1.2763 | 542.03 | 543.72 |
| 2021 | 23,665 | 10,570,470 | 10,613,054 | 1.2155 | 542.93 | 545.12 |
| 2022 | 24,095 | 11,454,617 | 11,473,955 | 1.1576 | 550.33 | 551.26 |
| 2023 | 24,437 | 11,904,691 | 12,079,674 | 1.1025 | 537.09 | 544.99 |
| 2024 | 24,978 | 13,578,681 | 13,240,711 | 1.0500 | 570.81 | 556.60 |
| 2025 | 24,973 | 12,349,411 | 13,115,247 | 1.0000 | 494.51 | 525.18 |

(f) Recommend the 2025 cost level pure premium. Justify your recommendation.

| | Trended PP Based on | |
|---|---|---|
| Average Trended Pure Premium at AY2025 Cost Level (excl. 2025) | Paid Claims | Reported Claims |
| All Years | 550.01 | 549.55 |
| Latest 5 Years | 548.64 | 548.34 |
| All Years Excluding High and Low | 548.04 | 549.24 |
| Latest 3 Years | 552.74 | 550.95 |

Selected (based on reported, all years excluding high and low): 549.24

Justification: Leveraged effect of development factors is more prominent on Paid Claims, where the most recent AY Pure Premiums are volatile. Reported Pure Premiums are more stable; selecting all year average (excluding highest and lowest) for more stability.

## 11. Continued

(g) Calculate the AY ***2023*** expected claims using the expected method and the recommended value from part (f).

Selected PP adjusted to 2023 cost level: 549.24/1.1025 = 498.177
2023 expected claims: 24,437×498.177 = 12,173,948