Exam 5

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CASUALTY ACTUARIAL SOCIETY
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CANADIAN INSTITUTE OF ACTUARIES

Exam 5

Basic Techniques for Ratemaking and Estimating Claim Liabilities

May 2, 2017

4 HOURS

INSTRUCTIONS TO CANDIDATES

1. This 57.5 point examination consists of 26 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.

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

CONTINUE TO NEXT PAGE OF INSTRUCTIONS

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.

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 16, 2017.

END OF INSTRUCTIONS

1. (1.25 points)

An insurance company portfolio consists of the following:

- 1,000 two-year policies with an effective date of April 1, 2015.
- 1,000 one-year policies with an effective date of July 1, 2015.

a. (0.75 point)

Calculate the following for calendar year 2015:

i. Written exposures
ii. Earned exposures

b. (0.5 point)

Calculate the earned exposures for calendar year 2016.

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2. (2 points)

Given the following policy year information:

Effective Date	Overall Average Rate Change
October 1, 2015	5%
April 1, 2016	10%
October 1, 2016	5%

- All policies are annual.
- Policy year 2016 written premium = $100,000.
- Policy year 2016 earned premium = $100,000.
- Policy year 2016 ultimate losses including LAE = $80,000.
- Loss trend = 0%.
- Premium trend = 0%.
- There are no fixed expenses.

a. (1 point)

Calculate the policy year 2016 earned premium at current rate level using the parallelogram method.

b. (0.25 point)

Calculate the variable expense ratio that would earn an underwriting profit of 5% at the current rate level.

c. (0.5 point)

Assume the company rapidly increased exposures throughout 2016. Explain whether the parallelogram method would overstate or understate a rate level indication.

d. (0.25 point)

Briefly describe a scenario in which policy year premium is not fixed at the completion of the policy year.

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3. (2 points)

Given the following information about two claims:

Claim Number	Accident Date	Transaction Date	Incremental Payment	Ending Case Reserves
1	January 1, 2015	January 1, 2015	$0	$20,000
1	January 1, 2015	January 1, 2016	$25,000	$0
2	April 1, 2015	July 1, 2015	$0	$50,000
2	April 1, 2015	October 1, 2015	$25,000	$75,000
2	April 1, 2015	April 1, 2016	$100,000	$20,000

a. (0.5 point)

Calculate the incurred losses for accident year 2015 as of May 1, 2016.

b. (1 point)

Calculate the incurred losses for calendar year 2015 and calendar year 2016.

c. (0.5 point)

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

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4. (2.25 points)

Given the following information for an insurance company:

	($000)
Written Premium	15,000
Earned Premium	12,000
Ultimate Losses and LAE	10,000
Commissions and Brokerage	2,250
Other Acquisition Costs	750
Taxes, Licenses, and Fees	300
General Expenses	360

- All expenses are variable.
- Underwriting profit provision = -5%.

a. (1 point)

Calculate the following expense ratios to premium and briefly justify the selection of the premium basis used in each calculation:

i. Commissions and brokerage
ii. General expenses

b. (0.5 point)

Calculate the permissible loss and LAE ratio.

c. (0.25 point)

Briefly explain how the company may return a profit with an underwriting profit provision less than 0%.

d. (0.5 point)

Demonstrate whether or not the company met underwriting profit expectations.

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5. (2 points)

Given the following information:

- Experience period on-level trended earned premium = $250,000.
- Experience period trended and developed losses and LAE = $200,000.
- Experience period earned exposure = 8,000.
- Variable expense provision = 19%.
- Fixed expenses for the experience period = $16,000.
- Profit and contingency factor = 4%.

a. (0.75 point)

Calculate the indicated average rate level change using the loss ratio method.

b. (0.75 point)

Calculate the indicated average rate using the pure premium method.

c. (0.5 point)

Briefly describe one situation where the loss ratio method cannot be used and one situation where the pure premium method cannot be used.

CONTINUED ON NEXT PAGE

6. (1.5 points)

Given the following information:

Class	Exposures	Current Rate	True Expected Cost	Proposed Rate
A	3,500	$500	$550	$540
B	8,000	$400	$350	$370

- Scenario 1: If the proposed rates are implemented, the projected number of class A exposures will decrease to 3,150; the projected number of class B exposures will remain unchanged.
- Scenario 2: If the proposed rates are not implemented, the projected number of class A exposures will increase to 4,500; the projected number of class B exposures will decrease to 7,000.
- No other expenses are changed in either scenario.
- Profit provision is 0% in the indicated rate.

a. (1 point)

Calculate the profit in each of the two scenarios.

b. (0.5 point)

Explain whether the proposed rates should be implemented given a $10,000 implementation cost.

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7. (2 points)

Given the following:

Class	Earned Exposures	Reported Loss and ALAE	Current Relativity
A	10,500	$512,000	1.00
B	5,200	$740,000	1.50
C	13,100	$632,000	1.30

- Full credibility standard is 13,260 exposures.
- Partial credibility is determined based on the square root rule.
- The complement of credibility is no change.

Calculate the indicated rate change for each class that results in a revenue-neutral overall change.

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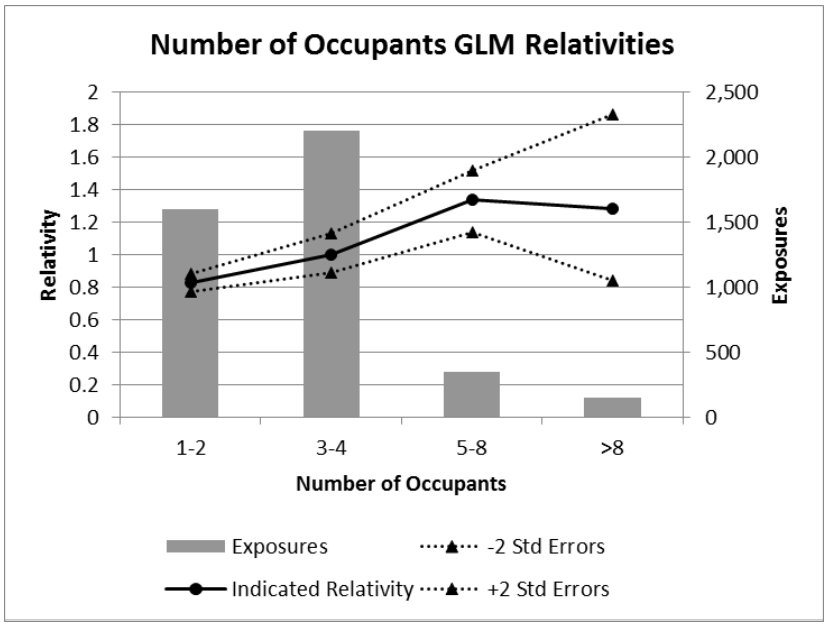
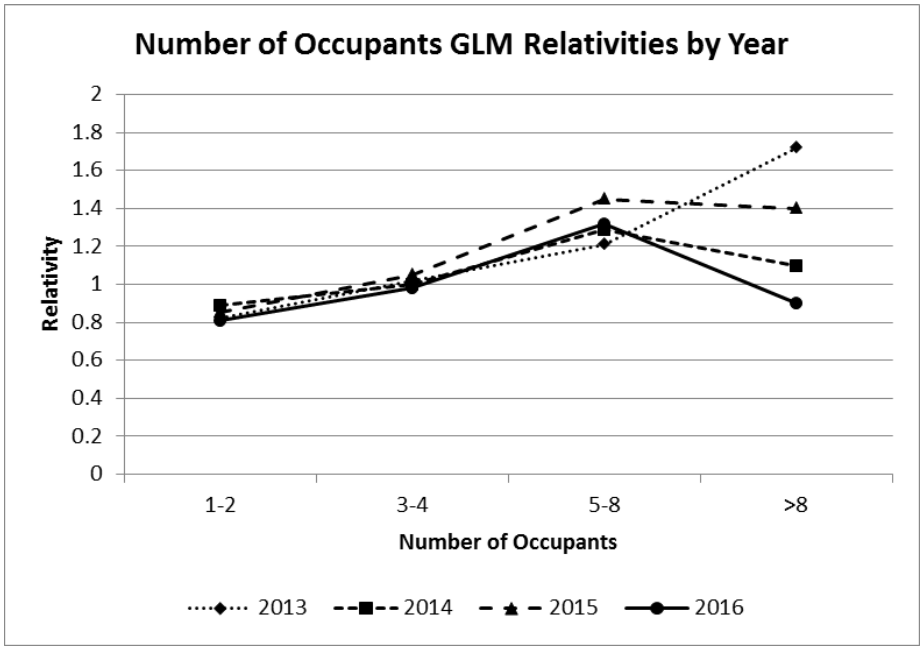
8. (1.75 points)

A company's current rating plan for fire coverage for personal property insurance only includes territory. The following GLM outputs and experience are from a recent analysis of pure premium:



Number of Occupants	1-2	3-4	5-8	>8
Indicated Relativity	0.83	1.00	1.34	1.28



- Number of occupants chi-squared percentage (entire variable) = 3.2%

<QUESTION 8 CONTINUED ON NEXT PAGE>

8. (continued)

a. (0.75 point)

Fully justify whether number of occupants would be an appropriate addition to the rating classification plan.

b. (1 point)

Identify and briefly describe two types of insurance environments which may discourage use of multivariate methods.

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9. (2.75 points)

Given the following information for an insurance company:

State	Class	Exposures	Losses	Current Pure Premium
A	1	200	$800	4.00
A	2	300	$2,100	7.00
A	Subtotal	500	$2,900	5.80
B	1	300	$600	2.00
B	2	300	$1,500	5.00
B	Subtotal	600	$2,100	3.50
C	1	500	$1,500	3.00
C	2	750	$4,500	6.00
C	Subtotal	1,250	$6,000	4.80
All	1	1,000	$2,900	2.90
All	2	1,350	$8,100	6.00
All	Total	2,350	$11,000	4.68

- Full credibility standard is 1,500 exposures.

a. (1.5 points)

Calculate the credibility-weighted pure premium for class 2, state B using Harwayne's method.

b. (0.5 point)

Discuss the appropriateness of using Harwayne's method for this company.

c. (0.75 point)

Evaluate Harwayne's method using three desirable qualities for a complement of credibility.

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10. (3.5 points)

Given the following information about an insurance product:

Territory Factors	
Territory	Factor
A	0.85
B	1.00
C	1.35

- Fixed expense per exposure = $50.
- Variable expense ratio = 17%.
- Underwriting profit provision = 3%.
- LAE provision = 16% of loss cost.
- Base rate = $435.
- Policy fee = $55.
- Policy fee is an additive fee added to each exposure in the last step of the rate calculation.

Based on a separate analysis, an actuary projects the following for calendar-accident year 2018:

Territory	Earned Exposures	Ultimate Loss Cost
A	150	$300
B	200	$350
C	100	$500

a. (1.5 points)

Calculate the projected total underwriting profit for calendar-accident year 2018.

b. (1.5 points)

Calculate the indicated policy fee, indicated territory factors, and indicated base rate.

c. (0.5 point)

Management suggests reaching the targeted profit by only increasing the base rate. Discuss this approach.

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11. (2.5 points)

Given the following information:

Size of Loss ($000)	Loss Distribution	Average Reported Loss ($000)
X <= 200	20%	100
200 < X <= 400	20%	300
400 < X <= 600	20%	500
600 < X <= 800	20%	700
800 < X <= 1,000	20%	900
Total	100%	500

- Expected claim frequency = 1%.
- Expected losses are uniformly distributed.
- A home is valued at $1,000,000.

a. (1 point)

Calculate the rate per $1,000 of coverage for the home at the following amounts of insurance:

i. $1,000,000
ii. $600,000

b. (0.5 point)

Briefly discuss a problem associated with underinsurance from the following perspectives:

i. Insured
ii. Insurer

c. (1 point)

The home is insured for $700,000 with no deductible and a coinsurance requirement of 80%. Calculate the indemnity payments and coinsurance penalties for the following losses:

i. $600,000
ii. $850,000

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12. (1.25 points)

Given the following information regarding an experience rating plan:

- Reported losses and ALAE limited by basic limits and maximum single limit per occurrence (MSL) for the policy being rated as of March 31, 2016 = $175,000.
- Company subject basic limit loss and ALAE for experience period = $225,000.
- Expected experience ratio = 0.875.
- Expected percentage basic limit loss and ALAE for experience period unreported at March 31, 2016 = 0.425.
- Credibility = 0.35.

a. (1 point)

Calculate the experience modification factor.

b. (0.25 point)

Briefly describe a scenario in which it would be appropriate for schedule rating to be used in addition to experience rating.

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13. (5.5 points)

Given the following information for a book of business as of December 31, 2016:

Calendar Year	Earned Premium ($000)
2015	3,910
2016	4,410

Rate Change History	
Effective Date	Average Rate Change
July 1, 2014	-2.0%
July 1, 2015	4.2%
July 1, 2016	3.6%

Accident Year	Reported Loss and ALAE ($000) Capped at $100,000 as of (months)		
	12	24	36
2014	1,116	1,448	1,610
2015	1,975	2,572	
2016	2,145		

Excess Loss and ALAE ($000) History		
	Trended Reported Loss and ALAE	
Accident Year	Unlimited	Excess of $100,000
2009	3,538	718
2010	3,193	130
2011	1,990	234
2012	4,580	1,949
2013	2,369	120

- All policies are annual.
- Exposures are written evenly throughout each calendar year.
- Annual premium trend = 2.8%.
- Annual frequency trend = -2%.
- Annual severity trend capped at $100,000 = 4%.
- Fixed expense ratio = 4%.
- Variable expense ratio = 22%.
- Profit and contingencies provision = 6%.
- ULAE provision = 6% of loss and ALAE.
- Rates are to be in effect for one year.
- There is no loss development beyond 36 months.
- Assume full credibility.

<QUESTION 13 CONTINUED ON NEXT PAGE>

13. (continued)

a. (0.75 point)

Calculate the ultimate loss and ALAE capped at $100,000 for accident years 2015 and 2016.

b. (4.5 points)

Determine the indicated rate change effective July 1, 2017 using the results from part a. above.

c. (0.25 point)

Briefly describe one reason the insurer might not take the full rate change determined in part b. above.

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14. (1.75 points)

Given the following accident year and report year information as of December 31, 2016:

Accident Year	Cumulative Reported Claims ($000) as of (months)		
	12	24	36
2014	120	200	276
2015	120	200	
2016	60		

Accident Year	Incremental Reported Claim Counts as of (months)		
	12	24	36
2014	60	10	3
2015	60	10	
2016	60		

Report Year	Cumulative Reported Claims ($000) as of (months)		
	12	24	36
2014	120	180	240
2015	140	210	
2016	86		

- No claims are reported beyond 36 months.
- Accident year 36-to-ultimate development factor = 1.06.
- No claims occurred prior to January 1, 2014.

Calculate the claims incurred but not yet reported (IBNYR) in total for all years as of December 31, 2016.

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15. (2.25 points)

Given the following information as of December 31, 2016:

Accident Year	Cumulative Paid Claims ($000) as of (months)		
	12	24	36
2014	1,150	2,250	3,000
2015	1,250	2,400	
2016	1,550		

Accident Year	Cumulative Reported Claims ($000) as of (months)		
	12	24	36
2014	5,150	7,200	8,000
2015	4,800	6,700	
2016	4,750		

Accident Year	Cumulative Reported Claim Counts as of (months)		
	12	24	36
2014	102	107	108
2015	96	101	
2016	99		

Accident Year	Open Claim Counts as of (months)		
	12	24	36
2014	52	28	12
2015	46	25	
2016	42		

- Reported claim counts exclude claims closed without payment.
- Historical claim cost inflation is 0%.

a. (0.75 point)

Calculate the paid to reported claim ratio triangle and briefly describe what it suggests about changes in:

i. Settlement rates
ii. Case reserve adequacy

b. (1.5 points)

Calculate the closed to reported claim count ratio triangle and the average case outstanding triangle and briefly describe what the triangles suggest about changes in:

i. Settlement rates
ii. Case reserve adequacy

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16. (2.75 points)

Given the following information for a private passenger auto insurer as of December 31, 2016:

Accident Year	Selected Ultimate Claim Counts	Earned Premium ($000)	Premium On-Level Adjustment Factor to 2016
2012	1,025	$132,500	1.405
2013	3,070	$275,250	1.300
2014	2,950	$330,750	1.070
2015	not provided	$360,825	1.050

- Annual claim count trend = -2%.
- Annual severity trend = 5%.
- Accident year 2016 selected ultimate severity = $13,370.
- Accident year 2015 cumulative reported claims as of December 31, 2016 = $30,880,900.

a. (2.25 points)

Estimate the IBNR for accident year 2015 as of December 31, 2016 using a frequency-severity technique.

b. (0.5 point)

Briefly describe one situation where the frequency-severity techniques are useful and one situation where they are not useful.

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17. (2 points)

Given the following information for an insurance company as of December 31, 2016:

Accident Year	Cumulative Reported Claims ($000) as of (months)		
	12	24	36
2014	68,600	87,800	100,000
2015	72,800	91,500	
2016	55,900		

Accident Year	Cumulative Reported Claim Counts as of (months)		
	12	24	36
2014	80	95	100
2015	85	99	
2016	87		

- There is no development after 36 months for reported claims or reported claim counts.
- A new law limiting claimant benefits came into effect on January 1, 2016 and is applicable to accidents occurring on or after January 1, 2016. The expected impact is a 25% reduction in claim severity.
- There is no loss trend.

Estimate ultimate claims for accident year 2016 as of December 31, 2016 using a frequency-severity technique.

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18. (2 points)

Given the following information as of December 31, 2016:

Accident Year	Cumulative Reported Claims as of (months)			
	12	24	36	48
2013	1,000	1,350	1,450	1,480
2014	4,500	6,000	6,400	
2015	4,800	6,350		
2016	4,100			

Accident Year	Reported Claims Age-to-Age Factors		
	12-24	24-36	36-48
2013	1.350	1.074	1.021
2014	1.333	1.067	
2015	1.323		

Accident Year	Earned Premium
2013	1,500
2014	6,800
2015	7,200
2016	7,500

- Accident year 2016 paid claims as of December 31, 2016 = 2,775.
- Expected claim ratio for all years = 75%.
- There is no reported claims development after 48 months.

a. (0.75 point)

Calculate the IBNR and the total unpaid claims for accident year 2016 as of December 31, 2016 using the expected claims technique.

b. (1.25 points)

Calculate the IBNR and the total unpaid claims for accident year 2016 as of December 31, 2016 using the reported Bornhuetter-Ferguson technique.

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19. (3.25 points)

Given the following information evaluated as of December 31, 2016:

Accident Year	Cumulative Paid Claims ($000) as of (months)			
	12	24	36	48
2013	1,000	2,000	3,100	3,410
2014	1,500	3,300	4,785	
2015	2,000	3,600		
2016	2,500			

Accident Year	Cumulative Reported Claims ($000) as of (months)			
	12	24	36	48
2013	3,000	3,600	3,960	4,000
2014	4,200	5,250	5,775	
2015	5,100	6,630		
2016	7,500			

Accident Year	Case Outstanding ($000) as of (months)			
	12	24	36	48
2013	2,000	1,600	860	590
2014	2,700	1,950	990	
2015	3,100	3,030		
2016	5,000			

a. (0.75 point)

Calculate the expected incremental reported claims for accident year 2016 in calendar year 2019 using the reported claim development technique.

b. (2 points)

Calculate the expected incremental reported claims for accident year 2016 in calendar year 2019 using the incremental paid to previous case outstanding technique.

c. (0.5 point)

Briefly describe whether the case outstanding technique is appropriate to project ultimate claims when performing an analysis on each of the following bases:

i. Report year
ii. Accident year

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20. (2.25 points)

Given the following data evaluated as of December 31, 2016:

Accident Year	Cumulative Paid Claims ($000) as of (months)			
	12	24	36	48
2013	300	550	647	700
2014	500	979	Not Provided	
2015	400	825		
2016	450			

Accident Year	Cumulative Reported Claims ($000) as of (months)			
	12	24	36	48
2013	500	660	700	700
2014	750	900	1,150	
2015	640	810		
2016	700			

- There is no development on paid or reported claims after 48 months.
- The reported claim development technique projects IBNR that is $50,000 lower than the IBNR projected by the paid claim development technique for accident year 2016.
- Age-to-age development factors are selected using an all year simple average.

Calculate the total claims paid in calendar year 2016 for all accident years.

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21. (1.5 points)

Given the following information:

Accident Year	Ultimate Claim Estimates ($000) as of December 31, 2015		Ultimate Claim Estimates ($000) as of December 31, 2016	
	Paid Claim Development Technique	Reported Claim Development Technique	Paid Claim Development Technique	Reported Claim Development Technique
2013	109	107	108	110
2014	107	108	105	117
2015	107	108	102	122
2016	---	---	100	150

- The actuary selects age-to-age factors for each development technique using a five-year volume-weighted average.

a. (0.5 point)

Describe one scenario that could explain the change in estimates from the December 31, 2015 evaluation to the December 31, 2016 evaluation for accident years 2015 and prior.

b. (0.5 point)

Describe one scenario impacting only accident year 2016 that could explain the difference between the two development techniques.

c. (0.25 point)

Briefly describe an adjustment or an alternate technique for estimating ultimate claims that is appropriate for the scenario identified in part a. above.

d. (0.25 point)

Briefly describe an adjustment or an alternate technique for estimating ultimate claims that is appropriate for the scenario identified in part b. above.

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22. (2 points)

Given the following data as of December 31, 2016:

Accident Year	Cumulative Closed Claim Counts as of (months)			
	12	24	34	48
2013	660	959	1,119	1,154
2014	768	1,104	1,317	
2015	620	825		
2016	806			

Accident Year	Cumulative Reported Claim Counts as of (months)			
	12	24	36	48
2013	1,100	1,155	1,178	1,178
2014	1,200	1,380	1,463	
2015	1,000	1,100		
2016	1,300			

Justify whether the closed claim counts for each accident year at 12 months maturity will be increased, decreased, or not adjusted when applying the Berquist-Sherman technique with paid claim development adjustment.

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23. (3 points)

Given the following data as of December 31, 2016:

Accident Year	Earned Premium	Cumulative Paid Claims as of (months)			
		12	24	36	48
2013	2,000	390	875	1,135	1,265
2014	2,260	425	1,065	1,355	
2015	2,730	564	1,267		
2016	3,215	619			

- A court decision on December 31, 2014 led to a 20% increase in severity for all payments occurring after the decision.
- The company took a rate change of +20% effective on January 1, 2014.
- Policies are annual and are written evenly throughout the year.
- There is no development beyond 48 months.

a. (1.5 points)

Calculate accident year 2016 ultimate claims using the paid claim development technique, incorporating the impact of the court decision.

b. (1.5 points)

Calculate the accident year 2016 ultimate claims using the Cape Cod technique, incorporating the impact of the court decision.

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24. (1.5 points)

For each of the following insurers, briefly describe why the classical technique is not optimal and briefly discuss an alternative technique that addresses the problem identified.

- There is no inflation.

a. (0.5 point)

An auto insurer expanding its operations by writing policies in two new states.

b. (0.5 point)

A homeowners insurer located in a hurricane prone area.

c. (0.5 point)

An insurer writing a long-tail line of business.

25. (1.5 points)

An insurance company has experienced a large claim in accident year 2016. Given the following information for accident year 2016:

Estimated Ultimate ALAE Without Adjustment for Large Claim	
Paid ALAE Development Technique	Paid ALAE to Paid Claims Only Ratio Technique
$11,000	$12,000

	Paid Claims Only	Paid ALAE	Ultimate Claims Only	Ultimate ALAE
All Claims	$7,000	$2,000	$30,000	Not Provided
Large Claim	$0	$1,500	$6,000	$2,000

a. (0.75 point)

Estimate ultimate ALAE for accident year 2016 using the paid ALAE development technique, including an adjustment for the large claim.

b. (0.75 point)

Estimate ultimate ALAE for accident year 2016 using the paid ALAE to paid claims ratio technique, including an adjustment for the large claim.

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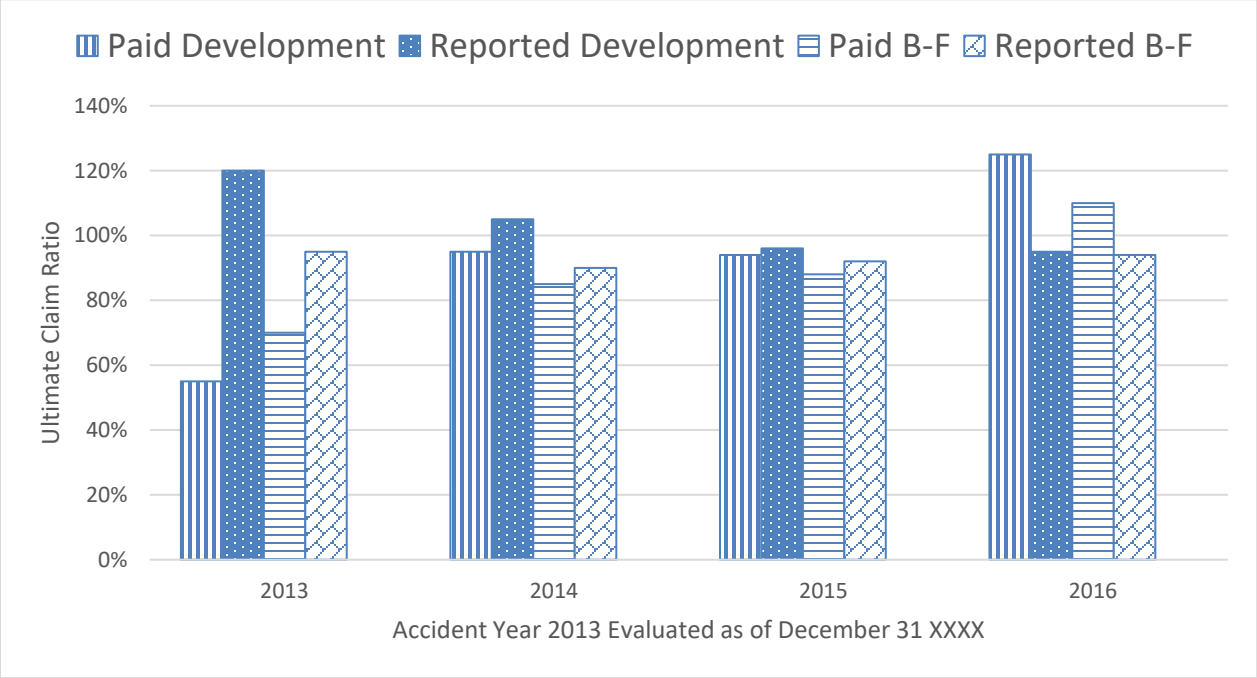
26. (1.5 points)

The following graph shows the results of four techniques for estimating the ultimate claim ratio for accident year 2013, as of December 31 for each year shown.



a. (0.5 point)

The actuary selected an ultimate claim ratio of 100% as of December 31, 2013. Assess the reasonability of this estimate using only information known as of December 31, 2013.

b. (0.5 point)

Discuss the relative position of the ultimate claim ratio for the reported Benktander technique versus the other techniques if the reported Benktander technique were added to the graph as of December 31, 2013.

c. (0.5 point)

Identify two questions that the actuary should ask company management based on the results observed for all four evaluations of accident year 2013.

END OF EXAMINATION

Exam 5
Basic Techniques for Ratemaking and Estimating Claim Liabilities

May 2, 2017

POINT VALUE OF QUESTIONS

QUESTION	VALUE OF QUESTON	SUB-PART OF QUESTION (a)	(b)	(c)	(d)	(e)	(f)	(g)
1	1.25	0.75	0.50					
2	2.00	1.00	0.25	0.50	0.25			
3	2.00	0.50	1.00	0.50				
4	2.25	1.00	0.50	0.25	0.50			
5	2.00	0.75	0.75	0.50				
6	1.50	1.00	0.50					
7	2.00	2.00						
8	1.75	0.75	1.00					
9	2.75	1.50	0.50	0.75				
10	3.50	1.50	1.50	0.50				
11	2.50	1.00	0.50	1.00				
12	1.25	1.00	0.25					
13	5.50	0.75	4.50	0.25				
14	1.75	1.75						
15	2.25	0.75	1.50					
16	2.75	2.25	0.50					
17	2.00	2.00						
18	2.00	0.75	1.25					
19	3.25	0.75	2.00	0.50				
20	2.25	2.25						
21	1.50	0.50	0.50	0.25	0.25			
22	2.00	2.00						
23	3.00	1.50	1.50					
24	1.50	0.50	0.50	0.50				
25	1.50	0.75	0.75					
26	1.50	0.50	0.50	0.50				
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	57.50							

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

GENERAL COMMENTS:

- Candidates should note that the instructions to the exam explicitly say to show all work; graders expect to see enough support on the candidate's answer sheet 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.
- Candidates should note that the sample answers provided in the examiner's report 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 examiner's report often provides 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.

EXAM STATISTICS:

- Number of Candidates: 783
- Available Points: 57.5
- Passing Score: 40.5
- Number of Passing Candidates: 338
- Raw Pass Ratio: 43.2%
- Effective Pass Ratio: 45.3%

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 1	
TOTAL POINT VALUE: 1.25	**LEARNING OBJECTIVE(S): A1**
SAMPLE ANSWERS	
Part a: 0.75 point	
Sample Response for written exposures: • 1000 * 2 + 1000 = 3000 *Sample Responses for earned exposures:* • 1000 * .75 + 1000 * .5 = 1250 • 2 (1000) * 9/24 + 1000 * 6/12 = 1250	
Part b: 0.5 point	
Sample 1 1000 * 1 + 1000 * .5 = 1500 *Sample 2* 2 (1000) * 12/24 + 1000 * 6/12 = 1500	
EXAMINER'S REPORT	
Candidates were expected to demonstrate how to calculate written and earned exposures for a portfolio of policies with different coverage terms for each calendar year.	
Part a	
Candidates were expected to demonstrate how to calculate written and earned exposures for a portfolio of policies consisting of 1-year and 2-year policies in the calendar year the policies were effective. Common errors included: • Not properly accounting for the 2-year policy term in determining written and earned exposures. • Miscalculations of percent earned in the calendar year.	
Part b	
Candidates were expected to demonstrate how to calculate earned exposures for a portfolio of policies consisting of 1-year and 2-year policies in year 2. Common errors included: • Not properly accounting for the 2-year policy term in determining earned exposures. • Miscalculations of percent earned in the calendar year.	

QUESTION 2

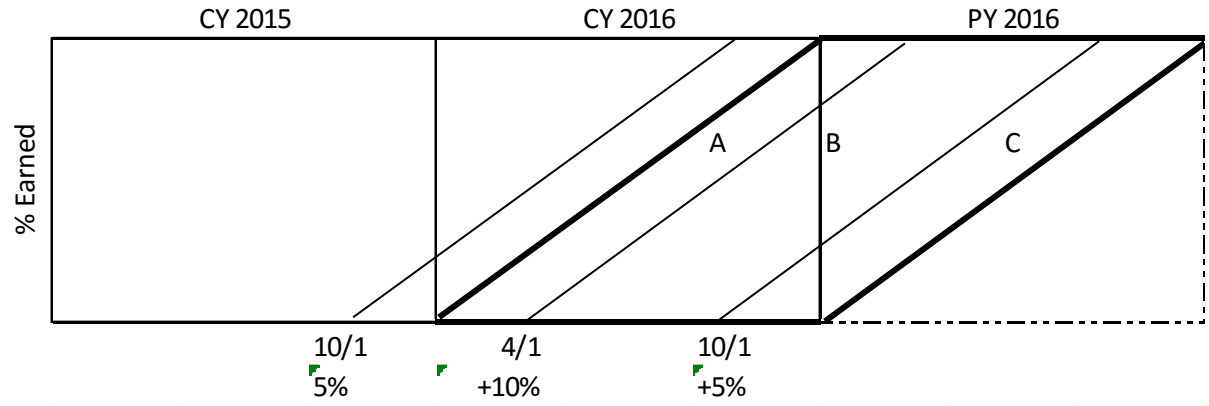
TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): A2**

SAMPLE ANSWERS

Part a: 1 point

Sample 1

PY 2016 EP @ Current (Annual policies)



Region	Rate Level	Area
A	1.0	0.25
B	1.1	0.5
C	1.1 x 1.05 = 1.155	0.25

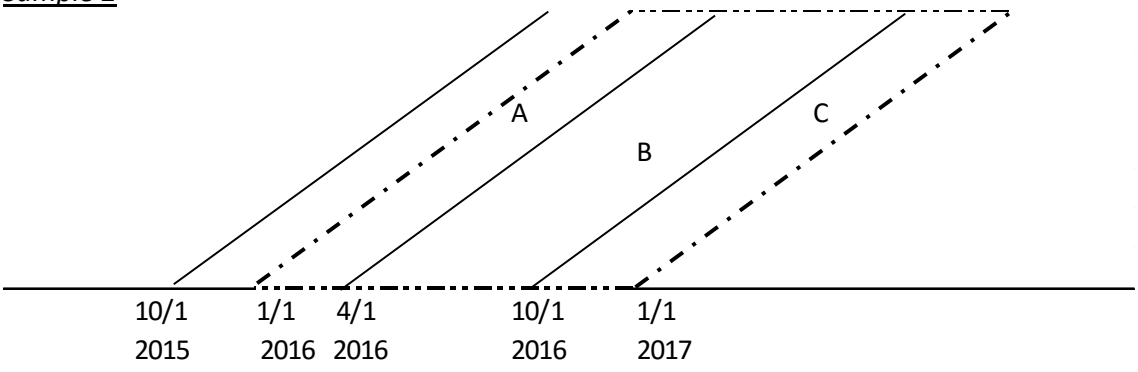
Current Rate Level = 1 x 1.1 x 1.05 = 1.155

Avg Rate Level = 0.25 (1) + 0.5 (1.1) + .25 (1.155)
= 1.08875

On-Level Factor = 1.155/1.08875 = 1.06085

PY 2016 EP @ Current Rate Level = 100,000 x 1.06085 = 106,085

Sample 2



Policy year is represented by the dotted parallelogram

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

Section	Area	Rate Level Index
A	1/4	1.05
B	1/2	1.1 x 1.05 = 1.155
C	1/4	1.155 x 1.05 = 1.21275

Avg rate level index: ¼ x 1.05 + ½ x 1.155 + ¼ x 1.21275 = 1.1431875

Current rate level index = 1.21275

OLF = 1.21275/1.1431875 = 1.06085

PY 2016 EP at CRL = 100,000 x 1.06085 = 106,085

Part b: 0.25 point

Sample 1

LR = 80,000 / 106,085 = 0.75411
LR/[1-V-Q] = indicated rate change factor
.75411/[1-V-.05] = 1.0 → .75411 = 1 – V - .05
V = 0.1959

Sample 2

80,000/[1-V-.05] = 106,085
1-V-.05 = .75
1-V = .804
V = 19.59%

Part c: 0.5 point

Sample 1

The exposures written towards the end of the year are at the new higher rate level. So the true avg rate level is higher than the one calculated with the parallelogram method. Therefore, the OLF found in a) is overstated and leads to overstated OL Premium → understated loss ratio → understated RL indication

Sample 2

If exposures were rapidly increasing more policies would be written at the higher rate level making the average rate level for 2016 actually higher. This would make the on-level factor lower and premium at current rate level lower. Parallelogram method would lead to an understated indication because it leads to an understand loss ratio.

Part d: 0.25 point

Any one of the following:

- When there is a premium audit after the end of a policy year
- Retrospective rating policies have premium adjustments years after a completed policy year due to loss development

EXAMINER'S REPORT

Candidates were expected to calculate policy year earned premium at current rate level using the parallelogram method and then use this premium to determine the variable expense ratio. Candidates were also expected to understand the basic assumption of the parallelogram method

and how a violation of that assumption would impact a rate level indication. Finally, candidates were expected to understand the reasons for policy year premium development.

Part a

Candidates were expected to calculate the appropriate on-level factor using the parallelogram method and apply to earned premium to develop policy year 2016 earned premium at current rate level.

Common errors included:

- Calculating an on-level factor for calendar year 2016 instead of policy year 2016.
- Calculating the average rate level without cumulating the rate changes.

Part b

Candidates were expected to estimate the variable expense ratio using the earned premium at current rate level calculated in part a. based on the loss ratio rate indication formula.

Common errors included:

- Using the 2016 earned premium not at current rate level.
- Mismatching between the premium used and the indicated rate level change.

Part c

Candidates were expected to understand the underlying assumption of the parallelogram method is that premium is written evenly throughout the year and that the growth in exposures violated this assumption. Candidates were expected to demonstrate the impact of the increase in exposures on the on-level factor/premium at current rate level that would then impact the loss ratio used in the rate level indication.

Common errors included:

- Commenting on the average rate level but not commenting on the impact this would have on the rate level indication.
- Stating that the parallelogram method assumes uniform writing of exposures but not explaining how this would impact the calculation underlying the indication.
- Pointing out changes to the loss experience or average accident date, as there is not enough information to discuss how this could be impacted by the growth in exposures.

Part d

Candidates were expected to differentiate between different premium aggregations and state the reasons for premium development after the end of the policy year.

Common errors included:

- Discussing loss development (other than retro policies), which would not impact policy year premium development.
- Discussing the mechanics of earning premium over the course of the policy year.
- Commenting on cancellations that occur mid-term but in the next calendar year. These would occur before the end of the policy year, and would not cause changes after the policy year ends.

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 3

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): A3**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

Incurred = Paid + Change in Case Reserve
= (0+(20,000 – 0)) + (25,000 + (0 – 20,000)) +(0 + (50,000 – 0)) + (25,000 + (75,000 – 50,000)) + 100,000 + (20,000 – 75,000)) = 170,000

Sample 2

Claim 1 = 20,000 + (25,000 + (0 – 20,000)) = 25,000
Claim 2 = 50,000 + (25,000 + (75,000 – 50,000)) + (100,000 + (20,000-75,000)) = 145,000
Total = 25,000 + 145,000 = 170,000

Sample 3

Paid = 25,000 + 25,000 + 100,000 = 150,000
Ending Case = 0 + 20,000 = 20,000
Incurred = Paid + Ending Case = 150,000 + 20,000 = 170,000

Part b: 1 point

Sample 1

CY 2015: (0 + (20,000 -0)) + (0 + (50,000 – 0)) + (25,000 + (75,000 – 50,000)) = 120,000

CY 2016: (25,000 + (0-20,000)) + (100,000 + (20,000 -75,000)) = 50,000

Sample 2

CY 2015: Claim 1 = 20,000; Claim 2 = 50,000+25,000 +(75,000-50,000) = 100,000
Total = 20,000 + 100,000 = 120,000

CY 2016: Claim 1 = 25,000 + (0 - 20,000) = 5,000; Claim 2 = 100,000 + (20,000-75,000) = 45,000
Total = 5,000 + 45,000 = 50,000

Part c: 0.5 point

Sample Responses for "advantages":

- Data is known at the end of the year (very responsive)
- There is no development after CY is over so it is the quickest to finish, can use latest CY data
- CY data is finalized at 12/31/yy so data is static and good for year-end financial reporting

Sample Responses for "disadvantages":

- Poor match of premium to losses
- Does not perfectly match premium to losses
- Doesn't allow losses to develop, may not be appropriate for long-tailed lines of business
- Not useful in estimating IBNR

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

EXAMINER'S REPORT
Candidates were expected to understand how to calculate incurred losses by calendar year and accident year. They were also expected to understand an advantage and a disadvantage of calendar year aggregation.
Part a
Candidates were expected to know the definition of incurred loss as well as how to aggregate losses by accident year. A common error was an incorrect calculation of ending case reserve.
Part b
Candidates were expected to know the definition of incurred loss as well as how to aggregate losses by calendar years. Common errors included: • Only calculating one calendar year instead of both. • Adding in the ending case reserve without subtracting out the prior case balance. • Not realizing that the beginning case reserve for both claims were zero at the start of the first calendar year.
Part c
Candidates were expected to know an advantage and a disadvantage of calendar year aggregation. Common errors included: • Only giving one response (either advantage or disadvantage) but not both. • Saying there was a mismatch of premium but not saying what it was mismatched with (losses). • Saying there was no development as a disadvantage but not describing why.

QUESTION 4	
TOTAL POINT VALUE: 2.25	**LEARNING OBJECTIVE(S): A4**

SAMPLE ANSWERS

Part a: 1 point

Sample Response for Commission and Brokerage Ratio:

$$\frac{Commission\ \&\ Brokerage\ Expense}{Written\ Premium} = \frac{2{,}250}{15{,}000} = 15\%$$

Sample Response for General Expense Ratio:

$$\frac{General\ Expense}{Earned\ Premium} = \frac{360}{12{,}000} = 3\%$$

Sample Responses for Selected Commission & Brokerage Ratio Premium Base:

- Relate commissions and brokerage to written premium because they are incurred at policy inception
- Commissions are proportional to written premium
- Commissions are based on how much agents write
- Commission and Brokerage incur at the beginning of the year, so we use written premium

Sample Responses for Selected General Expense Ratio Premium Base:

- Relate general expenses to earned premium because incurred throughout the policy
- General Expenses are the ongoing costs of the policies and insurer operation, so typically divided by earned premium
- General expenses are related to maintaining policies. They are incurred in line with the portion of policies earned. Use earned premium.
- General Expense is incurred throughout the year, so we use earned premium

Part b: 0.5 point

Other Acq: $\frac{Other\ Acquisition\ Expense}{Written\ Premium} = \frac{750}{15{,}000} = 5\%$

TLF: $\frac{Taxes,Licenses,and\ Fees}{Written\ Premium} = \frac{300}{15{,}000} = 3\%$

PLR = 1-V-Q_T

V = 0.15+0.03+0.05+0.02 = 0.25

Q_T = 0.05

PLR = 1-0.25 - 0.05 = 0.8

Part c: 0.25 point

Any one of the following:

- The profit can be from investment. If the company has a good investment performance, they can still have a positive total profit

- Investment Income
- Take a more aggressive investment strategy to offset a u/w profit provision less than 0%
- In a long tailed LOB where there is more time to earn investment income, the investment income + negative u/w profit can be net positive
- Under the asset share pricing model, the company may gain a positive return in a long run with a negative profit provision in the one-year horizon.
- The company may be seeking growth in the short-run and profitability in the long run as renewal expenses are lower than new business expenses.
- Have low profit provision to gain market share now and increase profits later.
- The company may have a favorable loss year where actual LR is well under permissible LR

Part d: 0.5 point

Sample 1

L&LAE Ratio = $\frac{10,000}{12,000}$ = 83%

83% > PLR of 80%

The company did not meet u/w profit expectations

Sample 2

$\frac{10,000}{12,000}$ = 83%

$83\%/_{80\%} - 1 = 4.17\%$ The rate indication suggests that the rate should be increased by 4.17%. Therefore, the company did not meet the u/w profit expectations.

Sample 3

$\frac{10,000}{12,000}$ = 83%

0.83 = 1 - 0.25 – u/w profit

u/w profit = -.083

Because -8.3%<-5% it did not meet expectations

Sample 4

$\frac{10,000}{12,000}$ = 83%

They did not meet expectations by 3.3%

Sample 5

Indicated Premium = $\frac{10,000}{0.8}$ = 12,500

12,500 > 12,000 so the company did not meet expectations

Sample 6

L&LAE Ratio = $\frac{10,000}{12,000}$ = 83%

Combined Ratio = 0.83+0.25 = 1.083

1.083>1.05 Did not meet expectations

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

EXAMINER'S REPORT

Candidates were expected to apply their knowledge of expense and profit provisions to determine whether or not the company had achieved an underwriting profit.

Part a

Candidates were expected to calculate underwriting expense ratios, select the appropriate premium base for each expense ratio, and give an explanation as to why the premium base was an appropriate selection. The explanation for the selected premium base needed to contain a clear reason for why the selection was appropriate for the given expense ratio.

Common errors included:

- Selecting the wrong premium base for one or both of the expense ratios.
- Vague or incorrect justifications for the selected premium base. Answers such as "Commission and Brokerage is more closely associated with written premium and General Expense is more closely associated with earned premium" were not given credit as these answers do not explain why the premium base is appropriate.

Part b

Candidates were expected to correctly identify the additional expense components of the total underwriting expense ratio, calculate them, and then calculate the permissible loss and LAE ratio (PLR).

Common errors included:

- Selecting the wrong premium bases for the Other Acquisition and Taxes, Licenses, and Fees expense ratios.
- Failing to include all of the components of expense and profit provisions in the PLR calculation.
- Not including the profit and contingencies provision in the PLR calculation, or including a 5% profit provision instead of a -5% profit provision.
- Calculating the actual loss and LAE ratio rather than the PLR.
  Assuming some expenses were fixed when the question states that all expenses are variable.

Part c

Candidates were expected to explain how the total profit could be positive given that the business was priced using a negative underwriting profit provision.

Common errors included:

- Explaining ways the company could improve its underwriting profit.
- Explaining reasons why a company might have a negative underwriting profit.

Part d

Candidates were expected to perform a calculation and use its results to state and justify a conclusion as to whether or not the underwriting profit expectations were met.

Common errors included:

- Completing a calculation but not clearly stating a conclusion.
- Using dollar amounts in the fundamental insurance equation instead of ratios.
- Using written premium as the base for the loss and LAE ratio.

- Stating that the company met profit expectations when the calculations indicated otherwise.
- Stating that the company did not meet profit expectations because the calculated profit was less than 0% when the expectation was a -5% profit.

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 5	
TOTAL POINT VALUE: 2	**LEARNING OBJECTIVE(S): A5**
SAMPLE ANSWERS	
Part a: 0.75 point	
Sample 1 Ind rate chg = $\frac{200/250 + 16/250}{1-.19-.04} - 1 = 12.21\%$ *Sample 2* Projected and trended LR = 200,000/250,000 = 80% Fixed exp % = 16,000/250,000 = 6.4% Ind avg rate change = (80% + 6.4%)/(1-19%-4%) = 12.21%	
Part b: 0.75 point	
Sample 1 Ind avg rate = $\frac{200/8 + 16/8}{1-.19-.04} = \$35.06$ *Sample 2* Projected and trended PP = \$200,000/8000 = \$25 Fixed exp per exposure = \$16,000/8000 = \$2 Ind avg rate = (25+2)/(1-19%-4%) = \$35.06	
Part c: 0.5 point	
Sample Responses for a situation where loss ratio method cannot be used • Loss Ratio method cannot be used in cases where you cannot on-level premium. • The loss ratio method gives a change, not an actual rate, so it cannot be used for a new territory or line of business where there is no prior rate. • Use the pure premium method when premium information is unavailable (newer business). • The loss ratio method cannot be used when historical loss ratio information is not available. • Loss ratio method cannot be used if trends are uncertain or unknown for either premium of losses. This relies on accurate trends and would not be useful without them. • LR method cannot be used without earned premium. • Loss ratio cannot be used in a case where historical rate change information is not available and therefore premium cannot be brought to the current rate level. *Sample Responses for a situation where pure premium method cannot be used* • Pure premium method cannot be used in cases where exposures are not clearly defined over the exposure period. • The pure premium method cannot be used if exposure information is not available. • Pure premium method cannot be used if looking at a certain variable that is highly correlated with another. PP method assumes uniform dist between variables. Would need to instead use Adjusted Pure Premium method. • The pure premium method cannot be used if exposure mix is changing and the exposure mix level of the experience period cannot be adjusted.	

- PP method cannot be used for some commercial lines where there are multiple exposures=>not clear which exposure base to use.
- Use the loss ratio method when there has been a change to the exposure base.
- Pure premium cannot be used without exposures.

EXAMINER'S REPORT

Candidates were expected to understand the loss ratio and pure premium methods, how to apply the formulas for each given rating information, and when each method can or cannot be used.

Part a

Candidates were expected to calculate an indicated rate level change using the loss ratio method.

Common errors included:

- Subtracting fixed expense ratio in the numerator of the formula.
- Using exposures as a step to get one of the inputs, as exposures are not required for this method.
- Calculating the indicated rate using the pure premium method and dividing by the current rate, as this did not use the method required in this part of the question.

Part b

Candidates were expected to calculate an indicated rate level using the pure premium method.

Common errors included:

- Subtracting fixed expense per exposure in the numerator of the formula.
- Dividing premium by exposure instead of dividing loss by exposure to get the pure premium.
- Using premium as a step to get one of the inputs, as premium is not required for this method.
- Calculating the rate change in part a. and applying it to the current rate to get the indicated rate level, as this did not use the method required in this part of the question.

Part c

Candidates were expected to briefly describe a situation where the loss ratio method and the pure premium method cannot be used.

Common errors included:

- Confusing the methods; for example, stating that the loss ratio method needed exposures or that the pure premium method needed on-level premiums.
- Providing an example situation without elaborating as to why the stated method cannot be used for the example identified (i.e., not mentioning that it is the absence of a critical input that makes the example valid).
- Incorrectly listing an input that is not required in order to use the method.

QUESTION 6

TOTAL POINT VALUE: 1.5 | **LEARNING OBJECTIVE(S): A6**

SAMPLE ANSWERS

Part a: 1 point

Sample 1

Scenario 1

(1) Class	(2) Exposures	(3) Prop. Rate	(4) Exp. Cost	(5)=(2)x[(3)-(4)] Profit
A	3,150	540	550	(31,500)
B	8,000	370	350	160,000
			Total	128,500

Scenario 2

(1) Class	(2) Exposures	(3) Prop. Rate	(4) Exp. Cost	(5)=(2)x[(3)-(4)] Profit
A	4,500	500	550	(225,000)
B	7,000	400	350	350,000
			Total	125,000

Part b: 0.5 point

Sample 1

The expected benefit to implement is 128,500 – 125,000 = 3,500. However the implementation cost is 10,000 > 3,500. The proposed rates should not be implemented because the overall benefit does not outweigh the costs.

Sample 2

The proposed rates should be implemented if the company expects these profits to continue in the future. They do $3,500 better each year they implement. In about 3 years (assuming yearly policies) they will make their money back and start making profit on the $10,000 investment.

Sample 3

Implementing the proposed rates results in profit of 128,500 including the 10,000 implementation fee results in a profit of 118,500 which is less than if the current rates continue. But implementing proposed rates seems more equitable and the cost of class A is not being supplemented by the profit of class B as much. Will reduce adverse selection so implement.

EXAMINER'S REPORT

Candidates were expected to understand how to calculate the expected profit given premium, expected loss, and exposure information. Candidates were also expected to determine the impact of implementing a proposed rating plan given an implementation cost.

Part a

Candidates were expected to calculate profit by class for two scenarios by taking the proper (rate – expected cost) x exposures.

Common errors included:

- Incorrectly stating the formula.
    - The proper formula for Scenario 1 is (proposed rate – true expected cost) x projected exposure. Common errors included using current exposures, current rate, or reversing the proposed rate and true expected cost.
    - The proper formula for Scenario 2 is (current rate – true expected cost) x projected exposure. Common errors included using current exposures, proposed rate, or reversing the current rate and true expected cost.
- Stating the formulas correctly but using the wrong values from the question as inputs.

Part b

Candidates were expected to reflect the implementation cost in the proposed rating plan in comparing to the current rating plan and determine if the proposed rates should be implemented given the resulting profit. Both short-term and long-term views of the implementation cost were acceptable.

Common errors included:

- Subtracting the $10,000 implementation cost from the profit in both scenarios; only Scenario 1 had an implementation cost.
- Subtracting the $10,000 implementation cost from Scenario 1 but not comparing it to the profit in Scenario 2.

QUESTION 7

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): A8**

SAMPLE ANSWERS

Sample 1

Class	Pure Premium	Indicated Relativity	Current Relativity	Normalized Curr Rel	Credibility	Cred Wtd Ind Rel
A	48.76	.7454	1.00	.8152	.89	.7531
B	142.31	2.1754	1.50	1.2228	.63	1.8193
C	48.24	.7375	1.30	1.0597	.99	.7394
Total	65.42		1.2267	1.0000		.9394

Class	Cred Wtd Normalized	Relativity Change	Change w/ Off Balance
A	.8017	-19.8%	-1.7%
B	1.9367	29.1%	58.4%
C	.7871	-39.5%	-25.7%
Total	1.0000	-18.5%	0.0%

Sample 2

Class	Pure Premium	Indicated Relativity	Current Relativity	Normalized Curr Rel	Credibility	Cred Wtd Ind Rel
A	48.76	.7454	1.00	.8152	.89	.7531
B	142.31	2.1754	1.50	1.2228	.63	1.8193
C	48.24	.7375	1.30	1.0597	.99	.7394
Total	65.42		1.2267	1.0000		.9394

Class	Cred Wtd Normalized	Relativity Change	Change w/ Off Balance
A	1.0000	0.0%	-1.7%
B	2.4157	61.1%	58.4%
C	.9818	-24.5%	-25.7%
Total	1.2473	1.7%	0.0%

- Pure Premium = Reported Loss and ALAE / Earned Exposures = 512,000/10,500 = 48.76
- Indicated Relativity = Pure Premium / Total Pure Premium = 48.76/65.42=.7454
- Normalized Current Relativity = Class Relativity / Average Class Relativity = 1/1.2267=.8152
- Credibility = (Exposures/Standard)^0.5 = (10,500/13,260)^0.5 =.89
- Credibility Weighted Indicated Relativity = Indicated Relativity * Credibility + Normalized Current Relativity * (1 – Credibility) = .7454*.89+.8152*.11=.7531
- Credibility Weighted Normalized Relativity
  - *Sample 1*: Class Credibility Weighted Indicated Relativity / Average Credibility Weighted Indicated Relativity = .7531/.9394=.8017
  - *Sample 2*: Class Credibility Weighted Indicated Relativity / Class A Credibility Weighted Indicated Relativity = .7531/.7531=1.0000

- Relativity Change = Credibility Weighted Normalized Relativity / Current Relativity = .8017/1.00-1=-19.8%
- Change with Off Balance = (1+Relativity Change)/(1+Average Relativity Change)-1 = (1+0.0)/(1+.017)-1=-1.7%

EXAMINER'S REPORT

Candidates were expected to know how to generate rating differentials, apply credibility standards, and off-balance to rate neutral.

Common errors included:

- Using the current rebased rates as the complement of credibility after calculating the rating differentials as a percent of the weighted average.
- Using 1 as the complement of credibility.
- In calculating and applying the off-balance, not comparing the new relativities (either raw, rebased, or relative to the weighted average) against the old relativities using the same basis.
- Inverting the off-balance factor.

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 8	
TOTAL POINT VALUE: 1.75	**LEARNING OBJECTIVE: A8**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1

Number of occupants would be an appropriate addition to the rating classification plan.

There's a clear upward trend in the indicated relativity with the increasing number of occupants clearly showing in the 1st graph and the CI is very small for # occupants 1-2 & 3-4 which has a clear different indicated relativity. Even though the CI for >8 is quite wide, it's due to lack of data.

In the second graph, the indicated relativity is very consistent through 2013-2016, which means the number of occupants is a good rating variable. The >8 variable is not consistent again due to lack of data.

Overall the chi-squared percentage is small enough.

Sample 2

I believe it would, but I would combine the 5-8 and 8+ groups into one as they are both quite small and the 8+ group is very volatile (not credible). However, there is a clear relationship in the data and a logical relationship that more people in the home means greater potential for fire or accidents.

Sample 3

Number of occupants should be a new rating variable.

Statistical significance: the expected loss increases as the number of occupants increases except for class >8: the results are statistically significant with acceptable confidence – the indicated relativity is within 2 std error lines.

The expected loss cost by class is fairly consistent over the years with 2013 year has a slightly different pattern. This is due to low volume of data in class >8. The fix is to group class 5-8 and >8 together.

Objective: the variable is objective and well-defined. It will be easy to administer.

Legal: this variable should comply with law and regulations review needed upon implementation

Part b: 1 point

Sample 1

A tightly regulated department of insurance might disallow the use of multivariate methods and impose restrictions on the local insurance environment.

When entering a brand new type of insurance market, often data is too limited to be able to accurately implement a multivariate method and other approaches are preferred.

Sample 2

Regulation – If a prescribed method is enforced by law which is not a multivariate method then it must be used.

Operational constraints – If the insurer does not have the Systems/computing power to make use of multivariate methods and the cost/benefit does not favor upgrading systems then multivariate methods would be discouraged

Sample 3

Some regulatory bodies do not allow multivariate methods for pricing. One example is California Private Passenger Auto where the process uses simple factor selection combined with the adjusted pure premium method.

Large commercial policies, such as large deductible or retro rated policies. The multivariate methods would likely have difficulty due to the volume of data and unique characteristics of each policy.

Sample 4

If an insurer is a monopolistic or otherwise competitive limited environment, there will be little competitive pressure to go through the costly hassle of multivariate ratemaking

An insurer may operate in a territory or LOB where regulators deem the multivariate ratemaking is inequitable, and may require the insurer to use community rating.

EXAMINER'S REPORT

Candidates were expected to interpret the graphs displayed, to determine whether number of occupants should be added to the insurers' rating plan for the fire coverage. Candidates were also expected to identify and explain two environments where use of multivariate methods would be discouraged.

Part a

Candidates were expected to interpret the sample GLM output to determine that the variable was statistically significant because it 1) had an increasing trend with fairly narrow standard errors, 2) was relatively consistent over time, and 3) had a chi-square statistic below the 5% threshold for determining if a variable should be used in a model.

Common errors included:

- Describing the variable simply as "statistically significant" without providing rationale and interpretation of the results.
- Recommending to implement the variable only based on narrow standard errors and not mentioning the slope of the indicated relativities.
- Recommending not to implement the variable solely due to the volatility of the >8 category.
- Not providing a recommendation on if the variable should be implemented.

Part b

Candidates were expected to identify and briefly explain two environments where multivariate methods were discouraged.

Candidates did not receive full credit for describing regulatory challenges due to inability to implement the insurer's desired rating variables. Regulatory limitations in allowable rating variables is not solely a reason to discourage use of multivariate methods.

Candidates did not receive credit for mentioning an environment where it's known the variables have no correlation. Multivariate methods analyze factors to account for possible correlation between variables, even if the correlation is not intuitive.

Common errors included:

- Listing only one environment/explanation.
- Providing two environments that were nearly identical and not distinct from one another.
- Stating that insurers should forgo multivariate methods due to regulatory limitations in allowable rating variables.
- Stating that multivariate methods would be discouraged solely due to non-intuitive results for a factor in the model.

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 9	
TOTAL POINT VALUE: 2.75	**LEARNING OBJECTIVE(S): A8**
SAMPLE ANSWERS	
Part a: 1.5 points	
Step 1 Pure Premiums at B Exposure B PP = 2100/6 = 3.5 A adjusted PP = (4*300 + 7*300) / 600 = 5.5 C adjusted PP = (3*300) + 6*300) / 600 = 4.5 Step 2 Adjustment factors A adjustment factor = 3.5/5.5 = .636 C adjustment factor = 3.5/4.5 = .778 Step 3 Adjusted Class 2 Adjusted A Class 2 = .636 * 7 = 4.45 Adjusted C Class 2 = .778 * 6 = 4.67 Step 4 Complement of Credibility Weighted Average A and C = (300 * 4.45 + 750 * 4.67) / 1050 = 4.6 Step 5 Credibility for B Class 2 Credibility = min(SQRT(300/1500),1) = .447 Step 6 Total Credibility Weighted Credibility weighted PP B Class 2 = .447*5 + 4.61*(1-.447) = 4.78	
Part b: 0.5 point	
Sample 1 This method is appropriate as it removes some distributional bias and since exposure volume is low for B2. *Sample 2* It is a good way to adjust for the different exposure distribution in state B for the classes relative to other states.	
Part c: 0.75 point	
Any 3 of the following: • It produces accurate estimates (close to the true value) • Unbiased – on average estimates are same as true value • Statically independent between complement & subject • Available – yes, the data is available • Easy to compute - It is NOT easy to compute, though doable, requires detail data; OR the method is relatively simple to use • Logical relationship to values being credibility weighted (using the same state's experience for other class adjusted for bias should be logical)	
EXAMINER'S REPORT	

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

Candidates were expected to calculate a credibility-weighted pure premium using given inputs and Harwayne's method. Using the results of this analysis, candidates were expected to assess the appropriateness of this approach on the specific company data and also evaluate the method using three desirable qualities of a credibility complement.

Part a

Candidates were expected to calculate a credibility weighted pure premium for class 2, state B using Harwayne's method.

Common errors included:

- Not using Harwayne's method, as the question specifically instructed that Harwayne's method should be used.
- Not calculating the average pure premium for states A and C.
- Not calculating the adjustment factors correctly.
- Not adjusting the class 2 pure premiums in states A and C to state B level correctly.
- Not calculating the complement of credibility correctly.
- Stopping after calculating the complement of credibility without calculating the credibility weighted pure premium.
- Not calculating the credibility of the experience correctly.
- Not using the correct pure premium in the calculation of the credibility weighted pure premium.
- Applying credibility to the complement of credibility rather than applying (1 – credibility).

Part b

Candidates were expected to evaluate the appropriateness of using Harwayne's method for this company given the data listed in part a. Harwayne's method is appropriate in this case because it adjusts for distributional bias.

Common errors included:

- Just commenting on credibility or the appropriateness of using a complement of credibility with no mention of the specific method; the question specifically asked for the appropriateness of Harwayne's method.
- Stating Harwayne's method was not appropriate because of low volume in all 3 states. Harwayne's method addresses distributional bias in the overall experience and can be used in low volume situations.

Part c

Candidates were expected to provide an evaluation of Harwayne's method using three desirable qualities of a complement of credibility. This part of the question was not specific to the data provided that was used in parts a. and b.

Common errors included:

- Providing a list of desirable qualities of a complement of credibility with no explanation of how they apply to Harwayne's method.

QUESTION 10

TOTAL POINT VALUE: 3.5 | **LEARNING OBJECTIVE(S): A7, A9**

SAMPLE ANSWERS

Part a: 1.5 points

Sample 1

Total Premium = (150)(.85)(435) + 150(55) + (200)(1)(435) + 200(55) + (100)(1.35)(435) + 100(55) = 225,937.5

Total Losses = 300(150) + 350(200) + 500(100) = 165,000

1 =((165,000/225,937.5)(1.16) + 50(450/225,937.5)) /(1 - .17 – Profit)

Profit = 11.67%

Sample 2

Terr	Prem/Exp	Total Prem	Ult Loss Cost	LAE	Ult Loss Cost + LAE	Total L + LAE
A	435 * .85 + 55	63,713	300	1.16	348	52,200
B	435 * 1 + 55	98,000	350	1.16	406	81,200
C	435 * 1.35 + 55	64,225	500	1.16	580	58,000
	502.08	225,938				191,400

Prem = Loss + LAE + Fixed Exp + Var Exp + Profit

Profit = Prem – Loss – LAE – Fixed Exp – Var Exp

Profit = 225,938 – 191,400 – 50(150 + 200 + 100) – 0.17(225,938) = -26,371.46

Part b: 1.5 points

Sample 1

- Indicated territory factors

Territory	Ult Loss Cost	Indicated Factors
A	300	300/350 = 0.857
B	350	1
C	500	500/350=1.429

- Indicated policy fee = fixed expense/(1-V-Q) = 50/(1-17%-3%) = 62.5
- Indicated base rate
  Assume the indicated base rate = B. Then,
  (150 X 0.857 + 200 x 1 + 100 x 1.429) x B x (1-V-Q) = 191,400
  ⇨ 239,250 = 471.45B => B = 507.5

Sample 2

Average Territory Factor = (150 x 0.857 + 200 + 100 x 1.429)/(150 + 200 + 100) = 1.0477

Average Loss Cost = (150 x 300 + 200 x 350 + 100 x 500)/450 = 366.66

Ind Rate = (366.66 + 50)/(1 – 17% - 3%) = 594.17

Ind Base Rate = (594.17 – 62.50) x (1/1.0477) = 507.48

Sample 3

Indic Pol Fee = 50/(1-.17-.03) = 62.5

Terr	Factors (Keep B as base)
A	300/350 = .857
B	1.000
C	1.429

Base Rate = 350(1.16)/(1-.17-.03) = 507.5

Part c: 0.5 point

Sample 1

Over time, this will lead to adverse selection as Terr C is underpriced and should have its relativity increased. In the short term, this approach will not have a large impact and would make for a simpler regulatory rate filing.

Sample 2

Assuming no shift in the mix of business, this will bring the company to the correct rate level. However, this analysis shows that the relativity is too low for territory C. This means that even after increasing the base rate, rates for territory C will be too low to cover their loss cost in that territory. This means part of C's loss cost will be subsidized by territories A and B. If other insurers price more accurately for C, this insurer will get more territory C customers and less customers from A and B due to adverse selection. This would lead to the insurer becoming unprofitable.

Sample 3

I would advise against this as by changing the policy fee and relativities prices will be more equitable and better aligned with expected loss per policy.

EXAMINER'S REPORT

Candidates were expected to understand the pure premium method and how to include different loss, expense and premium amounts. They needed to understand how to calculate premiums with a fixed expense fee.

Part a

Candidates were expected to use the pure premium formula to calculate the profit realized.

Common errors included:

- Forgetting to include expenses in the calculation.
- Forgetting to apply the variable expense ratio to premium including fixed expenses premium.
- Forgetting to apply LAE to the losses.
- Getting the fixed expense and policy fee mixed up in the calculation; or adding both as premium; or subtracting both as expenses.

Part b

Candidates were expected to know how to calculate territorial relativities, an indicated policy fee, and an indicated base rate.

Common errors included:

- Using the $55 current expense fee instead of the $50 fixed expense amount when calculating the indicated policy fee.
- Dividing the per exposure loss amount by exposures to create an incorrect pure premium amount when calculating the territorial relativities.
- Calculating an indicated total rate instead of an indicated base rate.
- Using the average loss cost instead of the base loss cost.

Part c

Candidates were expected to understand the implications of taking a simple base rate change instead of a more comprehensive rate change that results in more appropriate rates by territory.

Common errors included:

- Only providing one reason in the explanation.
- Providing a reason without any discussion, such as "agree with Management".
- Not understanding which territories are underpriced versus overpriced, such as providing a discussion that suggests that territory C was overpriced.

QUESTION 11

TOTAL POINT VALUE: 2.5 | **LEARNING OBJECTIVE(S): A10**

SAMPLE ANSWERS

Part a: 1 point

Sample Response for i. 1,000,000 AOI

Rate per \$1000 = $\frac{1\% \times 500{,}000}{1{,}000{,}000/1000}$ = \$5.00

Sample Response for ii. 600,000 AOI

Severity = 100,000 x 20% + 300,000 x 20% + 500,000 x 20% + 600,000 x 40% = 420,000

Rate per \$1000 = $\frac{1\% \times 420{,}000}{600{,}000/1000}$ = \$7.00

Part b: 0.5 point

Sample Responses for i. Insured

- Insured will not be fully covered for a total loss or near total loss
- Insured will suffer coinsurance penalties for losses below the coinsurance requirement (i.e. not fully reimbursed for loss)

Sample Responses for ii. Insurer

- If the insurer assumes all policies are insured to value, then rates will be inadequate for those underinsured policies
- If the insurer doesn't recognize the underinsurance of some homes, it will charge them an inappropriate rate which will be too low to cover expected losses

Part c: 1 point

Sample Response for i. 600,000

a = min(1, 700,000/(1,000,000 x 80%)) = 0.875

Indemnity = min(700,000, 600,000 x .875) = 525,000

Penalty = 600,000 – 525,000 = 75,000

Sample Responses for ii. 850,000

Indemnity = min(700,000, 850,000 x .875) = 700,000

Penalty = 700,000 – 700,000 = 0

OR

When loss > coinsurance requirement, there is no coinsurance penalty and the indemnity payment will be 700,000

EXAMINER'S REPORT

Candidates were expected to illustrate knowledge of coinsurance calculations and their implications.

Part a

Candidates were expected to calculate rates both with full insurance to value and with underinsurance. That process included capping severities in the upper layers of the expected loss distribution as well as calculating a pure premium and subsequent rate.

Common errors included:

- Not recognizing the need for capping in the loss distribution.

- Ignoring the frequency component of the calculation.
- Using the wrong limit in the denominator of the rate calculation (usually using $1 million in the denominator for both limits).
- Performing calculations for just one of the limits provided.
- Using incorrect values in calculated the expected loss including using percentage weights that did not sum to 1.0 (ex. 20% x 100 + 20% x 300 + 20% x 500 = 180).

Part b

Candidates were expected to identify a shortcoming of underinsurance from both the perspective of the insured and the insurer.

Common errors included:

- Assuming those who are fully insured are paying a rate that subsidizes the underinsured when, in reality, the rate charged to the fully insured policyholder is just adequate and not excessive.
- Identifying regulator actions after a catastrophe as a possible disadvantage to the insurer. As this is an issue that would likely cause payments higher than purchased limits on both those underinsured and those insured to value (due to increased cost of construction, for example), the candidates did not identify a problem specific to underinsurance.
- Using "rates are inequitable or inappropriate" as an issue for the insurer. There is a broad array of issues that cause rates to be inequitable – candidates need to demonstrate that they understand the mechanics of what is happening specific to underinsurance. This simple statement does not demonstrate which rate is equitable and which is not (between the fully insured and underinsured). This answer could reasonably be interpreted as stating that both groups of insureds are being charged the wrong rate but actually those insured to value are being charged the correct rate.

Part c

Candidates were expected to calculate indemnity payments and coinsurance penalties for an underinsured policy given two loss scenarios.

Common errors included:

- Errors in calculating the coinsurance requirement or apportionment ratio.
- Performing calculations for just one of the losses provided.
- Not recognizing the need to cap the indemnity payment at the policy limit of $700,000 for the second loss amount.
- Calculating only indemnity payments or only penalties but not both.
- Using incorrect values (especially the loss amount or amount of insurance) in the calculation of indemnity payments or penalties.

QUESTION 12

TOTAL POINT VALUE: 1.25 | **LEARNING OBJECTIVE(S): A11**

SAMPLE ANSWERS

Part a: 1 point

Sample 1

Mod = Z* (AER – EER)/EER

Expected Development of Loss = 225,000*0.875*0.425 = 83,672
AER = (175,000+83,672)/225,000 = 1.15
Mod = (0.35*(1.15-0.875))/0.875 = 0.11

Sample 2

EER = 0.875
%unreported = 0.425
Expected Dev = CSBL*EER*unreported
=225,000*0.875*0.425
= 83,671.875

AER = (175,000 + 83,671.875) / 225,000 = 1.150
Mod factor = z*((AER-EER)/EER) + 1
= 1.11

Part b: 0.25 point

Sample 1

If there is a new safety program to be implemented by the insured, there was no performance that would be displayed by this plan in the experience rating method. The actuary would judgmentally select a schedule rating in addition to the experience plan.

Sample 2

In a situation where certain rating characteristics are not in the experience (so not captured by experience rating) but are expected to exist in the future policy period being rated.

Sample 3

If a company just introduced a new loss control method. This needs to be accounted for in the schedule rating as well as using experience rating. After the loss control method has been implemented for a few years, it will only be in the experience rating because then it would be fully recognized in the loss experience.

Sample 4

In the case of a small company where experience results alone are not fully credible, schedule rating can be incorporated.

EXAMINER'S REPORT

Candidates were expected to calculate the experience rating modification factor. Therefore, candidates had to calculate the expected unreported losses and ALAE, the projected ultimate losses and ALAE (reported plus unreported), the actual experience ratio, and the experience

modification factor. Additionally, candidates needed to understand the proper application of schedule rating avoiding possible overlap with experience rating.

Part a

Candidates were expected to calculate the expected unreported losses and ALAE, the projected ultimate losses and ALAE (reported plus unreported), the actual experience ratio, and the experience modification factor.

Common errors included:

- Calculating expected unreported losses.
- Not applying the expected experience ratio for the expected unreported loss calculation.
- Not using the unreported percentage or using it solely as a development factor.
- Applying the factors to reported losses rather than basic limit loss.
- Applying credibility improperly (only to the actual experience ratio).

Part b

Candidates were expected to understand that schedule rating is for individual risk characteristics that are expected to have a material impact on the future loss experience but are not adequately reflected in the prior loss experience (or experience rating plan).

Common errors included:

- Providing a reason for schedule rating that had already been contemplated in the insured's experience. For example, stating "safety program" was not sufficient; while a new safety program would be incorporated through schedule rating, an insured with a safety program that had been in place for many years would have the safety program addressed through experience rating.

QUESTION 13

TOTAL POINT VALUE: 5.5 | **LEARNING OBJECTIVE(S): A2, A3, A5, A6, B3**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1

LDF's based on capped losses to avoid instability from large claims.

AY	12-24	24-36	36-Ult
2014	1.297	1.112	1.00
2015	1.303		
Avg	1.3	1.112	1.0
selected	1.3	1.112	1.0

ult loss+ALAE for AY 15 = 2572 x 1.112 x 1.0 = 2860
ult loss+ALAE for AY 16 = 2145 x 1.3 x 1.112 x 1 = 3101

Sample 2

Loss capped $100K LDFs

AY	12-24	24-36
2014	1.297	1.112
2015	1.302	
select avg	1.299	1.112
	1.445	1.112

AY	Trends	CDF	Ultimate (Develop) Loss	Ultimate Trended
2015	[(1.04)(0.98)]^3	1.112	2860	3028
2016	[(1.04)(0.98)]^2	1.445	3100	3220

Part b: 4.5 points

Sample 1

AY	capped loss = unlimited - excess	XS loss	XS/capped loss
09	3538 - 718 = 2820	718	
10	3063	130	
11	1756	234	
12	2631	1949	
13	2249	120	
Total	12519	3151	0.252

XS loss factor = 1.252 ← apply to capped loss to bring to uncapped level.

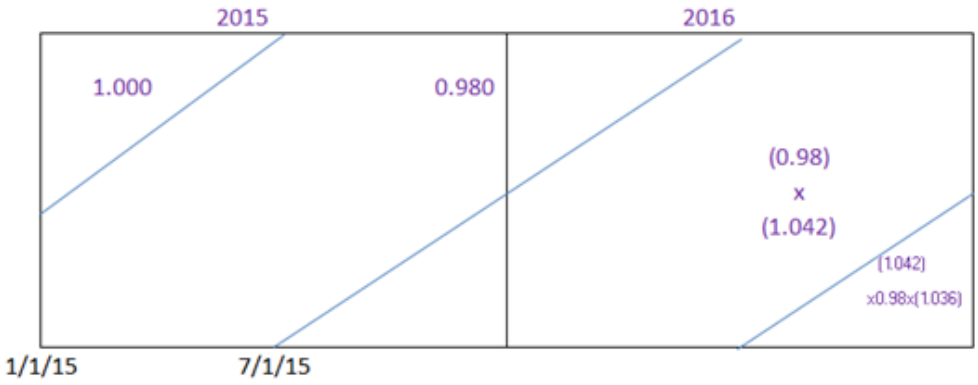
Trend periods for loss: average accident date of exp period = 7/1/XX

" future " = 7/1/18

Trend periods for prem: average accident date of exp period = 7/1/XX

" future " = 7/1/18

On-leveling:



CRL = (0.98) x (1.042) x (1.036) = 1.058

Avg Rate level for CY15 = 0.125x(1.0) + 0.125x(0.98)x(1.042) +0.75x0.98

= 0.987645

On-level factor = 1.058 / 0.987645 = 1.071

Avg RL for CY16 = 0.125x0.98 + 0.125xCRL + 0.75x1.042x0.98

= 1.0206

OLF CY 16 = 1.037

CY	(1) EP	(2) on level factor	(3) trend factor	(4) = (1) x (2) x (3) on level trended prem
15	3910	1.071	(1.028)^3	4549

16	4410	1.037	(1.028)^2	4833

CY	(5) capped loss ult	(6) trend factor	(7) XS loss factor	(8) ULAE factor
15	2860	[(0.98)(1.04)]^3	1.252	1.06
16	3101	[(0.98)(1.04)]^2	1.252	1.06

CY	(9) = (5)(6)(7)(8) ult trended loss	(10) = (9)/(4) loss ratio
15	4018	88.3%
16	4275	88.6%

Total LR (weighted all year) = 88.4%

indicated rate change

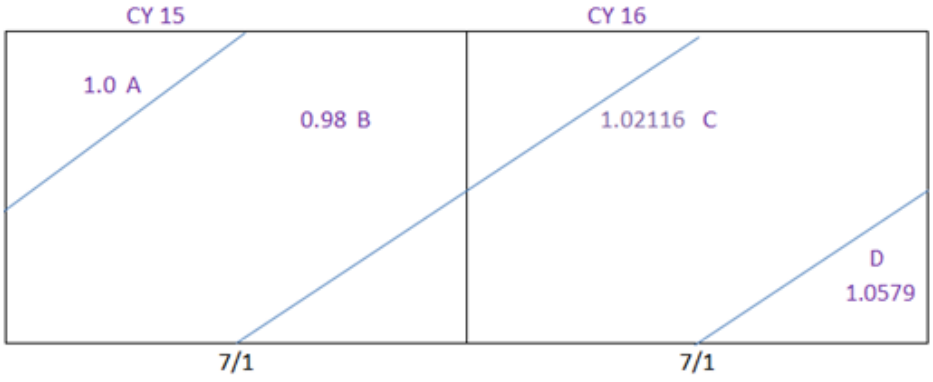
$$= \frac{0.884 + .04}{1 - 0.06 - 0.22} - 1 = 28.3\%$$

Sample 2

AY	Trends	CDF	Ultimate (Develop) Loss	Ultimate Trended
2015	[(1.04)(0.98)]^3	1.112	2860	3028
2016	[(1.04)(0.98)]^2	1.445	3100	3220

Rate eff 7/1/17 – 7/1/18

Avg Written Dt 1/1/18 Avg Earned/Accident 7/1/18



CY	A	B	C	D	Avg RL	OLF
15	0.125	0.75	0.125	0	0.9876	1.0712
16	0	0.125	0.75	0.125	1.0206	1.0365

CY	OLF	Prem Trend	Trended OLEP	capped loss ratio
15	1.0712	(1.028)^3	4550	0.665
16	1.0365	(1.028)^2	4831	0.667
			stable, select avg	66.6%

XS loss load:

$$\text{XS ratio} = \frac{\text{XS loss}}{\text{non XS loss}} = \frac{\text{XS loss}}{\text{(unlim - XS)}}$$

AY	XS loss ratio
09	0.255
10	0.042
11	0.133
12	0.741
13	0.053
select avg	24.5%

Loss Ratio Method

$$\text{Indic rate chg} = \frac{0.666(1.06)(1.245) + .04}{1 - 0.22 - .06} - 1 = 27.6\%$$

Part c: .25 point

Sample 1
Insurer may not decide to take full rate to be competitive in market.

Sample 2
This rate change is quite high compared to industry usual rate filings. Insurer may want to continue growing and cap rate changes to maintain/grow market share.

Sample 3
Regulators may not allow rate change.

Sample 4
Insurer may not have computer system resources to implement rate change.

EXAMINER'S REPORT

Candidates were expected to calculate ultimate losses given a loss development triangle, and use these losses (along with other information) to calculate an overall rate change indication. Lastly,

candidates were expected to explain one reason an insurer might not take the full rate change indication.

Part a

Candidates were expected to calculate ultimate losses, given a loss development triangle. Candidates were expected to calculate age-to-age loss development factors, cumulative development factors, and apply these factors to the correct losses.

Common errors included:

- Applying the correct CDFs to the incorrect losses.
- Applying the incorrect LDFs or only the latest year LDF to the losses instead of CDFs.
- Applying the excess loss provision to losses, as it was specifically stated in the question to cap losses at $100,000.

Part b

Candidates were expected to calculate the rate change indication with the given loss, premium, and expense information provided. The question included several pieces, including current rate leveling, trending, application of excess loss, and the inclusion of each piece in the final indication formula.

Common errors included:

- Using an incorrect trend period.
- Failing to apply trend factors.
- Missing a rate change in the calculation of the average rate level, or failing to calculate the correct areas associated with each rate change.
- Using a non-excess/unlimited loss ratio in the indication; as non-excess losses were provided, the ratio needed was a ratio of excess to non-excess losses.
- Failing to incorporate excess losses in the indication.
- Applying fixed expenses to the denominator (vs. the numerator).
- Not calculating a final indication amount.
- Failing to subtract '1' from the indication formula at the very end.

Part c

Candidates were expected to briefly describe one reason the insurer might not take the full rate change determined in part b.

Common errors included:

- Stating that the excess loss provision was volatile so the full indication shouldn't be taken.
- Stating that only 2 years were used so the indication is not credible enough. The question provided an assumption of full credibility.

QUESTION 14	
TOTAL POINT VALUE: 1.75	**LEARNING OBJECTIVE(S): B1**

SAMPLE ANSWERS

Sample 1

RY	12-24	24-36
2014	180/120=1.5	240/180=1.33
2015	210/140=1.5	
Selected LDF	1.5	1.33
ATU	2.0	1.33

Ultimate	
2014	240
2015	210*1.33=280
2016	86*2=172
Sum	692

AY	12-24	24-36	
2014	200/120=1.667	276/200=1.38	
2015	200/120=1.667		
Selected LDF	1.667	1.38	
ATU	2.44	1.46	1.06

Ultimate	
2014	276*1.06=292.56
2015	200*1.46=292
2016	60*2.44=146
Sum	731

IBNYR=IBNR-IBNER=731-692=39

Sample 2

AY LDFs

	12-24	24-36
2014	1.67	1.38
2015	200/120=1.67	
Sel	1.67	1.38

A	Ult Claims
2014	1.06*276=292.56
2015	1.06*1.38*200=292.56
2016	1.06*1.38*1.67*60=146.57

Total IBNR=IBNYR+IBNER=731.69-(276+200+60)=195.69

Projected counts:

AY	12 - 24	24 - 36
2014	1.167	1.04=(10+60+3)/(60+10)
2015	1.167	
Selected ATA	1.167	1.04

AY	Ult CC
2014	73
2015	(60+10)*1.04=72.8->73
2016	60*1.04*1.167=73

Unreported counts=73*3-(73+70+60)=16

AY	Avg severity
2014	292.56/73=4.007
2015	4.007
2016	1.99

Select 4.007 because 2016 is too green.

Ultimate on claims not yet reported = 16*4.007=64.11
So of the 195.69 indicated IBNR, 64.11 is purely for not yet reported. The rest is for development on known.

EXAMINER'S REPORT

Candidates were expected to construct the accident year and report year triangles, select loss development factors, calculate cumulative development factors, and calculate the ultimate loss for both accident years and report years. Additionally, candidates were expected to know the relationship between IBNR, IBNER, and IBNYR.

Some candidates calculated the IBNYR by using a frequency-severity method. With this method, candidates were expected to calculate the correct pure IBNR count and select a reasonable ultimate severity with which to calculate total IBNYR.

Common errors included:

- Calculating IBNR or IBNER rather than IBNYR.
- Not including the given tail factor in calculating the accident year CDFs.
- Including a tail factor in calculating the report year CDFs.
- Not developing the severity to ultimate.

QUESTION 15	
TOTAL POINT VALUE: 2.25	**LEARNING OBJECTIVE(S): B2**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1:

Paid to Rpt Claim Ratio

AY	12	24	36
2014	22%	31%	38%
2015	26%	36%	
2016	33%		

- It is possible that settlement rates are increasing as the triangle is increasing down the columns.
- It is possible that case reserve adequacy is decreasing as the ratios in the triangle are increasing down the columns.

Sample 2:

Paid to Rpt Claim Ratio

AY	12	24	36
2014	22%	31%	38%
2015	26%	36%	
2016	33%		

- There could be a speed-up in settlement rates as paid is a higher percentage of reported than it has been historically in most recent diagonal.
- There may be a deterioration of reserve adequacy or change in reserving philosophy as paid to reported ratio has been increasing down each column.

Part b: 1.5 points

Sample 1:

Closed to Rpt Claim Count Ratio

AY	12	24	36
2014	49%	74%	89%
2015	52%	75%	
2016	58%		

Average Case Outstanding Triangle

AY	12	24	36
2014	77	177	417
2015	77	172	
2016	76		

- The closed to reported claim count triangle is increasing down the columns. So, it seems a speedup in settlement has occurred.
- There may have been a slight deterioration in case reserve adequacy in calendar year 2016 since the last diagonal is lower than the previous diagonals.

Sample Answer 2:

Closed to Rpt Claim Count Ratio

AY	12	24	36
2014	49%	74%	89%
2015	52%	75%	
2016	58%		

Average Case Outstanding Triangle

AY	12	24	36
2014	77	177	417
2015	77	172	
2016	76		

- The closed to reported counts triangle would indicate a speedup in settlement rates.
- The average case triangle indicates no change to reserve adequacy. The small decrease in most recent diagonal could just be randomness.

EXAMINER'S REPORT

Candidates were expected to calculate three different diagnostic triangles and draw inferences based on those diagnostic tests.

Part a

Candidates were expected to compute a paid to reported claim ratio triangle and draw correct inferences on possible changes in settlement rates or case reserve adequacy.

Common errors included:

- Interpreting the diagnostic triangle by going "across the rows" instead of "down the columns".
- Stating that no inferences could be drawn from the diagnostic tests.

Part b

Candidates were expected to compute a closed to reported claim count ratio triangle and an average case outstanding triangle. Candidates were expected to draw an inference on settlement rate changes from the closed to reported claim count ratio triangle and an inference on case reserve adequacy from the average case outstanding triangle.

Common errors included:

- Interpreting the diagnostic triangle by going "across the rows" instead of "down the columns".
- Stating that no inferences could be drawn from the diagnostic tests.
- Calculating average reported claims rather than average case outstanding.

QUESTION 16

TOTAL POINT VALUE: 2.75 | **LEARNING OBJECTIVE: B3**

SAMPLE ANSWERS

Part a: 2.25 points

Sample 1

AY	2016 On-level Premium (000)	Trended Claim counts	Frequency
2012	186,162.5	1,025 x 0.98^4 = 946	0.00508
2013	357,825	3,070 x 0.98^3 = 2890	0.00808
2014	353,902.5	2,950 x 0.98^2 = 2833	0.00801
2015	378,866.25		

Assuming 2012 as outlier, the frequency I chose is 0.008

Adjust frequency to 2015 level = $\frac{0.008 \times 1.05}{0.98} = 0.00857$

Ult AY 2015 = 13,370 x 1.05^-1 x 0.00857 x 360,825 = 39,374,908

IBNR for AY 2015 = 39,374,908 – 30,880,900 = 8,494,008

Sample 2

First adjust severity to 2015 level

AY 15 Ult severity = $\frac{13,370}{1.05} = 12,733.33$

AY	(1) Ult Claim Count	(2) OLEP = EP x OLF / 1.05 (000) (put on 2015 levels)
'12	1025	177,298
'13	3070	340,786
'14	2950	337,050

AY	(3) = (1) / (2) Untrended Freq	(4) Trend to 7/1/15	(5) = (3) x (4) Trended Freq
'12	.0058	.98^3	.0054
'13	.0090	.98^2	.0087
'14	.0088	.98	.0086
Select 2 yr straight avg (AY 12 appears to be anomaly)			.0086

AY 2015 Ult = .0086 x 360,825 x 12,733.33 = 39,512,733

IBNR = AY 15 Ult – AY 15 Rept = 39,512,733 – 30,880,900 = 8,698,948

Part b: 0.5 point

Sample Responses for "useful" situations

- Useful when there is an inflation trend impacting claims since they are simple to include.
- Frequency-severity techniques can incorporate frequency and severity trend in the estimation.
- They are useful when there is a change in case reserve adequacy, the paid F-S method is not impacted by changes in case reserve adequacy.

- Useful for longer tail lines of business where earlier development can be highly leveraged.
- These techniques are useful when frequency & severity are changing at different rates because the two pieces can be broken apart & analyzed separately.

Sample Responses for "not useful" situations

- Not useful when claim count definition is not consistent over the years.
- FS technique is not useful when there are significant partial payments, i.e. claims are not closed when they are paid.
- They are not useful when claims frequently reopen since there isn't a consistent claim count.
- It is not useful if there has been a change to the exposure base or if it is difficult to know what counts as 1 exposure.
- Not useful when attempting to use disposal rate technique when settlement rates are changing
- If the mix of business has recently changed & each segment has different frequency/severity trends.
- Not useful when we don't have enough data to calculate accurate trends since this method is sensitive to trend selections.

EXAMINER'S REPORT

Candidates were expected to estimate IBNR using a frequency-severity method and provide comments regarding the usefulness of frequency-severity methods, in general.

Part a

Candidates were expected to know how to calculate claim frequency, adjust frequency for claim count trend and book of business growth (after using on-level premium factors), adjust severity for severity trend, and finally estimate IBNR using a frequency-severity method.

Common errors included:

- Failing to calculate on-level earned premium or trended claim count.
- Trending on-level earned premium and claim count to different periods, causing a mismatch in the frequency calculation.
- Failing to calculate frequency.
- Selecting a claim count from the untrended historical experience instead of a frequency, not considering the growth in the book of business.
- Failing to or incorrectly detrending the selected frequency at the 2016 level to 2015.
- Failing to detrend the given accident year 2016 severity to accident year 2015.

Part b

Candidates were expected to describe situations that indicate the usefulness of frequency-severity methods (i.e. one useful situation and one not useful situation).

Common errors included stating that frequency-severity methods are:

- Useful when the claim count definition is consistent (or other method assumptions). When method assumptions are found to be true, it means that the actuary can reasonably perform the method. It does not provide any insight into the method's usefulness.

- Useful for long-tailed lines of business. This is not descriptive enough and does not adequately show that the candidate understands the usefulness of the method. Candidates were expected to demonstrate an understanding that the CDFs at early maturities are highly leveraged when using the development method on long tail lines of business, whereas this issue may not occur in frequency-severity methods.
- Generic comments above improving the actuary's insight into the claims process without any details about claim reporting, settlement rates or average claim values.
- Useful when incorporating trend. This is not descriptive enough and does not adequately show that the candidate understands the method. Frequency-severity methods are useful to incorporate inflation trend or separate frequency and severity trends.

QUESTION 17	
TOTAL POINT VALUE: 2	**LEARNING OBJECTIVE(S): B3**

SAMPLE ANSWERS

Sample 1

cumulative rptd cnts

	12:24	24:36	36:ult
2014	1.1875	1.0526	
2015	1.1647		
Straight Avg	1.1761	1.0526	1.0000

rptd clms brought to current

	12	24	36	
2014	51450	65850	75000	75000 = 100000x0.75
2015	54600	68625		
2016	55900			

severity = adj claims / rptd cnts

	12	24	36
2014	643.13	693.16	750.00
2015	642.35	693.18	
2016	642.53		

severity dev

	12:24	24:36	36:ult
2014	1.078	1.082	
2015	1.079		
Straight Avg	1.078	1.082	1.000

Ult Cnts = 87 x 1.1761 x 1.0526 = 107.7
Ult Sev = 642.53 x 1.078 x 1.082 = 749.8
Ult Claims = 107.7 x 749.8 = 80753

Sample 2

cumulative rptd cnts

	12:24	24:36	36:ult
2014	1.1875	1.0526	
2015	1.1647		
Straight Avg	1.1761	1.0526	1.0000

severity = rptd claims / rptd cnts

12	24	36

2014	857.50	924.21	1000.00
2015	856.47	924.24	
2016	642.53		

severity dev

	12:24	24:36	36:ult
2014	1.078	1.082	
2015	1.079		
Straight Avg	1.078	1.082	1.000

Ult Cnts = 87 x 1.1761 x 1.0526 = 107.7
Ult Sev = 642.53 x 1.078 x 1.082 = 749.8
Ult Claims = 107.7 x 749.8 = 80753

Sample 3

We assume no impact to reporting patterns

Rpt Ct LDFs

AY	12-24	24-36
2014	1.188	1.053
2015	1.165	
Avg	1.176	1.053
Age to Ult	1.238	1.053

AY 2016 Ult Counts = 1.238 x 87 = 107.7

Inc Rpt

AY	12	24	36
2014	68600	19200	12200
2015	72800	18700	

Inc Rpt

AY	12	24	36
2014	80	15	5
2015	85	14	

Inc Sev

AY	12	24	36
2014	857.5	1280.0	2440.0
2015	856.5	1335.7	

No loss trend
Restate Inc Sev @ 75%

	12	24	36
2014	643	960	1830
2015	642	1002	
Avg	643	981	1830

AY 2016 12-24 Cnts = 87 x 0.176 = 15.3
AY 2016 24-36 Cnts = (87 +15.3) x 0.053 = 5.4
Ult Claims = 55900 + 15.3 x 981 + 5.4 x 1830 = 80790

EXAMINER'S REPORT

Candidates were expected to perform a frequency-severity method, separately developing claim counts and severity to ultimate to determine the ultimate loss, or performing the incremental method.

Common errors included:

- Mistreatment of the 25% reduction in claim severity, including:
  - Assuming the adjustment was based on report date.
  - Applying the adjustment to the latest accident year.
  - Dividing by 1.25 rather than multiplying by .75.
- Averaging ultimate counts by year for an ultimate count selection.
- Calculating ultimate reported claims using a loss development method, and then using this result to calculate ultimate severity based on developed counts.
- Attempting an incremental method but not using incremental severities in the calculation.

QUESTION 18

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE: B3**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1

AY 2016 Ult = .75*7500 = 5625
Unpaid = 5625-2775 = 2850
IBNR = 5625-4100 = 1525

Sample 2

IBNR = .75*7500-4100 = 1525
Unpaid = .75*7500-2775 = 2850

Part b: 1.25 points

Sample 1

Ultimate = 4100 + (.75)*(7500)*(1-1/1.458) = 5867
Unpaid = 3092
IBNR = 1766.97

	12-24	24-36	36-48
Select LDFs	1.335	1.07	1.021
CDF	1.458	1.0925	1.021

Sample 2

	12-24	24-36	36-Ult
ATA	1.328	1.0705	1.021
ATU	1.451	1.093	1.021
% reported	0.689	0.915	0.979

IBNR = 7500*0.75*(1-0.689) = 1749
Unpaid = 1749 + 4100 – 2775 = 3074

EXAMINER'S REPORT

Candidates were expected to understand difference between IBNR and total unpaid claims, and how to calculate these values given various claims development techniques.

Part a

Candidates were expected to understand and apply mechanics of the expected claims technique to calculate IBNR and total unpaid claims.

Common errors included:

- Calculating either IBNR or total unpaid claims but not both.
- Calculating an expected claims ratio based upon experience rather than utilizing the 75% provided in the question.

Part b

Candidates were expected to understand and apply mechanics of the Bornhuetter-Ferguson technique to calculate IBNR and total unpaid claims. Candidates were expected to make

reasonable age-to-age factor selections and calculate age-to-ultimate cumulative development factors.

Common errors included:

- Calculating either IBNR or total unpaid claims but not both.
- Using the 12-24 age-to-age factor instead of the 12-Ultimate cumulative development factor to determine percent unreported.

QUESTION 19

TOTAL POINT VALUE: 3.25 | **LEARNING OBJECTIVE(S): B1, B3**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1

AY	12-24	24-36	36-48
2013	1.20	1.10	1.01
2014	1.25	1.10	
2015	1.30		
Avg	1.25	1.10	1.01
Selected	1.25	1.10	1.01

AY 2016 Cumulative Reported Claims
@12months = 7500
@24 months = 7500 x 1.25 = 9375
@36 months = 9375 x 1.10 = 10312
@48 months = 10312 x 1.01 = 10415

Incremental reported in 2019 = 10415 – 10312 = 103

Sample 2

Reported Claim Dev

AY	12-24	24-36	36-48
2013	1.20	1.10	1.01
2014	1.25	1.10	
2015	1.30		
Avg	1.25	1.10	1.01
Selected	1.25	1.10	1.01
CDF	1.39	1.111	1.01

7500 x 1.39 – 7500 x 1.25 x 1.1 = 103

Sample 3

Reported Claim Dev

AY	12-24	24-36	36-48
2013	1.20	1.10	1.01
2014	1.25	1.10	
2015	1.30		
Avg	1.25	1.10	1.01
Selected	1.25	1.10	1.01
CDF	1.3888	1.111	1.01

% reported @ age 36 = 99%

7500 x 1.3888 x (1-99%) = 104

Part b: 2 points

Sample 1

Case Development

AY	12-24	24-36	36-48
2013	0.800	0.538	0.686
2014	0.722	0.508	
2015	0.977		
sel	0.832	0.523	0.686

AY 2016 Case Outstanding

12	24	36	48
5000	4160	2176	1493

4160 = 5000 x .832

Incremental Paid

AY	12	24	36	48
2013	1000	1000	1100	310
2014	1500	1800	1485	
2015	2000	1600		
2016	2500			

Incremental Paid to Case Outstanding

AY	12-24	24-36	36-48
2013	0.500	0.688	0.360
2014	0.667	0.762	
2015	0.516		
sel	0.561	0.728	0.360

AY 2016 Incremental Paid

12	24	36	48
2500	2805	3028	783

2805 = 5000 x 0.561

Cumulative Paid

12	24	36	48
2500	5305	8333	9116

Cumulative Reported

12	24	36	48
7500	9465	10509	10609

Expected Incremental Reported in CY 2019 = 10609 – 10509 = 100,000

Sample 2
Using same development factors from sample 1 above.

Case Outstanding
@36 = 5000 x 0.832 x 0.523 = 2176
@48 = 2176 x 0.686 = 1493
Change in case = 1493-2176 = -683

Incremental paid
@48 = 2176 x 0.36 = 783

Incremental reported
@48 = 783 + -683 = 100

Part c: 0.5 point

Sample Responses for Report Year

- More appropriate on a reporting basis because assumes all claims known in first year
- Report year has no pure IBNR. The technique assumes there is only IBNER, thus it is appropriate.
- Case reserves set when claims reported, tracks with this technique

Sample Responses for Accident Year

- Not appropriate for immature years where not all claims have been reported.
- Appropriate if most claims are reported by the first maturity.

EXAMINER'S REPORT

Candidates were expected to understand and use the reported claims development technique and the incremental paid to previous case outstanding technique. Additionally, candidates were expected to know when those techniques are appropriate and when they are not.

Part a

Candidates were expected to know how to use the reported claims development technique given a triangle of cumulative reported claims. Candidates needed to understand how to use that triangle to project ultimate claims as well as the projected claims at immature ages.

Common errors included:

- Calculating the age-to-age factors but failing to calculate the cumulative development factors if taking an approach where cumulative factors were needed.
- Developing 2016 to ultimate but not calculating the incremental portion of that ultimate reported in calendar year 2019.

Part b

Candidates were expected to know how the incremental paid to previous case outstanding technique worked and to interpret the outputs. Candidates were expected to construct the incremental paid to case outstanding triangle, make selections, and calculate the expected incremental reported claims.

Common errors included:

- Calculating the incremental paid claims instead of the incremental reported claims.

Part c

Candidates were expected to know when the incremental paid to previous case outstanding technique was appropriate to use given different data aggregation options.

Common errors included:

- Discussing accident year and report year in general without any explanation of how the technique works for each of these aggregation options.
- Providing an assessment without an explanation, such as "appropriate" or "not appropriate".

QUESTION 20

TOTAL POINT VALUE: 2.25 | **LEARNING OBJECTIVE: B3**

SAMPLE ANSWER

	Reported Claim Link Ratios		
	12-24	*24-36*	*36-48*
2013	*1.32*	*1.06*	*1.00*
2014	*1.20*	*1.28*	
2015	*1.27*		
All-Year Straight Average	*1.26*	*1.17*	*1.00*

	Paid Claim Link Ratios		
	12-24	*24-36*	*36-48*
2013	*1.83*	*1.18*	*1.0819*
2014	*1.96*	*x / 979*	
2015	*2.06*		
All-Year Straight Average	*1.95*	*(1.18 + x / 979) / 2*	*1.08*

AY 2016 Reported Development
CDF = 1.475374053
Ultimate(r) = 700 * 1.475 = 1033
IBNR(r) = 1033 – 700 = 333

AY 2016 Paid Development
Ultimate(p) = 450 * 1.95 * (1.18 + x/979)/2 * 1.08
IBNR(p) = 450 * 1.95 * (1.18 + x/979)/2 * 1.08 - 700

IBNR(r)+ 50 = IBNR(p)
333 + 50 = 450 * 1.95 * (1.18 + x/979)/2 * 1.08 - 700
Solve for x = 1080

Paid in calendar year 2016 = 450 + (825-400) + (1080-979) + (700-647) = 1029

EXAMINER'S REPORT

Candidates were expected to demonstrate paid and reported claims development method knowledge, understand what IBNR includes, and correctly calculate the incremental paid claims in calendar year 2016.

Common errors included:

- Calculating IBNR as (ultimate – paid) rather than (ultimate – reported).
- Mistaking the $50,000 difference as the total across all accident years, rather than just accident year 2016.

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 21	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): B4, B8**
SAMPLE ANSWERS	
Part a: 0.5 point	
Sample 1 There could have been an increase in case reserve adequacy in CY 2016 → this would increase rep. development estimates while keeping paid estimates steady. *Sample 2* A speed up in claim reporting with no change to the speed of claim settlement would increase reported estimates but not change paid estimates.	
Part b: 0.5 point	
There could be a large unpaid claim in AY 2016 which causes reported development to be higher than past years while paid dev estimate remains steady.	
Part c: 0.25 point	
Sample 1 The B-S reported adj. technique could be used to adj previous years case reserve adequacy to current levels. The rep dev technique could then be used on the adj rep triangle. *Sample 2* Use Expected Claims Method, it will not be affected by operational changes.	
Part d: 0.25 point	
Sample 1 Use reported Bornhuetter Ferguson method if large rep loss is expected to be paid. This will recognize the large loss but estimate IBNR based on expected claims estimate that is not overstated by large loss. *Sample 2* Remove the large loss, run the reported development method on all other losses, and then add back the claim department's estimate of ultimate on the large loss.	
EXAMINER'S REPORT	
Candidates were expected to understand both the paid and reported claim development techniques, their inherent weaknesses, and appropriate alternatives for those weaknesses.	
Part a	
Candidates were expected to understand the differences between the paid and reported claim development techniques in the context of multiple calendar, accident, and evaluation years. A common error was only discussing the changes in paid claim development technique and missing the more material change in estimates under the reported claim development technique.	
Part b	
Candidates were expected to understand the differences between the paid and reported claim development techniques for a single accident year. A common error was describing scenarios that impact more accident years than just 2016, such as "case reserve strengthening" or "slow down in payments".	

Part c

Candidates were expected to understand the weaknesses of the reported claim development technique and provide a brief description of an appropriate alternative technique.

A common error was simply identifying an alternative technique without describing why the technique would be appropriate in this scenario.

Part d

Candidates were expected to understand the weaknesses of the reported claim development technique and provide a brief description of an appropriate alternative technique.

Common errors included:

- Simply identifying an alternative technique without describing why the technique would be appropriate in this scenario.
- Treating the issue of a large claim as if in a pricing context instead of estimating ultimate claim liabilities. For example, replacing case incurred with an average load representing future expected large claims is not appropriate.

QUESTION 22

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE: B5**

SAMPLE ANSWERS

Sample #1

A to A Factors

AY	12-24	24-36	36-48
2013	1.050	1.020	1.000
2014	1.150	1.060	
2015	1.100		

Avg	1.100	1.040	1.000	1.000
CDF	1.144	1.040	1.000	1.000

* Assume no development past 48 months

Disposal Rate

660 / 1178 = .560
768 / 1463 = .525
620 / 1144 = .542
806 / 1487 = .542

2013	Decrease. Since .560 > .542
2014	Increase. Since .525 < .542
2015	No Change. Since .542 = .542
2016	No Change. Since latest diagonal

Sample #2

AY	12-24	24-36	36-48
2013	1.050	1.020	1.000
2014	1.150	1.060	
2015	1.100		

Vol Weighted	1.102	1.042	1.000
CDF	1.148	1.042	1.000

AY	Ultimate	Closed	DR
2013	1,178	660	56.0%
2014	1,463	768	52.5%
2015	1,146	620	54.1%

2016	1,492	806	54.0%

Select latest diagonal

AY	Adj Closed Count	Change
2013	636	-24
2014	790	22
2015	619	-1
2016	806	0

EXAMINER'S REPORT

Candidates were expected to complete the initial steps required when performing a Berquist-Sherman adjustment for changes in the settlement rate of claims. The potential need for adjustments to each accident year is determined by comparing historical disposal rates to the latest disposal rate at the same maturity.

Candidates were expected to estimate ultimate counts through application of the chain ladder method on reported claim counts. Candidates were then expected to either calculate the adjusted closed claim counts for each accident year and compare them to the original unadjusted closed claim counts, or to simply recognize the relationship between disposal rates in order to make the proper recommendation.

Common errors included:

- Not developing reported claim counts to ultimate, and instead basing decisions on relationships between ratios of closed-to-reported claim counts.
- Deriving ultimate claim counts using the chain ladder method on the closed count triangle instead of reported. Calculation of ultimate claim counts based on the triangle of closed claim counts was not appropriate, as it resulted in ultimate counts that fall short of the given cumulative reported counts.
- Calculating a development pattern using the reported count triangle, but applying the pattern to the cumulative closed counts.
- Calculating disposal rates as reported count divided by ultimate count.
- Attempting to identify a general trend or relationship in historical disposal rates, as opposed to addressing each accident year individually.
- Misstatement of the direction of the required adjustment, e.g., stating that an accident year's closed counts should be increased, when should have been decreased, and vice versa.
- Comparing historical disposal rates to an average disposal rate at 12 months, as opposed to the accident year 2016 disposal rate at 12 months.
- Calculating the disposal rates for each accident year, but not comparing or elaborating on the need for potential adjustments.

QUESTION 23

TOTAL POINT VALUE: 3 | **LEARNING OBJECTIVE(S): B5**

SAMPLE ANSWERS

Part a: 1.5 points

Adjust the paid claims before 12/31/2014

Incremental Paid Claims

AY	12	24	36	48
2013	390	485	260	130
2014	425	640	290	
2015	564	703		
2016	619			

Adjusted

AY	12	24	36	48
2013	468	582	260	130
2014	510	640	290	
2015	564	703		
2016	619			

Adjusted Cumulative Paid Claims

AY	12	24	36	48
2013	468	1050	1310	1440
2014	510	1150	1440	
2015	564	1267		
2016	619			

Development Factor

AY	12-24	24-36	36-48
2013	2.24	1.25	1.10
2014	2.25	1.25	
2015	2.25		
Select:	2.25	1.25	1.10

Ultimate claims for AY 2016: 619 × 2.25 × 1.25 × 1.10 = 1,915

Part b: 1.5 points

Sample 1:

AY	EP	On-level Factor	Used up on-level EP	Paid Claims
2013	2,000	1.2		1,440
2014	2,260	1.091		1,440
2015	2,730	1	$2{,}000 \times 1.2 \times 1 = 2{,}400$ $2{,}260 \times 1.091 \times (\frac{1}{1.1}) = 2{,}242$	1,267
2016	3,215	1	$2{,}730 \times 1 \times (\frac{1}{1.1 \times 1.25}) = 1{,}985$ $3{,}215 \times 1 \times (\frac{1}{1.1 \times 1.25 \times 2.25}) = 1{,}039$	619
		$\frac{1.2}{(1+1.2)/2} = 1.091$	7,666	4,766

Cape Cod technique loss ratio: 4,766 / 7,666 = 62.2%

AY 2016 Ultimate Claims: $619 + 3215 \times 62.2\% \times \left(1 - \frac{1}{2.25 \times 1.25 \times 1.1}\right) = 1{,}972$

Sample 2:

AY	EP	OL factor	OLEP	Adj. Paid	CDF	Ult. Loss
2013	2,000	1.2	2400	1440	1	1440
2014	2,260	1.09	2465	1440	1.1	1584
2015	2,730	1	2730	1267	1.38	1742
2016	3,215	1	3215	619	3.09	1915
Total			10810			6681

Expected Loss Ratio: = 6681/10810 = 61.8%
Cape Cod AY 2016 Ult. = 619 + 3215 x 0.618 x (1 - 1/3.09)
= 1,964

EXAMINER'S REPORT

Candidates were expected to know the mechanics and assumptions associated with the paid loss development method and Cape Cod technique. Candidates were expected to adjust the loss triangle for a legal change and to on-level premium for a rate change.

Part a

Candidates were expected to know the mechanics and assumptions associated with the paid loss development method.

Common errors included:

- Not adjusting the triangle for the law change.
- Adjusting the triangle for payments occurring after December 31, 2014. These payments were made after the law change and already at the higher severity level.
- Adjusting the triangle to reflect the higher severity in the 2013 and 2014 diagonals, but not carrying this adjustment to the 2015 and 2016 diagonals for accident years 2013 and 2014. For example, the incremental portion of the cumulative payments for accident year 2015 at 36 months that were made in 2013 and 2014 needed to be increased to account for the higher severity.
- Ignoring the 2013-to-2014 and 2014-to-2015 diagonals when selecting LDFs to only use data post-law change. The question specifically asks for the impact of the court decision to be included, and one diagonal of data is not sufficient to incorporate the impact.

Part b

Candidates were expected to know the mechanics and assumptions associated with Cape Cod method.

Common errors included:

- Incorrectly calculating on-level factor. For example, calculating the correct average rate factor (1.1) for AY 2014 but not adjusting the rate to the current level. The correct on level factor is 1.2/1.1 = 1.09.
- Not using court decision adjusted paid losses for the loss ratio calculation.
- Selecting an expected loss ratio rather than using aggregated losses and used up premium for the Cape Cod loss ratio calculation.
- Using the incorrect formula for the ultimate loss calculation.

QUESTION 24	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): B7**

NOTE FROM THE SYLLABUS AND EXAMINATION COMMITTEE

The question as printed in the exam was intended to be answered using alternate techniques to estimate ULAE. It was subsequently acknowledged that some candidates interpreted "classical technique" to be the loss development method, and provided responses containing alternate techniques to estimate unpaid losses. Due to the ambiguity, full credit was given for correct responses under either scenario.

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1:

As the Insurer is expanding his business, his book of business will grow and it will create an immediate increase in ULAE. However, payment will be made at much later maturity. So a paid-to-paid ratio would be distorted. The Kittel approach corrects this distortion by using an average of paid and incurred loss as reserves will also increase right away like ULAE, and would create more stable ratio.

Sample 2:

(Assuming "classical method" meant loss development)

A different external environment may affect the loss differently (*e.g.* judicial, regulatory, economic, *etc.*). Also, there won't be enough data for the new business. I would use expected claim technique and borrow expected loss ratio from other states while adjusting for external factors if possible.

Part b: 0.5 point

Sample 1:

As payment in one calendar year may be artificially increased by a catastrophic event while ULAE will not follow the same increase, it could distort paid to paid ratio. It would create low paid ULAE to paid claim for year with catastrophe and high ratio for year without catastrophe. The Mango-Allen approach would use the expected claim paid and would correct for unstable data.

Sample 2:

Catastrophe like hurricane will result in volatile frequency and severity. Classical approach assumes that ULAE is proportional to claims in timing and amount, which doesn't hold here. Use count-based technique instead of dollar-based technique such as Brian tech.

Sample 3:

(Assuming "classical method" meant loss development)

The book of business is subject to large or catastrophe loss. I would separate large loss above certain threshold to conduct separate reserve analysis and use loss ratio based projection.

Part c: 0.5 point

Sample 1:

For long-tailed lines, there are more ULAE spent on closing the claim than opening as these claims will stay open for a long time and usually require several payments (maintenance). The 50/50 assumption does not hold. However, the generalized Kittel approach works well in this

situation as it has the flexibility to select ULAE proportional to opening, maintaining, and closing claims.

Sample 2:
Long-Tail LOB can have ULAE patterns that change over the life of the claim. The ULAE practice of Classical technique is not complex enough for these types of claims. Majority of development incurred maintaining claim. Alternative is to use Brian ULAE technique which analyzes claims by ULAE spent opening, maintaining, paying, closing, and reopening a claim.

Sample 3:
(Assuming "classical method" meant loss development)
LDF method is not appropriate for immature years due to highly leveraged LDF for the long-tail line. Use BF instead.

Sample 4:
(Assuming "classical method" meant loss development)
Class tech not optimal because claim costs pattern could be changing over extended period of time. Use Freq-Sev to break out frequency and severity separately.

EXAMINER'S REPORT

Candidates were expected to demonstrate knowledge of weaknesses in the classical method of ULAE analysis and recommend an alternative technique that accounts for the deficiency in the classical technique in each of three given situations common to an insurer's operations.

As noted above, responses that provided appropriate alternatives to the loss development technique were also given credit.

Part a

Candidates were expected to diagnose why the classical method of ULAE analysis may provide a poor result when applied to a company writing business in two new states, then provide an alternative method of analysis that corrects for the deficiency in the classical method. Credit was given for candidates who assumed the "classical method" referred to the loss development method.

Common errors included:

- Providing an alternative method without a supporting explanation as to why the alternative was appropriate.
- Suggesting Mango-Allen as an alternate technique, as the issue with a growing book of business is not instability in the paid amounts, but rather the assumption that paid and reported amounts are equivalent.

Part b

Candidates were expected to diagnose why the classical method of ULAE analysis may provide a poor result when applied to a company writing business in a catastrophe-prone area, then provide an alternative method of analysis that corrects for the deficiency in the classical method. Credit was given for candidates who assumed the "classical method" referred to the loss development method.

For candidates that answered with an alternate ULAE method, responses that involved separating catastrophe from non-catastrophe ULAE did not receive credit for an alternate approach. ULAE from different types of claims is generally difficult to separate, requiring some significant assumptions. This approach was accepted for candidates who assumed the question referred to the loss development method, as catastrophe and non-catastrophe claim payments can be separated much more readily than ULAE payments.

For candidates that assumed the question related to the loss development method, responses involving catastrophe modeling or average catastrophe loads did not receive credit for an alternative approach, as a company would not reserve for an "average" catastrophe in years when a catastrophe did not occur.

Common errors included:

- Selecting alternate methods that did not appropriately account for the volatility in the underlying loss payments. The Kittel Refinement and the Generalized approach both rely on ratios of paid ULAE to paid claims that are volatile in a catastrophe-prone area.

Part c

Candidates were expected to diagnose why the classical method of ULAE analysis may provide a poor result when applied to a company writing a long-tailed line of business, then provide an alternative method of analysis that corrects for the deficiency in the classical method. Credit was given for candidates who assumed the "classical method" referred to the loss development method.

A common mistake was attributing the deficiencies of the ULAE classical method to difficulties in establishing the IBNR for the losses themselves.

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 25	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): B7**
SAMPLE ANSWERS	
Part a: 0.75 point	
Paid ALAE CDF = 11,000 / 2,000 = 5.5 Ultimate = (2000 – 1500) (5.5) + 2000 = 4750	
Part b: 0.75 point	
Paid Ratio CDF = (12,000 / 30,000) / (2000 / 7000) = 1.4 Ultimate Ratio = 1.4 x (2000 – 1500) / 7000 = 0.1 Ultimate ALAE = 0.1 x (30,000 – 6000) + 2000 = 4400	
EXAMINER'S REPORT	
Candidates were expected to estimate ultimate ALAE in a situation where a large claim has distorted the ultimate ALAE estimate resulting from standard ALAE techniques. The question required a thorough understanding of both the ALAE development method and the paid ALAE to paid claims ratio method.	
Part a	
Candidates were expected to compute the correct paid ALAE development technique CDF, apply that CDF to the non-large claim paid ALAE to get the all non-large claim ultimate ALAE, then add back in the large claim ultimate ALAE. Common errors included: • Computing a large claim adjustment factor and applying it to the all claims excluding large claim ultimate. This approach neglected to use the large claim ultimate that was provided in the question. • Neglecting to add the large claim ultimate. • Calculating an incorrect development factor.	
Part b	
Candidates were expected to compute the paid ALAE to paid claims ratio technique CDF, apply the CDF to the ratio of all non-large paid ALAE to all large paid claims to get the ultimate ALAE to claims ratio, and multiply that ratio by all non-large ultimate claims to get all non-large ultimate ALAE. Then, candidates were expected to add the large claim ultimate ALAE. Common errors included: • Miscalculating the development factor as if the method used was not the ratio method, but a standard paid development method. • Not developing the paid ALAE to paid claims ratio to ultimate (i.e. no CDF used in calculation). • Computing a large claim adjustment factor and applying it to the all claims excluding large claim ultimate. This approach neglected to use the large claim ultimate that was provided in the question. • Neglecting to add the large claim ultimate.	

EXAM 5 SPRING 2017 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 26	
TOTAL POINT VALUE: 1.5	
SAMPLE ANSWERS	**LEARNING OBJECTIVE(S): B1, B8**
Part a: 0.5 point	
Sample 1: This seems reasonable. Given the discrepancy between paid and reported methods, I suspect a large claim has been reported but not paid. The actuary selected the reported BF method, which would capture the impact of such a claim without allowing it to distort the IBNR estimate. *Sample 2:* I find this unreasonable – only the rpt dev method is above 100% - and this method can be highly leveraged/volatile in early years. The BF methods are weighted w/ expected development & are better to use for early years. More reasonable to choose the midpoint of the BF methods around 80%. *Sample 3:* The selection seems reasonable. The reported development methods give a higher ultimate claim ratio, but it appears that this may be due to large case reserves. The paid development methods return far lower ultimate claim ratios. Given what we know as of CY2013 end, I think it is wise to trust the case estimates indicating larger losses to come while still considering historical claim ratios. Thus, selecting the BF method, a weighted average, makes sense. *Sample 4:* With paid and reported development UCR so different, this suggests a strengthening of case adequacy vs the historical period. Therefore, reported is high. I will use the Paid BF method to weigh the paid development technique with expected claims to select 75%. I believe the assessment is too high.	
Part b: 0.5 point	
The reported Benktander technique would be higher than the reported BF but lower than the reported development techniques, because it is a weighted average of the two.	
Part c: 0.5 point	
Any two of the following: • Have there been any changes to strengthen or weaken the case reserves? • Are there any changes to claim settlement practices? • Was there a large unpaid claim in 2013 that was paid in 2016? • Has there been more focus on settling larger claims instead of smaller claims?	
EXAMINER'S REPORT	
Candidates were expected to demonstrate knowledge about the principles of basic reserving methods, including the paid and reported claim development methods, B-F method, and the Benktander technique, as well as fundamental issues to be discussed within a company regarding circumstances to consider when evaluating reserve indications.	
Part a	
Candidates were expected to assess the reasonability of a claims ratio selection.	

Candidates did not receive credit for supporting their reasonability assessment by merely comparing the positioning of the estimate relative to the indications, thereby restating information given in the question.

A common error was supporting the reasonability assessment to a limited degree by making observations/assumptions of possible scenarios, but not connecting these observations with strengths/weakness nor mechanics of the various methods.

Part b

Candidates were expected to know the basic concept underlying the Benktander technique and relate that understanding to its position relative to the B-F and loss development techniques.

A common error was providing the relative position of the Benktander indication as being between the LDF and BF methods but not discussing that this was due to the Benktander technique being a credibility-weighting between the two methods.

Part c

Candidates were expected to identify and articulate fundamental principles of company operations which impact claims reserving.

Common errors included:

- Providing two questions that were essentially the same, such as "Has there been a change in settlement rates?" and "Have claim closure rates changed?"
- Providing questions that were not related to the graphical information provided for 2013 but more general in nature, such as "Have there been underwriting changes?"