Exam 5

CASUALTY ACTUARIAL SOCIETY
AND THE
CANADIAN INSTITUTE OF ACTUARIES

Exam 5

Basic Techniques for Ratemaking and Estimating Claim Liabilities

April 29, 2019

4 HOURS

INSTRUCTIONS TO CANDIDATES

1. This 52 point examination consists of 24 problem and essay questions.

2. For the problem and essay questions, the number of points for each full question and part of a question is indicated at the beginning of the question or part. Answer these questions on the lined sheets provided in your Examination Envelope. Use dark pencil or ink. Do not use multiple colors or correction fluid/tape.

   - Write your Candidate ID number and the examination number, 5, at the top of each answer sheet. For your Candidate ID number, four boxes are provided corresponding to one box for each digit in your Candidate ID number. If your Candidate ID number is fewer than 4 digits, begin in the first box and do not include leading zeroes. Your name, or any other identifying mark, must not appear.
   - Do not answer more than one question on a single sheet of paper. Write only on the front lined side of the paper – **DO NOT WRITE ON THE BACK OF THE PAPER**. Be careful to give the number of the question you are answering on each sheet. If your response cannot be confined to one page, please use additional sheets of paper as necessary. Clearly mark the question number on each page of the response in addition to using a label such as "Page 1 of 2" on the first sheet of paper and then "Page 2 of 2" on the second sheet of paper.
   - The answer should be concise and confined to the question as posed. When a specified number of items are requested, do not offer more items than requested. For example, if you are requested to provide three items, only the first three responses will be graded.
   - In order to receive full credit or to maximize partial credit on mathematical and computational questions, you must clearly outline your approach in either verbal or mathematical form, showing calculations where necessary. Also, you must clearly specify any additional assumptions you have made to answer the question.

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3. Do all problems until you reach the last page of the examination where "END OF EXAMINATION" is marked.

   All questions should be answered according to the United States statutory accounting practices and principles, unless specifically instructed otherwise. SAP refers to Statutory Accounting Principles, and GAAP refers to Generally Accepted Accounting Principles. NAIC refers to the National Association of Insurance Commissioners.

4. Prior to the start of the exam you will have a **fifteen-minute reading period** in which you can silently read the questions and check the exam booklet for missing or defective pages. A chart indicating the point value for each question is attached to the back of the examination. Writing will NOT be permitted during this time and you will not be permitted to hold pens or pencils. You will also not be allowed to use calculators. The supervisor has additional exams for those candidates who have defective exam booklets.

5. Your Examination Envelope is pre-labeled with your Candidate ID number, name, exam number and test center. Do not remove this label. Keep a record of your Candidate ID number for future inquiries regarding this exam.

6. Candidates must remain in the examination center until two hours after the start of the examination. The examination starts after the reading period is complete. You may leave the examination room to use the restroom with permission from the supervisor. To avoid excessive noise during the end of the examination, candidates may not leave the exam room during the last fifteen minutes of the examination.

7. At the end of the examination, place all answer sheets in the Examination Envelope. Please insert your answer sheets in your envelope in question number order. Insert a numbered page for each question, even if you have not attempted to answer that question. Nothing written in the examination booklet will be graded. Only the answer sheets will be graded. Also place any included reference materials in the Examination Envelope. BEFORE YOU TURN THE EXAMINATION ENVELOPE IN TO THE SUPERVISOR, BE SURE TO SIGN IT IN THE SPACE PROVIDED ABOVE THE CUT-OUT WINDOW.

8. If you have brought a self-addressed, stamped envelope, you may put the examination booklet and scrap paper inside and submit it separately to the supervisor. It will be mailed to you. Do not put the self-addressed stamped envelope inside the Examination Envelope. Interoffice mail is not acceptable.

   If you do not have a self-addressed, stamped envelope, please place the examination booklet in the Examination Envelope and seal the envelope. You may not take it with you. Do not put scrap paper in the Examination Envelope. The supervisor will collect your scrap paper.

   Candidates may obtain a copy of the examination from the CAS Web Site.

   All extra answer sheets, scrap paper, etc. must be returned to the supervisor for disposal.

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9. Candidates must not give or receive assistance of any kind during the examination. Any cheating, any attempt to cheat, assisting others to cheat, or participating therein, or other improper conduct will result in the Casualty Actuarial Society and the Canadian Institute of Actuaries disqualifying the candidate's paper, and such other disciplinary action as may be deemed appropriate within the guidelines of the CAS Policy on Examination Discipline.

10. The exam survey is available on the CAS Web Site in the "Admissions/Exams" section. Please submit your survey by May 13, 2019.

END OF INSTRUCTIONS

1. (2.5 points)

Given the following:

Policy	Number of Vehicles	Effective Date	Expiration Date
A	2	January 1, 2018	June 30, 2018
B	3	March 1, 2018	August 31, 2018
C	1	July 1, 2018	December 31, 2018
D	2	October 1, 2018	March 31, 2019
E	1	November 1, 2018	April 30, 2019

- All policies remain in-force until their expiration date.
- An exposure is defined as one vehicle insured for one year.

a. (0.25 point)

Calculate the calendar year 2018 written exposures.

b. (0.5 point)

Calculate the calendar year 2018 earned exposures.

c. (0.5 point)

Calculate the policy year 2018 earned exposures as of February 28, 2019.

d. (0.25 point)

Calculate the in-force exposures as of October 15, 2018.

e. (1 point)

Identify two criteria of an exposure base and briefly evaluate miles driven as an exposure base for personal auto insurance using those criteria.

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2. (2.25 points)

Given the following:

Calendar Year	Earned Premium ($)
2017	3,850,000
2018	4,200,000

Rate Change Effective Date	Overall Rate Change
January 1, 2017	10%
July 1, 2017	5%

Quarter and Year	Average Written Premium at Current Rate Level
2Q 2016	$1,771
4Q 2016	$1,806
2Q 2017	$1,840
4Q 2017	$1,877
2Q 2018	$1,914
4Q 2018	$1,953

- No rate changes occurred in 2016 or 2018.
- Rates will be in effect for one year.
- All policies are semi-annual.
- All policies are written uniformly throughout the year.

a. (1.75 points)

Calculate the trended on-level earned premium for 2017 to be used in a rate change effective July 1, 2019.

b. (0.5 point)

Briefly describe two reasons why the 2017 trended on-level earned premium would be higher if all policies were annual rather than semi-annual.

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3. (1.5 points)

a. (0.5 point)

Briefly describe one advantage and one disadvantage of calendar year data aggregation.

b. (0.5 point)

Justify an appropriate data aggregation approach for a risk classification plan for a long-tailed line of business.

c. (0.5 point)

Justify using report year data aggregation for a claims-made line of business.

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4. (2.25 points)

Given the following information:

Claim Number	Total Limits Loss ($000s)
1	15
2	21
3	24
4	55

- Each total limits loss is subject to an 8% annual severity trend.
- Basic limit = $25,000.

a. (1 point)

Calculate the basic limits loss trend over a one-year timeframe.

b. (0.75 point)

Calculate the excess loss trend over a one-year timeframe.

c. (0.5 point)

Discuss the appropriateness of applying total limits trend to losses at basic limits for purposes of ratemaking.

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5. (4.25 points)

Given the following loss data as of December 31, 2018 for an insurer:

Accident Year	Cumulative Reported Losses ($000s)			
	12	24	36	48
2012				169,000
2013				181,000
2014				180,000
2015				169,000
2016			161,000	
2017		150,000		
2018	121,000			

	Shock Losses	
Accident Year	Claim Count	Reported Ground-Up Losses ($000s)
2012	3	3,000
2013	4	5,000
2014	3	3,000
2015	1	600
2016	1	900
2017	0	0
2018	1	900

Selected Age-to-Age Development Factors:		
12 - 24	24 - 36	36 - 48
1.2	1.1	1.05

$500,000	Excess loss threshold used by the insurer for individual reported losses

The annual frequency and severity exponential trend fits based on data for the 12 months ending each quarter evaluated through December 31, 2018 are as follows:

Exponential Trend		
	Frequency	Total Severity
20 point	1.7%	5.0%
16 point	1.4%	5.4%
12 point	1.8%	5.1%
8 point	1.5%	2.0%
6 point	1.3%	0.1%
4 point	1.6%	0.0%

- All policies are annual.
- Rates will be in effect for one year.
- There is no development after 48 months.
- Loss development is the same for basic and excess losses.
- Accident years 2012 through 2015 are used to estimate the shock loss adjustment.

a. (3.75 points)

Calculate the projected trended ultimate losses for accident year 2018 to be used to determine a rate change effective January 1, 2020. Briefly justify the trend selections.

b. (0.5 point)

Briefly describe two approaches for selecting an excess loss threshold used for capping shock losses.

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6. (2.5 points)

Given the following countrywide information:

	2016 Expense Ratio	2017 Expense Ratio	2018 ($000s)
Direct Premium Written			6,100
Direct Premium Earned			5,920
Commission and Brokerage Expenses Incurred	12.0%	13.0%	945
Other Acquisition Expense Incurred	12.8%	12.7%	760
General Expenses	15.0%	5.5%	325
Taxes, Licenses, & Fees Incurred	2.1%	2.2%	130

- Profit provision = 7%.

a. (1.25 points)

Select and justify a total expense ratio for use in ratemaking assuming all expenses are variable.

b. (0.25 point)

Calculate the variable permissible loss ratio using the expense ratio from part a. above.

c. (0.5 point)

Briefly discuss two potential distortions from using the results in part b. above to determine rates in a new state.

d. (0.5 point)

Calculate the variable permissible loss ratio if 100% of the taxes, license & fees and 75% of the general expenses do not vary by premium.

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7. (4.75 points)

Given the following data as of December 31, 2018:

Accident Year	Reported Loss and ALAE ($000s)
2016	2,000
2017	1,750
2018	800

Calendar Year	Earned Premium ($000s)
2016	4,600
2017	5,100
2018	5,800

Development Age to Ultimate	Selected Cumulative Development Factors
36	1.46
24	2.08
12	4.90

65%	Expected loss and ALAE ratio
4%	Annual loss and ALAE trend
3%	Annual premium trend
6%	Fixed expense ratio
26%	Variable expense ratio
5%	Profit and contingencies provision
8%	ULAE provision as a % of loss and ALAE
0.7	Credibility of historical experience
+8%	Complement of credibility taken from a competitor rate change filing

Rate change history:

-2%	Rate change effective January 1, 2016
+3%	Rate change effective July 1, 2018

- All policies are annual.
- Exposures are written evenly throughout each calendar year.
- New rates will be in effect for one year starting January 1, 2020.

a. (0.5 point)

Calculate the ultimate loss and ALAE for each accident year using the reported Bornhuetter-Ferguson technique.

b. (3.5 points)

Calculate the credibility-weighted indicated rate change using the latest three accident years.

c. (0.75 point)

Briefly describe a disadvantage of using a competitor rate change filing as the complement of credibility and justify a more suitable alternative.

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8. (1.75 points)

Given the following pricing strategies for an insurer with two classes of business:

- Strategy 1: Make no change to current rates.
- Strategy 2: Implement a new rating variable to charge different rates for Class A and Class B.
- Strategy 3: Do not implement a new rating variable, but increase rates for all risks.

Strategy 1 - No Change			
Class	Number of Risks	Losses & Expenses per Risk	Rate per Risk
A	5,000	900	1,050
B	10,000	1,000	1,050
One-time expense to implement Strategy 1:			0

Strategy 2 - New Rating Variable			
Class	Number of Risks	Losses & Expenses per Risk	Rate per Risk
A	5,000	900	1,000
B	10,000	1,000	1,100
One-time expense to implement Strategy 2:			500,000

Strategy 3 - Rate Increase for All Risks			
Class	Number of Risks	Losses & Expenses per Risk	Rate per Risk
A	5,000	900	1,100
B	10,000	1,000	1,100
One-time expense to implement Strategy 3:			500,000

a. (0.75 point)

Calculate the expected total profit for the insurer under each strategy.

b. (1 point)

Briefly evaluate the following for strategy 2 and strategy 3:

i. Assumption that the number of risks by class will be the same as strategy 1.
ii. Impact this assumption has on each strategy's expected total profit.

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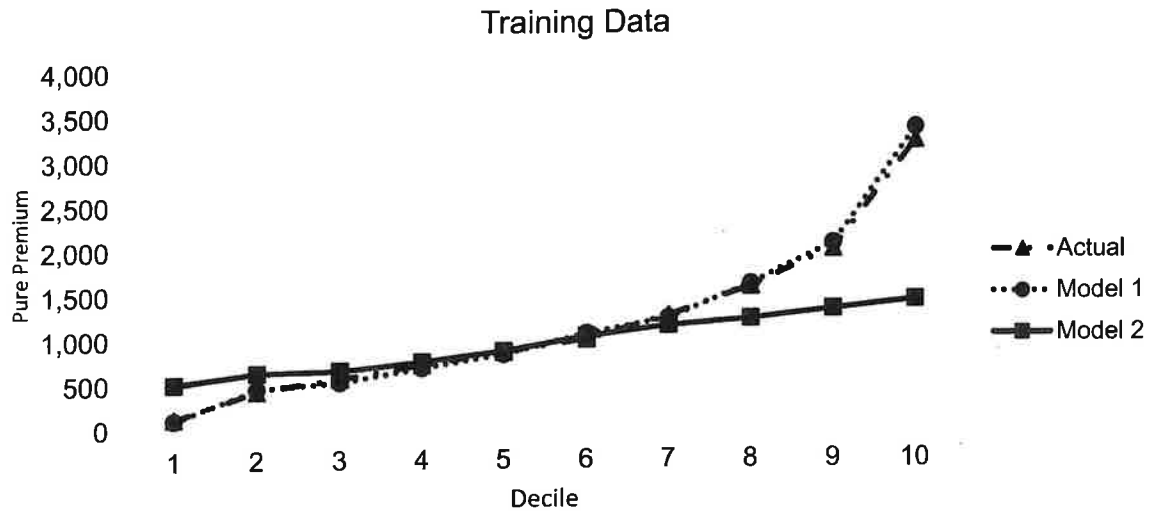
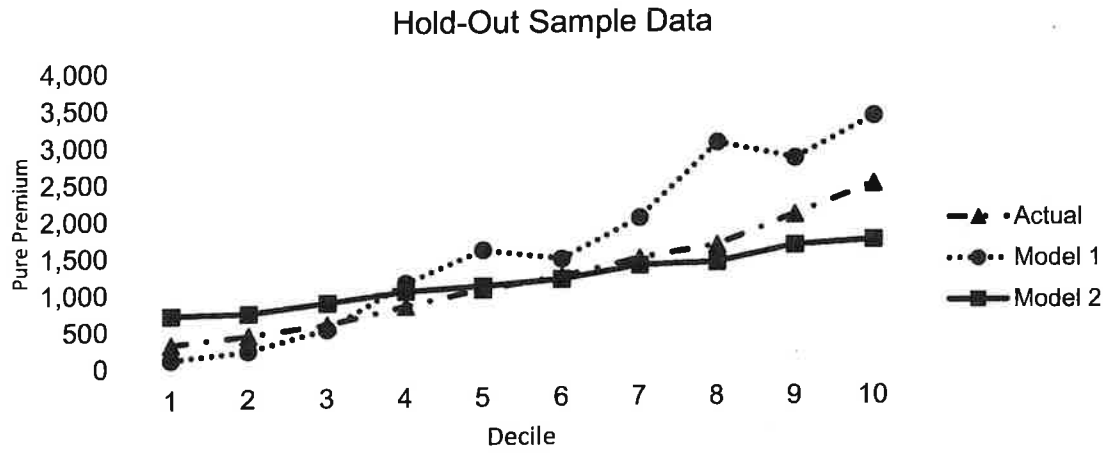
9. (1 point)

The following graphs show two competing generalized linear models' (GLMs) predictions versus the data used in modeling ("training") and a hold-out sample. Data in each graph has been sorted into equal volume deciles, ranked from low to high actual loss.





Assess each of the models.

10. (2.75 points)

Given the following information for the rating variables vehicle class, driver type, and territory:

Exposures	Territory		
Vehicle Class	1	2	3
A	30	15	200
B	80	22	104
C	20	80	60

Exposures	Territory		
Driver Type	1	2	3
X	50	45	140
Y	80	72	224

Loss ($000s)	Territory		
Vehicle Class	1	2	3
A	30	15	200
B	100	33	135
C	30	200	105

Loss ($000s)	Territory		
Driver Type	1	2	3
X	40	65	115
Y	120	180	325

- All segments are fully credible.
- Vehicle class A, Driver type X, and Territory 1 are used as the bases.

Propose rating factors for all three variables using a univariate method, considering any exposure correlation.

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11. (1.5 points)

A risk manager has the following concerns about a quote for a large deductible policy compared to the company's current small deductible policy.

i. The expense provision in the rates includes expenses associated with claims below the deductible.
ii. The rates include a provision associated with the chance of the insured becoming bankrupt. This does not appear to be relevant to the exposure being underwritten.
iii. The profit margin is higher than the one used for the small deductible option.

Explain why each of the concerns may be invalid.

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12. (2.5 points)

Given the following outputs from a retention model:

Number of Policies Renewed		
Rate Change	Territory A	Territory B
-20%	11,610	6,825
-10%	11,475	6,750
0%	11,408	6,600
+10%	10,800	6,300
+20%	9,450	6,000

	Territory A	Territory B
Current Policy Count	13,500	7,500
Current Premium ($)	2,700,000	1,350,000
Ultimate Loss Ratio	80%	70%

- All expenses are variable.
- Policy count retention level does not affect premium projections.
- Rates are set to meet management targets:
  - i. 70% permissible loss ratio for total book.
  - ii. 80% minimum retention ratio in each territory.

a. (1.5 points)

Recommend rate changes for territories A and B using the loss ratio method, taking management targets into account.

b. (0.5 point)

Describe how the rate changes recommended in part a. above could drive adverse selection.

c. (0.5 point)

Identify two non-pricing solutions that could return the fundamental insurance equation to balance.

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13. (1.75 points)

An insurer writes private passenger automobile liability coverage in two states.
Given the following bodily injury (BI) and property damage (PD) information as of December 31, 2018:

State A:

Accident Year	Earned Exposure	Ultimate Claim Count	
		BI	PD
2016	36,000	50	950
2017	37,800	60	1,140
2018	41,580	72	1,368

Paid Age-to-Ultimate Factors			
Coverage	12-to-Ult	24-to-Ult	36-to-Ult
BI	5.00	1.50	1.20
PD	1.20	1.01	1.00

Coverage	Ultimate Severity
BI	15,000
PD	5,000

State B:

Accident Year	Earned Exposure	Ultimate Claim Count	
		BI	PD
2016	100,000	1,250	5,000
2017	105,000	1,300	5,200
2018	110,250	1,375	5,500

Paid Age-to-Ultimate Factors			
Coverage	12-to-Ult	24-to-Ult	36-to-Ult
BI	9.00	2.10	1.30
PD	1.30	1.01	1.00

Coverage	Ultimate Severity
BI	10,000
PD	2,500

- There is no exposure, claim count, or severity trend.

a. (0.5 point)

Discuss an argument for performing a bodily injury and property damage combined unpaid claims analysis for state A.

b. (0.5 point)

Discuss an argument against performing an all-state combined unpaid claims analysis for bodily injury.

c. (0.75 point)

Fully evaluate management's assertion that state A should be charged a higher premium than state B for bodily injury coverage due to its higher ultimate severity.

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14. (1.25 points)

Given the following data for an insurance company evaluated as of December 31, 2018:

Average Case Outstanding				
Accident Year	12	24	36	48
2015	550	1,100	1,300	1,800
2016	575	1,150	1,500	
2017	600	1,300		
2018	700			

Average Reported Claims				
Accident Year	12	24	36	48
2015	400	800	1,200	1,500
2016	420	835	1,250	
2017	440	875		
2018	460			

- Industry average claim cost trend = 4.5%.

Fully evaluate the reasonableness of using the paid claim development technique for this company.

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15. (2.25 points)

Given the following data evaluated as of December 31, 2018:

Accident Year	Cumulative Reported Claim Counts as of (months) 12	24	36	48
2015	250	238	245	260
2016	275	270	278	
2017	323	320		
2018	375			

Accident Year	Cumulative Reported Claims ($000s) as of (months) 12	24	36	48
2015	1,250	1,280	1,325	1,430
2016	1,365	1,395	1,450	
2017	1,625	1,675		
2018	1,900			

Accident Year	Reported Claim Count Age-to-Age Factors 12-24	24-36	36-48
2015	0.952	1.029	1.061
2016	0.982	1.030	
2017	0.991		

$700,000	Accident year 2018 claim payments to date

- There is no development after 48 months.

a. (2 points)

Calculate an unpaid claims estimate for accident year 2018 using a frequency-severity technique.

b. (0.25 point)

Briefly describe a situation that would lead to the downward development in reported claim counts observed from 12 to 24 months.

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16. (1.75 points)

Given the following data for an insurance company evaluated as of December 31, 2018:

Accident Year	Cumulative Reported Claims ($000s) as of (months)			
	12	24	36	48
2015	900	2,150	3,125	3,900
2016	800	2,075	3,225	
2017	850	2,125		
2018	950			

1.100	48 to ultimate reported claim development factor

a. (0.75 point)

Calculate the company's accident year 2018 ultimate claims using the reported claim development technique.

b. (0.5 point)

Briefly describe two factors the company should take into consideration prior to supplementing their own loss development data with industry loss development data.

c. (0.5 point)

Describe the impact that doubling the number of claims handlers may have on the reported development technique.

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17. (2.75 points)

Given the following information for a company that writes the same line of business in Region 1 and Region 2, as of December 31, 2018:

	Reported Claims		
Accident Year	Region 1	Region 2	Combined
2016	180,000	200,000	380,000
2017	150,000	180,000	330,000
2018	N/A	N/A	180,000

	Reported Age-to-Ultimate Factors	
Age	Region 1	Region 2
12-Ult	2.283	1.558
24-Ult	1.154	1.192

	Earned Premium		
Calendar Year	Region 1	Region 2	Combined
2016	900,000	900,000	1,800,000
2017	1,000,000	1,000,000	2,000,000
2018	1,610,000	690,000	2,300,000

Annual Industry Trends	Region 1	Region 2	Combined
Frequency	-2%	0%	-1%
Severity	10%	0%	5%

40.0%	Region 2 accident year 2016 expected claims ratio
45.8%	Combined accident year 2016 expected claims ratio

- Equal amount of business is underwritten in Regions 1 and 2 for the entire industry.
- The company is subject to the same claims trends as the industry.
- Each region is fully credible.
- There have been no rate changes in 2017 or 2018.
- There is no premium trend.

a. (1 point)

Estimate the ultimate claims for region 1 for accident year 2017 using the reported Bornhuetter-Ferguson technique.

b. (1.25 points)

Estimate the total ultimate claims for region 1 and region 2 for accident year 2018 using the reported Bornhuetter-Ferguson technique.

c. (0.5 point)

Construct an argument against using the combined data to estimate the ultimate claims for accident year 2018.

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18. (2 points)

Given the following information as of December 31, 2018:

	Reported Claims Data			
Accident Year	Reported Claims	Age - to - Ultimate	Earned Premium	Pure Premium Trend Factors
2016	2,900	2.300	6,500	1.067
2017	1,800	3.900	8,100	0.983
2018	1,000	7.600	8,000	1.000

- There are no historical rate changes.
- There is no premium trend.

a. (1.5 points)

Calculate the ultimate claims for accident year 2017 using the reported Cape Cod technique.

b. (0.5 point)

Describe a scenario where the paid Cape Cod technique is preferred to the reported Cape Cod technique.

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19. (1.25 points)

Given the following as of December 31, 2018:

2,500	Earned premium ($000s)
60%	Expected claims ratio
1,285	Reported claims at 12 months ($000s)
1.385	Reported age-to-ultimate factor at 12 months
625	Paid claims at 12 months ($000s)

- Tort reform is passed on January 1, 2019, with an expected reduction of 20% on future claim payments.

Determine the ultimate claims using the following techniques incorporating tort reform:

i. Reported development technique.
ii. Reported Bornhuetter-Ferguson technique.

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20. (2 points)

Given the following information as of December 31, 2018:

Incremental Closed Claim Counts as of (months)			
Accident Year	72	84	96
2011	141	81	13
2012	145	61	
2013	59		

Incremental Paid Claims ($000s) as of (months)			
Accident Year	72	84	96
2011	7,600	6,100	2,400
2012	8,800	3,900	
2013	5,600		

6%	Annual severity trend
20%	Reduction in claim costs from legislative change for claims occurring after January 1, 2012

a. (1.5 points)

Estimate the trended tail severity for age 84 and older at 2018 cost levels.

b. (0.5 point)

Briefly describe two considerations when choosing the maturity age of the tail severity.

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21. (1.5 points)

Given the following data evaluated as of December 31, 2018:

Net of Reinsurance Reported Claims ($000s)				
Accident Year	12	24	36	Ultimate Frequency
2016	5,000	5,500	5,700	15%
2017	5,800	6,400		15%
2018	12,000			15%

- There are no catastrophes or large claims in accident year 2018.
- No changes have been made to claims handling practices.

a. (0.5 point)

Briefly describe two scenarios that could drive the elevated reported claims in accident year 2018.

b. (1 point)

Discuss a reasonable approach to estimate ultimate claims for each scenario identified in part a. above.

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22. (2.5 points)

Given the following:

Accident Year	Average Case Outstanding ($) on Large Claims as of (months)				Average Case Outstanding ($) on Small Claims as of (months)			
	12	24	36	48	12	24	36	48
2015	650	700	720	850	75	310	75	50
2016	670	700	900		80	400	65	
2017	750	1,000			110	190		
2018	1,200				90			

Accident Year	Open Large Claim Counts as of (months)				Open Small Claim Counts as of (months)			
	12	24	36	48	12	24	36	48
2015	14	16	18	22	150	115	100	80
2016	15	18	20		155	130	120	
2017	11	13			145	120		
2018	10				150			

Accident Year	Cumulative Paid Claims ($) on Large Claims as of (months)				Cumulative Paid Claims ($) on Small Claims as of (months)			
	12	24	36	48	12	24	36	48
2015	520,000	802,000	1,021,000	1,140,000	25,000	55,000	174,000	268,000
2016	510,000	789,000	1,008,000		23,000	37,000	170,000	
2017	540,000	829,000			20,000	67,000		
2018	525,000				22,000			

5%	Annual severity trend

Cumulative Unadjusted Reported Claim Development Factors				
Age	12-to-Ult	24-to-Ult	36-to-Ult	48-to-Ult
Large Claims	2.638	1.715	1.345	1.200
Small Claims	9.007	3.597	1.798	1.200

- Large claims are defined as greater than or equal to $500,000 in reported claims and small claims are defined as less than $500,000 in reported claims.
- In 2018, the company hired additional claims handling personnel to increase the case reserve adequacy on large claims.
- Case reserves for small claims are not impacted by the change in claims handling personnel.
- There have been no changes to settlement rates.

Calculate the estimated ultimate claims for accident year 2018 using the reported development technique adjusting for the change in case reserve adequacy.

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23. (1.5 points)

Given the following as of December 31, 2018:

Accident Year	Per Occurrence Retention	Stop-Loss Limit
2015	1,000,000	***
2016	1,000,000	***
2017	1,500,000	5,000,000
2018	2,000,000	7,000,000

***2015 and 2016 have a combined stop-loss limit of 10,000,000 that applies to all claims occurring in both years.

Summary of Claims Under Per Occurrence Retention		
Accident Year	Reported Claims	Percent Reported
2015	2,000,000	70%
2016	1,500,000	35%
2017	800,000	20%
2018	450,000	10%

Large Claims (not included in the claims table above)		
Claim	Accident Year	Reported Claim
A	2015	1,200,000
B	2015	1,500,000
C	2016	3,000,000
D	2017	1,750,000

- There will be no further development on large claims.

Calculate the estimated retained IBNR for all accident years using the reported development technique.

CONTINUED ON NEXT PAGE

24. (2 points)

Given the following information:

Accident Year	Cumulative Paid Claims Only as of (months) 12	24	36	48
2015	3,800	10,640	15,960	17,556
2016	3,900	10,920	15,600	
2017	3,850	11,858		
2018	4,050			

Accident Year	Cumulative Paid ALAE as of (months) 12	24	36	48
2015	77	316	512	571
2016	81	337	517	
2017	75	334		
2018	82			

Accident Year	Selected Ultimate Claims Only
2015	17,500
2016	17,900
2017	17,600
2018	18,500

- There is no development beyond 48 months.

a. (1.25 points)

Estimate ultimate ALAE for accident year 2018 using the multiplicative ratio development approach.

b. (0.25 point)

Briefly describe when it is more appropriate to use an additive development approach than a multiplicative development approach.

c. (0.5 point)

Briefly describe one advantage and one disadvantage of the ratio techniques.

END OF EXAMINATION

Exam 5
Basic Techniques for Ratemaking and Estimating Claim Liabilities

POINT VALUE OF QUESTIONS

QUESTION	TOTAL POINT VALUE OF QUESTON	SUB-PART OF QUESTION (a)	(b)	(c)	(d)	(e)	(f)	(g)
1	2.50	0.25	0.50	0.50	0.25	1.00		
2	2.25	1.75	0.50					
3	1.50	0.50	0.50	0.50				
4	2.25	1.00	0.75	0.50				
5	4.25	3.75	0.50					
6	2.50	1.25	0.25	0.50	0.50			
7	4.75	0.50	3.50	0.75				
8	1.75	0.75	1.00					
9	1.00	1.00						
10	2.75	2.75						
11	1.50	1.50						
12	2.50	1.50	0.50	0.50				
13	1.75	0.50	0.50	0.75				
14	1.25	1.25						
15	2.25	2.00	0.25					
16	1.75	0.75	0.50	0.50				
17	2.75	1.00	1.25	0.50				
18	2.00	1.50	0.50					
19	1.25	1.25						
20	2.00	1.50	0.50					
21	1.50	0.50	1.00					
22	2.50	2.50						
23	1.50	1.50						
24	2.00	1.25	0.25	0.50				
25	0.00							
26	0.00							
27	0.00							
28	0.00							
29	0.00							
30	0.00							
31	0.00							
32	0.00							
33	0.00							
34	0.00							
35	0.00							
36	0.00							
37	0.00							
38	0.00							
39	0.00							
40	0.00							
41	0.00							
42	0.00							
43	0.00							
44	0.00							
45	0.00							
TOTAL	52.00							

EXAM 5 SPRING 2019 – SAMPLE ANSWERS AND EXAMINER'S REPORT

The Syllabus and Examination Committee has prepared this Examiner's Report as a tool for candidates preparing to sit for a future offering of this exam. The Examiner's Report provides:

- A summary of exam statistics.
- General observations by the Syllabus and Examination Committee on candidate performance.
- A question-by-question narrative, describing where points were commonly achieved and missed by the candidates.

The report is intended to provide insight into what the graders for each question were looking for in responses that received full or nearly-full credit. This includes an explanation of common mistakes and oversights among candidates. We hope that the report aids candidates in mastering the material covered on the exam by providing valuable insights into the differences between responses that are comprehensive and those that are lacking in some way.

Candidates are encouraged to review the Future Fellows article from June 2013 entitled "Getting the Most out of the Examiner's Report" for additional insights.

EXAM STATISTICS:

- Available Points: 52
- Passing Score: 37.5
- Number of Candidates: 734
- Number of Passing Candidates: 294
- Raw Pass Ratio: 40.1%
- Effective Pass Ratio: 42.6%

GENERAL COMMENTS:

- Candidates should note that the instructions to the exam explicitly say to show all work; graders expect to see enough support in the candidate's response to follow the calculations performed. While the graders made every attempt to follow calculations that were not well-documented, lack of documentation may result in the deduction of points where the calculations cannot be followed or are not sufficiently supported.
- Candidates should justify all selections when prompted to do so. For example, if the candidate selects an all year average and the question prompts a justification of all selections, a brief explanation should be provided for the reasoning behind this selection. Candidates should note that a restatement of a numerical selection in words is not a justification.
- Incorrect responses in one part of a question did not preclude candidates from receiving credit for correct work on subsequent parts of the question that depended upon that response.
- Candidates should try to be cognizant of the way an exam question is worded. They must look for key words such as "briefly" or "fully" within the problem. We refer candidates to the Future Fellows article from December 2009 entitled "The Importance of Adverbs" for additional information on this topic.
- Some candidates provided lengthy responses to a "briefly describe" question, which does not provide extra credit and only takes up additional time during the exam.

EXAM 5 SPRING 2019 – SAMPLE ANSWERS AND EXAMINER'S REPORT

- Candidates should note that the sample answers provided in the sample solutions file are not an exhaustive representation of all responses given credit during grading, but rather the most common correct responses.
- In cases where a given number of items were requested (e.g., "three reasons" or "two scenarios"), the sample solutions will include multiple solutions that cumulate to more sample answers than the requested number. The additional responses are provided for educational value, and would not have resulted in any additional credit for candidates who provided more than the requested number of responses. Candidates are reminded that, per the instructions to the exam, when a specific number of items is requested, only the items adding up to that number will be graded (i.e., if two items are requested and three are provided, only the first two are graded).
- It should be noted that all exam questions have been written and graded based on information included in materials that have been directly referenced in the official syllabus, which is located on the CAS website. The CAS takes no responsibility for the content of supplementary study materials and/or manuals produced by outside corporations and/or individuals which are not directly referenced in the official syllabus.

QUESTION 1

TOTAL POINT VALUE: 2.5 | **LEARNING OBJECTIVE(S): A1**

SAMPLE ANSWERS

Part a: 0.25 point

Sample 1

0.5*(2 + 3 + 1 + 2 + 1) = 4.5

Sample 2

All policies are written in 2018. All policies are 6 months policies.

0.5*(2 + 3 + 1 + 2 + 1) = 0.5 * 9 = 4.5

Part b: 0.5 point

Sample 1

0.5*(2 + 3 + 1 + 2*(3/6) + 1*(2/6)) = 3.67

Sample 2

Policies A, B, C are fully earned in CY 2018.

Policy D has 3 months earned out of 6 months in CY 2018.

Policy E has 2 months earned out of 6 months in CY 2018.

2*6/12 + 3*6/12 + 1*6/12 + 2*(3/12) + 1*(2/12) = 3.67

Sample 3

Policy	# of risks	% earned	Factor for 6 months	Earned exposure in CY 2018
A	2	100%	0.5	1
B	3	100%	0.5	1.5
C	1	100%	0.5	0.5
D	2	50%	0.5	0.5
E	1	33%	0.5	0.17
			Total	3.67

Part c: 0.5 point

Sample 1

0.5*(2 + 3 + 1 + 2*(5/6) + 1*(4/6)) = 4.17

Sample 2

Policies A, B, C are fully earned in PY 2018, as of February 28, 2019

Policy D has 5 months earned out of 6 months in PY 2018, as of February 28, 2019

Policy E has 4 months earned out of 6 months in PY 2018, as of February 28, 2019

2*6/12 + 3*6/12 + 1*6/12 + 2*(5/12) + 1*(4/12) = 4.17

Sample 3

Policy	# of risks	% earned	Factor for 6 months	Earned exposure in PY 2018
A	2	100%	0.5	1
B	3	100%	0.5	1.5
C	1	100%	0.5	0.5
D	2	83%	0.5	0.83
E	1	67%	0.5	0.33
			Total	4.17

Sample 4

Start with answer from subpart b. Policies A, B, C are still fully earned in PY 2018 as of February 28, 2019. Policies D and E each have 2 additional months of earned exposures in PY 2018 as of February 28, 2019.

3.67 + 2*(2/6)*0.5 + 1*(2/6)*0.5 = 4.17

Part d: 0.25 point

Sample 1

Policies A and B are expired as of October 15, 2018.
Policies C and D are in force as of October 15, 2018.
Policy E isn't in effect yet as of October 15, 2018.
1 + 2 = 3

Sample 2

Policies A and B are expired as of October 15, 2018.
Policies C and D are in force as of October 15, 2018.
Policy E isn't in effect yet as of October 15, 2018.
0.5 * (1 + 2) = 1.5

Sample 3

0 + 0 + 1 + 2 + 0 = 3

Sample 4

0.5 * (0 + 0 + 1 + 2 + 0) = 1.5

Part e: 1 point

Any two of the following criteria:

- Proportional to expected losses
- Practical/Easy to obtain, inexpensive to verify/Objective
- Considerate of historical precedence

For each criterion, provide an evaluation of miles driven as an exposure base.

Criterion: Proportional to expected losses.
Evaluation:

- Satisfied. The more you drive, the more you are exposed to risk of having an accident
- Satisfied. The more you drive, it increases the probability of losses for Liability and Collision, but not Comprehensive.

Criterion: Practical

- Not satisfied. Miles driven can be easily obtained by telematics, but may not be cheap to implement.
- Satisfied. Miles driven can be obtained and verified by telematics.

Criterion: Easy to obtain, inexpensive to verify

- Not satisfied. Easy to obtain, but costly to verify
- Not satisfied. If the insured is self-reporting, then miles driven can be easily manipulated.

Criterion: Objective

- Satisfied. Miles driven is a number and not subjective.

Criterion: Considerate of historical precedence

- Not satisfied. Current exposure base is car years. Changing exposure base would be costly to implement from an IT perspective, would require adjustment for future analysis, and could cause large premium swings for individual insureds.

EXAMINER'S REPORT

Candidates were expected to understand the differences between calendar year and policy year. Candidates were expected to be able to calculate written, earned, and inforce exposures. Candidates were also expected to know the different criteria that an appropriate exposure base must satisfy and be able to evaluate them against a new exposure base.

Part a

Candidates were expected to know how to calculate written exposure. They were also expected to realize that the policies were 6-month term policies.

A common mistake was forgetting to multiply by 0.5 to account for the 6-month term.

Part b

Candidates were expected to know how to calculate calendar year earned exposure. They were also expected to realize that the policies were 6-month term policies.

Common mistakes included:

- Forgetting to multiply by 0.5 to account for the 6-month term.
- Double counting the 6-month term by dividing the months earned by 12, but still multiplying by 0.5.

Part c

Candidates were expected to know how to calculate policy year earned exposure. They were also expected to realize that the policies were 6-month term policies.

Common mistakes included:

- Forgetting to multiply by 0.5 to account for the 6-month term.
- Double counting the 6-month term by dividing the months earned by 12, but still multiplying by 0.5.

Part d

Candidates were expected to identify the policies in force and know how to calculate inforce exposure.

A common mistake was to identify Policy E as an inforce policy and count it in the inforce exposure when the policy had not yet been effective on October 15, 2018.

Part e

Candidates were expected to know the different criteria for an appropriate exposure base and be able to evaluate them against a new exposure base.

For the criteria "proportional to expected losses", a common mistake was simply stating miles driven was proportional to expected losses. An explanation of why they were proportional was expected. Another common mistake was simply stating that car years was a better exposure base than miles driven in terms of proportionality to expected losses without explaining why.

For the criteria "practical", a common mistake was simply stating that miles driven was easy to verify without providing an explanation, such as mentioning telematics or technology.

For the criteria "considerate of historical precedence", a common mistake was simply stating the current exposure base is car years. Candidates were expected to explain the impact of changing to a new exposure base.

Some candidates confused the exposure base criteria with the social criteria and mentioned causality or controllability.

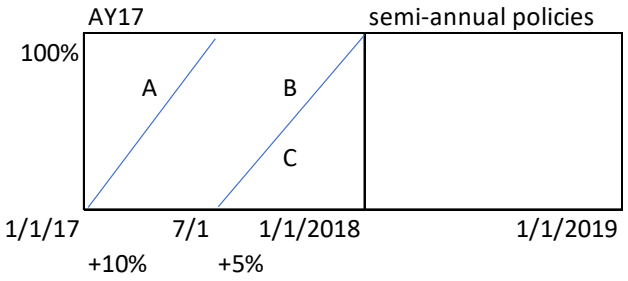
QUESTION 2

TOTAL POINT VALUE: 2.25 | **LEARNING OBJECTIVE(S): A2**

SAMPLE ANSWERS

Part a: 1.75 points

Sample 1



	rate	area	
A	1.0	1/2 (1/2) (1)	= 0.25
B	1.10	1/2 (1)	= 0.5
C	1.155	1/2 (1/2) (1)	= 0.25

AY17 avg rate level =
1.0 x .25 + 1.1 x .5 +1.155 x .25 = 1.08878

curr rate level = 1.0 x 1.1 x 1.05 = 1.155

AY17 OLF = $\frac{1.155}{1.08878}$ = 1.06085

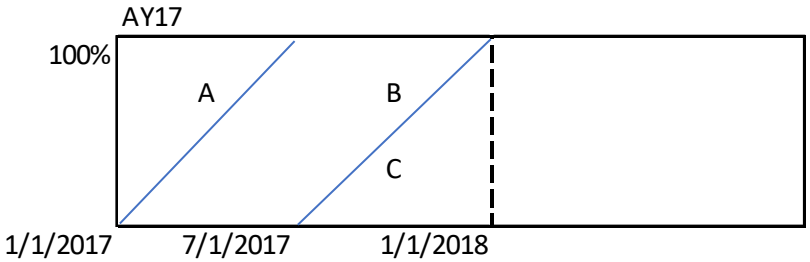
AY17 OLEP = 3850000 x 1.06085 = 4,084,271

QY	Avg Written Prem @ CRL	Annual % chg	rates in effect 7/1/19 - 7/1/20
2Q16	1771		
4Q16	1806		
2Q17	1840	3.9% = 1840 / 1771 -1	
4Q17	1877	3.9% = 1877 / 1806 -1	
2Q18	1914	4.0%	
4Q18	1953	4.0%	

select a 4% trend rate
trend from avg written date for EP AY17 = 7/1/17 -1/2 pol term = 4/1/17
Avg written date for EP in future policy: 1/1/20
trend from 4/17/17 - 1/1/20 2.75 years

Trended OLEP = 4084271 x $1.04^{2.75}$ = 4,549,422

Sample 2



	Area	A	B	C
CY2017		=0.5x0.5=0.25	0.5	0.25
	Factor	1	1.1	1.1x1.05

OL-Factor
1.1x1.05/(0.25+0.5x1.1+0.25x1.1x1.05)
=1.06085

byYrs Average Trend

2Q2016-2Q2017	1840/1771-1 = 3.86%
4Q2016-4Q2017	1877/1806 -1 = 3.93%
2Q2017-2Q2018	0.04022
4Q2017-4Q2018	4.049%

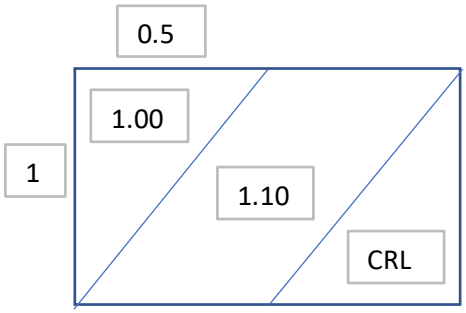
The premium trend is increasing by years
Using two-step trend

First step, trend from 4/1/2017 ~ 4/1/2018, select trend 4.022% (2Q2017 - 2Q2018)
$Trend_1 = 1.04022$

Second step, trend from 4/1/2018 to 1/1/2020, select latest trend 4.049%
$Trend_2 = 1.04022^{1.75}$

Trended on-level EP for 2017 = 3.850,000 x OL Factor x $Trend_1$ x $Trend_2$
=4,554,128

Sample 3



On-level factors:

CRL = (1.10)(1.05)

2017 RL =

(.5 * 1)(.5)(1.00) + [1 - 2(.5 * 1)(.5)](1.10) + (.5 * 1)(.5)(CRL)

= 1.08875

2017 OLF = CRL / 1.08875 = 1.0608

Quarters	**% change in CRL WP**
2Q16 - 4Q16	1.020
4Q16 - 2Q17	1.019
2Q17 - 4Q17	1.020
4Q17 - 2Q18	1914/1877 = 1.020
2Q18 - 4Q18	1.020

Select 2% half-year trend (1.02^2 annual)

Rates eff. Jul 1 2019 - Jun 30 2020

Avg written date of 2017 EP: 4/1/17

Avg written date of new rate EP: Jan 1 2020 (1/1/20)

Trend period = 2.75 yr

CY	**EP (000)**	**OLF**	**Trend**	**Trended on-level EP**
2017	3850	1.0608	$(1.02^2)^{2.75}$	4,554,236

Part b: 0.5 point

- Reason 1: trend period would be longer
  The trend period would be from 7/1/17 – ½ pol term = 1/1/17 to 1/1/20 which is 3 years and since the trend is positive this would result in a higher '17 trended OLEP
- Reason 2: the OLF would be higher since it would take longer to get to the latest rate level (so the rate change lines would be less steep in the parallelogram method, so more time would be spent at lower rate levels causing the avg rate level for AY17 to be lower)

EXAM 5 SPRING 2019 – SAMPLE ANSWERS AND EXAMINER'S REPORT

EXAMINER'S REPORT

Candidates were expected to demonstrate knowledge of on-leveling (parallelogram method) and trending and be able to explain how moving from semi-annual to annual policies impacted each.

Part a

Candidates were expected to successfully complete the calculation for trended, on-level earned premium.

Numerous candidates attempted to complete this problem using two-step trending. The way the data was presented made this approach more challenging.

Common mistakes included:

- Arithmetic/calculation errors:
  - Parallelogram method
  - Evaluating semiannual written premium changes
  - Final premium calculation
- Applying an annual trend period to a semiannual trend selection.
- Incorrect trending period.
- When attempting a two-step trend, trending the 2017Q4 premium to 2018Q4 without recognizing that this was only the average for half of 2017.

Part b

Candidates were expected demonstrate that they understood the reasons why the premium would be higher if the policies were annual policies rather than semi-annual.

Common mistakes included:

- Providing two explanations for one of the reasons, rather than an explanation for each of the two reasons.
- Stating "OLF would be higher" without additional explanation.

QUESTION 3

TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): A1, A3**

SAMPLE ANSWERS

Part a: 0.5 point

Advantages:

- Fixed at year end
- Easy to obtain
- Readily available at the end of the CY
- It's immediately available after the year is ended

Disadvantages:

- Poor matching of premium and losses

Part b: 0.5 point

- Policy Year aggregation would match up the losses and premium perfectly
- Calendar/accident year aggregation would provide a better match between premium/exposure and losses
- Accident year data aggregation, it develops more quickly than policy year aggregation
- If the long-tailed line sells claims-made policies (as is common) then I'd recommend using Report Year data aggregation because it will provide the best match of premium to losses.

Part c: 0.5 point

- At the end of a claims made policy there is no pure IBNR so at the end of the policy period almost all losses are known (except for IBNER). This aligns with report year data aggregation, so it is a good fit. This will also tie premium/exposures to their losses.
- There is no pure IBNR in either report year aggregation or a claims-made policy. Reporting is also the trigger for a CM policy so grouping claims by RY makes sense.
- The coverage trigger in the case of a claims-made policy is the report of the claim. That makes the match between premium and losses to be ideal using a report year data aggregation.

EXAMINER'S REPORT

Candidates were expected to understand the Calendar Year, Accident (Calendar/Accident) Year, Policy Year, and Report Year data aggregation methods. They were expected to know the advantages and disadvantages of these methods, when it may be appropriate to use each method in ratemaking, and the mechanics/definitions of these methods.

Part a

Candidates were expected to know an advantage and a disadvantage of using the Calendar Year data aggregation method.

Common mistakes included:

- Only discussing the loss data or the premium/exposure data, not both.
- Citing no loss development as a disadvantage
- Stating that an advantage of calendar year aggregation is its suitability for financial reporting. The advantage of using calendar year data is its availability.

Part b

Candidates were expected to know that the Accident Year and/or Policy Year data aggregation methods are appropriate for a risk classification plan for a long-tailed line of business.

Candidates were also expected to know why their selected data aggregation method may be appropriate in this situation.

Common mistakes included:

- Not selecting an appropriate data aggregation method, such as Calendar Year or Report year without the assumption that coverage was provided through a claims-made policy
- When using losses as justification, failing to discuss the appropriateness of the match between losses and premium/exposure. Examples of this include:
    - Stating that the selected method can be used to calculate IBNR
    - Stating that the selected method can be used to develop losses
    - Explaining the development patterns of a long-tailed line
- Stating that accident year provides the 'best' or is a 'perfect' match between premium and losses

Part c

Candidates were expected to understand why Report Year data aggregation is appropriate for a claims-made line of business.

Common mistakes included:

- Providing no justification, only stating that Report Year is appropriate
- Providing a response that was too brief, such as:
    - Claims-made policies cover reported claims
    - There is no pure IBNR
    - Report year matches premium to losses
- Declaring claims-made policies and/or report year data aggregation do not have IBNR without clarifying that claims-made policies only have IBNER.
- Justifying the use of a claims made policy rather than discussing appropriateness of report year aggregation

QUESTION 4

TOTAL POINT VALUE: 2.25 | **LEARNING OBJECTIVE(S): A8**

SAMPLE ANSWERS

Part a: 1 point

Sample 1

	Total Trended	Basic Limit Loss Trended	Basic Limit Loss
1	16.2	16.2	15
2	22.68	22.68	21
3	25.92	25	24
4	59.4	25	25
		88.88	85

BLL Trend = 88.88 / 85 - 1 = 4.565%

Sample 2

Claim	BL Loss at t=0	BL Loss at t=1
1	15	16.2
2	21	22.68
3	24	25
4	25	25
	85	88.88

88.88 / 85 – 1 = 4.56% BL Loss Trend

Part b: 0.75 point

Sample 1

Trended total loss = 16,200 + 22,680 + 25,920 + 59,400 = 124,200
Trended excess loss = 124,200 – 88,880 = 35,320
Original excess loss = 30,000
Excess loss trend = 1.177

Sample 2

Claim	XS of 25	Trended Uncapped	XS of 25
1	0	16.2	0
2	0	22.68	0
3	0	25.92	.92
4	30	59.4	34.4
	30		35.32

35.32 / 30 - 1 = 17.73%

Part c: 0.5 point

- Assuming the trend is positive, applying the total trend would overestimate basic limit losses, because the actual basic limit trend is less than the total.
- Not appropriate
  - for losses above basic limit, trend is entirely on XS layer
    none applied to basic limit
  - for losses close to basic limit, trend will push loss into XS layer
    not all of the trend will apply to basic losses

- Not appropriate. Trend impacts basic limit losses and excess losses differently. The two layers should be trended separately.

EXAMINER'S REPORT

Candidates were expected to calculate the basic limits loss trend and excess loss trend from the information given, and to discuss the inappropriateness of applying a total limits trend to basic limits losses.

Part a

Candidates were expected to calculate the basic limits loss trend.

A common mistake was incorrectly totaling the trended basic limit losses by not including each of the 4 claims.

Part b

Candidates were expected to calculate the excess loss trend.

Common mistakes included:

- Applying trend to only the excess portion of the loss
- Using a basic limit other than the one given to determine the excess portion of the loss

Part c

Candidates were expected to discuss the inappropriateness of applying total limits trend to basic limits losses, such as stating that the trends are different, explaining why the trends are different, describing the impact of applying total limits trend to basic limits losses, or providing a valid alternative method.

Common mistakes included:

- Providing a response that was not robust enough, such as stating that the trends are different but not why they are different or how it would impact the estimated loss
- Providing conflicting supporting statements, such as stating that total limits trend is higher than basic limits trend and that applying total limits trend to basic limits losses would cause trended basic limits losses to be underestimated.
- Stating it is inappropriate due to volatility in excess losses, or that losses should be capped at basic limits and a large loss applied as those comments are not specifically related to trend.
- Stating it is appropriate to apply total limits trend to basic limits losses, without stating that is only the case when the trends are the same for basic, excess, and total limits losses, or when the total limits trend would be applied to the total limits loss as the sum of basic limits loss and excess loss.

QUESTION 5	
TOTAL POINT VALUE: 4.25	**LEARNING OBJECTIVE(S): A3**

SAMPLE ANSWERS

Part a: 3.75 points

Sample 1

Freq Trend = stable over time. Use 16 point 1.4% to ensure credibility
Sev Trend = decrease over time. Use 16 point for experience period 5.4%.
6 point for future period 0.1%

Assume cum. rpt losses are gross of shock losses.

AY	Trended Gross Rpt Loss (000)
12	169,000 x 1.054^6 x 1.001^2.5 x 1.014^(6+2.5) = 267,068
13	181000 x 1.054^5 x 1.001^2.5 x 1.014^(5+2.5) = 261,061
14	243,762
15	212,659
Total	984,550

Trend from: step 1: 7/1/201x to 7/1/2018
Step 2: 7/1/2018 to 1/1/2021: 2.5 years

AY	Trended XS Loss (000)
12	3,000 x 1.054^6 x 1.001^2.5 x 1.014^8.5 – 3 x 500 = 3,141
13	5,237
14	2,563
15	260
Total	11,200

XS Loss Ratio = (11,200) / (984,550 – 11,200) = 1.15%

AY2018 xs loss = 900-500 = 400
Ult. Loss Adj. by xs load = (121,000 – 400) x (1.21 x 1.1 x1.05) x (1 + 1.15%) = 169,073.84
Trend to 1/1/2021: 2.5 years using future trend: Freq 1.4%, Sev 0.1%
169,073.84 x (1.014 x 1.001)^2.5 = 175,492

Sample 2

Trend Selections: Frequency seems stable. Select 1.5% judgmentally for one-step. Severity has decreased. Current step: Select 5% based on longer-term regressions. Projected: Select 0% based on most recent regressions.

Current pure premium trend: (1.015)(1.05) = 1.066 Proj.: 1.015

Select Excess Loss Load:

AY	Losses Trended to 1/1/21	Trended Ground-up shock losses
12	169 * (1.066)^6 * (1.015)^2.5 = 257,030	3000 * (1.066)^6 * 1.015 ^ 2.5 = 4,563
13	169 * (1.066)^5 * (1.015)^2.5 = 258,298	7,135
14	169 * (1.066)^4 * (1.015)^2.5 = 241,023	4,017
15	169 * (1.066)^3 * (1.015)^2.5 = 212,333	754

	Primary Losses	Excess Losses	% Excess to Primary
12	257,030 – 4563 + (3 * 500) = 263,093	4,563 – (3 * 500) = 3,063	1.164%
13	253,163	5,135	2.028%
14	238,506	2,517	1.055%
15	212,079	254	0.120%
Total			1.135%

Selected total; 1.135% of non-excess losses

Develop losses to ultimate for 2018

121,000 * 1.2 * 1.1 * 1.05 = 167,706 900 * 1.2 * 1.1 * 1.05 = 1,247

Trend ultimate and shock loss for 2018:

167,706 * 1.015^2.5 = 174,066 1,247 * 1.015^2.5 = 1,294

Trended ult primary losses:

174,066 – 1,294 + 500 = 173,272

Total projected losses

173,272 * (1.01135) = **175,238,000**

Part b: 0.5 point

Any two of the following:

- Select a quantile from the loss distribution
- Quantile approach to total losses
- Certain % of amount of insurance
- Basic Limit
- Reinsurance Limit
- Policy Limit
- Industry Benchmark
- Balance stability and responsiveness of indication
- Actuarial Judgement
- Capping at a percentage of coverage, e.g. homeowners could cap at 70% of coverage A
- Analyze the distribution of losses. Select a threshold as a percentile of the loss distribution
- Look at losses and select a claim value where large losses start to get volatile and thin to select a threshold

EXAMINER'S REPORT

Candidates were expected to develop accident year losses for ratemaking purposes. Ultimate losses should have reflected the appropriate application of trending and loss development, as well as appropriate adjustments for shock losses.

Part a

Candidates were asked to:

Trend historical losses

- Make frequency and severity trend selections and briefly justify the selections, including the need for two-step trending for severity
- Determine and apply the correct number of trend years for each selection.
- Appropriately trend historical cumulative and shock losses (accident years 2012-15)

Calculation of Excess of Loss Factor

- Remove trended shock losses from the trended cumulative losses, but retain the amount below the threshold for each claim.
- Calculate an appropriate excess loss factor using 2012-2015 accident years only.

Final Calculation of Accident Year 2018 Losses

- Appropriately remove excess losses and retain $500,000
- Apply appropriate trend and loss development factors
- Multiply the previously developed excess loss provision correctly (1+factor)

Common mistakes included:

- Not justifying the trend selections
- Not identifying the need for two-step severity trending (making a selection on recent points only)
- Not trending AY 2012-2015 losses (both cumulative and shock) used in the excess of loss calculation
- Not retaining $500,000 for each shock loss in the cumulative accident year losses
- Not removing the excess losses from the cumulative losses in the denominator of the excess loss calculation or the Accident Year 2018 losses

Part b

Candidates were asked to briefly describe two approaches for selecting an excess loss threshold used for capping shock losses.

Candidates were expected to demonstrate knowledge and thought behind an appropriate selection of an excess loss threshold.

Common mistakes included:

- Stating "arbitrary selection" without some justification or use of judgement.
- Stating "Historical selections" because they may be not be relevant in present times
- Stating "ask Claims Department" because shock losses for Claims Department use may be different than those for ratemaking purposes
- Listing a data source without any explanation or justification (e.g. "use industry data" without describing how to use the data to get a threshold)

- Repeating the same answer in different words
- Explaining how to apply the threshold rather than explaining how to select a threshold.
- Stating "quantile approach" without relating the quantile to losses.

QUESTION 6	
TOTAL POINT VALUE: 2.5	**LEARNING OBJECTIVE(S): A4**
SAMPLE ANSWERS	
Part a: 1.25 point	
Sample 1 2018 Ratios: C/B = 945 / 6100 = 15.5% O/A = 760 / 6100 = 12.5% G/E = 325 / 5920 = 5.5% TL&F = 130 / 6100 = 2.1% Selected Ratios: C/B = 13.5% - Average of 2016-2018 O/A = 12.7% - Average of 2016-2018 G/E = 5.5% - Average of 2017-2018, G/E levels seem to have decreased after 2016 year TL&F = 2.1% - Average of 2016-2018 Total Expense Ratio = 33.8% *Sample 2* Using projected ratios as C/B ratio is up significantly from 2016-2017 levels. Total Expense Ratio = (945+760+130)/6100 + 325/5920 = 35.6%	
Part b: 0.25 point	
Sample 1 VPLR = 1 – Total Expense Ratio – Profit Provision = 1 – 33.8% - 7% = 59.2% *Sample 2* VPLR = 1 – 35.6% - 7% = 57.4%	
Part c: 0.5 point	
Any two of the following*:* • If there are some expenses that are truly fixed this will understate premiums for small premium policies and overstate them for large policies. • Expenses such as TLF and C/B often vary by state, so it may not be appropriate to use countrywide ratios. • Historical expense ratios may be very different than future ratios. • Expenses will likely be increased while gaining traction in the new state, due to start-up costs for infrastructure and new staff.	
Part d: 0.5 point	
Sample 1 VPLR = 1 – 13.5% - 12.7% - 5.5%x25% - 7% = 65.4% *Sample 2* Fixed Expense % = 130/6100 + 75%x325/5920 = 6.25% VPLR = 57.4% + 6.25% = 63.6%	

EXAM 5 SPRING 2019 – SAMPLE ANSWERS AND EXAMINER'S REPORT

EXAMINER'S REPORT

Candidates were expected to calculate the 2018 expense ratios and compare them to the given 2016 & 2017 values to justify their total selected expense ratios. Candidates were expected to calculate the variable permissible loss ratio under a scenario where all expenses were considered variable and also where some expenses were considered fixed. Candidates were expected to provide examples of potential issues when using benchmark data in a new state and/or when assuming all expenses vary with premium.

Part a

Candidates were expected to calculate the 2018 expense ratios and compare/contrast them to the given 2016 & 2017 values to justify their total selected expense ratios.

Common mistakes included:

- Using an average of 2016 & 2017 expense ratios directly, not considering the given 2018 data
- Using the incorrect premium base (written/earned) in calculating an expense ratio

Part b

Candidates were expected to calculate the variable permissible loss ratio.

A common mistake was not considering the profit provision.

Part c

Candidates were expected to provide examples of potential issues when using benchmark data in a new state or when assuming all expenses vary with premium.

A common mistake was not fully developing an answer, for example, simply stating there could be some fixed expenses, but not explaining how that would lead to some distortion.

Part d

Candidates were expected to adjust the variable expense ratio for the fixed expenses and recalculate the VPLR.

Common mistakes included:

- Including 75% of the General Expenses as variable as opposed to the stated 25%
- Not considering the profit provision

QUESTION 7

TOTAL POINT VALUE: 4.75 | **LEARNING OBJECTIVE(S): A5, A8, B3**

SAMPLE ANSWERS

Part a: 0.5 point

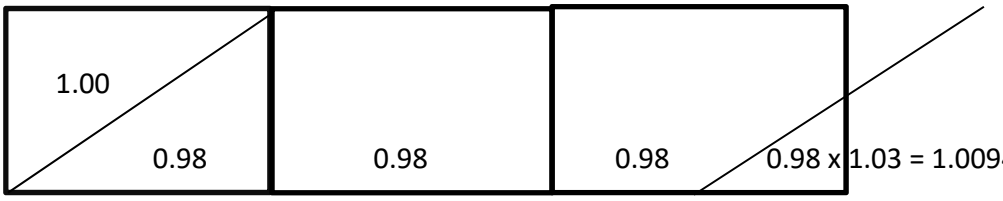
B-F Ult Loss = Rep Loss + (1 – 1/Rep CDF to Ult) (EP) (Exp Loss + LAE Ratio)

2016: 2,000 + (1 – 1/1.46) (4,600) (0.65) = 2,942
2017: 1,750 + (1 – 1/2.08) (5,100) (0.65) = 3,471
2018: 800 + (1 – 1/4.90) (5,800) (0.65) = 3,801

Part b: 3.5 points

Sample 1

Avg written date: 7/1/20
Avg loss date: 1/1/21



1/1/16 7/1/18
CY 2016 CY 2017 CY 2018

CY	Avg Rate Level	On Level Factor = current level/CY avg level
'16	(1.00 + 0.98) / 2 = 0.99	1.020
'17	0.98	1.030
'18	7/8 (0.98) + (1/2)(1/2)^2(.98 x 1.03) = 0.9837	1.026

CY	On Level EP	Avg written date of EP	Trend to 7/1/20	Trended OLEP
'16	4600 x 1.02 = 4692	1/1/16	$1.03^{4.5}$	4692 x $1.03^{4.5}$ = 5360
'17	5100 x 1.03 = 5253	1/1/17	$1.03^{3.5}$	5826
'18	5800 x 1.026 = 5951	1/1/18	$1.03^{2.5}$	6407

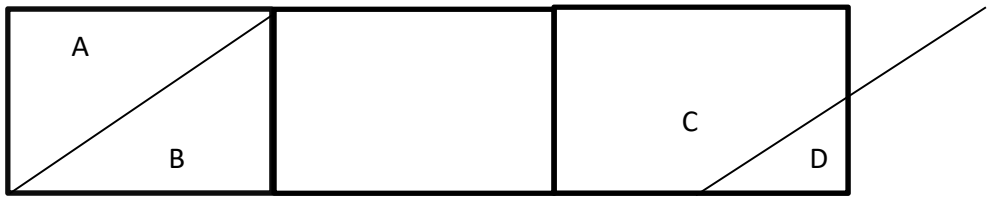
AY	Ult Loss	Trend to 1/1/21	Trended Ult Loss	Loss Ratio
'16	2942	$1.04^{4.5}$	3510 = 2942 x $1.04^{4.5}$	3510/5360 = .655
'17	3471	$1.04^{3.5}$	3982	.683
'18	3801	$1.04^{2.5}$	4192	.654
				.664

Ind Chg = $\frac{\text{Loss \& ALAE Ratio (1 + ULAE) + FE\%}}{1 - V - Q} - 1 = \frac{.664\ (1.08) + 0.06}{1 - .26 - .08} - 1 = 12.63\%$

Cred Wtd Ind Chg = .1263 (.70) + .08 (.30) = 11.24%

Sample 2

Region	Area	RL
A	0.5	1
B	0.5	0.98
C	0.875	0.98
D	0.125	1.0094



CY '16 RL = 0.99 CY '16 OLF = 1.0196
CY '17 RL = 0.98 CY '17 OLF = 1.03
CY '18 RL = 0.9837 CY '18 OLF = 1.0261

CY	On Level EP	Trend	Trended OLEP
'16	4690	$1.03^{4.5}$	5357
'17	5253	$1.03^{3.5}$	5826
'18	5951	$1.03^{2.5}$	6408

AY	Ult Loss & ALAE	Trend	ULAE	Trended Ult Loss & LAE	Loss Ratio
'16	2942	$1.04^{4.5}$	1.08	3791	70.76%
'17	3471	$1.04^{3.5}$	1.08	4301	73.82%
'18	3801	$1.04^{2.5}$	1.08	4528	70.66%

Will use a weighted average loss ratio = 71.74%

Ind rate change = $\frac{.7174 + 0.06}{1 - .26 - .05} - 1 = 12.6\%$

Cred Wtd Ind Chg = .126 (.70) + .08 (.30) = 11.26%

Part c: 0.75 point

- Disadvantage: Since the competitor may have a different mix of business, limits, or deductibles, there may not be a logical relationship to the company's indication. A more suitable alternative would be to use the company's regional or countrywide data (rate change) for the same LOB since the mix of business may be more uniform.
- A disadvantage is that rate could be biased based on different underwriting guidelines, capacity, and levels of accepted profit. A better complement would be trended present rates. It is more relatable and relies on company own experience and underwriting provisions.

- Using competitor rate change as the complement is biased because the two companies are likely to have different underwriting guideline, mix of business, etc. It is better to use Harwayne method which is independent, accurate, unbiased.

EXAMINER'S REPORT

Candidates were expected to use the Bornhuetter-Ferguson technique to calculate ultimate losses and incorporate the result into development of an overall credibility weighted indicated rate change. Candidates were also expected to identify a disadvantage of using competitor rate changes as the complement of credibility for the overall indicated rate change and propose a suitable alternative.

Part a

Candidates were expected to calculate ultimate losses using the Bornhuetter-Ferguson technique.

Common mistakes included:

- Using trended or on-level premium in place of earned premium

Part b

Candidates were expected to determine the appropriate trend period to be applied to earned premium and ultimate losses developed in part a. In addition, candidates needed to incorporate on-leveling to determine on-level trended earned premium.

Candidates were also expected to calculate an overall indication incorporating the given ULAE and expenses using the loss ratio method. This indication was then to be adjusted for the provided credibility and credibility complement.

Common mistakes included:

- Incorrectly calculating the on-level factors, particularly for 2018
- Not using the appropriate trend period for losses and premium

Part c

Candidates were expected to explain a disadvantage of the given credibility complement and justify an alternative complement of credibility.

Common mistakes included:

- Providing an incomplete disadvantage for the given credibility complement
- Not providing justification for the alternative credibility complement

QUESTION 8

TOTAL POINT VALUE: 1.75 | **LEARNING OBJECTIVE(S): A6**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1

Strat 1) 5,000(1,000 – 900) + 10,000(1,050 – 1,000) = 1,250,000 – 0 = 1,250,000
Strat 2) 5,000(1,000 – 900) + 10,000(1,100 – 1,000) = 1,500,000 – 500,000 = 1,000,000
Strat 3) 5,000(1,100 – 900) + 10,000(1,100 – 1,000) = 2,000,000 – 500,000 = 1,500,000

Sample 2

Total Profit = (Rate – Loss) x # of risk – exp

Strategy 1

Class	#	Profit	Total Profit
A	5,000	1,050 – 900 = 150	750,000
B	10,000	1,050 – 1,00 = 50	500,000
			1,250,000

Strategy 2		Expense	Profit
A	100x5,000 = 500,000	500,000	1,000,000
B	100x10,000 = 1,00,000		
	1,500,000		

Strategy 3		Expense	Profit
A	1,000,000	500,000	1,500,000
B	1,000,000		
	2,000,000		

Part b: 1 point

Sample 1

- S2: Not appropriate. Class A number of risks may increase because of the decrease of rate per risk. Class B number of risks may decrease because of the increase of rate per risk

  S3: Not appropriate. Both class A and class B number of risks may decrease because of the increase of rate per risk

- S2: May overrate the expected total profit. Because the class B number of risks is 2 times of class A, so the impact of the decrease of class B number of risks may be higher than impact of the increase of class A number of risks, which results in the decrease of the expected total profit

  S3: May overrate, because the potential decrease of no. of risks is ignored, so the expected total profit may be lower

Sample 2

- 2) Invalid because we will see a rise in class A from the drop in & and a decrease in class B from the increase in price

  3) Invalid because if we raise both premiums we will see a decrease in policies thus number of risks

- 2) By differentiating classes, we are avoiding adverse selection & would see a rise in profit long term but at first renewal, we would see less because of one time expense

  3) The insurer will be making more per policy but total profit would likely drop from lost policies & expense incurred for switch

Sample 3

- The number of risks for strategy 2 will increase for class A and decrease for class B. The expected profit will likely be about the same if the same number of risks are gained and lost
- The number of risks for strategy 3 will decrease for class A & B because of the rate increase. This will lower the expected profit.

Sample 4

- For the first round of renewals this may be true, but based on competitive pricing, strategy 2 will likely gain class A and lose class B risks compared to strategy 1. Strategy 3 will likely reduce both class types if these risks decide to shop around and realize there's cheaper rates elsewhere

- Strategy 2: by pricing lower risks with lower rates this strategy is likely to increase profits in the long run since they are appropriately pricing risk classes.
  Strategy 3: In the short term they may be increasing profits with high rates, but they will not be competitive & will lose class A/low risks & experience some adverse selection

Sample 5

- Assuming # of risks by class is same as strategy 1 will not hold for strategy 2 and 3 over time. If company implemented strategy 2, it would likely keep class A given it is priced better for more favorable risks. Then assuming prices are more competitive elsewhere for class B, we would see a decrease in number of risks in class B with the increase in price. Strategy 3 is increasing for all risks. Assuming prices are more competitive elsewhere, we would see a decline in both class A & B given prices have increased for both classes.

- With strategy 2, insurer would have a higher expected profit over time. It would attract better risk (class A) given its better premium and would also retain class A. This is good for company given expected losses are lower than B. Strategy 2 may also make class B insureds shop around and move insurance companies given the increase in price. This is also good for the company given class B has higher expected loss costs. Overall would expect profits to increase.

Strategy 3, would likely see decrease in profits over time. Given risks are seeing rate increase, insureds may shop around and leave for another company. Or on the other hand class A may find better pricing elsewhere, while class B remains or increases because price is still competitive causing adverse selection with strategy 3.

EXAMINER'S REPORT

Candidates were expected to calculate the expected profit for an insurer under different pricing strategies. Candidates were also expected to assess the behavior of insureds in different risk classes resulting from implementation of a new rating variable as well as price increases, and the impact to expected profit.

Part a

Candidates were expected to calculate expected total profit for an insurer under different pricing strategies. This included calculating total revenue under each strategy based on the number of risks and rate per risk for each class, and subtracting the total losses and expenses, as well as subtracting the one-time expense associated with implementation of each rating strategy.

Common mistakes included:

- Failing to subtract the one-time expense in calculating the expected total profit under each strategy
- Adding the one-time expense when calculating expected total profit instead of subtracting

Part b

Candidates were expected to evaluate the assumption that the number of risks by class under strategy 2 and strategy 3 will be the same as strategy 1. Candidates were also expected to evaluate the impact the assumption has on each strategy's expected total profit. Candidates should have recognized the price sensitivity of individual insureds and the potential for individuals to switch companies based on price elasticity and market competition.

Common mistakes included:

- Stating that there would be zero impact to expected profit under strategy 2, which is only true if the increase and decrease in the number of risks for each class exactly offset.
- Failing to consider the impact on number of risks and expected profit for the different strategies, and instead basing answers on the results calculated in part a.
- Not understanding the behavior of individual insureds as it pertains to price sensitivity and competition in the marketplace.

QUESTION 9

TOTAL POINT VALUE: 1	**LEARNING OBJECTIVE: A8**

SAMPLE ANSWERS

Sample Responses for Model 1

- Fits the actual really well in training data; might be overfit since it doesn't seem very predictive in the hold out sample.
- Model 1 has a consistent pattern in the training data as pure premium goes up each decile. For the holdout data, however, it is sporadic/volatile. It does not follow the actual result closely and begins to go up and down in terms of pure premium after decile 5.
- Model 1 is over fitted to the training data and is capturing the noise too much.
- Model 1 has a steady increasing trend and good fit with training data, but has some irregularity with the hold out sample data.
- Deceptively strong training performance compared to hold-out performance, which has significant error, especially above the 3rd decile. Hold-out predictions vary considerably. Model 1 is a poor fit.
- For training Model 1 is a near-perfect fit, but seems to overestimate for higher deciles for hold out.

Sample Responses for Model 2

- Follows the general shape of actual data in training and hold out, but is very flat. Might be missing predictive variables.
- Model 2 seems very consistent for both the training data and hold-out sample. Model 2 is a bit closer to the actual result of the hold-out sample.
- Model 2 fit was consistently fairly close to the actual in both graphs. Model 2 focused more on the signal.
- Model 2 does not match the training data as well as model 1, but it performs much better on the hold-out data, although overestimating for smaller deciles and underestimating for higher deciles.
- Strong results on hold-out data. Hold out predictions are consistent with regard to decile, compared to training data. Model 2 appears to be a good fit. I would recommend Model 2.
- Model 2 has a consistent upward trend (higher deciles have higher pure premium). For both training and hold-out Model 2 fails to capture amplitude of decile differences.
- Model 2 has a stable prediction on both the training and hold-out data and shows better prediction than model 1 on hold-out sample.

EXAMINER'S REPORT

Candidates were expected to know and understand desirable/undesirable characteristics of a generalized linear model (GLM). Candidates were expected to interpret graphical information and make observations about the performance of each GLM.

Common mistakes included:

- Only listing one brief observation per model
- Evaluating the data sets as opposed to the GLMs
- Not specifying which model the commentary was intended for

- Recommending a model without any supporting commentary. Recommendation of one model over the other was not required.
- Commenting on the possibility of the models performing a particular way due to low volume of data / loss in certain deciles. The prompt stated that all deciles had equal volume.

QUESTION 10

TOTAL POINT VALUE: 2.75 | **LEARNING OBJECTIVE(S): A8**

NOTE FROM THE SYLLABUS AND EXAMINATION COMMITEE

There was an inconsistency in the question, where the total losses for Territory 2 across vehicle class and driver type were not equal. This was unintended. The question was still possible to answer using either vehicle class or driver type for the territory analysis.

SAMPLE ANSWERS

Sample 1

For territory, I find the distribution of driver type is same in each territory, so I assume territory and driver type is not correlated, so the rating factors:

Territory 1: $\frac{120+40}{50+80}$= 1.2308 Territory 2: $\frac{65+180}{45+72}$= 2.094 Territory 3: $\frac{115+325}{140+224}$= 1.2088

	1	2	3
Rebased:	1	1.7013	0.9821

	X	Y
Driver X: 0.9362 Y: 1.6622 Rebased:	1	1.7755

Adjusted exposure for vehicle class:
A: 30*1 + 15*1.7013 + 200*0.9821 = 251.96
B: 219.57
C: 215.03

So the relativity of vehicle class is: 0.9725 1.2206 1.5576
Rebased: 1 1.2551 1.602

Sample 2

Driver Type	Exp	Loss	Pure Prem	Ind Rel
X	235	220	936.17	1.0
Y	376	625	1662.2	1.776
		845		

Veh Class	Exp	Loss	Pure Prem	Ind Rel
A	245	245	1000	1.0
B	206	268	1300.97	1.301
C	160	335	2093.75	2.094
		848		

Territory	Exp (1)	Wtg Avg Driver Type Fac (2)	Wtd Avg Veh Class Fac (3)	Adj Exp (4) = (1)(2)(3)	Loss	Pure Prem	Ind Rel
1	130	1.4775	1.3535	259.97	160	615.46	1.0

B	117	$\frac{45+72(1.776)}{45+72} = 1.4775$	1.8046	311.96	248	794.97	1.292
C	364	1.4775	1.2663	681.03	440	646.08	1.050

Loss tables didn't match Used Terr x Veh Class Table

Sample 3

I will attempt to perform sequential analysis starting with the vehicle class variable, then perform adj. pure premium on the other 2 variables

Vehicle Class	Loss	Exposures	Relativity to Class A
A	30+15+200=245	245	1.0
B	268	206	1.301
C	335	160	2.0938
			1.3078

Vehicle class & terr (Ad. Pure premium on territory)

Territory	Adj. Exposures)	Loss	Pure Prem	Relativity to Terr 1
1	30*1.0+80*1.301+20*2.0938=30+104+42+176	160	0.9091	1.0
2	211	248	1.1754	1.293
3	461	440	0.9544	1.05

Adj. Pure Prem on driver type

Driver Type	Adj. Exposures)	Loss	Pure Prem	Relativity to Driver X
X	50*1.0+45*1.293+140*1.05=255	220	0.863	1.0
Y	408	625	1.532	1.776

EXAMINER'S REPORT

Candidates were expected to recognize exposure correlations across rating variables and demonstrate how to adjust for correlations using univariate analysis.

Common mistakes included:

- Performing univariate analysis on rating variables, ignoring exposure correlations
- Using loss tables rather than exposure tables in developing exposure adjustment weights
- Using loss relativities rather than pure premium relativities in the analysis
- Incorrect weights used for exposure adjustment
- Incorrect application of sequential analysis

QUESTION 11	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): A8**

SAMPLE ANSWERS

Part (i) sample answers:

- Insurers typically handle claims below the deductible, then bill the losses to the insured. Insurers are responsible for claims expenses below the deductible so it makes sense to price for them.
- The company may still have expense costs associated with claims below the deductible if they are handling all claims and getting reimbursed later. Therefore, the concern is invalid.
- Assume Insurer handles and pays claims ground-up, then seeks reimbursement for claims below deductible. Insurer still incurs claim handling expenses as well as billing and processing expenses. Invalid.

Part (ii) sample answers:

- If insurer pays the deductible and needs to be reimbursed for the deductible, then there is credit risk for the insurer. If the insured goes bankrupt the insurer may not be able to recover all deductible payments.
- If the company is handling all the claims below the deductible and the insured goes bankrupt, it will never be reimbursed for those claims thus a provision should be included in the rates. Therefore, concern is invalid.

Part (iii) sample answers:

- Higher deductible policies charge lower premiums and have more volatile loss experience from higher severity. Higher volatility is more risk which justifies a higher profit margin.
- Since high-deductible policies come with a greater level of risk (e.g., high severity and volatility), it makes sense for the company to want a greater return (i.e. higher profit margin) on that risk.
- Losses above a large deductible are more difficult to predict as data is sparser and more volatile at higher levels. Thus, it is appropriate to be compensated at a higher rate for taking on a higher level of risk.

EXAMINER'S REPORT

Candidates were expected to understand the difference between a small deductible policy and a large deductible policy, including identifying common practices for large deductible policies and justifying the expenses that come with these unique practices.

Common mistakes included:

- Explanations in the wrong direction
- Not understanding the functionality of a large deductible policy
- Incomplete explanations such as identifying the common practice but neglecting to tie back to the need for expenses.

QUESTION 12	
TOTAL POINT VALUE: 2.5	**LEARNING OBJECTIVE(S): A5, A6, A7, A8, A9**

SAMPLE ANSWERS

Part a: 1.5 points

Sample 1

80% retention for A = (13500) (0.8) = 10800
B = (7500) (0.8) = 6000
Ind. rate change for A = 0.8 / 0.7 - 1 = 0.1429
Limit this to 0.10 to meet retention target

Premium shortfall = (0.0429) (2,700,000) = 115,714

115,714 / 1,350,000 = 0.085714

$$0.7 = \frac{0.8\,(2{,}700{,}000) + 0.7\,(1{,}350{,}000)}{2{,}700{,}000\,(1.1) + (1{,}350{,}000)\,(1.085714)}$$

Rate increase of 10% for territory A, 8.57% for territory B.

Sample 2

Weighted Avg Ult LR = $\frac{2{,}700{,}000\,(0.8) + 1{,}350{,}000\,(0.7)}{2{,}700{,}000 + 1{,}350{,}000}$ = 76.67%
For Total Book

Ind Rate Change = 0.7667 / 0.7 – 1 = +9.5%
For Total Book

Increasing rates for both territories by +9.5% as indicated above would achieve the overall 70% PLR desired by management. The Retention ratios for a rate change of +10% for territory A and B are 80% and 84% respectively. Since +9.5% is below 10%, the retention ratio goal of at least 80% is also achieved. I suggest implementing a rate change of +9.5% for both territories.

Sample 3

70% permissible loss ratio
80% min retention ratio : A : 13,500 x 0.8 = 10,800 cap at +10%
B : 7,500 x 0.8 = 6,020 cap at +20%

Territory	Premium	Ult Loss Ratio	Indicated Rel.	Total Rel.
A	2,700,000	80%	1.0435	1.0435 x 1.0952 = 1.1428 > 1.1
B	1,350,000	70%	0.9130	0.913 x 1.0952 = 1 < 1.2
Total	4,050,000	76.67%	1.0000	

Overall change = 76.67% / 70% = 1.0952
Overall Prem = 1.0952 x 4,050,000 = 44,355,600
A : 2,700,000 x 1.1 = 2,970,000 B : 44,355,600 – 2,970,000 = 1,465,560
=> A : +10% B : +8.56%

Sample 4

Rate Change	Territory A Retention	Territory B Retention
-20%	86.0%	91%
-10%	85.0%	90%
0%	84.5%	88%
10%	80.0%	84%
20%	70.0%	80%

Current Ultimate Loss Ratio = 76.6%
Indicated Rate Change = 76.6% / 70% - 1 = 9.52%

As such, I proposed a +10% rate change in each territory which will meet both management targets.

Sample 5

Terr		Min Retention	Ind. Rate Chg.
A	13,500 (0.8) =	10,800	0.8 / 0.7 = 1.1428 or 14.28%
B	7,500 (0.7) =	5,250	0.7 / 0.7 = 1.0 or 0.0%

Any rate change under +10% will hit the target retention for Terr A and any rate change at all will hit target retention for Terr B, thus, I recommend +10% as it splits the indicated change for both territories while still maintaining the desired retention ratio for each.

Part b: 0.5 point

- If competitors charge A and B indicated rates, more insureds from territory A will come to this company for their low rate and insureds from territory B will go to the competition since our rate is too high. So we will have more insureds with higher loss costs.
- Since territory B is the more profitable territory, raising the rates for all territories by the same amount could lead to adverse selection if competitor also recognize this difference and reflect it in their rates.
  Insureds in territory B will non-renew because there are lower prices at competitors while the portion of the book in territory A will grow as more insureds in territory A move to the lower prices at this insurer. This will cause the overall profit to decrease.
- Since it is an aggregate rate change, both territory rate will be increased by 10%. As such, Territory B is currently on the PLR target and this increase may result in an overpriced premium for this territory and we will eventually decrease in policy count since the rate is probably not competitive and will eventually result in profit loss.
- We could end up losing more and more Terr B insured in the long run as they are overcharged and gain more undercharged insureds in Terr A, which could lead to insolvency if not addressed.
- Since A is capped at a lower than needed premium and B is increased higher than needed, the company may begin to lose profitable Terr B risks and write more unprofitable Terr A risks. This could lead to even more future rate increases.

Part c: 0.5 point

Any two of the following:

- Cutting expenses

- Laying off employees
- Cutting benefits / coverage
- Marketing targeted toward lower risk insureds
- Adjust underwriting guidelines to better target more profitable business
- Reduce target profit
- Increase investment profit with an aggressive strategy

EXAMINER'S REPORT

Candidates were expected to understand the concepts of retention, rate change, permissible loss ratio, and adverse selection and be able to apply those concepts in a business use case.

Part a

Candidates were expected to recommend a set of rate changes that satisfy the operational constraints and management targets.

- Calculate the indicated rate change for each territory
- Identify the territory cap restriction from retention constraints and apply, as needed
- Recognize if the overall loss ratio would not be achieved due to the territory cap and then determine premium shortfall due to application of territory cap
- Determine an adjustment to bring the total loss ratio across all territories to 70%, i.e. offset Territory B with the premium shortfall from Territory A

Although an unnecessary additional step, many candidates took the time to determine territory relativities, overall rate change, and then combined the two to determine territory rate changes.

Common mistakes included:

- Calculating rate changes, but using them as relativities (or vice versa).
- Calculation of the premium shortfall and offset adjustment by multiplying an additive factor or adding a multiplicative factor.
- Calculating the indicated rate change, applying the territory cap, but then not taking the next step to offset the shortfall from the territory cap.
- Adjusting the expected losses. The losses for each territory have not changed in this scenario, but rather the insurer is attempting to adjust rates/premium to cover the same losses.
- Simply stating the proposed rate change for A and B without any justification or calculation

Part b

Candidates were expected to understand how the deviation of rate implementation from indication could lead to adverse selection.

Common mistakes included:

- Not describing the change in portfolio mix that would occur in the event of adverse selection
- Stating the rate increase as the factor, not recognizing that adverse selection is driven by undercharging or overcharging a risk.
- Citing risk classification as a reason when the question asks to relate to rate change recommendation in part a

- Not understanding which territory is underpriced versus overpriced

Part c

Candidates were expected to understand the fundamental insurance equation and identify non-pricing alternatives to bring the equation back into balance. Candidates were required to identify what component of the equation to adjust (expenses, expected loss, profitability load, etc) and give an example of how this could be adjusted without altering price.

Common mistakes included:

- Not providing a thorough response, such as simple identification of a component of the equation without stating how to adjust
- Identifying pricing changes to bring the equation back into balance, when the question specifically asked for an alternative to pricing changes
- Listing two non-pricing actions, but both are adjusting the same component of the equation such as restrict writing in Territory A through revising underwriting guidelines and market heavily to Territory B

QUESTION 13

TOTAL POINT VALUE: 1.75 | **LEARNING OBJECTIVE(S): B1, B3, B8**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

BI has low claim counts compared to PD, so by combining them, it gives more credibility to the result than if BI alone.

Sample 2

Claim count for BI is small relative to PD. So combining the two coverages may provide a more stable result.

Part b: 0.5 point

Sample 1

Ultimate severity for state A is higher than B, and State A seems to be growing faster than B

Sample 2

The two books have different development patterns as seen in the paid age ultimate factors. They are also growing at different rates.

Part c: 0.75 point

Sample 1

Ultimate severity alone is not enough to assess rating. Based on loss cost that would be an incorrect assumption to make. See below for details:

State A	(1)	(2)	(3)	(2)*(3)/(1)
AY	Expos	Ult BI Count	Ult BI Sev	Loss Cost
2018	41,580	72	15,000	25.97

State B	(1)	(2)	(3)	(2)*(3)/(1)
AY	Expos	Ult BI Cnt	Ult BI Sev	Loss Cost
2018	110,250	1375	10,000	124.72

Sample 2

AY	A Pure Premium	B Pure Premium
16	(50*15,000)/36000=20.83	(1,250*10,000)/100,000=125.00
17	(60*15,000)/37,800=23.81	(1,300*10,000)/105,000=123.81
18	(72*15,000)/41,580=25.97	(1,373*10,000)/110,250=124.72

While severity is higher for A, Pure Prem is higher for B (driven by higher frequency). With this, State B should actually be charged higher than A

EXAMINER'S REPORT

Candidates were expected to understand the concepts of credibility, homogeneity, and that frequency and severity relative to an exposure base make up pure premium.

EXAM 5 SPRING 2019 – SAMPLE ANSWERS AND EXAMINER'S REPORT

Part a

Candidates were expected to review two sets of data and determine that one set was not credible on its own due to low claim counts and needed to be combined with the second set to produce more accurate results.

Common mistakes included:

- Stating data or exposure not credible instead of claim count data.
- Misreading question and comparing State A and State B data instead of BI and PD for state A.
- Stating that BI and PD should not be combined and giving a reason.

Part b

Candidates were expected to review two sets of data and determine that they should not be combined since they are not homogeneous due to different paid development factors or securities. The two sets of data also have different growth rates.

Common mistakes included:

- Making opposite argument that state A and state B should be combined
- Misreading the question and comparing BI and PD instead of BI for state A and state B

Part c

Candidates were expected to realize that pricing decisions should not be made based on severity alone. Frequency also needs to be taken into consideration. Candidates should know that they should calculate pure premium = frequency * severity or loss per exposure = Ult Claim Counts * Severity / Exposure. The results of these calculations show that management came to an incorrect conclusion.

Common mistakes included:

- Applying LDFs to ultimate claim counts
- Combining PD with BI in the calculations
- Calculating ultimate losses without dividing by exposure
- Not directly addressing the comparison between state A and state B such as discussing the credibility of State A, complements of credibility, industry data, waiting until more data comes in, attributing state A's higher severity to volatility and bad luck, or entering a new market.

QUESTION 14	
TOTAL POINT VALUE: 1.25	**LEARNING OBJECTIVE(S): B2**

SAMPLE ANSWERS

Sample 1

Avg C/O trend

AY	12	24	36
15-16	1.045	1.04545	1.15384
16-17	1.0435	1.0130	
17-18	1.166		

Avg Rept Trend

Avg C/O trend

AY	12	24	36
15-16	1.05	1.044	1.042
16-17	1.0476	1.0479	
17-18	1.045		

From these two trend graphs we can see that case outstanding is growing much faster in the most recent year than the reported. The reported trend seems to be right around 4.5%. Since reported = paid + Chg in case reserve and we can see that our reserves are growing while reported is not, this suggests we are slowing down claim payments and increasing our reserves. Using the paid development technique would underestimate our ultimate claims.

Sample 2

Avg Case o/s @ 2018 levels

AY	12	24	36	48
2015	550(1.045^3) = 627.6	1255.28	1483.52	2054.99
2016	624.9 (0%=624.9/627.6-1)	1255.83	1638.04	
2017	627 (0%=627/624.9-1)	1358.5 (8%=1358.5/1255.83-1)		
2018	700 (11.6%)			

Avg Rept @ 2018 levels

AY	12	24	36	48
2015	400(1.045^3) = 456.47	912.9	1369.4	1711.75
2016	458.65	911.8	1365.03	
2017	459.8	914.38		
2018	460			

Due to the increase in avg case o/s in the most recent CY and the consistence of the rept. Triangle, it seems that there have been changes in the setting of case reserves and settlement rates. It would not be reasonable to use the paid dev triangle because of the distortion in the paid since if case increased, paid must have decreased in order to have the rept. Triangle be steady. Thus the rept triangle will not be influenced by changes in the avg case o/s and will be more reasonable than the paid triangle.

EXAMINER'S REPORT

Candidates were expected to diagnose the appropriateness of an estimation technique without being able to directly observe the data that is used in that technique. Candidates were required to infer the effect on a paid development triangle from observations of average reported and average outstanding claims.

Candidates were expected to use their knowledge of the interrelationships between reported, outstanding, and paid claims to infer changes in a paid loss triangle based on observations of average reported and average outstanding claim amounts.

Common mistakes included:

- Attempting to derive the paid triangle, which was impossible with the data given – the average paid and average reported triangles have different claim counts, and without that claim count information, an average paid (or cumulative paid) triangle cannot be derived.
- Misdiagnosing the patterns in the data as a simple increase in case reserve adequacy, in which case the average reported values would be increasing above the trend rate in the latest diagonal.
- Many candidates seemed confused that the average case outstanding was higher than the average reported values throughout the triangle. While this would be unusual in cumulative triangles, it is common in average triangles because companies typically close small claims earlier, leaving the larger claims open to influence the average case outstanding.

QUESTION 15

TOTAL POINT VALUE: 2.25 | **LEARNING OBJECTIVE(S): B2, B3**

SAMPLE ANSWERS

Part a: 2 points

Selected A-A	0.975	1.030	1.061	
Selected A-U	1.065	1.093	1.061	1.000
Claim count	375			
Indicated ult claims	399			

Claim severity

Acc Yr	12	24	36	48
2014	5,000	5,378	5,408	5,500
2015	4,964	5,167	5,216	
2016	5,031	5,234		
2017	5,067			

Age-to-Age factors

Acc Yr	12-24	24-36	36-48	48-Ult
2014	1.076	1.006	1.017	
2015	1.041	1.010		
2016	1.040			

Selected A-A	1.052	1.008	1.017
Selected A-U	1.078	1.025	1.017

Ultimate Severity 5,463

Ultimate claims (000) = claim count x severity	*2,182*
Unpaid Claims Estimate = ultimate claims - paid claims	*1,482*

Part b: 0.25 point

Sample 1

Closed without payment

Sample 2

Claims subsequently closed without pay, including occurrences which would have caused such, like claims found to be fraudulent, or otherwise rejected by the insurer

EXAMINER'S REPORT

Candidates were expected to calculate unpaid claims using a frequency severity technique and identify a situation which might cause downward development in reported claim counts.

EXAM 5 SPRING 2019 – SAMPLE ANSWERS AND EXAMINER'S REPORT

Part a

Candidates were expected to develop claim counts to ultimate, create an average severity triangle and develop severity to ultimate, multiply claim counts by severity, and subtract paid to date.

Common mistakes included:

- Calculating an "average" claim count.
- Using a single diagonal or a single value to derive ultimate severity.
- Subtracting reported loss instead of paid loss.
- Omitting the calculation of unpaid claims and stopping at ultimate claims.
- Performing a reported loss development technique instead of a frequency-severity technique.

Part b

Candidates were expected to identify a situation that would cause reported claim counts to decrease.

Common mistakes included:

- Explanations that would cause a restatement to the entire triangle (e.g. law change, court decision, deductible change)
- Vague or incomplete explanation

QUESTION 16

TOTAL POINT VALUE: 1.75 | **LEARNING OBJECTIVE(S): B1, B3, B4**

SAMPLE ANSWERS

Part a: 0.75 point

LDF's

	12-24	24-36	36-48	48-Ult
2015	2.389	1.453	1.248	
2016	2.594	1.554		
2017	2.5			
Selected	2.494	1.504	1.248	

Ultimate 2018 = 950 x 2.494 x 1.504 x 1.248 x 1.1 = 4892

Part b: 0.5 point

Any two of the following:

- Mix of business differs from industry
- Does industry data count claims as being gross or net of reinsurance?
- Are claims handling processes different?
- Does the data include any large claims that could distort estimates?
- What data aggregation the industry was using, whether it was based on policy year or accident year.
- Claims counts could include closed without pay or losses could be paid or reported.
- They should determine the credibility of their data to see if industry data is even needed.
- The cost of industry data may not justify added credibility.
- Consider the independence of industry experience. That is, if company is 90% market share, the industry data is not independent.

Part c: 0.5 point

Sample 1

There may be changes in case adequacy if now more claims adjusters are working allowing each to spend more time on each claim. Depending on how adequacy changes, reported development would be too high or low.

Sample 2

An increased number of claims handlers may increase the claims recording process so that once claims are reported, they have a case reserve put up quicker. In this case, applying old LDFs to new reported losses would overstate ultimate claims.

Sample 3

Doubling the number of claims handlers will increase the settlement rate. The case reserve won't change. Therefore the ultimate loss will be overestimated as the historical LDFs are based on a slower settlement rate.

Sample 4

This may increase the settlement rate but not the level of case adequacy. Thus the reported development method would not be affected.

EXAMINER'S REPORT

Candidates were expected to perform a simple age-to-age development technique. They also were asked to consider circumstances that might distort this technique if not considered carefully. In particular, what issues might arise when incorporating industry data and what effect would changes to internal claims staffing have on the method.

Part a

Candidates were expected to:

- Accurately calculate reported claim development factors based on the triangle of data given in the question and select reasonable factors for each age-to-age period.
- Calculate a cumulative development factor that incorporates both the selected age-to-age factors and the given tail factor. Multiply that factor by the current reported claims given for AY 2018.

Common mistakes included:

- Failure to include the tail factor in the calculation.

Part b

Candidates were expected to:

- Provide two factors to consider when using industry data to supplement company data.
- Responses could include specific concerns that may make industry data irrelevant when compared to the given company's data. Examples include a difference in the line of business being evaluated or claims handling operations (settlement rates, case adequacy, etc.).
- While responses could include considerations the company would undertake before deciding if use of industry data was needed, candidates were also expected to provide discussion on what to evaluate when considering the appropriateness of industry data once the decision has been made that the company needs to augment their own data.

Common mistakes included:

- Assuming the industry development pattern must be similar to the company's pattern to use industry data. The concept underlying use of an industry pattern is predicated on the idea that the company is skeptical of its own pattern in some way, so the patterns may indeed be different. It is more important that definitional differences between the company's operations and the industry's have been identified – these differences could make the industry data irrelevant.
- Responses that vaguely referred to industry data irrelevance or bias needed to be more specific in terms of the cause of that irrelevance/bias.
- Providing two responses that were not sufficiently different from one another. Examples include: "claim settlement rates" plus "claim handling procedures" or "mix of products" coupled with "mix of business".

Part c

Candidates were expected to:

- Describe the effect of hiring additional claims adjusters on the reported development pattern.
- Describe both how the addition to staff affects the claim operation but also what impact that change has on the resulting development pattern. For example, an increase in

adjusters could increase the rate of claim settlement. The candidate must also describe how that increase in settlement rate would manifest in the reported development pattern.

Common mistakes included:

- Either drawing an incorrect conclusion or making no statement at all on the impact to the reported development pattern. This includes saying that changing payment patterns has no impact on reported development without making it clear if they believe case reserves would also be affected.
- Demonstrating an incorrect understanding on how payment patterns affect reported claim patterns either with or without case reserve changes.
- Assuming an increase in adjusters affects either the number of claims ultimately being reported or that it would possibly result in an increase in ALAE without explaining why.

QUESTION 17	
TOTAL POINT VALUE: 2.75	**LEARNING OBJECTIVE(S): B3, B5**

SAMPLE ANSWERS

Part a: 1 point

Sample 1

$$Ult.Clm = 150{,}000 + (2 * 45.8\% - 40\%) * (1 - 2\%) * (1 + 10\%) * 1{,}000{,}000 * \left(1 - \frac{1}{1.154}\right)$$
$$= 224{,}231$$

Sample 2

ELR 2016 Region 1:

$$Combined\ ELR\ 2016 = \frac{ELR_{Reg1} * Prem_{Reg1} + ELR_{Reg2} * Prem_{Reg2}}{Combined\ 2016\ Premium}$$
$$45.8\% = \frac{ELR_{Reg1} * 900{,}000 + 40\% * 900{,}000}{1{,}800{,}000}$$
$$ELR_{Reg1} = 51.6\%$$

ELR 2017 Region 1:

$$ELR_{2017} = ELR_{2016} * Freq.Trend_{Reg1} * Sev.Trend_{Reg1}$$
$$= 51.6\% * (1 - 2\%) * (1 + 10\%)$$
$$= 55.62\%$$

Ultimate Claims Region 1 for Accident Year 2017:

$$Ult.Clm. = Rep_{Reg1} + ELR_{Reg1} * Prem_{Reg1} * \left(1 - \frac{1}{LDF_{Reg1\ 24-Ult}}\right)$$
$$= 150{,}000 + 55.62\% * 1{,}000{,}000 * \left(1 - \frac{1}{1.154}\right)$$
$$= 224{,}224$$

Part b: 1.25 points

Sample 1

ELR at 2018 level:

$$ELR_{Reg1} = 51.6\% * (1 - 2\%)^2 * (1 + 10\%)^2 = 60\%$$
$$ELR_{Reg2} = 40\% * (1 + 0\%)^2 * (1 + 0\%)^2 = 40\%$$

Ultimate Claims for regions combined in AY 2018:

$$Ult.Clm\ 2018 = Rep_{Combined}$$
$$+ELR_{Reg1} * Prem_{Reg1} * \left(1 - \frac{1}{LDF_{Reg1\ 12-Ult}}\right)$$
$$+ELR_{Reg2} * Prem_{Reg2} * \left(1 - \frac{1}{LDF_{Reg2\ 12-Ult}}\right)$$
$$= 180{,}000$$
$$+60\% * 1{,}610{,}000 * \left(1 - \frac{1}{2.283}\right)$$
$$+40\% * 690{,}000 * \left(1 - \frac{1}{1.558}\right)$$
$$= 821{,}722$$

Sample 2

Region 1 IBNR BF = $+51.6\% * (1.078\%)^2 * 1{,}610{,}000 * \left(1 - \frac{1}{2.283}\right) = 542{,}543$

Region 2 IBNR BF = $+40.0\% * 690{,}000 * \left(1 - \frac{1}{1.558}\right) = 98{,}850$

Reported claims combined $= 180{,}000$

Ultimate claims for region 1 and 2 for AY 2018 $= 180{,}000 + 542{,}543 + 98{,}850 = 821{,}393$

Part c: 0.5 point

Sample 1

Region 1 has distinctly different development patterns than Region 2, so combining them when Region 1 is growing in 2018 would underestimate ultimates in the future.

Sample 2

Freq and sev trends are different between region 1 and region 2 and region 1 is growing and region 2 is shrinking in 2018 so if we combine both regions, the trends will be distorted and ultimates will be distorted.

Sample 3

They have different ECR, they are growing at different rates, Region 2 is shrinking vs Region 1 as seen in the data and have different development patterns, which would distort results for ultimate claims in both regions.

Sample 4

Region 1 has a much higher ECR than region 2. The mix of EP is shifting towards Region 1 starting in 2018. They have different reporting patterns as LDF is highly leveraged.

EXAMINER'S REPORT

Candidates were expected to know how to derive and trend the expected loss ratio (ELR) for a specific region. They were also expected to know when it is possible to combine data from different regions and what to do when it should not be combined. Finally, they were expected to know how to calculate a Bornhuetter-Ferguson (BF) technique.

EXAM 5 SPRING 2019 – SAMPLE ANSWERS AND EXAMINER'S REPORT

Part a

Candidates were expected to know how to derive the claims estimate using the BF technique. Candidates were expected to know how to derive the individual region ELR from the combined ELR and trend it to the appropriate accident year. They were also expected to know how to use the BF formula to obtain ultimate claims.

Common mistakes included:

- Using either the combined ELR or Region 2 ELR instead of calculating the Region 1 ELR
- Not trending the selected ELR to the appropriate period/level or not properly applying the trends
- Using the wrong reported age-to-ultimate factor in the calculation
- Not properly applying the BF formula

Part b

Candidates were expected to know how a change in an underlying assumption (i.e.: Mix of business) would affect the BF method. Candidates were expected to recognize that they must use data from both regions separately as that they don't have the Reported Age-to-Ultimate factor for the combined claims nor the individual reported claim for Accident Year 2018.

Common mistakes included:

- Using a mixture of Region 1 CDF and Region 2 CDF to obtain a combined CDF instead of using both separately
- Using inappropriate ELRs for the individual regions
- Using inappropriate premiums for the individual regions
- Not trending or not properly trending Region 1's ELR to 2018 level
- Not properly calculating the BF IBNR for Region 1 and/or for Region 2
- Applying trends to Region 2's ELR
- Not estimating the total ultimate claims

Part c

Candidates were expected to know in which circumstances actuarial assumptions selected for Region 1 & 2 separately should be used instead of combined.

Common mistakes included:

- Giving only reasons related to the claims and not talking about the change in mix of business (earned premium has changed)
- Only saying earned premium are not equal without providing details and an argument of the implication to the results
- Giving only reason that premium has changed without talking about the implication to the claims (reporting pattern, trends, etc.)

QUESTION 18

TOTAL POINT VALUE: 2 points | **LEARNING OBJECTIVE(S):** B3

SAMPLE ANSWERS

Part a: 1.5 points

Sample 1

AY 2018 Loss Ratio = $\frac{2900\ (1.067) + 1800\ (.983) + 1000\ (1)}{(6500/2.3) + (8100/3.9) + (8000/7.6)} = .985$

2017 Loss Ratio = .985 x (1/.983) = 1.002

AY	Reported Loss		EP		LR		% unreported		CC ultimate
2017	1800	+	8100	x	1.002	x	(1 - 1/3.9)	=	7835

Sample 2

AY	Reported claims at 2017 level
2016	2900 x 1.067/.983 = 3148
2017	1800 x .983/.983 = 1800
2018	1000 x 1/.983 = 1017

ECR = $\frac{3148 + 1800 + 1017}{(6500/2.3) + (8100/3.9) + (8000/7.6)} = 1.002$

Ultimate Claims = reported claims + ECR x EP x % unreported
= 1800 + 1.002 x 8100 x (1 - 1/3.9) = 7833

Sample 3

AY	Used-Up Premium	Trended losses to 2018 level
2016	(1/2.3) x 6500 = 2826	2900 x 1.067 x .983 = 3041
2017	(1/3.9) x 8100 = 2077	1800 x .983 = 1769
2018	(1/7.6) x 8000 = 1053	1000
Total	5956	5783

Loss Ratio = 5783 / 5956 = .971
De-trend Loss ratio to 2017: .971 / .983 = .988

Estimated ultimate = .988 x 8100 = 8003
2017 Cape Cod Ultimate = 1800 + (1 - 1/3.9) x 8003 = 7750

Part b: 0.5 point

- If there is an increase in case reserve adequacy, the reported Cape Cod technique will be overstated. The paid Cape Code technique is not affected by changes in case reserve adequacy
- The paid would be preferred to the reported in the case where case outstanding strength is changed. This could lead to distorted LDF's and used up premium, ultimately affecting the expected loss ratio and the percent unpaid

EXAMINER'S REPORT

Candidates were expected to estimate ultimate losses using the Cape Cod method and assess the differences between paid and reported Cape Cod Method.

Part a

Candidates were expected to estimate ultimate losses using the reported Cape Cod method, while taking into account a changing pure premium trend.

Common mistakes included:

- Not taking the pure premium trend into account in the calculation
- Using the pure premium trends on premiums, rather than reported losses
- Not trending the reported losses to the 2017 level (i.e., trending losses to the 2018 level, but not de-trending that value to the 2017 level)
- Using 2018 reported losses, earned premium, and Age-to-Ultimate factors to calculate the ultimate loss, rather than the 2017 values

Part b

Candidates were expected to know the differences between paid and reported Cape Cod Methods, and state a scenario where the reported Cape Cod method would calculate a distorted ultimate loss, while the paid Cape Cod method would not have a distorted ultimate loss

Common mistakes included:

- Simply stating that a change in case reserve adequacy would cause a preference of paid Cape Cod over reported Cape Cod without further explanation.
- Stating that a large loss would result in a preference for the reported method over the paid.

QUESTION 19	
TOTAL POINT VALUE: 1.25	**LEARNING OBJECTIVE(S): B3, B5**

SAMPLE ANSWERS

Sample 1

Reported Development Technique: 1,285*(1.385) = 1780 w/o tort adj
The estimate of unpaid claims = 1780-525=1155
Adjusting for tort reform: 1155*.8 = 924
Reported Dev Technique for Ult Claims = 924 +625 = 1549

BF Technique: 1285+.6*2500*(1-1/1.385) = 1702 w/o tort
BF Unpaid est = 1702-625=1077
Adjusting for tort reform: 1077*.8 = 862
BF Ult Claims estimate = 625+862=1487

Sample 2

Reported Development: 1285*(1.385-1.0) *.8 + .8*(1285-625) + 625 = 1549
Reported BF: .6*2500*(1-1/1.385) *.8 + .8*(1285-625) + 625 = 1487

Sample 3

i: 1,285,000*.8*1.385 + (625,000) *(1-.8) = 1,548,780
ii: (625 +.8*(1,285 – 625) + (2,500) *(.6) * (.8) * (1-1/1.385) *1,000 = 1,486,574

EXAMINER'S REPORT

Candidates were expected to adjust the reported development technique and the Bornhuetter-Ferguson technique for a change in the legal environment.

Common mistakes included:

- Not reducing IBNR for the tort reform in both techniques
- Reducing the paid losses by the tort reform since there would be no impact to losses already paid before the tort reform
- Not reducing the case reserves for the tort reform in both techniques
- Not properly applying the Bornhuetter-Ferguson technique formula

QUESTION 20

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): B3**

SAMPLE ANSWERS

Part a: 1.5 points

Sample 1

$$\frac{(6100 + 2400) * 1.06^7 * 0.8 + 3900 * 1.06^6}{81 + 61 + 13} = 101.66$$

Sample 2

Trended and Adjusted Inc Avg Paid (000)

	72	84	96
2011	64.84	90.59	222.07
2012	86.04	90.69	
2013	127.02		

	Adj Factor
2011	$(1.06)^7$ x .8
2012	$(1.06)^6$
2013	$(1.06)^5$

Trended Tail Severity at 84+ months =

$$\frac{81 * 90.59 + 13 * 222.07 + 61 * 90.69}{81 + 61 + 13} = 101.66$$

Sample 3

AY	Sev Trend	Leg. Adj
2011	1.06^7	0.8
2012	1.06^6	1
2013	1.06^5	1

Adj. Inc Paid

AY	72	84	96
2011	9142	7338	2887
2012	12483	5532	
2013	7494		

Est. 84 older tail =

$$\frac{7338 + 2887 + 5532}{81 + 61 + 13} = 101{,}658$$

Part b: 0.5 point

Sample 1

- Consider at what age data becomes erratic
- % of claims expected to close beyond the selected maturity age

Sample 2

- Choose so that there is enough data in the tail for it to be stable or credible, but not too much data that could be used for more reliable age-to-age factors
- Need to consider the industry maturity age. As it's easier to use industry data as a complement

Sample 3

- Should consider at what age results become erratic as combining them may increase stability
- Should consider the overall impact on the total projections – if combining the data has a small impact on total projections then the added effort to gain some stability may not be worth it

EXAMINER'S REPORT

Candidates were expected to be able to apply a frequency-severity method to calculate a tail severity and to adjust the data for annual severity trend and a reduction in claim cost due to a legislative change. They were also expected to provide two distinct considerations when choosing the maturity age of the tail severity and to explain their reasoning.

Part a

Candidates were expected to calculate a tail severity for maturity age 84 and older by pooling the experience of the relevant older development periods, adjust 2011 incremental paid claims for the legislative change and trend to 2018 cost level.

Common mistakes included:

- Applying the legislative change factor to the wrong years, or not applying it at all.
- Not determining the proper trend period.
- Correctly determining severity by accident year/development period but failing to properly weight them to provide a meaningful estimate.
- Calculating the trended tail severity for age 72 and older rather than 84 and older

Part b

Candidates were expected to provide two distinct relevant elements to consider when choosing the maturity age of the tail severity and to explain their reasoning.

Common mistakes included:

- Repeating the same statement twice but phrased differently. For example, point at which data becomes volatile and point at which data becomes erratic
- Blanket statements such as: judgment of the actuary
- Stating the tail should start when development factors are close to 1
- Not providing sufficient explanation. For example, simply stating "credibility of data" without identify which data elements needed to be credible and why.

QUESTION 21

TOTAL POINT VALUE: 1.5 | **LEARNING OBJECTIVE(S): B4**

SAMPLE ANSWERS

Part a: 0.5 point

Any two of the following:

- Per claim severity has increased possibly due to a mix of business change
- Tort reform that has increased losses paid after 2017
- Deductibles on policies were reduced or removed
- More business written
- Acquisition of another business
- Increasing the Stop Loss threshold
- Decreasing the Quota Share %

Part b: 1 point

- Use a frequency/severity method to directly address and account for the increased severity
- Use the reported development technique since it is responsive to changes in the claims ratio and is appropriate since there are no claims handling changes
- Separate the claims into homogenous groups and use reported development method
- The reported development method is still applicable if the new business is similar to existing
- Use the expected claims ration approach which will account for the change in premium
- You can use the B-F technique that will take into consideration the growth in the company in the unreported part of the ultimate estimate
- Since this may change the average accident date, I recommend using the reported development method with quarterly time intervals to minimize distortion
- Estimate claims using gross insurance data if available; then make adjustments based on new contract. Can use development methods if gross claims are consistent
- Use the development technique on net claims with 2016 and 2017 adjusted to the new higher limit so all years would be on an apples-to-apples comparison
- Quota Share change has no effect on loss development so historical LDFs can be used to estimate ultimate amounts.

EXAMINER'S REPORT

Candidates were expected to be able to identify the effect on estimation techniques due to change in: rate levels, claim ratio, mix of business. Between the two of these objectives the candidate should be able to identify a cause of the increased claims and a development method that addresses those issues.

Part a

Candidates were expected to identify a cause of the increased claims.

Common mistakes included:

- Not providing two causes
- Listing a change in case reserve adequacy as a cause, as that was stated to not be the case in the question.

- Listing a large or cat claim as a cause, as that was stated to not be the case in the question.
- Listing a change in frequency as a cause, as frequency was constant in the question.

Part b

Candidates were expected to identify a development method that addresses those issues.

Common mistakes included:

- Not providing two approaches
- Listing a correct approach without adequate detail or explanation
- Listing an approach that did not account for the cause listed

QUESTION 22

TOTAL POINT VALUE: 2.5 | **LEARNING OBJECTIVE(S): B5**

NOTE FROM THE SYLLABUS AND EXAMINATION COMMITEE

The average case outstanding triangles were mistakenly labeled as being in dollars rather than thousands of dollars. Credit was awarded for either treatment by candidates.

SAMPLE ANSWERS

Large claims:

Adjusted Case Outstanding

AY	12	24	36	48
2015	1,037	907	857	850
2016	1,088	952	900	
2017	1,143	1,000		
2018	1,200			

Detrend by dividing by 1.05

Adjusted Reported Claims

AY	12	24	36	48
2015	534,512	816,512	1,036,429	1,158,700
2016	526,327	806,143	1,026,000	
2017	552,571	842,000		
2018	537,000			

= adjusted case outstanding * open large claim counts + cumulative paid large claims

Calculate Ultimate

AY	12	24	36	
2015	1.53	1.27	1.12	
2016	1.53	1.27		
2017	1.52			
Age-to-Age	1.53	1.27	1.12	1.20
Age-to-Ultimate	2.60	1.71	1.34	1.20

2018 Ultimate large claims = 537,000 * 2.6 = 1,398,856

Small Claims:

2018 Ultimate small claims = (90*150 + 22,000) * 9.007 = 319,741

Total:

2018 Ultimate claims = 1,398,856 + 319,741 = 1,718,596

EXAMINER'S REPORT

Candidates were expected to demonstrate understanding of the reported development technique, particularly to handle the change in case reserve adequacy for large claims but not small.

Common mistakes included:

- Omitting the 48-Ult development factor for large claims.
- Applying the same technique to large and small claims, despite the question stating small claims are not impacted by the change.

QUESTION 23

TOTAL POINT VALUE: 1.5 | **LEARNING OBJECTIVE(S): B3, B6**

SAMPLE ANSWERS

AY	Ultimate excl. large claims	Per occurrence retention
15	2,000,000 / 70% = 2,857,143	1,000,000 x 2 = 2,000,000
16	1,500,000 / 35% = 4,285,714	1,000,000
17	800,000 / 20% = 4,000,000	1,500,000
18	450,000 / 10% = 4,500,000	

AY	Total claims gross of SL	Total claims net of SL
15	4,857,143	10,000,000
16	5,285,714	
17	5,500,000	5,000,000
18	4,500,000	4,500,000
		19,500,000

IBNR = 19,500,000 – (2,000,000 + 1,500,000 + 800,000 + 450,000 + 2,000,000 + 1,000,000 + 1,500,000) = 10,250,000

EXAMINER'S REPORT

Candidates were expected to calculate IBNR considering both per occurrence and stop-loss limits. They were also expected to apply the appropriate per occurrence limits to the large claims, develop the claims under the per occurrence retention to ultimate, apply the stop-loss limits appropriately, and finally, calculate IBNR.

Common mistakes included:

- Not limiting the large claims to the per occurrence limits
- Not assigning the large claims to the appropriate accident years
- Applying development factors to the large claims, even though the question states the large claims will have no further development
- Subtracting only the reported claims under the per occurrence retention from ultimate when calculating IBNR

QUESTION 24

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): B7**

SAMPLE ANSWERS

Part a: 1.25 points

ALAE Ratios

	12	24	36	48
2015	0.0203	0.0297	0.0321	0.0325
2016	0.0208	0.0309	0.0331	
2017	0.0195	0.0282		
2018	0.0202			

Link Ratios

	12-24	24-36	36-48
2015	1.463	1.081	1.012
2016	1.486	1.071	
2017	1.446		
Selected(Avg)	1.465	1.076	1.012
Cumulative	1.595	1.089	1.012

2018 Ult. Ratio = 0.0202 * 1.595 = 0.0322
2018 Ult. ALAE = 0.0322 * 18,500 = 595.7

Part b: 0.25 point

- When the ratios are very small, a multiplicative approach may lead to highly leveraged CDFs
- When early maturity LDFs from multiplicative approach are highly leveraged. Additive method will be less leveraged at early maturity.

Part c: 0.5 point

Advantages

- Recognizes the inherent relationship between losses and ALAE
- They provide diagnostics so that if the ratio produced for any AY seems unreasonable, it can be excluded
- The ratio development factors tend not to be as highly leveraged as the development factors based on paid ALAE dollars
- More stable/less volatile than developing paid ALAE dollars directly

Disadvantages

- An error in Ultimate Claims estimation can introduce an error in Ultimate ALAE calculations
- If there are many ALAE payments at early maturity with no accompanying paid claims at same maturity, the ratio will be distorted
- Not accurate if ALAE has different trend rate than claims cost

EXAMINER'S REPORT

Part a

Candidates were expected to provide a step by step calculations of Ultimate ALAE using the prescribed method.

Common mistakes included:

- Using a different reserving method than the multiplicative ratio method
- Recalculating the Ultimate Claims instead of using the provided Ultimate claims figure

Part b

Candidates were expected to describe a situation when the additive method is preferable over the multiplicative method.

A common mistake was providing an advantage of the additive method without describing the situation. For example, simply stating "more stable" or "more volatile".

Part c

Candidates were expected to provide 1 advantage and 1 disadvantage of the ratio method

Common mistakes included:

- Providing advantages or disadvantages too generic that would apply too broadly to many concepts or methods, such as: Method easier/harder to calculate, data hard to obtain or not available, easy to explain to management, etc.
- Noting that ALAE were not proportional to Claim without referring to volatility of the ratio for selection