ACTEX Learning

GI 101 Ratemaking and Reserving Study Manual

1st Edition

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An SOA Exam

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NOTES

This study manual ("the manual") is written with the purpose of assisting the candidates for the SOA GI 101 Ratemaking and Reserving Course (Converted from GIRR General Insurance Ratemaking and Reserving Exam).

According to the syllabus, the textbook, *Fundamentals of General Insurance Actuarial Analysis* (J. Friedland), 2nd edition, is required for this exam. While the manual is intended to follow the structure of the textbook as closely as possible, some chapters and/or sections are customized for a better presentation of the underlying study material.

Even though most case studies and examples used in the manual were taken from the textbooks, they were modified, sometimes even highly modified. Therefore, the numbers from the manual might not reconcile to the numbers found in the textbook. In addition, the numbers might not reconcile to totals due to rounding.

Past exam questions and answers have been taken from SOA's General Insurance Ratemaking and Reserving Exams, which are identified with "(SOA Exam Year-Spring/Fall Qi)" in the manual. The past exam questions and answers are copyrighted by the Society of Actuaries and are reproduced in this study manual with the permission of the SOA solely for the purpose of assisting students studying for the actuarial exams. I am very grateful to the SOA for its permission to use this material. The SOA, however, is in no way responsible for the structure or accuracy of the manual.

The past exam questions have been attached to the assignment on which the questions are most likely based. Note that some exam questions may make use of materials from multiple assignments of the textbooks.

Questions without identification of "(SOA Exam Year-Spring/Fall Qi)" are original questions based on the required study materials. Although I have made a conscientious effort to eliminate mistakes in questions and answers, errors may exist. I encourage students who find errors to bring them to my attention. You can send your comments to my email address - kemin.business@gmail.com. Any other feedback is also very welcome.

I would also like to thank Stephen Camilli, FSA and Former President of ACTEX Learning, for his insightful comments. I also would like to thank my wife, Casey Tong Li, for her support.

Best of luck with your studies!!!

Contents

FGIAA Chapter 3 Ultimate Claims and Expenses

Syllabus

- 1-b) to 1-d)

3.1 What are Ultimate Claims?

Ultimate claims is

- An estimate of ultimate claims beyond which no other claim payments are expected

3.1.1 Types of Ultimate Values

The following types of ultimate claims can be projected:

- Claims
- Claim-related expense (i.e. Allocated loss adjustment expense (ALAE) and Unallocated loss adjustment expense (ULAE))
- Counts
- Average value of claims
- Recoveries
- Ratios

3.1.2 Components of Ultimate Claims

Ultimate claims consist of:

- Cumulative paid payments
- Case estimates
- Development on case estimates (Incurred but not enough reported (IBNER))
- Claims that have been incurred but not yet reported (IBNYR)

Cumulative paid payments represent:

- All claim payments with a specific accident year (AY) that were paid between a specified time period
- Example:
  - o Assume an actuary is reviewing claims for AY1 at December 31, CY2
  - o In this case, the cumulative paid payments represent all claim payments, with accident dates during AY1, that were paid between January 1, CY1 and December 31, CY2.

Case estimates:

- Estimate of the amounts yet to be paid that will be required to settle the claim
- Tend to increase over time for long-tail coverages such as
  - o Automobile liability
  - o Medical practice
  - o Workers compensation
- Tend to decrease over time for short-tail coverages such as
  - o Property

    - Automobile physical damage coverages

Reported Claims represents:

- The sum of Cumulative claim payments and Case estimates

IBNER represents:

- The claims that are incurred but not enough reported

IBNYR represents:

- The claims that are incurred but not yet reported
- Also known as Pure IBNR

3.1.3 Mathematical Relationships between the Components of Ultimate Claims

- Ultimate claims = Reported claims + IBNR
- Reported claims = Cumulative claim payments + Case estimates
- IBNR = IBNER + IBNYR
- Ultimate claims = Cumulative claim payments + Case estimates + IBNER + IBNYR
- Ultimate claims = Cumulative claim payments + Claim liabilities
- Claim liabilities = Case estimates + IBNER + IBNYR
- Claim liabilities = Case estimates + IBNR
- Ultimate counts = Closed counts + Open counts + IBNR counts

3.2 Why are Estimates of Ultimate Values Required?

Estimate of Ultimate values are mainly used in following five areas:

- Financial Reporting
    - **Accounting date** (**Valuation date**, **As of date**): the date at which the claims are being valued
    - The term **Insurance Contract Liabilities** is the collection of **Claim liabilities** and **Premium liabilities**
    - **Claim liabilities** represent the estimate of liabilities for the claims incurred on or before the accounting date
    - **Premium liabilities** represent the estimates of claim and expense payments to be made after the accounting date
    - The income of a GI company arises from underwriting and investment income
    - Underwriting income = earned premiums – incurred claims – underwriting expense
    - Earned premiums are the revenue the insurer receives in selling its products
    - Incurred claims are essentially the insurer's cost of goods sold
    - $\text{Incurred Claims}_{CYx} = \text{Claim Liabilities}_{CYx} - \text{Claim Liabilities}_{CYx-1} + \text{Claim Paid}_{CYx}$
- Pricing
    - Projection of ultimate values is
        - Fundamental blocks for the development of GI rates
        - Used for the trending analysis (it will be covered in later chapters)
- Financial condition analysis

  - The intent of **Financial Condition Analysis** is to test the insurer's ability to withstand severe circumstances without failing in its obligations
  - In Canada, financial condition analysis is referred to as **Dynamic Capital Adequacy Testing (DCAT)**
- Planning
  - Projection of ultimate values is
    - Used for planning and budgeting purpose
    - A required input to compensation programs
- Merger and Acquisition Analysis

3.2.6 Estimates of Ultimate Values for Self-insurers

Self-insurers rely on the projection of ultimate values for:

- Determining claim liabilities
- Evaluating funding requirements
- Allocating costs of program to each participant

3.3 When are Projections of Ultimate Claims Prepared?

The timing depends on the purpose for which the projections are required:

- For financial reporting purpose, actuaries most frequently reply on data at the accounting date
- For GI pricing purpose, the time requirement varies tremendously by jurisdictions
- For planning, compensation, or cost allocation purpose, there is typically a standard time of year during which the estimate of Ultimate claims is required

3.4 Who Projects Ultimate Claims?

Projection of ultimate claims requires significant professional judgement. One should have the necessary knowledge and experience to:

- Identify and collet the appropriate data
- Verify the data
- Gather qualitative information about the internal and external environment
- Conduct diagnostic analyses
- Choose methodologies and assumptions
- Evaluate results in light of information gathered and diagnostic analyses

Standards address the following process involved in the projection of ultimate claims:

- Identification, collection, and verification of data
- Understanding of the internal and external environments
- Determination of appropriate methodology and assumptions
- Evaluation of results
- Documentation
- Communications and reporting of findings

Practice Questions

1. Which of the following items is not a component of ultimate claims:

   a. Cumulative paid claims
   b. DCAT
   c. Case estimates
   d. IBNER
   e. IBNYR

2. What do the ultimate claims consist of?

3. What are the five areas that the projection of ultimate claims is used in?

4. What is the main difference between claim liabilities and premium liabilities?

5. (2017-Spring Exam Q7) Your company, EB General Insurance, has just hired a new CFO who has no previous experience with the general insurance industry. The new CFO has made the following four statements:

(i) The reinsurers should rely on the case estimates provided by EB General Insurance.

(ii) The case estimates for automobile liability tend to increase over time and case estimates for automobile physical damage tend to decrease over time. Therefore, the modeling of estimates can be simplified by aggregating these coverages and assuming the increases and decreases will offset.

(iii) Large corporate clients are more effective at managing risk, and therefore more likely to self-insure and less likely to purchase insurance from EB General Insurance.

(iv) EB General Insurance should rely on software programs to project ultimate claims based on the appropriate actuarial methodology.

Provide *either* one argument for, *or* one argument against each statement the CFO has made.

Answers to Practice Questions

1. b. DCAT stands for Dynamic Capital Adequacy Test. It is referred to as financial condition analysis in Canada

2. Ultimate claims = Cumulative paid claims + Case estimate + IBNER + IBNYR

3. The five areas are financial reporting, pricing, financial condition analysis, planning and merger and acquisition analysis

4. Claim liabilities represent the estimate of liabilities for the claims incurred **on or before** the accounting date whereas Premium liabilities represent the estimates of claim and expense payments to be made **after** the accounting date.

For instance,

- Assume that Fake insurance company sells occurrence policies between April 1, 2015 and March 31, 2016 and the accounting date is December 31, 2015.
- In this case, claim liabilities represent the claims with accident date between April 1, 2015 and December 31, 2015 no matter when the payment occurs. Premium liabilities represent the claims with accident date between Jan 1, 2016 to March 31, 2016.

5. (2017-Spring Exam Q7)

(i) Argument against: Reinsurers will typically add additional case reserves to reflect the difference in view of the case estimates provided by the insurers.

(ii) Argument against: Development on case estimates may be very different, and combining the coverages may mask the difference.

(iii) Argument for: Large corporate clients would tend to know their own business better and have established programs in place to manage risk.

(iv) Argument against: Software can assist with the computations, but professional judgement should be used in selecting the ultimate claims estimates.

FGIAA Chapter 20 Berquist-Sherman Adjustments (BSA)

SYLLABUS

- 3-e) to 3-j)

20.0 Introduction

Used when there has been a significant change:

- In the adequacy of case estimates (AoCE)
- Or In the rate of settlement of claims (RoSC)
- Or both

20.1 Key Assumptions of the BSA

A key assumption unique to BSA is:

- The effect of operational changes can be quantified

A couple key assumptions for both the development method and BSA are:

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

Adjusted paid and reported claims from BSA are inputs to all previous projection methods.

20.3 Auto Insurer Example Using the BSA for Changes in the AoCE

An example is used to illustrate the BSA for changes in the AoCE.

Background

- The insurer is Auto Insurer (AI)
- AI needs BSA due to
  - The strength of case estimates in later years
- The annual severity trend is 3.5%
- For AY1 through AY4, a tort reform factor 0.625 is in effect
- The original case estimate triangle is shown below:

Accident Year	Average Case Estimates Excluding Large Claims at Total Limits					
	12	24	36	48	60	72
AY1	18,263	29,762	38,205	45,164	58,385	61,254
AY2	13,124	24,170	34,408	48,014	58,459	74,618
AY3	11,602	21,887	31,290	43,721	59,881	77,242
AY4	14,745	25,938	31,457	58,188	63,935	81,809
AY5	11,132	22,572	38,394	42,100	56,301	53,371
AY6	8,279	22,927	39,665	58,474	72,961	97,000
AY7	12,125	22,427	39,616	60,010	54,788	55,250
AY8	8,217	20,574	39,553	60,288	77,597	
AY9	9,071	24,782	51,947	81,624		
AY10	13,445	42,082	71,861			
AY11	10,475	59,349				
AY12	16,674					

Table continues:

Accident Year	Average Case Estimates Excluding Large Claims at Total Limits					
	84	96	108	120	132	144
AY1	70,662	101,344	194,182	222,400	364,000	0
AY2	117,722	211,077	570,333	0	0	
AY3	98,361	194,750	383,000	424,000		
AY4	124,818	148,200	305,000			
AY5	74,667	63,000				
AY6	167,045					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

- The open counts triangle is shown below:

Accident Year	Open Counts Excluding Large Claims at Total Limits											
	12	24	36	48	60	72	84	96	108	120	132	144
AY1	890	559	352	226	161	122	65	32	11	5	1	0
AY2	773	482	294	210	133	68	38	13	3	0	0	
AY3	616	390	272	201	134	66	36	16	4	2		
AY4	522	324	210	144	92	47	22	5	2			
AY5	408	201	142	120	73	35	24	11				
AY6	495	259	164	116	77	38	22					
AY7	496	253	151	100	80	56						
AY8	539	230	150	111	77							
AY9	535	257	152	117								
AY10	384	146	73									
AY11	360	126										
AY12	346											

- The paid claims triangle is shown below:

Accident Year	Paid Claims Excluding Large Claims at Total Limits					
	12	24	36	48	60	72
AY1	1,398	5,762	9,841	15,888	18,407	21,807
AY2	1,386	4,607	10,383	12,918	17,249	21,272
AY3	1,927	4,389	6,910	9,760	12,969	17,095
AY4	958	2,210	6,124	8,336	13,621	16,688
AY5	910	1,981	3,382	5,225	7,601	9,880
AY6	680	1,967	4,406	6,597	9,501	12,886
AY7	745	2,696	4,193	6,959	9,829	12,235
AY8	612	2,027	3,518	5,537	8,093	
AY9	683	2,271	4,326	6,975		
AY10	774	2,309	3,148			
AY11	632	1,890				
AY12	692					

Table continues:

Accident Year	Paid Claims Excluding Large Claims at Total Limits					
	84	96	108	120	132	144
AY1	26,027	29,104	30,520	31,307	32,289	32,936
AY2	23,255	25,384	27,170	28,782	28,782	
AY3	19,210	21,242	23,572	24,652		
AY4	18,465	20,398	21,365			
AY5	10,426	11,584				
AY6	14,323					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

BSA for changes in the AoCE

Step 1 Create a triangle of average adjusted case estimates

Accident Year	Adjusted Average Case Estimates Excluding Large Claims at Total Limits					
	12	24	36	48	60	72
AY1	18,273 (16,674 x 1.035^{-11} / 0.625)	67,318	84,363	99,178	97,585	71,913
AY2	18,913	69,674	87,315	102,649	101,000	74,430
AY3	19,575	72,113	90,371	106,242	104,535	77,035
AY4	20,260	74,636	93,534	109,960	108,194	79,732
AY5	13,106	48,280	60,505	71,131	69,988	51,576
AY6	13,564	49,970	62,623	73,620	72,438	53,382
AY7	14,039	51,719	64,815	76,197	74,973	55,250
AY8	14,530 (16,674 x 1.035^{-4})	53,529	67,083	78,864	77,597	
AY9	15,039	55,403	69,431	81,624		
AY10	15,565	57,342	71,861			
AY11	16,110	59,349				
AY12	16,674					

Table continues:

Accident Year	Adjusted Average Case Estimates Excluding Large Claims at Total Limits					
	84	96	108	120	132	144
AY1	225,036	87,841	275,093	395,809	0	0
AY2	232,912	90,916	284,721	409,662	0	
AY3	241,064	94,098	294,686	424,000		
AY4	249,501 (167,045 x 1.035^{-2} / 0.625)	97,391	305,000			
AY5	161,396	63,000				
AY6	167,045					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

Step 2 Calculate a triangle of adjusted reported claims

Accident Year	Adjusted Reported Claims Excluding Large Claims at Total Limits					
	12	24	36	48	60	72
AY1	17,661 (18,273x890/1,000 + 1,398)	43,393	39,537	38,302	34,118	30,580
AY2	16,006	38,190	36,054	34,474	30,682	26,333
AY3	13,985	32,513	31,491	31,115	26,977	22,179
AY4	11,534	26,392	25,766	24,170	23,575	20,435
AY5	6,257	11,685	11,974	13,761	12,710	11,685
AY6	7,394	14,909	14,676	15,137	15,079	14,915
AY7	7,708	15,781	13,980	14,579	15,827	15,329
AY8	8,444 (14,530x539/1,000 + 612)	14,339	13,580	14,291	14,068	
AY9	8,729	16,510	14,879	16,525		
AY10	6,751	10,681	8,394			
AY11	6,432	9,368				
AY12	6,461					

Table continues:

Accident Year	Adjusted Reported Claims Excluding Large Claims at Total Limits					
	84	96	108	120	132	144
AY1	40,654	31,915	33,546	33,286	32,289	32,936
AY2	32,106	26,566	28,024	28,782	28,782	
AY3	27,888	22,748	24,751	25,500		
AY4	23,954 (249,501x22/1,000+18,465)	20,885	21,975			
AY5	14,300	12,277				
AY6	17,998					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

Step 3 Project ultimate claims using the adjusted reported claims as input to the development method

20.4 AUTO INSURER EXAMPLE USING THE BSA FOR CHANGES IN THE ROSC

An example is used to illustrate the BSA for changes in the RoSC.

Background

- The insurer is Auto Insurer (AI)
- AI needs BSA due to
  - The increase in the settlement rates in the earliest maturity ages
- The basic formula for the mathematical curve is $y = ae^{bx}$ where y is paid claims and x is closed counts and a and b are the parameters.
- The closed counts associated with projected ultimate counts is shown below:

Accident Year	Closed Counts excluding Large Claims					
	12	24	36	48	60	72
AY1	1,243	1,693	1,914	2,045	2,110	2,149
AY2	1,264	1,667	1,880	1,972	2,049	2,114
AY3	1,004	1,285	1,409	1,488	1,560	1,628
AY4	717	983	1,108	1,175	1,227	1,274
AY5	840	1,099	1,165	1,190	1,237	1,275
AY6	815	1,101	1,207	1,255	1,294	1,333
AY7	795	1,085	1,230	1,282	1,302	1,326
AY8	812	1,174	1,281	1,320	1,354	
AY9	868	1,244	1,363	1,398		
AY10	651	957	1,072			
AY11	639	929				
AY12	662					

Table continues:

Accident Year	Closed Counts excluding Large Claims						Ultimate Counts
	84	96	108	120	132	144	
AY1	2,206	2,239	2,260	2,266	2,270	2,271	2,271
AY2	2,146	2,171	2,181	2,184	2,184		2,184
AY3	1,658	1,678	1,690	1,692			1,694
AY4	1,299	1,317	1,320				1,323
AY5	1,286	1,299					1,310
AY6	1,349						1,374
AY7							1,376
AY8							1,433
AY9							1,517
AY10							1,174
AY11							1,114
AY12							1,135

- The paid claims triangle is shown below:

Accident Year	Paid Claims excluding Large Claims					
	12	24	36	48	60	72
AY1	1,398	5,762	9,841	15,888	18,407	21,807
AY2	1,386	4,607	10,383	12,918	17,249	21,272
AY3	1,927	4,389	6,910	9,760	12,969	17,095
AY4	958	2,210	6,124	8,336	13,621	16,688
AY5	910	1,981	3,382	5,225	7,601	9,880
AY6	680	1,967	4,406	6,597	9,501	12,886
AY7	745	2,696	4,193	6,959	9,829	12,235
AY8	612	2,027	3,518	5,537	8,093	
AY9	683	2,271	4,326	6,975		
AY10	774	2,309	4,148			
AY11	632	1,890				
AY12	1,292					

Table continues:

Accident Year	Paid Claims excluding Large Claims					
	84	96	108	120	132	144
AY1	26,027	29,104	30,520	31,307	32,289	32,936
AY2	23,255	25,384	27,170	28,782	28,782	
AY3	19,210	21,242	23,572	24,652		
AY4	18,465	20,398	21,365			
AY5	10,426	11,584				
AY6	14,323					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

<u>BSA for changes in the RoSC</u>

Step 1 Review and select disposal ratios by maturity age

Accident Year	Ratio Closed Counts to Ultimate Counts excluding Large Claims					
	12	24	36	48	60	72
AY1	0.547 (1243 / 2271)	0.745	0.843	0.900	0.929	0.946
AY2	0.579	0.763	0.861	0.903	0.938	0.968
AY3	0.593	0.759	0.832	0.878	0.921	0.961
AY4	0.542	0.743	0.837	0.888	0.927	0.963
AY5	0.641	0.839	0.890	0.909	0.945	0.974
AY6	0.593	0.802	0.879	0.914	0.942	0.971
AY7	0.578	0.789	0.894	0.932	0.946	0.964
AY8	0.567 (812 / 1433)	0.819	0.894	0.921	0.945	
AY9	0.572	0.820	0.899	0.922		
AY10	0.555	0.815	0.913			
AY11	0.574	0.834				
AY12	0.583					
Selected Disposal Ratio by Maturity Age (Latest observed value)						
	0.583	0.834	0.913	0.922	0.945	0.964

Table continues:

Accident Year	Ratio Closed Counts to Ultimate Counts excluding Large Claims					
	84	96	108	120	132	144
AY1	0.971	0.986	0.995	0.998	1.000	1.000
AY2	0.983	0.994	0.999	1.000	1.000	
AY3	0.979	0.991	0.998	0.999		
AY4	0.982 (1299/1323)	0.995	0.998			
AY5	0.982	0.992				
AY6	0.982					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						
Selected Disposal Ratio by Maturity Age (Latest observed value)						
	0.982	0.992	0.998	0.999	1.000	1.000

Step 2 Create a triangle of adjusted closed counts based on selected disposal ratios

Accident Year	Adjusted Closed Counts excluding Large Claims					
	12	24	36	48	60	72
AY1	1,325 (2,271 x 0.583)	1,894	2,074	2,094	2,146	2,188
AY2	1,274	1,821	1,994	2,013	2,064	2,105
AY3	988	1,413	1,547	1,562	1,601	1,632
AY4	772	1,103	1,208	1,220	1,250	1,275
AY5	764	1,092	1,196	1,207	1,237	1,262
AY6	801	1,146	1,254	1,266	1,298	1,324
AY7	803	1,148	1,256	1,268	1,300	1,326
AY8	836 (1,433 x 0.583)	1,195	1,308	1,321	1,354	
AY9	885	1,265	1,385	1,398		
AY10	685	979	1,072			
AY11	650	929				
AY12	662					

Table continues:

Accident Year	Adjusted Closed Counts excluding Large Claims					
	84	96	108	120	132	144
AY1	2,230	2,253	2,266	2,268	2,271	2,271
AY2	2,145	2,166	2,179	2,181	2,184	
AY3	1,664	1,680	1,690	1,692		
AY4	1,299 (1,323 x 0.982)	1,312	1,320			
AY5	1,286	1,299				
AY6	1,349					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

Step 2 Seek a mathematical curve to approximate relationships between closed counts and paid claims

Step 2.1 Parameter "a" Value

Accident Year	Parameter "a" value					
	12-24	24-36	36-48	48-60	60-72	72-84
AY1	27.96	95.44	8.99	154.97	1.92	27.67
AY2	32.03	7.97	119.57	7.86	23.27	58.97
AY3	101.77	39.78	14.61	27.42	22.95	30.47
AY4	100.65	0.73	37.35	0.13	67.88	96.15
AY5	73.00	0.27	0.00	0.39	1.49	19.37
AY6	32.96	0.45	0.17	0.05	0.39	1.93
AY7	21.92	98.97	0.03	0.00	0.07	
AY8	41.70	4.78	0.00	0.00		
AY9	42.64	2.69	0.00			
AY10	75.66	17.63				
AY11	56.55					

Table continues:

Accident Year	Parameter "a" value				
	84-96	96-108	108-120	120-132	132-144
AY1	14.84	183.74	2.09	0.00	0.00
AY2	12.61	0.01	0.00	28782.00	
AY3	4.61	0.01	0.00		
AY4	14.00	0.00			
AY5	0.31				
AY6					
AY7					
AY8					
AY9					
AY10					
AY11					

Calculation examples:

- Using excel formula, for AY1 at duration 12-24, the value of parameter “a” is 27.96 (INDEX(LOGEST({1,398,5762},{1,243,1,693}),2))
- Using excel formula, for AY8 at duration 12-24, the value of parameter “a” is 41.70 (INDEX(LOGEST({612,2,027},{812,1,174}),2))

Step 2.2 Parameter “b” Value

Accident Year	Parameter “b” value					
	12-24	24-36	36-48	48-60	60-72	72-84
AY1	0.0032	0.0024	0.0037	0.0023	0.0044	0.0031
AY2	0.0030	0.0038	0.0024	0.0038	0.0032	0.0028
AY3	0.0029	0.0037	0.0044	0.0040	0.0041	0.0039
AY4	0.0031	0.0082	0.0046	0.0095	0.0043	0.0041
AY5	0.0030	0.0081	0.0176	0.0080	0.0069	0.0049
AY6	0.0037	0.0076	0.0084	0.0094	0.0078	0.0066
AY7	0.0044	0.0031	0.0098	0.0174	0.0092	
AY8	0.0033	0.0052	0.0117	0.0112		
AY9	0.0032	0.0054	0.0137			
AY10	0.0036	0.0051				
AY11	0.0038					

Table continues:

Accident Year	Parameter “b” value				
	84-96	96-108	108-120	120-132	132-144
AY1	0.0034	0.0023	0.0043	0.0078	0.0200
AY2	0.0035	0.0068	0.0194	0.0000	
AY3	0.0050	0.0087	0.0227		
AY4	0.0055	0.0156			
AY5	0.0081				
AY6					
AY7					
AY8					
AY9					
AY10					
AY11					

Calculation examples:

- Using excel formula, for AY1 at duration 12-24, the value of parameter “a” is 0.0032 (INDEX(LOGEST({1398,5762},{1243,1693}),1) – 1)
- Using excel formula, for AY8 at duration 12-24, the value of parameter “a” is 0.0033 (INDEX(LOGEST({612,2027},{812,1174}),1) – 1)

Step 3 Develop a triangle of adjusted paid claims

Step 3.1 Mapping of selected parameter “a” and “b”

Accident Year	Mapping of parameter “a” and “b”					
	12	24	36	48	60	72
AY1	12-24	24-36	48-60	48-60	60-72	72-84
AY2	12-24	24-36	48-60	48-60	60-72	60-72
AY3	12-24	36-48	48-60	60-72	60-72	72-84
AY4	12-24	24-36	48-60	48-60	60-72	72-84
AY5	12-24	**12-24**	48-60	48-60	60-72	**60-72**
AY6	12-24	24-36	36-48	48-60	60-72	60-72
AY7	12-24	24-36	36-48	36-48	48-60	60-72
AY8	12-24	24-36	36-48	48-60	48-60	
AY9	12-24	24-36	36-48	36-48		
AY10	12-24	24-36	24-36			
AY11	12-24	12-24				
AY12	12-24					

Table continues:

Accident Year	Mapping of parameter “a” and “b”					
	84	96	108	120	132	144
AY1	84-96	96-108	108-120	120-132	120-132	132-144
AY2	72-84	84-96	96-108	108-120	120-132	
AY3	84-96	96-108	108-120	108-120		
AY4	84-96	84-96	96-108			
AY5	84-96	84-96				
AY6	72-84					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

Step 3.2 Select parameter “a” value.

Accident Year	Selected "a" parameter					
	12	24	36	48	60	72
AY1	27.96	95.44	154.97	154.97	1.92	27.67
AY2	32.03	7.97	7.86	7.86	23.27	23.27
AY3	101.77	14.61	27.42	22.95	22.95	30.47
AY4	100.65	0.73	0.13	0.13	67.88	96.15
AY5	73.00	73.00	0.39	0.39	1.49	1.49
AY6	32.96	0.45	0.17	0.05	0.39	0.39
AY7	21.92	98.97	0.03	0.03	0.00	0.07
AY8	41.70	4.78	0.00	0.00	0.00	
AY9	42.64	2.69	0.00	0.00		
AY10	75.66	17.63	17.63			
AY11	56.55	56.55				
AY12	56.55					

Table continues:

Accident Year	Selected "a" parameter					
	84	96	108	120	132	144
AY1	14.84	183.74	2.09	0.00	0.00	0.00
AY2	58.97	12.61	0.01	0.00	0.00	
AY3	4.61	0.01	0.00	0.00		
AY4	14.00	14.00	0.00			
AY5	0.31	0.31				
AY6	1.93					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

Step 3.3 Select parameter "b" value.

Accident Year	Selected "b" parameter					
	12	24	36	48	60	72
AY1	0.0032	0.0024	0.0023	0.0023	0.0044	0.0031
AY2	0.0030	0.0038	0.0038	0.0038	0.0032	0.0032
AY3	0.0029	0.0044	0.0040	0.0041	0.0041	0.0039
AY4	0.0031	0.0082	0.0095	0.0095	0.0043	0.0041
AY5	0.0030	0.0030	0.0080	0.0080	0.0069	0.0069
AY6	0.0037	0.0076	0.0084	0.0094	0.0078	0.0078
AY7	0.0044	0.0031	0.0098	0.0098	0.0174	0.0092
AY8	0.0033	0.0052	0.0117	0.0112	0.0112	
AY9	0.0032	0.0054	0.0137	0.0137		
AY10	0.0036	0.0051	0.0051			
AY11	0.0038	0.0038				
AY12	0.0038					

Table continues:

Accident Year	Selected "b" parameter					
	84	96	108	120	132	144
AY1	0.0034	0.0023	0.0043	0.0078	0.0078	0.0200
AY2	0.0028	0.0035	0.0068	0.0194	0.0000	
AY3	0.0050	0.0087	0.0227	0.0227		
AY4	0.0055	0.0055	0.0156			
AY5	0.0081	0.0081				
AY6	0.0066					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

Step 3.4 Adjusted paid claims

Accident Year	Adjusted Paid Claims excluding Large Claims					
	12	24	36	48	60	72
AY1	1,820 ($27.96 \times e^{0.0032 \times 1325}$)	9,429	17,045	17,829	21,947	24,911
AY2	1,436	8,417	14,243	15,303	18,276	20,867
AY3	1,848	7,122	12,461	13,225	15,499	17,609
AY4	1,142	6,120	12,022	13,416	15,225	16,927
AY5	727	1,950	5,682	6,227	7,845	9,303
AY6	650	2,853	6,849	7,742	10,182	12,468
AY7	777	3,280	5,760	6,480	11,567	12,931
AY8	665 ($41.69 \times e^{0.0033 \times 836}$)	2,297	5,294	6,083	8,808	
AY9	724	2,589	6,626	7,950		
AY10	877	2,618	4,206			
AY11	661	1,903				
AY12	693					

Table continues:

Accident Year	Adjusted Paid Claims excluding Large Claims					
	84	96	108	120	132	144
AY1	28,642	30,200	31,933	34,108	34,824	51,650
AY2	23,387	25,321	28,200	41,075	28,782	
AY3	20,198	23,112	36,263	37,807		
AY4	18,878	20,289	25,025			
AY5	10,889	12,090				
AY6	14,752					
AY7						
AY8						
AY9						
AY10						
AY11						
AY12						

Step 4 Projected ultimate claims using adjusted paid claims as input to the development method

BSA for both changes in the AoCE and RoSC

In this case, the steps for AoCE can be used. That is,

- Step 1 Create a triangle of average adjusted case estimates
- Step 2 Calculate an adjusted reported claim triangle
    - Open counts triangle should be replaced with the adjusted open counts (reported counts – adjusted closed counts from case RoSC)
    - Original paid claims triangle should be replaced with the adjusted paid claims from case RoSC)
- Step 3 Project ultimate claims using the adjusted reported claims as input to the development method

PRACTICE QUESTIONS

1. Provide the reason as for why the unadjusted open counts cannot be used when the Berquist-Sherman adjustment is used for AoCE and RoSC.

2. (2013-Fall Exam Q6) You are projecting ultimate claims for Dunkum Auto Insurer for its third-party automobile property damage coverage. Investigative testing and interviews with management have led you to believe that a Berquist Sherman adjustment may be necessary.

You are given the information in the following table about closed and ultimate counts:

Closed Counts at Maturity Ages in Months					
Accident Year	**12**	**24**	**36**	**48**	**Selected Ultimate Counts**
2009	1,777	2,310	2,541	2,617	2,617
2010	1,884	2,449	2,514		2,800
2011	1,997	2,345			2,938
2012	1,860				3,081

(a) Describe two situations where Berquist Sherman methods are most commonly implemented.

(b) Recommend disposal ratios for each maturity age.

(c) Calculate the development triangle of adjusted closed counts using your recommended ratios from (b).

You determine that the best relationship between closed counts and cumulative paid claims (in thousands) can be described by an exponential curve of the form $y = ae^{bx}$, where y represents cumulative paid claims and x represents closed counts. Your analysis shows that the parameters for accident year 2009 from 24 to 36 months are a = 2,345.11 and b = 0.00047.

(d) Calculate adjusted paid claims at December 31, 2011 for accident year 2009 using the information above and the adjusted closed count triangle.

3. (2014-Spring Exam Q10) In conducting investigative analysis for XYZ Insurer, you noted a significant change in case reserve estimates. The following information is provided:

Accident Year	Average Case Estimates		
	12	**24**	**36**
2011	5,010	5,890	8,940
2012	5,260	8,450	
2013	7,200		

Accident Year	Open Counts		
	12	**24**	**36**
2011	210	175	70
2012	240	190	
2013	250		

Accident Year	Paid Claims		
	12	24	36
2011	610,000	1,840,000	3,250,000
2012	530,000	1,640,000	
2013	570,000		

- Assume the annual severity trend for XYZ Insurer is 5%.
- Use simple average age-to-age development factors and the Bondy method for the tail factor.

(a) Calculate the projected ultimate claims using the Berquist-Sherman method for XYZ Insurer.

Your analysis of XYZ Insurer has shown that there has also been a change in settlement rates.

(b) Explain how you create the reported claims triangle with the Berquist- Sherman adjustments for changes in both case estimates and settlement rates.

4. (2014-Fall Exam Q7) KMR Insurance is investigating the potential reserving impact of changes in its claims handling processes. You are given the following information:

Accident Year	Closed Counts			Selected Ultimate Count
	12	24	36	
2011	120	240	288	300
2012	132	297		330
2013	160			320

Accident Year	Paid Claims		
	12	24	36
2011	13,440	27,984	36,242
2012	16,558	36,708	
2013	22,479		

Parameters for Two-Point Exponential Curve Fitting				
Accident Year	a		b	
	12&24	24&36	12&24	24&36
2011	6,455	7,681	0.006112	0.005387
2012	8,758		0.004825	

- The selected relationship between paid claims *y*, and closed counts *x*, is $y = ae^{bx}$
- The selected tail factor is the square root of the last development factor.

(a) Assess whether there is any evidence of changed claims settlement rates.

(b) Estimate total unpaid claims using a Berquist-Sherman adjustment to paid claims and simple age-to-age development factors.

(c) Explain whether you would expect this unpaid claims estimate to be higher or lower than that calculated from the unadjusted paid claims triangle.

5. (2015-Spring Exam Q8) The triangle of average case estimates is a valuable investigative tool for assessing whether or not there have been changes in the overall adequacy of case estimates during the experience period.

(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.

You are given the following:

Accident Year	Reported Claims		
	12	24	36
2012	73,800	98,400	104,600
2013	75,600	88,200	
2014	66,000		

Accident Year	Paid Claims		
	12	24	36
2012	49,200	61,500	92,300
2013	50,400	63,000	
2014	52,800		

Accident Year	Open Counts		
	12	24	36
2012	154	275	209
2013	168	300	
2014	161		

The annual severity trend is 3%.

(b) Calculate the triangle of average case estimates.

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

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

You use the reported development method to estimate ultimate claims.

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

(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.

6. (2015-Fall Exam Q7) As part of your investigations into IBNR reserves for XYZ Insurer, you are conducting diagnostic tests for changing levels of case reserve adequacy. You are given the following information:

Accident Year	**Reported Claims (000)**		
	12	**24**	**36**
2012	3,850	4,950	5,533
2013	6,326	8,056	
2014	5,045		

Accident Year	**Paid Claims (000)**		
	12	**24**	**36**
2012	2,200	3,850	4,675
2013	2,472	6,326	
2014	2,461		

Accident Year	**Open Counts**		
	12	**24**	**36**
2012	900	300	150
2013	990	330	
2014	960		

- The annual severity trend is 0%.
- There is no development after 36 months.
- There was a large accident year 2013 claim of 2,000,000 reported in 2013 and paid in 2014.

(a) Calculate the average case estimate triangle, adjusted to eliminate the large accident year 2013 claim.

(b) Explain why the adjusted average case estimate triangle indicates decreasing, increasing or stable case reserve adequacy.

(c) Calculate the indicated IBNR using the reported development method, with a Berquist-Sherman adjustment.

7. (2016-Fall Exam Q11) You are estimating ultimate claims for ABC Insurance. You are provided with the following information:

Accident Year	**Closed Counts**			**Selected Ultimate Counts**
	12	**24**	**36**	
2013	80	100	180	200
2014	84	108		240
2015	101			337

The expected annual severity trend for ABC Insurance is 5%.

The claims department manager advises you that increased business volume is leading to delays in claims processing.

(a) Calculate the disposal ratio triangle.

(b) Explain how this disposal ratio triangle does or does not provide evidence of delays in claims processing.

You have decided to use a Berquist-Sherman adjustment to allow for changing settlement rates. Analysis indicates that the average claim paid varies only by accident year trend.
The selected average claim cost for accident year 2015 was 110.

(c) Calculate the adjusted paid claims triangle.

(d) Explain whether or not a Berquist-Sherman adjustment would be appropriate for a new line of business.

8. (2017-Spring Exam Q12) You are conducting diagnostic tests for changing levels of case reserve adequacy. As part of your investigations into IBNR reserves, you are given the following information:

Accident Year	**Reported Claims**		
	12	**24**	**36**
2014	51,800	72,300	102,500
2015	55,700	98,800	
2016	88,300		

Accident Year	**Paid Claims**		
	12	**24**	**36**
2014	31,800	52,000	82,500
2015	34,000	55,700	
2016	36,400		

Accident Year	**Reported Counts**		
	12	**24**	**36**
2014	800	1,030	1,250
2015	830	1,070	
2016	850		

Accident Year	**Closed Counts**		
	12	**24**	**36**
2014	600	840	1,150
2015	620	880	
2016	640		

- The annual severity trend is 4%.
- There is no development after 36 months.

(a) Calculate the average case estimate triangle.

(b) Explain why the triangle in part (a) indicates reducing, increasing or stable case reserve adequacy.

(c) Calculate ultimate claims for all accident years using the reported development method, with a Berquist-Sherman adjustment.

9. (2017-Fall Exam Q8) You are estimating IBNR reserves for Big Hat Insurance Company. You are given the following information:

Accident Year	**Cumulative Reported Claims**		
	12	**24**	**36**
2014	63,000	84,000	110,300
2015	87,800	108,000	
2016	85,200		

Accident Year	**Cumulative Paid Claims**		
	12	**24**	**36**
2014	31,500	52,500	94,500
2015	33,800	74,300	
2016	36,500		

Accident Year	**Outstanding Counts**		
	12	**24**	**36**
2014	190	170	100
2015	200	180	
2016	210		

Accident Year	**Average Case Estimate**		
	12	**24**	**36**
2014	166	185	158
2015	270	187	
2016	232		

- The expected annual severity trend is 6%.
- Ultimate claim estimates are based on the reported development method with simple all-year average development factors.

Discussions with the claims manager provide the following information:
- There was an unexpected class action suit in calendar year 2015.
- All claims from the class action suit were settled and paid in calendar year 2016.
- The settlement amounts were fully reserved for as of December 31, 2015 by a 50% increase in all case reserves from accident years 2014 and 2015.
- The suit and settlement are not expected to change any future claims development patterns.
- Despite this, the claims manager suspects that claims staff have become more conservative in setting reserves because of the high claims ratios in the 2015 financial year.

(a) (*2 points*) Recalculate the average case estimate triangle, eliminating the effects of the settlement.

(b) (*0.5 points*) Explain whether the recalculated average case estimate triangle provides any evidence for or against the claims manager's suspicion.

You have decided to use a Berquist Sherman adjustment to allow for changing case estimate adequacy.

(c) (*2 points*) Calculate the adjusted reported claims triangle, excluding the effects of the settlement.

You have decided to use a 5% tail factor for reported development beyond 36 months.

(d) (*1.5 points*) Calculate the indicated IBNR for accident years 2014 through 2016 using the reported development method and the adjusted reported claims triangle from part (c).

ANSWERS TO PRACTICE QUESTIONS

1. The reason is that as part of the adjustment for RoSC, the closed counts are adjusted. Therefore, the unadjusted open counts should be replaced by the adjusted open counts (Unadjusted reported counts – adjusted closed counts)

2. (2013-Fall Exam Q6)

(a) Two situations where Berquist-Sherman methods are most commonly used are:

- When there has been a significant change in the adequacy of case estimates in the most recent periods; and
- When there has been a significant change in the rate of settlement of claims in the most recent periods.

(b) The best recommended disposal ratios under the Berquist-Sherman method are the disposal ratios of closed counts at the current point in time to the selected ultimate counts. The following table shows calculation of ratios across the data set, with the bottom row indicating the recommended selected disposal ratios.

Accident Year	Ratio Closed Counts to Selected Ultimate			
	12	24	36	48
2009	0.68	0.88	0.97	1.00
2010	0.67	0.87	0.90	
2011	0.68	0.80		
2012	0.60			
Selected	0.60	0.80	0.90	1.00

(c) Adjusted closed counts are determined by using the above selected disposal ratios and applying them to ultimate claims. This leads to the following development triangle of adjusted closed counts.

Accident Year	Adjusted Closed Counts			
	12	24	36	48
2009	1,570	2,094	2,355	2,617
2010	1,680	2,240	2,514	
2011	1,763	2,345		
2012	1,860			

For example, the adjusted closed counts for Accident Year 2011 at month 12 would be 2,938 of ultimate counts, multiplied by the 0.60 disposal ratio to arrive at 1,763 of adjusted closed counts.

(d) Adjusted paid claims are determined as a function of the entry in the adjusted closed count table for Accident Year 2009 at 36 months, which is 2,355.

$$2{,}345.11\, e^{0.00047\times 2{,}355} = 7{,}094$$

3. (2014-Spring Exam Q10)

(a) Step 1: Calculate adjusted average case estimates

Accident Year	12	24	36
2011	6,531	8,048	***8,940***
2012	6,857	***8,450***	
2013	***7,200***		

(i.e. 7,200÷1.05 = 6,857)

Step 2: Calculate adjusted reported claims

Accident Year	12	24	36
2011	1,981,510	3,248,400	3,875,800
2012	2,175,680	3,245,500	
2013	2,370,000		

(i.e. 2,175,680 = 6,857×240 + 530,000)

Step 3: Calculate development factors

Accident Year	12-24	24-36	Tail
2011	1.639	1.193	
2012	1.492		
Average CDF	1.566 1.492	1.193 1.423	1.193 1.193

(i.e. 1.639 = 3,248,400÷1,981,510. Bondy method: tail factor = last development factor.)

Step 4: Calculate projected ultimate claims

Accident Year	Reported Claims	CDF	Projected Ultimate Claims
2011	3,875,800	1.193	4,623,829
2012	3,245,500	1.423	4,618,347
2013	2,370,000	2.229	5,282,730
Total			14,524,906

(b) First, determine adjusted open counts:

= (Original reported counts) – (Closed counts adjusted as part of the adjustment for settlement rates)

Second, adjusted reported claims:

= (Adjusted Open Counts) × (Adjusted Average Case Estimates) + (Adjusted Paid Claims)

4. (2014-Fall Exam Q7)

(a) Calculate disposal ratios (closed count / ultimate):

Accident Year	12	24	36
2011	40.0%	80.0%	96.0%
2012	40.0%	90.0%	
2013	50.0%		

Increase in the latest diagonal indicates a change in the claims settlement rates.

(b) Step 1: Select disposal ratios

	12	24	36
Selected Disposal	50.0%	90.0%	96.0%

Note - last diagonal of table from (a)

Step 2: Calculate adjusted closed counts

Accident Year	12	24	36
2011	150	270	288
2012	165	297	
2013	160		

Note: selected disposal ratios × Selected Ultimate Counts e.g. 165 = 50% × 330

Step 3: Calculate adjusted paid claims

Adjusted Paid Claims

Accident Year	12	24	36
2011	16,146	32,892	36,242
2012	19,416	36,708	
2013	22,479		

Last diagonal = Actual Paid Claims

Other three figures by substitution in $y \square ae^{bx}$ where x is adjusted closed count.

e.g. 19,416 = 8,758 × e $^{(0.004825 \times 165)}$

Step 4: Calculate development factors using Adjusted Paid Claims Accident

Year	12-24	24-36	36-Ult
2011	2.037	1.102	
2012	1.891		
2013			
Average	1.964	1.102	1.050
to-Ult	2.273	1.157	1.050

e.g. 2.037 = 32,892 / 16,146

Tail factor = square root of last tail factor $(1.102)^{0.5}$=1.050

Step 5: Calculate projected ultimate claims & unpaid claims.

Accident Year	Paid	Factor to Ultimate	Projected Ult. Claims	Unpaid Claims
2011	36,242	1.050	38,054	1,812
2012	36,708	1.157	42,471	5,763
2013	22,479	2.273	51,095	28,616
Total	95,429		131,620	36,191

e.g.
Projected Ultimate Claims: 42,471 = 36,708 × 1.157
Unpaid Claims: 5,763 = 42,471 – 36,708

(c) Unpaid claims using adjusted paid claims should be lower, since speed up in claim settlement has not been taken into consideration. Berquist-Sherman does take this into consideration, therefore lower future development is expected.

5. (2015-Spring Exam Q8)

(a) Two Reasons:

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) Calculation:

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

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

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

Accident Year	Adjusted Average Case Reserves		
	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) x (Open Counts)

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

(e) 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) 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.

6. (2015-Fall Exam Q7)

(a) Calculation:

1. Determine the adjusted reported claims triangle, by reducing the accident year 2013 reported claims for the large claim:

Adjusted Reported Claims

Accident Year	12	24	36
2012	3,850	4,950	5,533
2013	***4,326***	***6,056***	
2014	5,045		

2. Adjust the paid claims for the large accident year 2013 claim paid in calendar year 2014 (i.e., 24 months development):

Adjusted Paid Claims

Accident Year	12	24	36
2012	2,200	3,850	4,675
2013	2,472	***4,326***	
2014	2,461		

3. Adjust the open counts for the large claim open count removed in accident year 2013 12 months development (note: the claim was closed in 2014 and therefore no adjustment to open counts is required at 24 months development):

Adjusted Open Counts

Accident Year	12	24	36
2012	900	300	150
2013	***989***	330	
2014	960		

4. Calculate the adjusted average case estimate triangle:

$$\text{Average case estimate} = \frac{\text{Adjusted reported claims - Adjusted paid claims}}{\text{Adjusted open counts}}$$

Average Case Estimates

Accident Year	12	24	36
2012	1.833	3.667	5.720
2013	1.875	5.242	
2014	2.692		

(b) The average case estimates are increasing in the last calendar year (i.e., the latest diagonal). This suggests an increase in case reserve adequacy.

(c) Calculation:

1. Adjusted average case triangle (use latest diagonal from part (a) adjusted back with 0% trend).

Adjusted Case Estimates

Accident Year	12	24	36
2012	2.692	5.242	5.720
2013	2.692	5.242	
2014	2.692		

2. Adjusted reported claims triangle:
   = (Adjusted Case Estimates) x (Adjusted Open Counts) + Adjusted Paid Claims

Adjusted Reported Claims

Accident Year	12	24	36
2012	4,623	5,423	5,533
2013	5,134	6,056	
2014	5,045		

3. Determine development factors using the reported development method:

Accident Year	Age-to-Age Development Factors		
	12-24	24-36	36-ult
2012	1.173	1.020	
2013	1.180		
Avg	1.176	1.020	1.000

4. Calculate IBNR:

Accident year	(1) Adjusted Reported Claims	(2) Age-to-Ultimate Development Factors	(3) Ultimate Claims	(4) = (3) – (1) IBNR
2012	5,533	1.000	5,533	0
2013	6,056	1.020	6,179	123
2014	5,045	1.020×1.176	6,055	1,010
Total	16,634		17,767	1,133

7. (2016-Fall Exam Q11)

(a) Disposal ratios = closed counts / selected ultimate counts

Accident Year			
	12	24	36
2013	40%	50%	90%
2014	35%	45%	
2015	30%		

(b) There is a decrease down each column that confirms evidence of delays in claims processing.

(c) Calculation

Accident Year	12	24	36
Selected disposal ratios:	30%	45%	90%
Adjusted closed counts = (disposal ratio)(selected ultimate counts)			
2013	60	90	180
2014	72	108	
2015	101		
Severity trend:	5%		
Average claim cost (e.g., 104.76 = 110 / 1.05)			
2013	99.77	99.77	99.77
2014	104.76	104.76	
2015	110.00		
Adjusted Paid Claims = (Adjusted closed counts)(Average claim cost)			
2013	5,986	8,979	17,959
2014	7,543	11,314	
2015	11,110		

(d) It would not be appropriate as Berquist-Sherman adjustments depend on a significant volume of credible experience.

8. (2017-Spring Exam Q12)

(a) Case Reserves = Reported – Paid

Accident Year	12	24	36
2014	20,000	20,300	20,000
2015	21,700	43,100	
2016	51,900		

Open Counts = Reported Counts – Closed Count

Accident Year	12	24	36
2014	200	190	100
2015	210	190	
2016	210		

Average Case Estimate = Case Reserves / Open Counts

Accident Year	12	24	36
2014	100.00	106.84	200.00
2015	103.33	226.84	
2016	247.14		

(b) The last diagonal is higher, suggesting increasing case reserve adequacy.

(c) Adjusted Average Case

Accident Year	12	24	36
2014	228.49	218.12	200.00
2015	237.63	226.84	
2016	247.14		

The most recent diagonal, trended backwards at 4%; e.g., 247.14/1.04 = 237.6

Adjusted case estimate = open counts x adjusted average case

Accident Year	12	24	36
2014	45,698	41,443	20,000
2015	49,902	43,100	
2016	51,899		

Adjusted reported claims = paid claims + adjusted case estimate

Year	12	24	36
2014	77,498	93,443	102,500
2015	83,902	98,800	
2016	88,299		

Accident Year	Development Factors	
	12-24	24-36
2014	1.206	1.097
2015	1.178	
Average:	1.192	1.097

Ultimate Claims:
2014 = 102,500 (no development after 36 months)
2015 = 98,800×1.097 = 108,384
2016 = 88,299×1.192×1.097 = 115,46

9. (2017-Fall Exam Q8)

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

(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

(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

Practice Exam

1. (7 points) Your supervisor, Adam, asks you to convert the individual claims to claim triangle with the following transactions:

Transaction ID	Transaction Date	Claim ID	Accident Date	Payment
1	Jan 13, CY1	1	Jan 2, CY1	50
2	Jul 13, CY1	1	Jan 2, CY1	25
3	Dec 12, CY1	2	Dec 12, CY1	150
4	Mar 11, CY2	3	Feb 1, CY2	90
5	Oct 13, CY2	1	Jan 2, CY1	100
6	Feb 06, CY3	1	Jan 2, CY1	100
7	Jun 22, CY3	3	Feb 1, CY2	200
8	Aug 06, CY3	4	Apr 1, CY3	15
9	Mar 04. CY4	1	Jan 2, CY1	25

a) (2 points) Summarize the payments into accident year (row) by calendar year (column) matrix.

b) (1 point) Summarize the payments into incremental paid claims triangle.

c) (1 point) Summarize the payments into cumulative paid claims triangle.

d) (1 point) Determine the payments for each calendar year

You are also given the following policy data:

Claim	Accident Date	Policy	Effective date	Expiration date	Premium
1	Jan 2, CY1	101	Jan 01, CY1	Dec 31, CY1	1,000
2	Dec 12, CY1	102	Mar 01, CY1	Feb 28, CY2	1,000
3	Feb 1, CY2	103	Jan 01, CY2	Jun 30, CY2	500
4	Apr 1, CY3	104	Jan 01, CY2	Dec 31, CY3	1,500

e) (2 points) Determine the premium written and earned in each calendar year.

15. (4 points) Three months after the claim projection exercise, your supervisor, Irena, asks you to monitor the claim development situation. You are given the following data:

Report Year	Selected Ultimate Claims	Reported Claims at Dec 31, CY4	Reported Claims at Mar 31, CY5	Expected % Reported at	
				Dec 31, CY8	Mar 31, CY9
RY1	12,920	12,920	12,920	100.0%	100.0%
RY2	14,580	14,575	14,575	99.5%	99.6%
RY3	14,850	14,815	14,815	97.7%	98.2%
RY4	14,095	14,035	14,055	94.6%	95.4%

a) (2 points) Calculate the difference between actual and expected claims

b) (1 point) List two options of interpolation of development patterns

c) (1 point) List two areas that are specific to rate setting when conducting monitoring activities.

Answers to Practice Exam

1. a)

First, summarize the data in tabular format for each accident year.

Accident Year 1

Incremental Paid Claims				
Claim ID	CY1	CY2	CY3	CY4
1	75 (T1, T2)	100	100	25
2	150 (T2)	0	0	0
Total	**225** (75+150)	100	100	25

Note: T - Transaction

Accident Year 2

Incremental Paid Claims				
Claim ID	CY1	CY2	CY3	CY4
3	0	90 (T4)	200	0
Total	0	**90**	200	0

Accident Year 3

Incremental Paid Claims				
Claim ID	CY1	CY2	CY3	CY4
4	0	0	15	0
Total	0	0	**15**	0

Then, aggregate the data into AY by CY style:

Incremental Paid Claims				
Accident Year	Calendar Year			
	CY1	CY2	CY3	CY4
AY1	**225**	100	100	25
AY2	0	**90**	200	0
AY3	0	0	**15**	0
AY4	0	0	0	0

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QUESTION 19 OF 704 | Question # | Go! | ◀Prev | Next▶

Question — Difficulty: Advanced

An airport purchases an insurance policy to offset costs associated with excessive amounts of snowfall. The insurer pays the airport 300 for every full ten inches of snow in excess of 40 inches, up to a policy maximum of 700.

The following table shows the probability function for the random variable X of annual (winter season) snowfall, in inches, at the airport.

Inches	[0,20)	[20,30)	[30,40)	[40,50)	[50,60)	[60,70)	[70,80)	[80,90)	[90,inf)
Probability	0.06	0.18	0.26	0.22	0.14	0.06	0.04	0.04	0.00

Calculate the standard deviation of the amount paid under the policy.

Possible Answers

A 134 | ✓ 235 | X 271 | D 313 | E 352

Help Me Start

Find the probabilities for the four possible payment amounts: 0, 300, 600, and 700.

Solution

With the amount of snowfall as X and the amount paid under the policy as Y, we have

y	$f_Y(y) = P(Y=y)$
0	$P(Y=0) = P(0 \le X < 50) = 0.72$
300	$P(Y=300) = P(50 \le X < 60) = 0.14$
600	$P(Y=600) = P(60 \le X < 70) = 0.06$
700	$P(Y=700) = P(Y \ge 70) = 0.08$

The standard deviation of Y is $\sqrt{E(Y^2) - [E(Y)]^2}$.

$$E(Y) = 0.14 \times 300 + 0.06 \times 600 + 0.08 \times 700 = 134$$

$$E\left(Y^2\right) = 0.14 \times 300^2 + 0.06 \times 600^2 + 0.08 \times 700^2 = 73400$$

$$\sqrt{E\left(Y^2\right) - [E(Y)]^2} = \sqrt{73400 - 134^2} = 235.465$$

Common Questions & Errors

Students shouldn't overthink the problem with fractional payments of 300. Also, account for probabilities in which payment cap of 700 is reached.

In these problems, we must distinguish between the REALT RV (how much snow falls) and the PAYMENT RV (when does the insurer pay)?. The problem states "The insurer pays the airport 300 for every full ten inches of snow in excess of 40 inches, up to a policy maximum of 700 ." So the insurer will not start paying UNTIL AFTER 10 full inches in excess of 40 inches of snow is reached (say at 50+ or 51). In other words, the insurer will pay nothing if X<50.

Rate this problem | Excellent | Needs Improvement | Inadequate

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