GI IRR Model Solutions
Spring 2015

1. **Learning Objectives:**

1. The candidate will understand the key considerations for general insurance actuarial analysis.

Learning Outcomes:

(1l) Adjust historical earned premiums to current rate levels.

Sources:

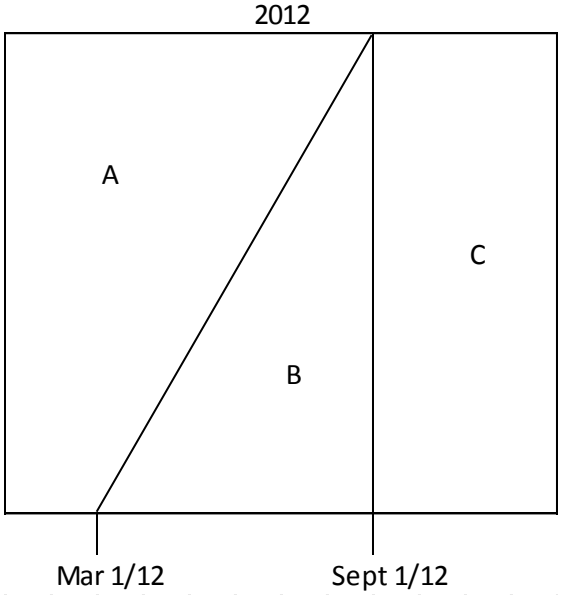
Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 12.

Commentary on Question:

This question tests the candidate's ability to adjust premium to current rate levels. Candidates also need to understand how certain assumptions affect the on-level calculation.

Solution:

(a) Calculate the 2012 earned premium at current rate level using the parallelogram method.



1. Continued

Area	Rate Level
(A): 1 – 4/12 – 3/12 = 5/12	1.00
(B): 1/2×6/12×12/12 = 1/4	1.04
(C): 4/12	1.04×0.85

Average rate level = $\frac{5}{12}\times 1.0+\frac{1}{4}\times 1.04+\frac{4}{12}\times 1.04\times 0.85=0.971333$

Current rate level = 1.04×0.85×1.05×1.07 = 0.993174
On-level factor = 0.993174 ÷ 0.971333 = 1.022485
2012 on-level earned premium = 475,000×1.022485 = 485,680

(b) Explain why you would expect the 2012 earned premium at current rate level to be greater or less than the answer from part (a) if all policies were twelve-month policies instead of six-month policies.

With all policies being 12-month policies, more of the area of 2012 would be at lower rates (higher percentage at rate level 1.00, lower percentage at rate level 1.04). Therefore, the average rate level in 2012 would be lower. The current rate level remains unchanged. Therefore, the on-level factor would be higher than the value from part (a).

(c) Explain how the increase in the state-mandated minimum policy limits would affect the on-level calculation from part (a).

The average premium would increase to reflect such a change, but claims would be expected to increase as policyholders would receive more coverage. Therefore, expect no change to the on-level calculation.

2. Learning Objectives:

2. The candidate will understand how to calculate projected ultimate claims and claims-related expenses.

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

6. The candidate will understand the need for monitoring results.

Learning Outcomes:

(2b) Estimate ultimate claims using various methods: development method, expected method, Bornhuetter Ferguson method, Cape Cod method, frequency-severity methods, Berquist-Sherman methods.

(3c) Describe the components of claim liabilities in the context of financial reporting.

(6a) Describe the role of monitoring in ultimate values and pricing.

(6b) Analyze actual claims experience relative to expectations.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 16, 17, 23 and 36.

Commentary on Question:

This question tests the candidate's ability to estimate ultimate claims using the expected method and the Bornhuetter Ferguson method. Candidates also need to calculate unpaid claims, split by case estimate and IBNR. This question also requires candidates to estimate expected paid claims for an interim period between actuarial analyses using the approach of Friedland Chapter 36, as well as understand reasons why the difference between actual and expected reported claims can be different than the difference between actual and expected paid claims.

Solution:

(a) Calculate the 2014 level expected claim ratio using reported claims and a three year average.

Accident Year	Earned Premium	Ultimate Claims Based on Reported	Claim Trend Factors at 2%	Premium On-Level Factor	Trended On-Level Claim Ratio
2012	12,200	11,296	1.0404	1.070	90.0%
2013	12,900	10,975	1.0200	1.034	83.9%
2014	13,800	11,770	1.0000	1.000	85.3%
			3 year average:		86.4%

2. Continued

$$\text{Trended On-Level Claim Ratio} = \frac{(\text{Ultimate Claims})(\text{Claim Trend Factor})}{(\text{Earned Premium})(\text{On-Level Factor})}$$

(b) Calculate the 2014 level pure premium using reported claims and a three year average.

Accident Year	Earned Exposures	Ultimate Claims Based on Reported	Claim Trend Factors at 2%	Trended Pure Premium
2012	95	11,296	1.0404	123.71
2013	94	10,975	1.0200	119.09
2014	94	11,770	1.0000	125.21
		3 year average:		122.67

$$\text{Trended Pure Premium} = \frac{(\text{Ultimate Claims})(\text{Claim Trend Factor})}{(\text{Earned Exposures})}$$

(c) Calculate the accident year 2013 expected claims for the following methods:

(i) Use the 2014 level expected claim ratio determined in part (a).

(ii) Use the 2014 level pure premium determined in part (b).

(i) Expected Claim Ratio method:
2013 expected claim ratio:

$$= \frac{(\text{selected expected claim ratio}_{2014}) \times (\text{premium on-level factor}_{2013})}{(\text{trend factor}_{2013})}$$

$$= \frac{86.4\% \times 1.034}{1.02} = 87.6\%$$

2013 expected claims = 87.6%×12,900 = 11,300

(ii) Pure Premium method:
2013 expected claims = 122.67×94÷1.02 = 11,305

(d) Calculate the accident year 2013 ultimate claims using the Bornhuetter Ferguson method with the expected claims from the expected claim ratio approach in part (c) and reported claims.

2. Continued

Implicit development factor = (10,975/8,970) =	1.224
Expected % undeveloped = 1 – 1/1.224 =	18.3%
Expected claims from part (c):	11,300
Expected claims undeveloped = 18.3% × 11,300 =	2,068
Reported claims @ Dec. 31, 2013:	8,970
Estimated ultimate claims = 2,068 + 8,970 =	11,038

(e) Calculate the accident year 2013 unpaid claims using the ultimate claims calculated in part (d). Show the case estimate and indicated IBNR separately.

Unpaid = ultimate claims from part (d) – paid to date = 11,038 – 6,950 = 4,088
IBNR = ultimate claims – reported to date = 11,038 – 8,970 = 2,068
Case = Unpaid – IBNR = 2,020

(f) Calculate the difference between the actual and expected paid claims from December 31, 2014 through March 31, 2015 for accident year 2014, using linear interpolation of the expected percent paid derived from the implied paid cumulative development factors.

Commentary on Question:
Candidates need to use the formula in the textbook, as the expected paid at March 31, 2015 is not equal to the ultimate claims multiplied by the expected percent paid at March 31, 2015.

- Expected % paid at December 31, 2014 for accident year 2013 = (Cumulative Paid) / (Selected Ultimate Based on Paid) = 6,950 / 10.544 = 65.9%
- Expected % paid at December 31, 2014 for accident year 2014 = 4,100 / 11,196 = 36.6%
- Interpolate to estimate accident year 2014 percent paid at March 31, 2015 = = 36.6%×0.75 + 65.9%×0.25 = 43.9%
- Actual claims paid between December 31, 2014 and March 31, 2015 = 4,790 – 4,100 = 690
- Expected paid between December 31, 2014 and March 31, 2015 = $\frac{11{,}196 - 4{,}100}{1 - 36.6\%} \times (43.9\% - 36.6\%) = 817$
- Difference between actual and expected paid claims between December 31, 2014 and March 31, 2015 = 690 – 817 = –127

(g) State two possible reasons why the difference between the actual and expected reported claims is different than the difference between the actual and expected paid claims for accident year 2014.

2. Continued

Possible reasons include:

- The payment pattern may be changing.
- There may be an issue with claim payments in the first quarter (e.g., processing delay).

3. Learning Objectives:

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

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

Learning Outcomes:

(4a) Identify the time periods associated with trending procedures.

(5f) Calculate overall rate change indications under the claims ratio and pure premium methods.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 25 and 31.

Commentary on Question:

This question requires candidates to estimate trended ultimate severity for ratemaking purposes. Candidates also need to understand the adjustments that may be required to complements of credibility.

Solution:

(a) Explain two situations where the pure premium ratemaking approach is preferred to the claim ratio ratemaking approach.

Any two of the following are acceptable:

- When trended earned premiums are not available or not reliable
- For self-insured entities
- With new products/new lines of business (i.e., where historical claim ratios are unavailable)

(b) Select the ultimate severity for the future rating period. Justify your selection.

Commentary on Question:

Justification for the selection is required for full credit.

Accident Year	Projected Ultimate Severity	Average Accident Date in Experience Period	Average Accident Date in Forecast Period	Trending Period (months)	Trend Factor	Trended Severity
2012	24,900	July 1, 2012	Apr 1, 2016	45	1.2008	29,900
2013	26,400	July 1, 2013	Apr 1, 2016	33	1.1436	30,191
2014	27,100	July 1, 2014	Apr 1, 2016	21	1.0891	29,515
					Average	29,869

Notes: Trend Factor = $(1 + 5\%)^{(\text{trending period})/12}$

Trended Severity = (Projected Ultimate Severity)(Trend Factor)

3. Continued

Selected Trended Severity is 29,869. This selection is reasonable as there is no evidence of any outliers.

(c) Describe an adjustment, if any, that may be required for each of these possible complements of credibility.

The pure premium underlying the current rates needs to be adjusted to the cost level of the forecast period.

The pure premium based on industry experience needs to be adjusted to reflect the insurer's mix of exposures and the cost level of the forecast period.

4. Learning Objectives:

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

Learning Outcomes:

(3b) Estimate unpaid unallocated loss adjustment expenses using ratio and count-based methods.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 22.

Commentary on Question:

This question tests the Wendy Johnson count-based method to calculate unallocated loss adjustment expenses.

Solution:

(a) Explain two weaknesses of the classical paid-to-paid unallocated loss adjustment expenses (ULAE) estimation method.

Any two of the following are acceptable:

- When there are significant changes in exposure volume occurring
- Inflationary periods
- Business in a run-off state
- ULAE associated with IBNYR is very different from IBNR

(b) Estimate unpaid ULAE as of December 31, 2014 using a simple three-year average of historical experience.

		Counts				Average
Calendar Year	Paid ULAE (000)	Newly Reported	Open	Closed	Weighted Total	ULAE per Weighted Count
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012	1,862	1,550	577	1,580	872	2,135
2013	2,100	1,700	614	1,663	936	2,244
2014	1,995	1,685	621	1,678	940	2,122
Selected Average ULAE per Weighted Count						2,167

Notes: (6) = [0.2×(3)] + [0.7×(4)] + [0.1×(5)]
(7) = 1000×(2) / (6)

4. Continued

	Counts							
Calendar Year	Newly Reported During the Year	Open at End of Year	Closed During the Year	Weighted Total	Trending Period in Years	Prospective Trend	Trended Average ULAE	Estimated Unpaid ULAE (000)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2015	665	316	970	451	1	1.030	2,232	1,007
2016	150	82	384	126	2	1.061	2,299	290
2017	-	-	82	8	3	1.093	2,368	19
								1,315

Notes: (5) = [0.2×(2)] + [0.7×(3)] + [0.1×(4)]
(8) = 2,167×(7)
(9) = (5)(8) / 1,000

5. Learning Objectives:

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

Learning Outcomes:

(5j) Perform individual risk rating using standard plans.

Sources:

"The Mathematics of Excess of Loss Coverages and Retrospective Rating – A Graphical Approach," Lee, Y., Casualty Actuarial Society, 1988 Proceedings, Vol. LXXV

Commentary on Question:

This question tests the understanding of retrospective rating.

Solution:

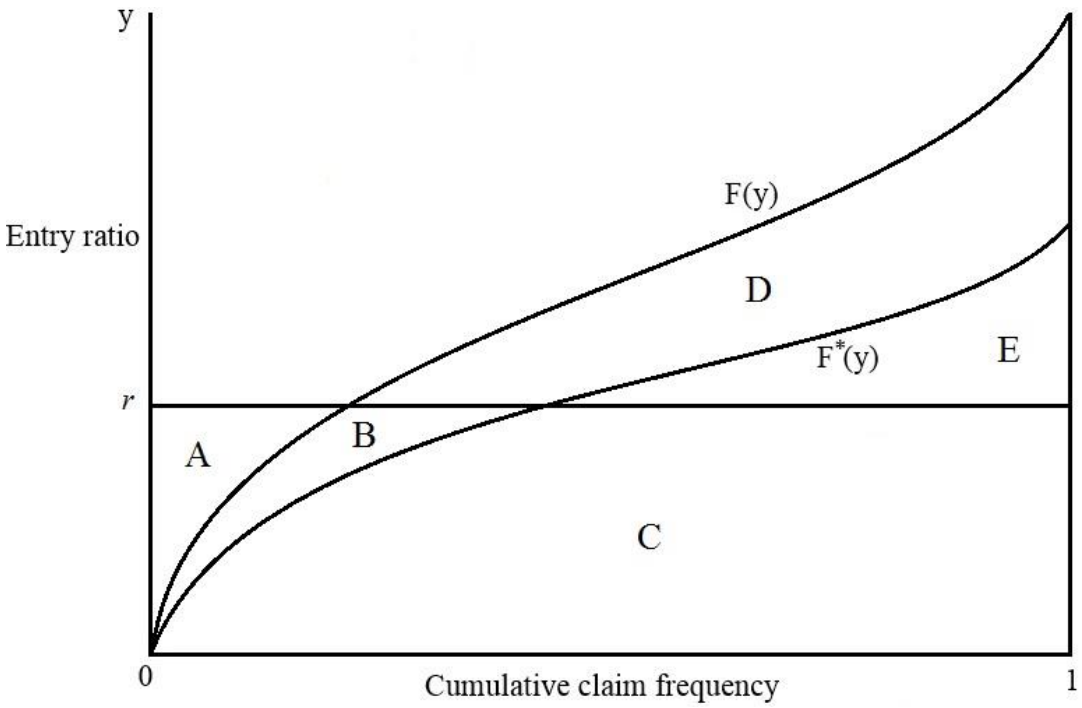
(a) Explain what the Table L savings and Table L charge indicate.

The Table L savings at entry ratio *r* is the expected amount by which the risk's actual limited loss falls short of *r* times the expected unlimited loss, divided by the expected unlimited loss.

The Table L charge at entry ratio *r* is the expected amount by which the risk's actual limited loss exceeds *r* times the expected unlimited loss, divided by the expected unlimited loss, PLUS the loss elimination ratio associated with the per accident limitation.

(b) Draw a graph with cumulative claim frequency along the x-axis and entry ratio along the y-axis, and identify the areas on the graph corresponding to $\psi^*(r)$ and $\phi^*(r)$.

5. Continued



$\psi^*(r)$ = (A + B)

$\phi^*(r)$ = (B + D + E)

(c) Demonstrate the validity of the fundamental relation above using the areas of the graph.

$\phi^*(r) - k = E$

$\psi^*(r) = [\phi^*(r) - k] + r$ (the lower rectangle) $-$ $[1-k]$ (the area under the lower curve)

= E + A + B + C – (C + E) = A + B

(d) Define $\psi^*(r)$ for the limiting case where losses are all equal.

$\psi^*(r) = 0, r \le 1-k$ and $\psi^*(r) = r - 1 + k, r > 1-k$

6. Learning Objectives:

2. The candidate will understand how to calculate projected ultimate claims and claims-related expenses.

Learning Outcomes:

(2b) Estimate ultimate claims using various methods: development method, expected method, Bornhuetter Ferguson method, Cape Cod method, frequency-severity methods, Berquist-Sherman methods.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 14.

Commentary on Question:

This question tests the application of the development method, including the understanding of Boor's algebraic method. Candidates also need to understand the incorporation of benchmark data when selecting tail factors.

Solution:

(a) Calculate the age-to-age factors for paid claims using the geometric three-year method.

Paid Development Factors

Accident Year	12-24	24-36	36-48
2011	1.200	1.333	1.150
2012	1.444	1.462	
2013	1.250		
Geometric 3-year	1.294	1.396	1.150

e.g. 12-24: $(1.2 \times 1.444 \times 1.25)^{(1/3)} = 1.294$

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

Advantage: It is based entirely on the data contained within the triangles; thus, no additional data are required.

Disadvantage: A reliable estimate of ultimate claims for the most mature periods is required, and such an estimate may not always be available.

(c) Calculate the paid claims tail factors for accident years 2011 and 2012 using Boor's algebraic method.

Ultimate claims (based on reported):
AY 2011: 48,000×1.03 = 49,440
AY 2012: 45,000×1.07×1.03 = 49,595

6. Continued

Paid claims at 48 months:
AY 2011: 46,000
AY 2012: 38,000×1.15 = 43,700

Tail factors:
AY 2011: 49,440 ÷ 46,000 = 1.075
AY 2012: 49,595 ÷ 43,700 = 1.135

(d) State two common sources of benchmark data.

Any two of the following are acceptable:
- Industry experience:
  - In the U.S. this includes A.M. Best, ISO, NCCI, and RAA
  - In Canada this includes Insurance Bureau of Canada and General Insurance Statistical Agency
- Data from affiliate companies
- Experience from similar lines of business

(e) State two potential limitations of benchmark data.

Any two of the following are acceptable:
- Differences in the way claims are adjusted or reserved
- Differences in the potential for long-developing high value claims
- Differences in the initial reporting pattern for claims
- Differences in the adjudication process for litigated claims
- Statistical reliability of the benchmark triangle

(f) Explain how you would evaluate and incorporate the benchmark data in your tail factor selection.

Compare the age-to-age factors of benchmark data against the insurer's data for earlier ages of development. If patterns are similar then consider using; if not then adjust or reject.

7. Learning Objectives:

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

Learning Outcomes:

(5h) Calculate deductible factors, increased limits factors, and coinsurance penalties.

Sources:

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

Commentary on Question:

This question tests the understanding of and application of deductibles. In addition, the question tests understanding of coinsurance.

Solution:

(a) Explain the importance of consistency in setting deductible factors.

Any of the following descriptions are acceptable:

- Important because it tests the reasonableness of the factors.
- The marginal premium per 1,000 of coverage should decrease as the deductible increases.
- Insured would not expect to pay marginally more for each additional 1,000 of coverage, because the probability of claims at each successively increasing layer is less than that of the immediately preceding layer.

(b) Demonstrate that the implied deductible factors are inconsistent.

The marginal rates per unit of deductible are as follows:
0-1,000: (10,000 – 9,500)/(1,000 – 0) = 0.500
1,000-2,500: (9,500 – 8,745)/(2,500 – 1,000) = 0.503
2,500-5,000: (8,745 – 7,960)/(5,000 – 2,500) = 0.314
The implied deductible factors are not consistent because the marginal rates are not decreasing.

(c) Adjust one premium so that the table has a consistent pattern.

Can adjust the first, second or third premium amount.

If the first premium is adjusted:

$$\frac{x-9,500}{1,000} > \frac{9,500-8,745}{1,500} \Rightarrow x > 10,003.33$$

7. Continued

If the second premium is adjusted:

- premium (x) must meet two conditions:
  1. $\frac{10,000-x}{1,000} > \frac{x-8,745}{1,500} \Rightarrow x < 9,498$
  2. $\frac{x-8,745}{1,500} > \frac{8,745-7,960}{2,500} \Rightarrow x > 9,216$

  Result: $9,216 < x < 9,498$

If the third premium is adjusted:

- premium (x) must meet two conditions:
  1. $\frac{9,500-x}{1,500} > \frac{x-7,960}{2,500} \Rightarrow x < 8,922.50$
  2. $\frac{9,500-x}{1,500} < \frac{10,000-9,500}{1,000} \Rightarrow x > 8,750$

  Result: $8,750 < x < 8,922.50$

(d) Define the following terms:

(i) Franchise deductible

(ii) Time deductible

(i) Franchise deductible of 1,000: losses below 1,000 are not covered whereas a loss greater than 1,000 is covered in full. For example, a loss of 500 would not be covered but a loss of 1,100 would be covered in full.

(ii) Time deductible: a time delay between the occurrence of the covered incident and the start of the insurance coverage.

(e) Explain how the responsibility for claims handling differs between large deductible policies and self-insured retention policies.

Large deductible policies: the insurer is typically involved in the adjustment and payment of all claims for insureds with deductibles.

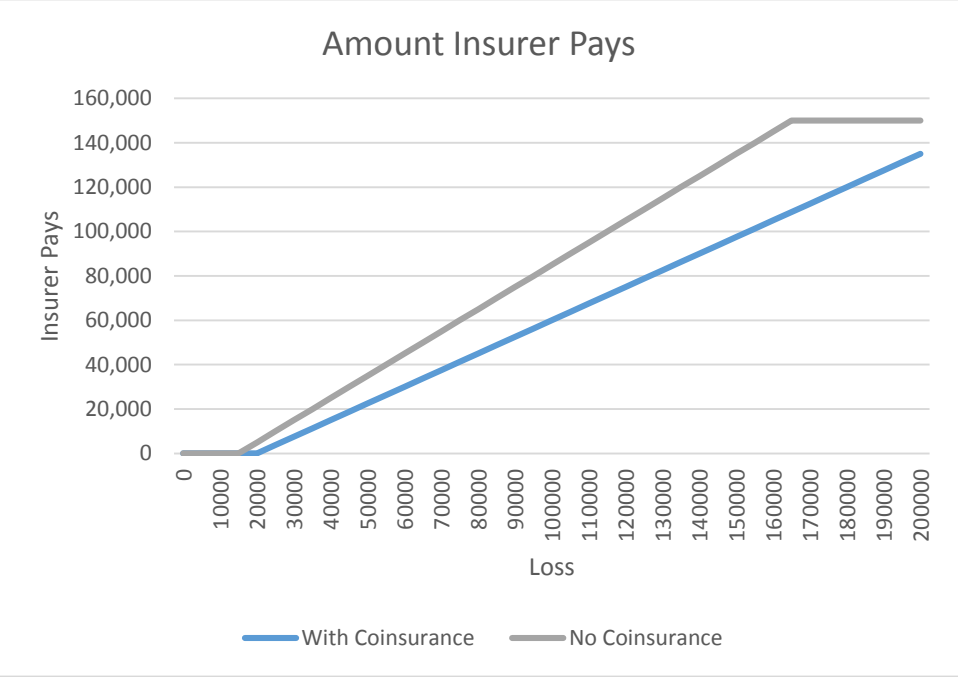
Self-insured retention (SIR): insureds with an SIR are responsible for the adjustment and payment of all claims that fall within the SIR.

7. Continued

(f) Illustrate graphically what the insurer would pay for losses from zero up to the property value in the following situations:

(i) 100% coinsurance requirement applicable to the loss before the deductible

(ii) No coinsurance requirement



8. Learning Objectives:

2. The candidate will understand how to calculate projected ultimate claims and claims-related expenses.

Learning Outcomes:

(2a) Use loss development triangles for investigative testing.

(2b) Estimate ultimate claims using various methods: development method, expected method, Bornhuetter Ferguson method, Cape Cod method, frequency-severity methods, Berquist-Sherman methods.

Sources:

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

Commentary on Question:

This question tests the candidate's ability to diagnose the triangle of average case estimates, as well as the understanding of the Berquist-Sherman adjustments when there has been a change in case reserve adequacy.

Solution:

(a) Explain two reasons why an actuary must be careful in using this investigative tool to reach a conclusion on the level of overall adequacy of case estimates.

1. What might appear to be changes in the average case estimates may simply be due to the presence or absence of large claims.
2. Any changes that affect counts, reported or closed, would influence the denominator of this average value.

(b) Calculate the triangle of average case estimates.

Accident	Case Reserves = Reported – Paid		
Year	12	24	36
2012	24,600	36,900	12,300
2013	25,200	25,200	
2014	13,200		

Accident	Average Case = Case / Open Counts		
Year	12	24	36
2012	159.7	134.2	58.9
2013	150.0	84.0	
2014	82.0		

(c) Explain why the triangle of average case estimates may indicate a change in case adequacy.

8. Continued

Changes down each column (accident year to accident year) should be explained by the trend rate only, so if it is different than trend, possible changes in case reserve adequacy are indicated.

(d) Adjust the reported claims triangle using the Berquist-Sherman methodology.

Adjusted Average Case Reserves = Average Case (latest diagonal), divided by trend

Accident	Adjusted Average Case Reserves		
Year	12	24	36
2012	77.3	81.6	58.9
2013	79.6	84.0	
2014	82.0		

e.g. 82.0 / 1.03 = 79.6

Adjusted Case Reserves = (Adjusted Average Case)(Open Counts)

Accident	Adjusted Case Reserves		
Year	12	24	36
2012	11,901	22,427	12,300
2013	13,373	25,200	
2014	13,200		

Adjusted Reported Claims = (Adjusted Case Reserves) + (Paid Claims)

Accident	Adjusted Reported Claims		
Year	12	24	36
2012	61,101	83,927	104,600
2013	63,773	88,200	
2014	66,000		

(e) Describe what adjustments may be appropriate to the tail factor.

If case reserve adequacy is falling, the possibility of an increased tail factor exists. But if the line of business is short-tailed, it may be fully developed after three years. Consider other available information.

(f) Explain why the IBNR based on the adjusted reported claims is likely to be higher or lower than the IBNR based on the unadjusted reported claims.

Unadjusted claims are likely to understate the ultimate claims estimate (higher reported claims will result in lower development factors and therefore lower IBNR). The Berquist-Sherman adjustment will produce a higher ultimate claims estimate, and therefore higher IBNR.

9. **Learning Objectives:**

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

Learning Outcomes:

(7b) Apply catastrophe models to insurance ratemaking, portfolio management, and risk financing.

Sources:

Catastrophe Modeling: A New Approach to Managing Risk, Grossi, P. and Kunreuther, H., Chapter 7.

Commentary on Question:

This questions tests the candidate's understanding of various risk financing strategies for catastrophe models.

Solution:

(a) Indicate for each of strategies 1 and 2 if it meets or does not meet XYZ management's requirement. Justify your conclusions.

Commentary on Question:

Candidates need to specifically say whether the strategy meets or does not meet management's requirement to get full credit.

For strategy 1, the 1% probability is at 0.7(700) = 490 and thus the requirement is met.

For strategy 2, the 1% probability is at 400 + 0.2(700 – 400) = 460 and thus the requirement is met.

(b) State the advantages and disadvantages of selecting strategy 1 instead of strategy 2.

The advantage of strategy 1 is that coverage is retained and so a proportion of expected profits is not passed to the reinsurer.

The disadvantage is that 30% of expected profits are surrendered. This is likely more than will be given up if reinsurance is purchased.

(c) Explain why, based on the information above, it is not possible to determine whether strategy 3 meets or does not meet XYZ management's requirement.

For strategy 3, it might meet the requirement, but without an exceedance curve for the industry portfolio and an evaluation of basis risk, that cannot be known for sure.

9. Continued

(d) Compare, with explanations, strategies 2 and 3 with regard to moral hazard and basis risk.

Strategy 2:

- No basis risk as losses from catastrophe are paid on the basis of actual company losses.
- This strategy has moral hazard, but mechanisms to reduce moral hazard can be built in to indemnity-based transactions.

Strategy 3:

- Index-based transactions reduce moral hazard, since an individual cedant has little control over industry losses.
- Cedant is exposed to basis risk to the extent that its own exposures - and therefore losses - differ in kind and geographical distribution from that of the industry's, or from that of the index used to determine the payoff of the contract.

10. Learning Objectives:

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

Learning Outcomes:

(5j) Perform individual risk rating using standard plans.

Sources:

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

Commentary on Question:

This question tests the understanding of experience rating and schedule rating.

Solution:

(a) Explain why insurers use experience rating.

Insurers use experience rating so that their premium reflects, at least in part, the insured's own claim experience.

(b) Explain why you may choose to base credibility on premium in individual risk rating.

Credibility is usually based on exposures or premium in individual risk rating so that a larger insurer receives greater credibility for its actual loss experience.

(c) Explain why insurers use schedule rating.

Insurers use schedule rating to incorporate judgment about specific risk characteristics of the insured that are either not considered at all or are not adequately reflected in the manual rating process (e.g., in the manual rates, rating rules, rating factors, and rating algorithm).

(d) State three examples of risk characteristics used in schedule rating plans.

Any three of the following are acceptable:

- Features of workplace maintenance or operation, including the condition and upkeep of the premises and equipment
- Availability of medical facilities in or near the workplace
- Quality of police and fire protection
- Safety equipment/devices present in/missing from the workplace
- Qualification of employees including employee training, selection, and supervision
- Construction features and maintenance
- Accommodations/cooperation with insurer by management
- Considerations related to policy expenses

10. Continued

(e) Define premium discounts and expense constants.

Premium discount plans are used primarily with U.S. workers compensation to recognize the administrative cost savings associated with insureds with larger premiums.

An expense constant or an acquisition expense load may be used to cover an insurer's cost of policy issuance, auditing, and management.

(f) Select two items from the list above and explain how actuaries can assist in their development and maintenance.

Any two of the following are acceptable:

- Trend factors: use similar methods to those for manual rating, conducted at limits that are consistent with any large claim capping that is used for the experience rating plan
- Development factors: use similar methods to those for manual rating; select development factors based on analysis of reported claims summarized in development triangles
- Expected claim ratios: use similar methods to those for manual rating
- Large claim thresholds: use similar methods to those for manual rating
- Credibility: actuary can determine credibility values

(g) Explain two problems with a retrospective rating plan in this case.

Any two of the following are acceptable:

- The insureds in the plan are small and may have variable claims experience.
- Particularly for small insureds, fire, windstorm and earthquake exposures can be catastrophe prone.
- The lure of a large increase in premium may seem to overshadow the risk, but the future could hold large individual fires or catastrophes that may be in excess of plan maxima.
- The experience, even for the entire group, may not be very predictable.

11. Learning Objectives:

2. The candidate will understand how to calculate projected ultimate claims and claims-related expenses.

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

Learning Outcomes:

(2b) Estimate ultimate claims using various methods: development method, expected method, Bornhuetter Ferguson method, Cape Cod method, frequency-severity methods, Berquist-Sherman methods.

(4b) Describe the influences on frequency and severity of changes in deductibles, changes in policy limits, and changes in mix of business.

Sources:

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

Solution:

(a) State two other changes in historical data that would require adjustment.

Commentary on Question:

Changes in limits, deductibles, inflation, etc., are the kinds of items that trend is measuring, so they are not adjustments that must be made prior to analyzing trend.

Any two of the following are acceptable:

- Catastrophe claims
- Seasonality
- Changes resulting from tort and product reform
- Legislated benefit-level changes
- Changes in claim settlement

(b) State three information sources you may take into account.

Any three of the following are acceptable:

- Professional judgment
- Insurer's own experience
- Trend rates indicated based on analyses of industry data
- Trends in the general economy
- The trend rate selected for pricing purposes
- The trend rate selected in the prior analysis of ultimate claims
- The trend rates selected by competitors if such information is available

11. Continued

(c) Calculate the indicated ultimate frequency at the 2014 level using a three-year average.

Accident Year	(1) Earned Exposures	(2) Projected Ultimate Counts from Development Method	(3) = (2)/(1) Indicated Ultimate Frequency	(4) = $(1-.02)^{(2014-AY)}$ Frequency Trend Factor	(5) = (3)(4) Indicated Ultimate Frequency at 2014 Level
2012	35,000	910	0.02600	0.960	0.0250
2013	36,000	900	0.02500	0.980	0.0245
2014	37,000	960	0.02595	1.000	0.0259
				Average	0.0251

(d) Project the ultimate counts for accident year 2013 using the indicated ultimate frequency from part (c).

Ultimate counts for accident year 2013 = (indicated ultimate frequency at the 2014 level)(AY2013 earned exposures) / (trend factor)
= 0.0251 × 36,000 ÷ 0.98 = 922

(e) Calculate the ultimate claims for accident year 2013 using the frequency-severity closure method.

Estimate incremental closed counts for 36 and 48 months:
@ 36 months: 0.8×(922 – 450 – 330) = 114
@ 48 months: 922 – (450 + 330 + 114) = 28

	12	24	36	48	Total
Incremental closed counts	450	330	114	28	
Incremental paid severity	1,000	5,200	14,300	19,100	
Projected incremental paid claims	450,000	1,716,000	1,630,200	534,800	4,331,000

projected incremental paid claims = (incremental closed counts)(incremental paid severity)

(f) Explain what adjustments, if any, are made to frequency-severity closure method estimates of ultimate claims when case reserve adequacy is changing.

The frequency-severity closure method projects frequency and severity based on paid claims to estimate ultimate claims. If case reserve adequacy is changing, no adjustment is required because the method is not reliant on case reserves.

12. Learning Objectives:

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

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

Learning Outcomes:

(4a) Identify the time periods associated with trending procedures.

(5b) Calculate expenses used in ratemaking analyses including expense trending procedures.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 26 and 29.

Commentary on Question:

This question tests the expense provisions that are used in ratemaking.

Solution:

(a) Select the variable expense percentage to use for ratemaking based on the historical ratio of variable expense to premium. Justify your selection.

Commentary on Question:

Justification is required for full credit.

	(1)	(2)	(3)	(4) = (3)×0.4	(5) = (4)/(1)
Calendar Year	Earned Premium	Earned Exposures	Total General Expenses	Variable	% Variable
2012	4,019,000	2,770	452,100	180,840	4.50%
2013	4,307,000	2,910	495,300	198,120	4.60%
2014	4,571,000	2,930	502,800	201,120	4.40%
Total:	12,897,000	8,610	1,450,200	580,080	4.50%

Selection: 4.5%

Justification: No indication of outlier or trend, so the total is a reasonable selection.

(b) Select the fixed expense per exposure to use for ratemaking. Justify your selection.

12. Continued

Commentary on Question:
Justification is required for full credit.

Trending experience period each calendar year: average accident date = July 1 each year.
Trending forecast period: rates in effect from July 1, 2015 through June 30, 2016.
Twelve-month policies so average accident date in forecast period is July 1, 2016.

	(1)	(2)	(3) = (2)×0.6	(4) = (3) / (1)	(5)	(6) = $1.02^{[(5)/12]}$	(7) = (4)(6)
Calendar Year	Earned Exposures	Total General Expenses	Fixed Expenses	Fixed Expense Per Exposure	Trending Period (months)	Trend Factor	Trended Fixed Expenses
2012	2,770	452,100	271,260	97.93	48	1.0824	106.00
2013	2,910	495,300	297,180	102.12	36	1.0612	108.37
2014	2,930	502,800	301,680	102.96	24	1.0404	107.12
Total:	8,610	1,450,200				Average:	107.17

Selection: 107

Justification: No indication of outlier or trend, so the average is a reasonable selection.

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

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

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

Solution must match the distortion identified in (c):
1. Use premiums adjusted to current rate level.
2. Apply trend to the premiums.
3. Track fixed expenses by jurisdiction and calculate fixed expense ratios for each jurisdiction.

13. Learning Objectives:

1. The candidate will understand the key considerations for general insurance actuarial analysis.

Learning Outcomes:

(1k) Estimate written, earned and unearned premiums.

(1l) Adjust historical earned premiums to current rate levels.

Sources:

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

Commentary on Question:

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

Solution:

(a) Calculate the unearned premium as of:

(i) December 31, 2013

(ii) December 31, 2014

(i) 2013 written premium = 1,200 + 1,800 + 900 = 3,900

2013 earned premium = $1,200 \times {}^{10}\!/_{12} + 1,800 \times {}^{6}\!/_{24} + 900 \times {}^{4}\!/_{6} = 2,050$

Unearned premium at December 31, 2013 = 2013 written premium – 2013 earned premium = 1,850

(ii) 2014 written premium = 0 (2-year policy only booked in 2013 as EWF Insurance records written premium in the year of the initial effective date)

2014 earned premium = $1,200 \times {}^{2}\!/_{12} + 1,800 \times {}^{12}\!/_{24} + 900 \times {}^{2}\!/_{6} = 1,400$

Unearned premium at December 31, 2014 = Unearned premium at December 31, 2013 + 2014 written premium – 2014 earned premium = 1,850 + 0 – 1,400 = 450

(b) Calculate the premium on-level factor to adjust the 2013 calendar year earned premium to the current rate level.

13. Continued

2013 earned premium (historical) = 2,050 (see part a)
Rates increased by 10% from August 1, 2013, therefore only policy #3 is at current rates. Need to increase policies #1 & #2 by 10% to reflect current rates.
2013 earned premium at current rates =

$$\left(1,200\times{}^{10}\!/_{12}+1,800\times{}^{6}\!/_{24}\right)\times 1.1+900\times{}^{4}\!/_{6}=2,195$$

On-level factor = $\frac{2,195}{2,050}=1.071$

(c) Explain why the premium for aggregate stop loss coverage is typically not earned evenly throughout a calendar year.

The exposure to claims is much greater near the end of the policy term rather than during the initial months of coverage as this coverage provides protection to the reinsured against the amount by which its claims during a specified period exceed an agreed upon threshold.

14. Learning Objectives:

2. The candidate will understand how to calculate projected ultimate claims and claims-related expenses.

Learning Outcomes:

(2b) Estimate ultimate claims using various methods: development method, expected method, Bornhuetter Ferguson method, Cape Cod method, frequency-severity methods, Berquist-Sherman methods.

Sources:

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

Commentary on Question:

This question tests the understanding of the assumptions and inputs to the Bornhuetter Ferguson, Benktander, and Cape Cod methods. In addition, candidates needs to estimate ultimate claims using the Cape Cod and the Generalized Cape Cod method.

Solution:

(a) State the key assumption from the expected method that is used when applying the Bornhuetter Ferguson method.

Actuaries can better project ultimate values based on an *a priori* estimate than from the experience observed to date.

(b) Explain the difference between the inputs to the Bornhuetter Ferguson method and the inputs to the Benktander method.

Bornhuetter Ferguson method: An input to the Bornhuetter Ferguson method is the expected claims from the expected method.

Benktander method: The projected ultimate values derived from the Bornhuetter Ferguson method become the expected value input to the Benktander method.

(c) Compare the expected claims that are used for the Bornhuetter Ferguson method with the expected claims that are used for the Cape Cod method.

Bornhuetter Ferguson method: Future claim activity is derived from the *a priori* estimate of the expected method.

Cape Cod method: Observed claims, adjusted for trend, tort reform and other measurable changes over time, and observed exposures (adjusted for measurable changes over time such as rate changes and trend) are used to estimate the cost per exposure which is used to calculate the expected values.

14. Continued

(d) Calculate the total expected claims using the Cape Cod method.

Accident Year	(1) Earned Exposures	(2) Paid Claims	(3) Paid Cumulative Development Factors	(4) Expected % Developed	(5) Used-Up Earned Exposures	(6) Trend	(7) Adjusted Claims	(8) Expected Claims
2012	200	94,260	1.370	73%	146	1.061	100,000	142,277
2013	210	67,960	2.500	40%	84	1.030	69,999	153,873
2014	219	30,000	6.250	16%	35	1.000	30,000	165,281
					265		199,999	461,432
				(A) Adjusted Expected Pure Premium			754.71	

Notes: (4) = 1 / (3)
(5) = (1)(4)
(6) = $(1 + 3\%)^{(2014\text{-AY})}$
(7) = (2)(6)
(A) = sum(7) / sum(5)
(8) = (A)(1) / (6)

(e) Calculate the 2014 expected claim ratio using the Generalized Cape Cod method.

Accident Year	(1) Used-Up On-Level Earned Premium	(2) 2014 Decay Factors	(3) Used-Up On-Level Earned Premium × Decay
2012	100,000	64.0%	64,000
2013	70,000	80.0%	56,000
2014	30,000	100.0%	30,000
Total			150,000

2014 Expected Claim Ratio

$$= \frac{(64,000 \times 0.80 + 56,000 \times 0.75 + 30,000 \times 0.90)}{150,000} = 80.1\%$$

15. Learning Objectives:

2. The candidate will understand how to calculate projected ultimate claims and claims-related expenses.

Learning Outcomes:

(2d) Explain the effect of changing conditions on the projection methods cited in (b).

Sources:

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

Commentary on Question:

This question tests the understanding of how various changing conditions affect the estimates of ultimate claims.

Solution:

(a) Explain how the expected claims in each of the Bornhuetter Ferguson and Cape Cod methods responds to deterioration in claims experience.

In the Bornhuetter Ferguson method, the expected claims are based on an *a priori* estimate and do not change unless the actuary deliberately makes a change.

In the Cape Cod method, the expected claims are a function of the reported claims to date.

(b) Explain whether the Bornhuetter Ferguson method or Cape Cod method is more responsive to a deterioration in claims experience.

For the Cape Cod method, deterioration in the claims experience will be reflected to some extent in the expected claims. Thus, the Cape Cod method is more responsive to a change in claims experience.

(c) Explain which projection method is likely to produce the most accurate estimate of ultimate claims if there is an unforeseen and unquantified increase in case reserve adequacy in recent years.

The expected method is likely to produce the most accurate estimate of ultimate claims if there is an unforeseen and unquantified increase in case reserve adequacy in recent years. All other methods incorporate actual reported claims experience which will reflect a distortion caused by the change in case reserve adequacy.

(d) Explain whether a change in policy exclusions is more likely to cause patterns to change on an accident or a calendar year basis.

15. Continued

Accident year basis: Changes in policy exclusions occur on a prospective policy year basis, rather than affecting all historical open claims. Therefore, accident year claims experience best reflects policy year changes.

(e) Explain whether a change in loss trend is more likely to cause patterns to change on an accident or a calendar year basis.

Calendar year basis: Trend changes are usually driven by external conditions which typically affect all open claims. Therefore, trend changes are most likely to affect an entire diagonal of open claims, regardless of accident year.

16. Learning Objectives:

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

Learning Outcomes:

(7a) Describe the structure of catastrophe models.

(7b) Apply catastrophe models to insurance ratemaking, portfolio management, and risk financing.

Sources:

Catastrophe Modeling: A New Approach to Managing Risk, Grossi, P. and Kunreuther, H., Chapters 3 and 5.

Commentary on Question:

This question tests the factors that are used in the various catastrophe modules.

Solution:

(a) Indicate, for each of the four factors listed by the CEA, which module or modules use that particular factor. Support your selections.

Commentary on Question:

Support for the selections is required for full credit.

1. Location: Hazard and Inventory
2. Soil: Hazard
3. Construction: Inventory and Vulnerability and Loss
4. Age: Inventory and Vulnerability and Loss

Explanations:

- Hazard module identifies the location of faults and the risk associated with each (with soil part of that)
- Inventory module contains location, construction, and age (among others), but not soil type
- Vulnerability module measures building damage given the event and is related to construction and age
- Loss module translates the event into money which depends on construction and age

(b) Propose two additional factors that might be considered. Support your proposal.

Any two of the following are acceptable:

- Presence of retrofitting (was actually called out in the other parts of the rules)
- Building occupancy
- Building codes at time of construction

17. Learning Objectives:

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

Learning Outcomes:

(3f) Evaluate premium liabilities.

Sources:

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

Commentary on Question:

This question tests the determination of premium liabilities.

Solution:

(a) Calculate net unearned premium as of December 31, 2014.

Net unearned premium = (Net written premium × Development factor) – Net earned premium = 1,000,000×1.04 – 500,000 = 540,000

(b) Calculate net premium liabilities as of December 31, 2014.

Expected Net Claims = Net unearned premium × 80%	432,000
Expected Net ULAE = Expected Net Claims × 15%	64,800
Expected Net Claims and ULAE	496,800
Selected Maintenance Expense Ratio = 20% × 30%	6.0%
Maintenance Expenses = Net unearned premium × 6.0%	32,400
Anticipated increase in Reinsurance = Net unearned premium × 3%	16,200
Premium Liabilities = Total Claims and Expenses	545,400

(c) Determine the net premium deficiency reserve, or net equity in unearned premium, at December 31, 2014, labeling your answer as a premium deficiency or equity in unearned premium, as applicable.

Commentary on Question:

Answer needs to be labeled as net premium deficiency.

Net premium deficiency = part (a) – part (b) = 540,000 – 545,400 = 5,400

(d) Explain the purpose of a premium deficiency reserve.

17. Continued

The purpose of a premium deficiency reserve is to supplement the unearned premium reserve as a liability for the unexpired contractual obligations of insurance policies.

18. Learning Objectives:

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

Learning Outcomes:

(5k) Calculate rates for claims-made coverage.

Sources:

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

Commentary on Question:

This questions tests the understanding of claims-made ratemaking.

Solution:

(a) State either one advantage or one disadvantage of claims-made coverage compared to occurrence coverage for each of the following perspectives:

(i) Insurer

(ii) Insured

Commentary on Question:

Candidate can select either the advantage or the disadvantage for each perspective.

(i) Insurer perspective:
- Advantage: more predictable loss cost
- Disadvantage: less opportunity for investment income

(ii) Insured perspective:
- Advantage: usually less expensive
- Disadvantage: more recordkeeping required to avoid gaps in coverage

(b) Demonstrate with a numerical example a situation in which the claims-made loss cost is greater than the occurrence loss cost.

Commentary on Question:

Other solutions are possible.

Example:

Consider the case where the reporting period is two years with a reporting pattern of 50% in year 1 and 50% in year 2. Assume claims cost trend is –20%. For an occurrence claims cost of 100, the claims-made claims cost would be $50\times\left(1+\frac{1}{1-0.20}\right)=112.50$. Thus, the claims-made claims cost is greater.

18. Continued

The answer could also be an example with a changing reporting pattern.

(c) Calculate tail factors for a claims-made policy for the following maturities:

(i) First-year
(ii) Second-year
(iii) Third-year
(iv) Mature

First Year:

	Report Year			
AY Lag	2015	2016	2017	2018
0	1			
1		*1*		
2			*1*	
3				*1*

Tail factor = *3* / 1 = 3.0

Second Year:

	Report Year			
AY Lag	2015	2016	2017	2018
0	1			
1	1	*1*		
2		*1*	*1*	
3			*1*	*1*

Tail factor = *5* / 2 = 2.5

Third Year:

	Report Year			
AY Lag	2015	2016	2017	2018
0	1			
1	1	*1*		
2	1	*1*	*1*	
3		*1*	*1*	*1*

Tail factor = *6* / 3 = 2.0

18. Continued

Fourth Year:

	Report Year			
AY Lag	2015	2016	2017	2018
0	1			
1	1	*1*		
2	1	*1*	*1*	
3	1	*1*	*1*	*1*

Tail factor = *6* / 4 = 1.5

(d) Determine the earned premium in 2015, 2016 and 2017 for a mature tail policy effective January 1, 2015 with a premium of 15,000.

With a 15,000 tail premium split into six units, the earning would be as follows:
2015: (3/6) of 15,000 = 7,500
2016: (2/6) of 15,000 = 5,000
2017: (1/6) of 15,000 = 2,500

19. Learning Objectives:

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

Learning Outcomes:

(5g) Calculate risk classification changes and territorial changes.

Sources:

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

Commentary on Question:

This question tests basic general insurance risk classification.

Solution:

(a) Describe three desirable attributes of a risk classification system.

Any three of the following are acceptable:

- Homogeneity: Risks within a risk class should be sufficiently homogeneous in nature such that there are no clear identifiable subclasses within a risk class; and therefore risks that are significantly dissimilar should belong to different risk classes.
- Objectivity: The definition of risk classes should be clear and objective. Where possible, the evaluation of a risk characteristic should be factual and not judgmental.
- Cost: There should be a reasonable relationship between the cost of adding a risk characteristic for classification purposes and the benefit of adding such characteristic.
- Verifiability: The risk characteristics used in a risk classification system should be reliable and conveniently verifiable.
- Other considerations: (a) comply with applicable law; (b) consider industry practices for that type of financial or personal security system as known to the actuary; and (c) consider limitations created by business practices of the financial or personal security system as known to the actuary.
- Reasonableness of the results: As with many types of actuarial work, professional judgment plays an important role in the work supporting risk classification systems.

(b) Calculate the relativities to base Territory B using the pure premium approach.

19. Continued

Territory	(1) Written Exposures	(2) Trended Ultimate Pure Premium	(3) Pure Premium Relativity	(4) Ultimate Counts	(5) Credibility
A	15,500	150	1.119	1,171	52.0%
B	8,900	110	0.821	530	35.0%
C	8,600	130	0.970	364	29.0%
	33,000	134	1.000		

Territory	(6) Industry Relativities	(7) Industry Credibility	(8) First Complement Credibility	(9) Existing Relativities	(10) Rebalanced Existing
A	1.009	80.0%	48.0%	0.850	0.870
B	1.316	60.0%	60.0%	1.320	1.351
C	0.658	50.0%	50.0%	0.850	0.870
	1.000			0.977	1.000

Territory	(11) Balance of Credibility	(12) Credibility Weighted Indicated Relativity	(13) Relative to Base
A	0.0%	1.066	0.932
B	5.0%	1.145	1.000
C	21.0%	0.793	0.693

Notes: Col (2) total: weighted average using col (1) written exposures
Col (3) = Col $(2)_i$ / $Col(2)_{Total}$
Col (5) = square root[(4) / 4329]
Col (8): First complement (industry) cannot exceed 100% less primary credibility
Col (9) total: weighted average using col (1) written exposures
Col (10) = Col $(9)_i$ / $Col(9)_{Total}$
Col (11) = 100% – Col(5) – Col(8)
Col (12) = (3)(5) + (6)(8) + (10)(11)
Col (13): relativity to Territory B

19. Continued

(c) Recommend three approaches to increase the stability of risk class relativities.

Any three of the following are acceptable:

- Use capped claims instead of total claims.
- Use the territory with the highest exposure for the base relativity.
- Use a longer experience period.
- Increase the credibility standard (give more weight to the industry).
- Give greater weight to existing relativities.
- Use statistical tools to assess predictive stability.

20. Learning Objectives:

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

Learning Outcomes:

(5d) Calculate loadings for catastrophes and large claims.

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 30.

Commentary on Question:

This question tests the understanding of claim loadings for ratemaking.

Solution:

(a) Describe the difference between large claims and catastrophe claims.

Catastrophes typically result in a significant number of GI claims for multiple insurers providing coverage in the area affected by the event.

Large claims do not typically affect the entire GI industry, or even all GI companies operating in a specific area, but rather one or only a few policyholders for one insurer.

(b) Calculate the hail loading for State X expressed as a claim ratio.

Average accident date in forecast period = June 1, 2016.
Trending period for accident year 2014 is from July 1, 2014 to June 1, 2016, or 23 months.

	Average Accident Date					
Accident Year	Experience Period	Forecast Period	# of months trend	Severity Trend at 7%	Hail Ultimate Claims	Trended Hail Ultimate Claims
2010	July 1, 2010	June 1, 2016	71	1.4923	111,000	165,644
2014	July 1, 2014	June 1, 2016	23	1.1385	550,000	626,155
						791,799

20. Continued

(1)	Selected hail ultimate claims	791,799
(2)	Total earned house years 2010 through 2014	72,452
(3)	Trended pure premium for hail claims (1) / (2)	10.929
(4)	CY 2014 earned house years	14,850
(5)	Hail expected claims (3)(4)	162,290
(6)	CY 2014 trended earned premium at current rate level	10,335,000
(7)	Catastrophe hail loading expressed as a claim ratio (5) / (6)	1.57%

(c) Recommend the catastrophe hail loading for State X. Justify your answer.

- The experience in State X does not seem credible and could be ignored.
- The model matches the insurance experience when the exposure is significant, suggesting a reasonable model.
- Therefore, the model estimate for X of 3.4% is reasonable.