GIIRR Model Solutions
Fall 2017

1.

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

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

Sources:
Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapter 11.

Commentary on Question:
This question tests the candidate's understanding of written premiums, earned premiums, unearned premiums, and in-force premiums.

Solution:
(a) Calculate written premium for calendar years 2015 and 2016.

		(1)	(2)	(3)	(4) = (1)(2)	(5) = (1)(3)
			% Written in		Written Premium	
Effective Date	Policy Term	Premium	Calendar Year 2015	Calendar Year 2016	Calendar Year 2015	Calendar Year 2016
Apr. 1, 2014	2-year	4,000	0%	0%	0	0
Jan. 1, 2015	1-year	7,000	100%	0%	7,000	0
Apr. 1, 2015	2-year	8,000	100%	0%	8,000	0
Oct. 1, 2015	6-month	6,000	100%	0%	6,000	0
Feb. 1, 2016	1-year	6,000	0%	100%	0	6,000
Total					21,000	6,000

1. Continued

(b) Calculate earned premium for calendar years 2015 and 2016.

		(1)	(2)	(3)	(4) = (1)(2)	(5) = (1)(3)
			% Earned in		Earned Premium	
Effective Date	Policy Term	Premium	Calendar Year 2015	Calendar Year 2016	Calendar Year 2015	Calendar Year 2016
Apr. 1, 2014	2-year	4,000	50.0%	12.5%	2,000	500
Jan. 1, 2015	1-year	7,000	100.0%	0.0%	7,000	0
Apr. 1, 2015	2-year	8,000	37.5%	50.0%	3,000	4,000
Oct. 1, 2015	6-month	6,000	50.0%	50.0%	3,000	3,000
Feb. 1, 2016	1-year	6,000	0.0%	91.67%	0	5,500
Total					15,000	13,000

(c) Calculate the unearned premium at December 31, 2016.

Only the third and fifth policies have unearned premiums as of December 31, 2016.

Unearned premium = (3/24)(8,000) + (1/12)(6,000) = 1,500

(d) Calculate the in-force premiums at January 1, 2016.

The first, third and fourth policies are in-force on January 1, 2016:

In-force premiums at January 1, 2016 = 4,000 + 8,000 + 6,000 = 18,000

(e) Explain why earned premium might be different if ABC wrote motorcycle policies in a winter climate instead of general liability policies.

Motorcycles written in a winter climate would typically only have exposure to loss in the spring, summer and fall months. As a result, the insurer might recognize this difference by modifying the even earnings throughout the policy term.

2. 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.

(5i) Calculate rates for large accounts.

Sources:

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

Commentary on Question:

This question tests the candidate's understanding of deductibles.

Solution:

(a) Define the following terms:

(i) Morale Hazard

(ii) Risk Control

(i) An insured's indifference to loss because they have insurance protection.

(ii) Any process, procedure or method that manages risk.

(b) State how a deductible can limit losses to an insurer for each term in part (a).

(i) Morale Hazard: A deductible which is paid by the insured would reduce this indifference.

(ii) Risk Control: A deductible can encourage loss control measures because the insured retains some of the loss; they have a financial incentive to minimize losses.

(c) State two other ways in which a deductible can limit loss exposure to an insurer.

- Eliminate the processing costs associated with small claims
- Reduce exposure to catastrophic claims

2. Continued

(d) Explain two alternative deductible applications for a 10,000 per claim deductible.

Alternative 1: Assumes all losses submitted to insurer are one claim
Result: 10,000 retained by the insured, 190,000 claim to insurance company

Alternative 2: Assumes there were four tornadoes and each is considered a separate claim
Result: 40,000 retained by the insured, 160,000 claim to insurance company

(e) Calculate the losses retained by the insured and the insurer's claims for each deductible shown below, stating any assumptions.

(i) 10,000 per occurrence

(ii) 10,000 per location

10,000 Per Occurrence:
10,000 retained by the insured, 190,000 claim to insurance company
Assumes all losses resulting from the hurricane are one occurrence.

10,000 Per Location:
40,000 retained by the insured, 160,000 claim to insurance company
(10,000 per restaurant = 40,000 total)

(f) Explain why aggregate deductibles are more common for commercial insureds than for individual insureds.

Commercial insureds are exposed to multiple incidents within a policy year which can result in multiple claims. Individuals are less likely to have multiple incidents within a policy year.

(g) Describe how each of the following typically affect policy limits:

(i) A large deductible

(ii) A self-insured retention (SIR)

(i) Deductibles typically erode the limit – the claim amount is the policy limit less the deductible.

(ii) The SIR does not erode the limit. The insured claim is the policy limit after the SIR has been applied.

2. Continued

(h) Calculate the amount retained by the insured and the insurer's claims for each of the following:

(i) Large deductible of 100,000

(ii) SIR of 100,000

(i) 200,000 retained by insured, 900,000 claim to insurance company. Insured retains the first 100,000 for the deductible. The deductible erodes the policy limit, so the insurer pays the next 900,000 in claims. The insured is responsible for the remaining 100,000 of loss.

(ii) 100,000 retained by insured, 1,000,000 claim to insurance company. The SIR does not erode the policy limit.

3. 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 18.

Commentary on Question:

This question tests the estimation of ultimate claims using the Cape Cod method.

Solution:

(a) Explain the difference between inputs to the Bornhuetter Ferguson method and the Cape Cod method.

The expected value for Bornhuetter Ferguson method is based on an independent a priori estimate which can incorporate significant professional judgement.

The expected value for Cape Cod method is based on trended historical experience. No judgment is involved.

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

	(1)	(2)	(3) = 1/(2)	(4) = (1)(3)
Accident Year	On-Level Earned Premium	Reported Cumulative Development Factors	Expected Percent Reported	Used-Up On-Level Earned Premium
2014	16,700	1.40	0.7143	11,929
2015	16,200	2.00	0.5000	8,100
2016	15,800	4.50	0.2222	3,511
Total				23,540

3. **Continued**

	(5)	(6)	(7)	(8) = (5)(6)(7)	(9) = [(1)(A)] / [(6)(7)]
		Claim Adjustment Factors			
Accident Year	Reported Claims	Trend at 2%	Tort Reform	Adjusted Claims	Expected Claims
2014	8,200	1.0404	0.95	8,105	11,574
2015	5,700	1.0200	0.95	5,523	11,452
2016	2,500	1.0000	1.00	2,500	10,823
Total				16,128	33,849

Adjusted Expected Claim Ratio = 16,128/23,540 = 68.5% (A)

	(10) = 1 − (3)	(11) = (9)(10)	(12) = (5) + (11)
Accident Year	Expected Percent Unreported	Expected Unreported Claims	Projected Ultimate Claims
2014	0.2857	3,307	11,507
2015	0.5000	5,726	11,426
2016	0.7778	8,418	10,918

(c) Calculate the accident year 2016 IBNR using the Generalized Cape Cod method and a decay factor of 0%.

If decay is 0, the Generalized Cape Cod method returns the development method because all other accident years receive a weight of zero and only the current accident year enters the calculation.

Accident year 2016 IBNR from development method:
= (2,500×4.500) – 2,500 = 8,750

4. **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 risk financing for catastrophe losses.

Solution:

(a) State three alternatives to reinsurance that R30 might consider to improve its risk/return profile.

Any three of the following are acceptable:

- maintaining a cash or other liquid reserve
- borrowing
- issuing debt
- issuing equity
- securitization

(b) Calculate the risk and return measures for both of the reinsurance schemes.

Scheme (i):

$P_{MEB} = 1.3[15(0.08) + 30(0.06) + 60(0.04) + 125(0.02)] = 1.3(7.9) = 10.27$

$\text{Risk} = \Pr(10.27 + L_{R30} > 150) = 0.04 + 0.02 = 0.06$

$E[L_{R30}] = 25(0.8) + 115(0.08) + 130(0.06) + 160(0.04) + 225(0.02) = 47.90$

$\text{Return} = 100 – 10.27 – 47.9 = 41.83$

Scheme (ii):

$P_{MEB} = 1.3[20(0.04) + 150(0.02)] = 1.3(3.8) = 4.94$

$\text{Risk} = \Pr(4.94 + L_{R30} > 150) = 0.06 + 0.04 + 0.02 = 0.12$

$E[L_{R30}] = 25(0.8) + 130(0.08) + 160(0.06) + 200(0.04) + 200(0.02) = 52$

$\text{Return} = 100 – 4.94 – 52 = 43.06$

4. **Continued**

(c) Determine, using an efficient-frontier approach, which, if either, of the two reinsurance schemes present viable options for R30.

Compared to no reinsurance, scheme (i) has lower return and lower risk, and is therefore viable.

Compared to no reinsurance, scheme (ii) has lower return but the same risk, and is therefore not viable.

5. 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.

Learning Outcomes:

(2c) Estimate claims-related expenses and recoveries.

(3a) Describe the key assumptions underlying ratio and count-based methods for estimating unpaid unallocated loss adjustment expenses.

Sources:

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

Commentary on Question:

This question tests the candidate's understanding of estimating unpaid ULAE.

Solution:

(a) Describe why unallocated loss adjustment expenses (ULAE) are usually analyzed on a calendar year basis.

ULAE expenses are not usually allocated or assigned to a specific claim. Therefore, ULAE cannot be tracked on an accident year basis.

(b) Describe an approach you would use to estimate unpaid ULAE if you believed that carried claim reserves might be low or inadequate.

Either of the following options are acceptable:

- Use the Wendy Johnson method because it is a count-based/transaction-based method so it will not be distorted by inadequate carried reserves.
- Use the classical paid-to-paid method to estimate a ULAE ratio so it is not affected by reserves and apply it to indicated reserves rather than carried reserves.

(c) Provide two disadvantages of using a classical paid-to-paid method to estimate unpaid ULAE for RIC.

Any two of the following are acceptable:

- It overestimates unpaid ULAE for a growing company.
- It overestimates unpaid ULAE in an inflationary environment.
- Historical ratio may not be appropriate due to new system change.
- Classical paid-to-paid method assumes 50% of expenses relate to opening a claim and 50% relate to maintaining & closing a claim. This is not the case for RIC.

5. **Continued**

(d) Calculate unpaid ULAE as of December 31, 2016 using the Kittel refinement to the classical paid-to-paid method.

	(1)	(2)	(3) = 0.5[(1)+(2)]
	Ratio of Paid ULAE to Claims		
Calendar Year	Gross Paid Claims	Gross Reported Claims	Kittel Method
2014	14.4%	13.2%	13.80%
2015	10.7%	11.8%	11.25%
2016	11.3%	9.8%	10.55%
Total	12.0%	11.5%	11.75%
Selected:			***10.55%***

The Kittel method uses an average of the paid-to-paid ratio and the paid-to-reported ratio.

Selected ratio is based on calendar year 2016 to reflect the decreasing trend.

Unpaid ULAE = (ULAE ratio × IBNR) + (ULAE ratio × multiplier × case estimates)
= (ULAE ratio × IBNYR) + [ULAE ratio × multiplier × (case estimates + IBNER)]
= (0.1055×2,500) + [0.1055×0.60×(15,300+10,000)] = 1,865
(gross unpaid claims are used)

(e) Describe the input for the Mango and Allen smoothing adjustment.

The ULAE ratio is determined as paid ULAE to expected paid claims (and/or reported claims) rather than actual claims.

(f) Provide two reasons to justify using a Mango and Allen smoothing adjustment in this case.

Any two of the following are acceptable:

- Mango & Allen is advantageous for long-tail lines of business which this is (i.e., line of business is professional liability).
- Mango & Allen is advantageous for a changing exposure volume which this is (i.e., RIC is a growing company).
- Mango & Allen is advantageous when data is volatile which this is (i.e., downward trend in ratios).
- Mango & Allen replaces actual claims with expected claims, so it's a good method anytime actual claims may include a distortion or volatility.

6. 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.
(4e) Choose trend rates and calculate trend factors for exposures.
(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 candidate's understanding of expenses used for ratemaking, including trending of fixed expenses.

Solution:

(a) Explain how a premium-based expense ratio analysis may be distorted if countrywide expense ratios are used to project fixed expenses for State X.

If a significant variation exists in average rates across the states, a disproportionate share of projected fixed expenses will be allocated to the higher-than-average premium states. Thus, the estimated fixed expenses will be overstated in higher-than-average premium states and understated in the lower-than-average premium states.

(b) Assess the reasonableness of using the publicly available cost index for this line of business by comparing it with the historical trend in fixed expenses.

Calendar Year	Fixed Expense per On-Level Earned Premium	Change in Fixed Expense per On-Level Earned Premium
2013	4.20%	
2014	4.58%	9.05%
2015	4.95%	8.08%
2016	5.38%	8.69%

Assessment: Due to the company trend being so much higher, the publicly available cost index is likely not reasonable as it is too low.

6. **Continued**

(c) Recommend the annual fixed expense trend. Justify your recommendation.

Recommend 8.6%, based on all year average.

Justification: Since there are no outliers, the average is reasonable. Publicly available cost index is too different, indicating that company data should be given more weight.

(d) Calculate the fixed expense ratio to be used in ratemaking, based on the average of 2015 and 2016.

Commentary on Question:
Candidates can alternatively trend the fixed expense ratios calculated in part (b) to determine the fixed expense ratio to be used in ratemaking.

	(1)	(2)	(3) = from (1) to (2)	(4) = $1.086^{(3)}$	(5) = (4)(Fixed Expenses)	(6) = (5) / (On-Level Earned Premium)
	Average Incurred Date					
Calendar Year	Experience Period	Forecast Period	Trend Period (years)	Trend Factors	Trended Fixed Expenses	Fixed Expense per On-Level Earned Premium
2015	7/1/2015	1/1/2019	42/12	1.3348	66,740	6.61%
2016	7/1/2016	1/1/2019	30/12	1.2291	61,455	6.62%
					Average	6.62%

Notes:

- trend from average incurred date (midpoint of each year)
- trend to average incurred date in forecast period (average date between April 1, 2018 to 6 months after March 31, 2019, or 9 months after April 1, 2018)

7. 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 (2b).

(2e) Assess the appropriateness of the projection methods cited in (2b) in varying circumstances.

Sources:

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

Commentary on Question:

This question tests the candidate's understanding of changing conditions on different projection methods.

Solution:

(a) Explain how each of the following methods is likely to be affected by each of the recent changes at Old Co:

(i) Expected method

(ii) Reported development method

(iii) Reported Bornhuetter Ferguson method

(i) Expected method:
- Increased claim ratio: this method is not responsive, unless expected claim ratio changes, therefore it will underestimate ultimate claims
- Volume increase: this method is responsive
- Change in reporting pattern: this method is not responsive, but the results will be reasonable if expected ultimate claims ratio is correct

(ii) Reported development method:
- Increased claim ratio: this method should be responsive to changing claim ratio
- Volume increase: this method should be responsive to a volume increase
- Change in reporting pattern: this method will distort the factors and under estimate ultimate claims

7. Continued

(iii) Reported Bornhuetter Ferguson method:

- Increased claim ratio: the changing claim ratio is only reflected to extent it is already reflected in reported claims – the IBNR will be understated
- Volume increase: this method should be responsive to this, though increasing volume will increase understatement from claims ratio effect
- Change in reporting pattern: this method will distort factors, and under estimate ultimate claims, but not as much as reported development

All three methods will underestimate ultimate claims.

(b) Provide two reasons why actuaries use multiple methods to estimate ultimate claims.

Any two of the following are acceptable:

- Required by actuarial standards
- Each method has different underlying assumptions, none of which are usually perfectly true
- To allow the results of different methods to be compared
- To better reflect the complexities of the business being modelled
- To identify sensitivity to the underlying assumptions

(c) Explain whether or not the reported Cape Cod method is likely to produce a more accurate estimate than the reported Bornhuetter Ferguson based on the recent changes at Old Co.

- Increased claim ratio: the reported Cape Cod method is better than Bornhuetter Ferguson method, since past experience will adjust expected future claim ratio. It will underestimate ultimate claims by less.
- Volume increase: the reported Cape Cod method is the same as Bornhuetter Ferguson method
- Change in reporting pattern: the reported Cape Cod method is worse than the Bornhuetter Ferguson method, influenced by reporting factors more

On balance, the change in reporting factors seems to be larger than change in claim ratio and therefore suspect reported Cape Cod method will be overall worse than the Bornhuetter Ferguson method (i.e., underestimate more).

8. **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 14 and 19.

Commentary on Question:

This question tests the candidate's ability to estimate ultimate claims using Berquist-Sherman adjustments when there has been a change in case reserve adequacy.

Solution:

(a) Recalculate the average case estimate triangle, eliminating the effects of the settlement.

Calculate case estimates affected by the class action settlement:
Outstanding accident year (AY) 2014 @ 24 months = Reported AY 2014 @ 24 months – Paid AY 2014 @ 24 months = 84,000 – 52,500 = 31,500
Outstanding AY 2015 @ 12 months = Reported AY 2015 @ 12 months – Paid AY 2015 @ 12 months = 87,800 – 33,800 = 54,000

Calculate the class action settlement:
Settlement AY 2014 @ 24 months = 31,500 × 50% / 150% = 10,500
Settlement AY 2015 @ 12 months = 54,000 × 50% / 150% = 18,000

Recalculate case estimates:
Outstanding AY 2014 @ 24 months = 31,500 – 10,500 = 21,000
Outstanding AY 2015 @ 12 months = 54,000 – 18,000 = 36,000

Recalculate the average outstanding claim:
AY 2014 @ 24 months = 21,000 / 170 = 124
AY 2015 @ 12 months = 36,000 / 200 = 180

Accident	Revised Average Case Estimate		
Year	12	24	36
2014	166	*124*	158
2015	*180*	187	
2016	232		

8. Continued

(b) Explain whether the recalculated average case estimate triangle provides any evidence for or against the claims manager's suspicion.

The average case estimates are increasing in the last calendar year (diagonal) at a rate much greater than severity trend. This suggests a possible increase in case reserve adequacy.

(c) Calculate the adjusted reported claims triangle, excluding the effects of the settlement.

Adjusted Average Case = Selected Last Diagonal from part (a), trended to each AY at 6%:

AY	12	24	36
2014	207	176	158
2015	219	187	
2016	232		

e.g., 219 = 232 / 1.06

Adjusted Case = Adjusted Average Case Estimate × Outstanding Counts:

AY	12	24	36
2014	39,330	29,920	15,800
2015	43,800	33,660	
2016	48,720		

e.g., 43,800 = 219 × 200

Adjustment to Paid for Settlement

AY	12	24	36
2014			(10,500)
2015		(18,000)	
2016			

Adjusted Reported, excluding Settlement = Adjusted Case + Paid + Adjustment to Paid for Settlement

AY	12	24	36
2014	70,830	82,420	99,800
2015	77,600	89,960	
2016	85,220		

e.g., 89,960 = 33,660 + 74,300 – 18,000

8. **Continued**

(d) Calculate the indicated IBNR for accident years 2014 through 2016 using the reported development method and the adjusted reported claims triangle from part (c).

Development Factors

AY	12 to 24	24 to 36	36 to Ultimate
2014	1.164	1.211	
2015	1.159		
2016			
Average	1.162	1.211	1.050
Factor to Ultimate	1.478	1.272	1.050

e.g.,
1.164 = 82,420 / 70,830
1.211 = 99,800 / 82,420
1.159 = 89,960 / 77,600

	(1)	(2)	(3) = (1)(2)	(4) = (3) – (2)
AY	Factor to Ultimate	Reported Claims	Ultimate Claims	IBNR
2014	1.050	99,800	104,790	4,990
2015	1.272	89,960	114,429	24,469
2016	1.478	85,220	125,955	40,735

9. **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.

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.

(3d) Evaluate the estimates of ultimate claims to determine claim liabilities for financial reporting.

Sources:

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

Commentary on Question:

This question tests the estimation of ultimate allocated loss adjustment expenses (ALAE) using the expected method and the Bornhuetter Ferguson method. This question also tests the estimation of IBNR for ALAE.

Solution:

(a) Calculate the projected RY 2016 ultimate ALAE using the expected method.

	(1)	(2)	(3) = (2) / (1)	(4)	(5) = (3)(4)
Report Year	Earned Exposures	Projected Ultimate ALAE Based on Reported Development Method	Pure Premium	Trend Factors	Trended Pure Premium
2013	480	26,000	54.17	1.0927	59.19
2014	500	28,500	57.00	1.0609	60.47
2015	520	32,000	61.54	1.0300	63.39
2016	550	28,000	50.91	1.0000	50.91

Average (2013-2015)	61.02
Selected pure premium	61.00
2016 ultimate ALAE = 550 × 61.00 =	33,550

Note: (4) Trend factors use the annual claim trend trended to report year 2016 (i.e., $1.03^3 = 1.0927$).

9. **Continued**

(b) Calculate the projected RY 2016 ratio of ultimate ALAE to ultimate claims using the Bornhuetter Ferguson method and your results from part (a).

RY 2016 expected ultimate ALAE to ultimate claim ratio = 33,550 / 516,040 =	0.065
IBNR Factor = 1 – 1/0.922 =	–0.085
RY 2016 Bornhuetter Ferguson ultimate ALAE ratio = 0.067 + 0.065×–0.085 =	0.062

(c) Evaluate the reasonableness of the inputs for the Bornhuetter Ferguson method in part (b) by comparing the actual reported ALAE ratio to the expected ALAE ratio.

Actual reported ALAE ratio =	0.067
Expected ultimate ALAE ratio =	0.065
Expected percent reported = 1 / 0.922 =	1.085
Expected reported ALAE ratio = 0.065 × 1.085 =	0.071
Actual minus expected difference = 0.067 – 0.071 =	–0.004
Difference as a percent of expected ultimate ALAE ratio = –0.004 / 0.065 =	–6.2%

(d) Calculate the RY 2016 IBNR for ALAE using your results from part (b).

RY 2016 expected ultimate claims =	516,040
RY 2016 ultimate ALAE ratio from Bornhuetter Ferguson method =	0.062
RY 2016 Ultimate ALAE = 516,040×0.062 =	31,994
RY 2016 actual reported ALAE = 420,000×0.067 =	28,140
RY 2016 ALAE IBNR = 31,994 – 28,140 =	3,854

10. 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.

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

(4c) Choose trend rates and calculate trend factors for claims.

Sources:

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

Commentary on Question:

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

Solution:

(a) Calculate the annual change in severity for each year.

	(1)	(2)	(3)	(4) = (1)/(2)	(5)
Accident Year	Ultimate Claims Based on Development Method	Ultimate Counts Based on Development Method	Earned Exposures	Severity	Change in Severity
2012	1,602,000	172	2,200	9,314	
2013	1,745,000	179	2,300	9,749	4.67%
2014	1,828,000	185	2,400	9,881	1.36%
2015	1,940,000	188	2,400	10,319	4.43%
2016	2,302,000	203	2,600	11,340	9.89%

e.g., 4.67% = 9,749/9,314 – 1

10. Continued

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

All year average = 5.09%. Recommend 5% annual severity trend. Rationale is that the historical changes are somewhat erratic. The 2016 number is possibly influenced by highly leveraged development factors so not too much weight should be given to 2016. As a result, a trend similar to the average of all years is reasonable.

(c) Calculate the ultimate claims for accident year 2015 using the development based frequency-severity method.

	(4)	(6)	(7) = (4)(6)	(8) = (2)/(3)	(9)	(10)	(11) = (9)(10)
Accident Year	Severity	Severity Trend at 5.0%	Trended Severity	Indicated Frequency	Selected Ultimate Severity	Selected Ultimate Counts	Ultimate Claims
2012	9,314	1.2155	11,321	0.0782			
2013	9,749	1.1576	11,285	0.0778			
2014	9,881	1.1025	10,894	0.0771			
2015	10,319	1.0500	10,835	0.0783	10,556	187	1,973,972
2016	11,340	1.0000	11,340	0.0781			
Selection (average excl. 2016)			11,084	0.0779			

Notes: (9) = 10,556 = 11,084 / 1.05
(10) = (3) × Selected Frequency = 2,400×0.0779

11. **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 16.

Commentary on Question:

This question tests the estimation of ultimate claims using the expected method.

Solution:

(a) Recommend the 2016 cost and rate level expected claim ratio to be used to estimate expected claims. Justify your recommendation.

	(1)	(2)	(3)	(4)	(5)	(6) = [(2)(3)(4)] / [(1)(5)]
Accident Year	Earned Premium	Projected Ultimate Claims from Development Method	Trend Factor	Tort Reform	Premium On-Level Factors	Trended On-Level Claim Ratio
2013	12,000	11,000	1.077	0.75	1.10	67.31%
2014	15,000	10,000	1.051	1.00	1.06	66.08%
2015	14,000	9,000	1.025	1.00	1.04	63.36%
2016	11,000	8,000	1.000	1.00	1.00	72.73%

Average of 2013-2015 = 65.6%.
Recommend claim ratio of 65.6%. 2016 is highly leveraged so this accident year should be excluded.

(b) Calculate the accident year 2015 expected claims.

AY 2015 expected claim ratio = 65.6% × 1.04 / (1.025 × 1.00) = 66.6%
AY 2015 expected claims = 66.6% × 14,000 = 9,324

(c) Explain how a development factor can highly leverage a projection.

Cumulative development factors are highly leveraged in the most immature time periods and affect the most recent year's calculation.

11. Continued

(d) Explain how a trend factor can highly leverage a projection.

Trend factors are highly leveraged in the oldest time periods and affect the oldest year's calculation.

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:

(4e) Choose trend rates and calculate trend factors for exposures.

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

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 26 and 33.

Commentary on Question:

This question tests the fundamental trend adjustments to premium as well as an understanding of deductibles.

Solution:

(a) State two reasons why an insurer would want to encourage insureds to increase their deductibles.

Any two of the following are acceptable (other answers are possible):

- Assist in reducing moral and morale hazard
- Encourage insureds to adhere to some measure of risk control
- Eliminate the processing costs associated with small claims
- Reduce exposure to catastrophic claims

(b) Calculate the annual change in premium for each year.

	Current	% Earned Exposures by Deductible				
Deductible	Differentials	2012	2013	2014	2015	2016
200	1.10	50%	45%	20%	18%	15%
500	1.00	30%	32%	55%	52%	50%
1,000	0.90	20%	23%	25%	30%	35%
Total		100%	100%	100%	100%	100%
Weighted average differential		1.030[(1)]	1.022	0.995	0.988	0.980
Change in average differential			–0.78%[(2)]	–2.64%	–0.70%	–0.81%

Notes: (1): $(0.50\times1.10 + 0.30\times1.00 + 0.20\times0.90) = 1.030$

(2): $1.022 / 1.030 - 1 = -0.78\%$

12. Continued

(c) Recommend the annual premium trend rate to use in adjusting from calendar year 2016 to the future rating period. Justify your recommendation.

2014 needs to be excluded due to the one-time initiative to encourage insureds to increase their deductibles from 200 to 500. This is not expected in the future and should not be considered in the recommended annual premium trend rate. Recommend the average of 2013, 2015 and 2016 = –0.76%.

(d) Calculate the calendar year 2012 earned premium to use for ratemaking.

Trend from experience period in 2012 to forecast period in 2016 (trend period 1), and then from forecast period in 2016 to forecast period in future rating period (trend period 2).

Trend period 1: from average earned date in 2012 to average earned date in 2016 (July 1, 2012 to July 1, 2016):

(1) Weighted average differential in 2012:	1.030
(2) Weighted average differential in 2016:	0.980
(3) Trend factor from 2012 to 2016 [(2) / (1)] =	0.9515

Trend Period 2: from average earned date in 2016 to future rating period

(4) Average earned date in CY 2016:	1-Jul-16
(5) Average earned date in future rating period:	1-Sep-18
(6) Trending period (months):	26
(7) Trend factor = $(1 + -0.0076)^{(26/12)}$ =	0.9836
(8) 2012 Earned Premium @ current rate level	240,000

(9) Total 2012 trended on level EP = (8)(3)(7)
= 240,000×0.9515×0.9836 = 224,615

13. 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.

Sources:

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

Commentary on Question:

This question is concerned with identifying potential issues with data triangles and what diagnostic tests can be used on data triangles.

Solution:

(a) Explain three ways a development triangle can be useful in investigative testing.

Any three of the following are acceptable:

- Compare reasonableness of year to year, between types of data.
- Help with identification of data quality issues.
- Source of documentation required for information gathering phase.
- Reasonableness of management's assertions on company's operations.
- Determine if the qualitative information is consistent with the patterns observed in the quantitative data.
- Leads to further questions to identify additional data or information needs.

(b) Explain the value of each of the following additional investigative tests in analyzing claims data:

(i) Ratio of closed counts to reported counts

(ii) Ratio of counts closed with no payment to closed counts

(iii) Average case estimates

(i) Ratio of closed counts to reported counts:
This triangle is used to see if there are similar trends between counts and amounts when looked in in combination with paid claims to reported claims. It can indicate a possible claims processing backlog.

(ii) Ratio of counts closed with no payment to closed counts:
This triangle can be used to help identify changes in settlement practices, and look for stability in ratios.

13. **Continued**

(iii) Average case estimates:
This triangle can be used to determine if there have been changes in the overall adequacy of case estimates, recognizing that large claims can distort any change.

(c) Identify two anomalies in the ratio of paid claims to reported claims triangle that might require further investigation.

Commentary on Question:
Other anomalies are possible.

- The 12 month trend is increasing (down the column) while all others are decreasing.
- Across the rows, claims are being paid out faster in 2014 and 2015 than 2013.

(d) Identify two anomalies in the average reported claims triangle that might require further investigation.

Commentary on Question:
Other anomalies are possible.

- 2014 seems to be low across the durations, suggesting there might be something unique to this year.
- There is an outlier possible in 2016 at 12 months, suggesting possible large claim(s).

14. 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.
(4c) Choose trend rates and calculate trend factors for claims.
(5d) Calculate loadings for catastrophes and large claims.
(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, 30, and 31.

Commentary on Question:

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

Solution:

(a) Calculate a loading for ice storm claims to use in your ratemaking analysis.

Trending period for ice storm claims: trend from date of ice storm to average accident date in rating period (average date between November 1, 2017 and May 1, 2019) = March 1, 2014 to August 1, 2018 = 53 months, or 4.417 years

(1) Trended ultimate ice storm claims = 2,350,000×(1+0.04)$^{(53/12)}$ = 2,794,464
(2) Total earned exposures over the 5 years = 41,300
(3) Trended ultimate ice storm claims pure premium =(1) / (2) = 67.663
(4) Ice storm pure premium for ratemaking = (3) / 2 = 33.832
{Spread the 5 year pure premium over 10 years as the question states these types of events are expected every 10 years}
(5) 2016 earned exposures = 8,600
(6) Ice storm expected claims = (4)(5) = 33.832×8,600 = 290,955
(7) Trended 2016 earned premium at current rates = 8,730,000
(8) Ice storm loading as a claim ratio = (6) / (7) = 3.33%

14. **Continued**

(b) Calculate the indicated rate level change based on the latest three years' experience.

Pure premium trend = (1 + 0.04)(1 – 0.01) – 1 = 2.96%

	(9)	(10) = $(1.0296)^{(9)}$	(11)	(12) = (10)×Ultimate Claims	(13) = (12)/(11)
Accident Year	Trend Period	Pure Premium Trend Factors	Trended Earned Premium at Current Rate Level	Trended Ultimate Claims excluding Ice Storm	Claim Ratio
2014	4.0833	1.1265	8,430,000	6,297,135	74.7%
2015	3.0833	1.0941	8,630,000	6,488,013	75.2%
2016	2.0833	1.0627	8,730,000	6,142,406	70.4%
Total			25,790,000	18,927,554	73.4%

(14) Selected claim ratio = 73.4%
(8) Ice storm claim ratio (from part (a)) = 3.33%
(15) ULAE = 8% (given)
(16) Total claim ratio including ULAE = [(14) + (8)]×[1 + (15)] = 82.87%
(17) Indicated rate level change = [(16) + 0.04] / (1 – 0.19 – 0.05) – 1 = 14.30%

Notes: (9) Trend Period = July 1 each year to August 1, 2018
(12) AY 2014 trended ultimate claims excludes ultimate ice storm claims

15. 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 the candidate's understanding of risk classification.

Solution:

(a) Describe how an effective risk classification system can assist an insurance system in achieving the criterion noted above.

An effective risk classification system can reduce adverse selection, which facilitates estimation of cost and its variation.

(b) Define distributional bias in the context of risk classification systems, including a numerical example with a 2×2 risk classification matrix.

Commentary on Question:

Any example that demonstrates distributional bias can be used.

Distributional bias occurs when there are differences in the distribution of exposures by risk characteristic between risk classes. For example, male drivers may represent a larger percentage of young drivers than they do of old drivers.

Numerical example:

Number of Exposures

	Old	Young
Male	100	200
Female	200	300

Ratio of male to female:

Old	0.50
Young	0.67

The ratios are not the same; therefore there is distributional bias.

15. Continued

(c) Define dependence in the context of risk classification systems, including a numerical example with a 2×2 risk classification matrix.

Commentary on Question:
Any example that demonstrates dependence can be used.

Dependence occurs when knowing the risk class of an insured within one risk characteristic changes the true relativities for the risk classes in another risk characteristic from what they would be without that knowledge. For example, the ratio of pure premium for male drivers to the pure premium for female drivers may be different for young drivers than old drivers.

Numerical example:

Pure Premium

	Old	Young
Male	50	100
Female	50	50

Ratio of male to female:	
Old	1.0
Young	2.0

The ratios are not the same; therefore there is dependence.

(d) Describe an approach that can be used to resolve:

(i) Distributional bias in the context of risk classification systems

(ii) Dependence in the context of risk classification systems

(i) The minimum bias procedure can correct for distributional bias.

(ii) An alternative model is needed for dependence. One possibility would be to calculate pure premium directly for each cell.

16. **Learning Objectives:**

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

Learning Outcomes:

(5i) Calculate rates for large accounts.

Sources:

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

Commentary on Question:

This question tests the candidate's understanding of funding allocation for self-insurers.

Solution:

(a) State two reasons why a group of schools might want to self-insure their risk.

Any two of the following are acceptable:

- Dissatisfaction with existing insurance coverage or costs
- Reduction in long-term costs
- Need for tailor-made solutions to address unique exposures to risk
- Ability to improve and enhance risk management operations
- Increased control over the risk financing function

(b) Provide an example of an experience rating program objective that might conflict with each of the following objectives of a self-insurance program:

(i) Stability in the allocations from year-to-year

(ii) An allocation formula that is simple to apply and easy to understand

(i) Experience rating formulas that hold insureds responsible for claims may not produce stable results.

(ii) A program that promotes equity among insureds may not be easy to understand.

16. **Continued**

(c) Explain which approach would result in an allocation that would satisfy each of the following objectives of the self-insurance program:

(i) Stability of year-to-year allocation

(ii) Encourage the schools to participate in risk control activities

(i) Using capped losses over a longer experience period are ways to produce a more stable allocation. Therefore, recommend using limited losses over 5 years.

(ii) Recommend using claim count percentage in this calculation because it measures the actual experience of each school.

(d) Calculate next year's allocation using the allocation base from part (c)(i).

Limited Claims Last 5 years

School	Credibility	Experience Modification	Allocation
1	0.45	1.225	25.6%
2	0.50	1.100	28.7%
3	0.75	0.795	45.7%

Notes: Credibility (Z) = Squareroot(Payroll / 40,000)
Experience Modification = Z×(Limited Claims Last 3 Years % of Total)/(Payroll % of Total) + (1 – Z)
e.g., 1.225 = 0.45×0.30/0.20 + (1 – 0.45)
Allocation = (Experience Modification)(Payroll % of Total) / Sumproduct(Experience Modifications, Payroll %'s of Total)
e.g., 25.6% = (1.225×0.20) / (1.225×0.20 + 1.100×0.25 + 0.795×0.55)

(e) Explain how the allocation for School X is affected by this change in credibility.

By making the minimum credibility = 0.5, the full credibility standard would decrease. This would increase the credibility for school 1, which would assign more weight to the experience mod factor that is greater than 1, which increases the allocation.

17. **Learning Objectives:**

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

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.

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

Sources:

Fundamentals of General Insurance Actuarial Analysis, J. Friedland, Chapters 14 and 36.

Commentary on Question:

This question tests the development method for estimating ultimate claims. In addition, it tests the understanding of expected paid and reported claims for an interim period between actuarial analyses.

Solution:

(a) List the next five steps of the development method.

- Calculate average age to age factors
- Select age to age factors for each maturity age interval
- Select a tail factor
- Calculate cumulative development factors
- Project ultimate values

(b) Explain one advantage and one disadvantage for each of the following approaches:

(i) Bondy method

(ii) Algebraic method

(iii) Use of benchmark data

(i) Bondy method:
Advantage: easy to understand and explain
Disadvantage: potential to greatly underestimate the remaining development for long tail lines

17. Continued

(ii) Algebraic method:
Advantage: based on data contained within the development triangles so no additional data is required
Disadvantage: a reliable estimate of ultimate claims is required for the most mature periods and is not always available

(iii) Use of benchmark data:
Advantage: significant amount of relevant and credible data
Disadvantage: requires judgement to the appropriateness of the external data

(c) Recommend a development factor and justify your recommendation.

Accident Year	Cumulative Reported Claims (000) 12	24	Development Factors (24/12)
2013	140	260	1.857
2014	230	395	1.717
2015	300	520	1.733
Simple Average			1.769
Volume Weighted Average			1.754

Recommend volume-weighted average of 1.754 because it reflects the increasing exposure volume.

(d) Describe one disadvantage of using a medial average for your development factor recommendation in part (c).

The disadvantage of medial average in this case is the development factor is selected based on a sample size of one.

(e) Describe two likely explanations for the differences between the expected and actual claims in this situation.

Any two of the following are acceptable:

- The development selections (ultimate claims) are too conservative.
- There was an issue with paid claims in the first quarter that affects paid and reported development.
- There a legal decision that affected claims in all years.

18. Learning Objectives:

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

Learning Outcomes:

(3e) Describe the components of premium liabilities in the context of financial reporting.

(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 the net premium liabilities as of December 31, 2016.

	Gross of Reinsurance	Net of Reinsurance
Unearned Premiums	15,000	10,500
Net = 15,000 × 70% (after quota share)		
Expected Claims = 15,000 × 70%	10,500	7,350
Net expected claims = 10,500 × 70%. The large claim should not be carried forward.		
Expected ULAE = 10,500 × 9.1%	956	956
Maintenance Expenses = 15,000 × 8%	1,200	1,200
Commissions are N/A because they were pre-paid	0	0
Total Claims & Expenses = Net Premium Liabilities		9,506

(b) Determine either the premium deficiency reserve or the equity in the unearned premium as of December 31, 2016 and label accordingly.

Equity in Unearned Premium = 10,500 – 9,506 = 994.
{*Equity since the number is positive*}

(c) State the purpose of a premium deficiency reserve.

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

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

Solution:

(a) Define the following terms:

(i) trigger for coverage

(ii) retroactive date

(iii) extended reporting endorsement

(iv) prior acts coverage

(i) Event that initiates coverage (for occurrence policies this is the accident date; for claims-made policies this is the report date).

(ii) The beginning of the timeframe for which occurrences are covered under claims-made policies.

(iii) The part of a claims-made policy that covers claims reported after the policy expires or is cancelled, provided that that the occurrence is during the claims-made coverage period.

(iv) The claims-made coverage for occurrences prior to the effective date of a new policy reported during the new policy period.

19. **Continued**

(b) State a formula for pure premium using notation underlying the C_{ij} cells in the table above for each of the following items:

(i) Occurrence policy for year 1

(ii) Third-year claims-made policy for year 3 with retroactive date January 1, year 3

(iii) Mature claims-made policy for report year 3

(iv) Extended reporting endorsement for mature claims-made policy effective January 1, year 2 terminating December 31, year 2

(i) $C_{0,1}+C_{1,2}+C_{2,3}+C_{3,4}+C_{4+,5}$

(ii) $C_{0,3}+C_{1,3}+C_{2,3}$

(iii) $C_{0,3}+C_{1,3}+C_{2,3}+C_{3,3}+C_{4+,3}$

(iv) $C_{1,3}+C_{2,3}+C_{3,3}+C_{4+,3}+C_{2,4}+C_{3,4}+C_{4+,4}+C_{3,5}+C_{4+,5}+C_{4+,6}$

(c) Identify the coverage gap for the following situations:

(i) First-year claims-made policy effective January 1, year 1 and second-year claims-made policy effective January 1, year 4

(ii) Occurrence policy effective January 1, year 1 and mature claims-made policy effective January 1, year 6

(i) $C_{0,2}+C_{1,2}+C_{1,3}+C_{2,3}+C_{0,3}+C_{2,4}+C_{3,4}$

(ii) $C_{0,2}+C_{0,3}+C_{1,3}+C_{0,4}+C_{1,4}+C_{2,4}+C_{0,5}+C_{1,5}+C_{2,5}+C_{3,5}$

20. 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 understanding of adjusting premium to current rate level for purpose of projecting ultimate claims as well as for ratemaking analysis.

Solution:

(a) Identify two key requirements for an insurer to be able to use the extension of exposures method.

Any two of the following are acceptable:

- Sophisticated IT systems
- Comprehensive databases of prior exposures
- No new rating variables for which there is no historical data

(b) Explain why the extension of exposures method is less valuable for commercial lines that apply experience rating and/or schedule rating.

It is much more complex to reflect adjustments from experience rating and schedule rating when trying to adjust historical premiums to the current rate level for commercial lines in an extension of exposures approach.

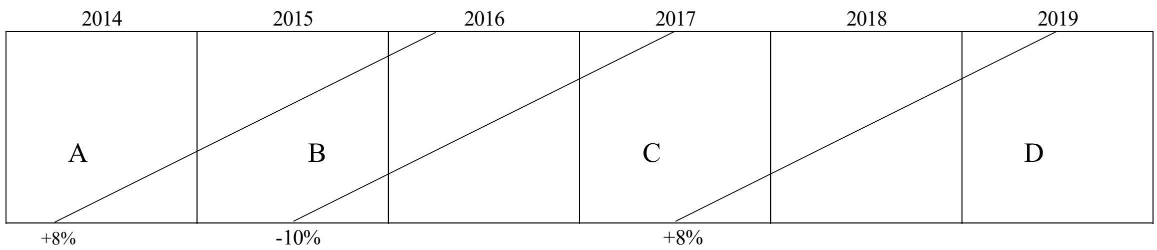
(c) Explain how the extension of exposures method could be applied to commercial lines that apply experience rating and/or schedule rating.

Use the extension of exposures method to restate historical premium at the current base rates and capture the changes over time in rating adjustments through premium trending procedures

20. Continued

(d) Calculate the weighted average rate level value for calendar year 2014.

Candidates do not need to draw diagram, but may find it helpful to solve the question.



Rate Level	Rate Level Relative Value	2014
A	1.0000	85.9375%
B	1.0800	14.0625%
C	0.9720	
D	1.0498	
Weighted average rate level		1.01125

i.e., 14.0625% = (1/2)(9/12)(4.5/12)
1.01125 = (1×0.859375) + (1.08×0.140625)

(e) Calculate the premium on-level factor for 2014 for the purpose of:

(i) Projecting ultimate claims as of December 31, 2017

(ii) Ratemaking analysis

Weighted average rate level for calendar year 2017:

Rate Level	Rate Level Relative Value	2017
A	1.0000	
B	1.0800	6.25%
C	0.9720	87.50%
D	1.0498	6.25%
Weighted average rate level		0.98361

i.e., 0.98361 = (1.08×0.0625) + (0.972×0.875) + (1.0498×0.0625)

20. **Continued**

(i) For projecting ultimate claims as of December 31 2017, need to adjust to calendar year 2017 average rate level of 0.98361.

Premium on-level factor for 2014 = 0.98361 / 1.01125 = 0.9727

(ii) For ratemaking analysis, need to adjust to current rate level of 1.0498.

Premium on-level factor for 2014 = 1.0498 / 1.01125 = 1.0381