Exam 5

CASUALTY ACTUARIAL SOCIETY
AND THE
CANADIAN INSTITUTE OF ACTUARIES

Exam 5

Basic Techniques for Ratemaking and Estimating Claim Liabilities

October 23, 2017

4 HOURS

INSTRUCTIONS TO CANDIDATES

1. This 55.75 point examination consists of 28 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 November 6, 2017.

END OF INSTRUCTIONS

1. (1.5 points)

Given the following information:

Calendar Year	Average Earned Premium at Current Rate Level	Average Written Premium at Current Rate Level
2014	$210	$212
2015	$220	$224
2016	$235	$240

- The projected annual premium trend = -2%.
- Fourth quarter 2016 average earned premium at current rate level = $236.
- Fourth quarter 2016 average written premium at current rate level = $242.
- The company uses a calendar-accident year aggregation of data for indications.
- All policies are annual.
- Rates are in effect for one year.
- The rate revision is planned to be effective January 1, 2018.

a. (1 point)

Calculate the premium trend factor for each year using two-step trending.

b. (0.5 point)

Identify two scenarios that could lead to a negative premium trend when analyzing average premium at current rate level.

CONTINUED ON NEXT PAGE

2. (2 points)

Given the following information:

Rate Change Effective Date	Overall Rate Change
July 1, 2013	5%
October 1, 2015	2%
October 1, 2016	-4%

Calendar Year	Earned Premium ($000)	Earned Premium ($000) at Current Rate Level
2014	15,000	14,775
2015	18,000	17,622

- 2016 Earned Premium = $22,000,000.
- 2014 through 2016 combined projected ultimate loss and LAE = $40,000,000.
- Selected annual premium trend = 2%.
- Fixed expense provision = 8%.
- Variable expense provision = 20%.
- Target underwriting profit provision = 5%.
- All policies are annual.
- Rates are to be in effect for one year.
- The rate revision is planned to be effective October 1, 2017.

a. (1.5 points)

Calculate the projected earned premium at current rate level for 2014 through 2016.

b. (0.5 point)

Calculate the indicated rate change.

CONTINUED ON NEXT PAGE

3. (1.5 points)

Given the following for an insurance company that writes only annual policies:

Policy	Effective Date	Annual Premium
A	July 1, 2014	$200
B	October 1, 2014	$240
C	January 1, 2015	$260
D	July 1, 2015	$280

- Policy D was cancelled March 31, 2016.

a. (0.5 point)

Calculate the following for calendar year 2015:

i. Earned premium
ii. Written premium

b. (0.5 point)

Calculate the following as of December 31, 2016:

i. Policy year 2015 earned premium
ii. Policy year 2015 written premium

c. (0.5 point)

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

CONTINUED ON NEXT PAGE

4. (1.5 points)

Given the following information for an insurance company:

- All policies are annual.
- For all claims reported in one year, 40% of the ultimate loss is from claims occurring in the same year, 35% from the prior year and 25% from the 2nd prior year.
- Annual report year loss cost trend = 3%.
- The company writes policies uniformly through the year.
- Exposure levels are constant.
- For report year 2013, the loss cost per exposure from claims occurring in 2013 = $200.

a. (1 point)

Calculate the loss cost per exposure for the following:

i. Occurrence policy effective January 1, 2016
ii. Claims-made policy effective January 1, 2018 with retroactive date of January 1, 2017

b. (0.5 point)

A customer is switching from a claims-made policy to an occurrence policy effective January 1, 2016. Calculate the total loss cost per exposure that would provide complete coverage without overlap for this customer.

CONTINUED ON NEXT PAGE

5. (2 points)

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

Accident Year	Earned Premium ($000)	Reported Loss ($000)	Cumulative Loss Development Factors
2012	3,000	1,500	1.05
2013	3,500	1,925	1.10
2014	3,300	1,749	1.20
2015	3,200	1,984	1.35
2016	3,800	2,470	1.40

- All policies are annual.
- Annual loss cost trend = 3%.
- The company has increased rates by 5% every year on January 1.
- The company writes policies uniformly throughout the year.

Calculate accident year 2016 trended ultimate loss using the Bornhuetter-Ferguson method with the expected loss ratio based on accident years 2012 through 2014 experience.

CONTINUED ON NEXT PAGE

6. (2 points)

The current workers compensation indemnity benefit structure in a state is as follows:

- The compensation rate is 80% of the workers pre-injury wage.
- The state average weekly wage (SAWW) is currently $1,500.
- The minimum indemnity benefit is 50% of the SAWW.
- The maximum indemnity benefit is 125% of the SAWW.

The following changes have been proposed to the workers compensation indemnity benefit structure:

- The proposed minimum indemnity benefit is 75% of the SAWW.
- The proposed maximum indemnity benefit is 100% of the SAWW.

The distribution of injured workers for Company A is shown below:

Ratio to SAWW	# Workers	Total Weekly Wages
<50%	150	$108,750
50%-75%	100	$110,000
75%-100%	95	$137,750
100%-125%	50	$87,500
>125%	45	$216,000
Total	440	$660,000

a. (1.5 points)

Calculate the impact to Company A of the state's proposed workers compensation indemnity benefit change.

b. (0.5 point)

Briefly describe two potential indirect effects of the benefit change.

CONTINUED ON NEXT PAGE

7. (2 points)

Given the following information for the past year for an insurance company:

	($000)	% Fixed
Written Premium	25,000	-
Earned Premium	20,000	-
Agent Commission	3,000	0%
Other Acquisition Cost	300	100%
Premium Tax & Licensing Fees	1,000	0%
General Expense	2,500	100%
Loss Adjustment Expenses	1,200	0%

- Underwriting profit provision = 5%.

a. (0.75 point)

Calculate the underwriting expense ratio using the premium-based projection method.

b. (0.25 point)

Calculate the operating expense ratio using the premium-based projection method.

c. (0.25 point)

Calculate the total permissible loss ratio.

d. (0.75 point)

Calculate the indicated rate change using a projected loss ratio of 65% (excluding loss adjustment expenses).

CONTINUED ON NEXT PAGE

8. (2.25 points)

Given the following information about an insurance product filing with annual policies:

- 2018 projected pure premium = $350.
- Loss cost annual trend = 3%.
- Premium annual trend = 4%.
- Fixed expense per exposure, new business = $50.
- Fixed expense per exposure, renewals = $6.
- Variable expense ratio = 18%.
- Profit and contingencies provision = 6%.
- LAE provision = 10% of loss.
- Retention ratio = 80%.
- Discount rate = 5%.

a. (1.5 points)

Calculate the new business premium per exposure for 2018 indicated by a lifetime value analysis using a two-year time horizon.

b. (0.75 point)

Fully justify the use of lifetime value analysis in a rate indication using the Statement of Principles Regarding Property and Casualty Ratemaking.

CONTINUED ON NEXT PAGE

9. (1.75 points)

An actuary is developing a rating algorithm for a new product covering professional liability for nurses working in hospitals.

Characteristics considered:

- Age of nurse
- Gender of nurse
- Hours worked per week by each nurse
- Number of nurses employed by the hospital
- Specialty of the nurse (Cardiac or General)

Given the following:

- 20% of customers will switch insurers based on price.
- The company's competitor uses specialty of nurse in their rating algorithms and charges the true expected cost.
- At the start of the program the company and the competitor each write 100 policies for Cardiac Nurses and 100 policies for General Nurses.
- There are no underwriting expenses or profit.

Specialty	True Expected Cost
Cardiac	$500
General	$200

a. (0.5 point)

For one of the characteristics, briefly discuss two reasons why it would be an appropriate exposure base.

b. (0.5 point)

Assess if age of nurse is an appropriate rating variable using two social criteria.

c. (0.75 point)

The company decides not to use specialty of nurse in their rating algorithm. Quantify the effect on profitability for the company after one renewal cycle.

CONTINUED ON NEXT PAGE

10. (1.75 points)

Given the following:

Territory	True Relativity	Univariate Indicated Relativity	Loss & ALAE ($000)
1	0.50	0.46	3,680
2	1.00	1.00	8,000
3	1.20	1.28	11,636

Earned Exposures (000)			
Territory	Class A	Class B	Class C
1	150	70	110
2	105	115	110
3	70	180	125

Class	A	B	C
Charged Factor	0.85	1.15	1.00

a. (0.5 point)

Explain why the univariate indicated relativities are different from the true relativities.

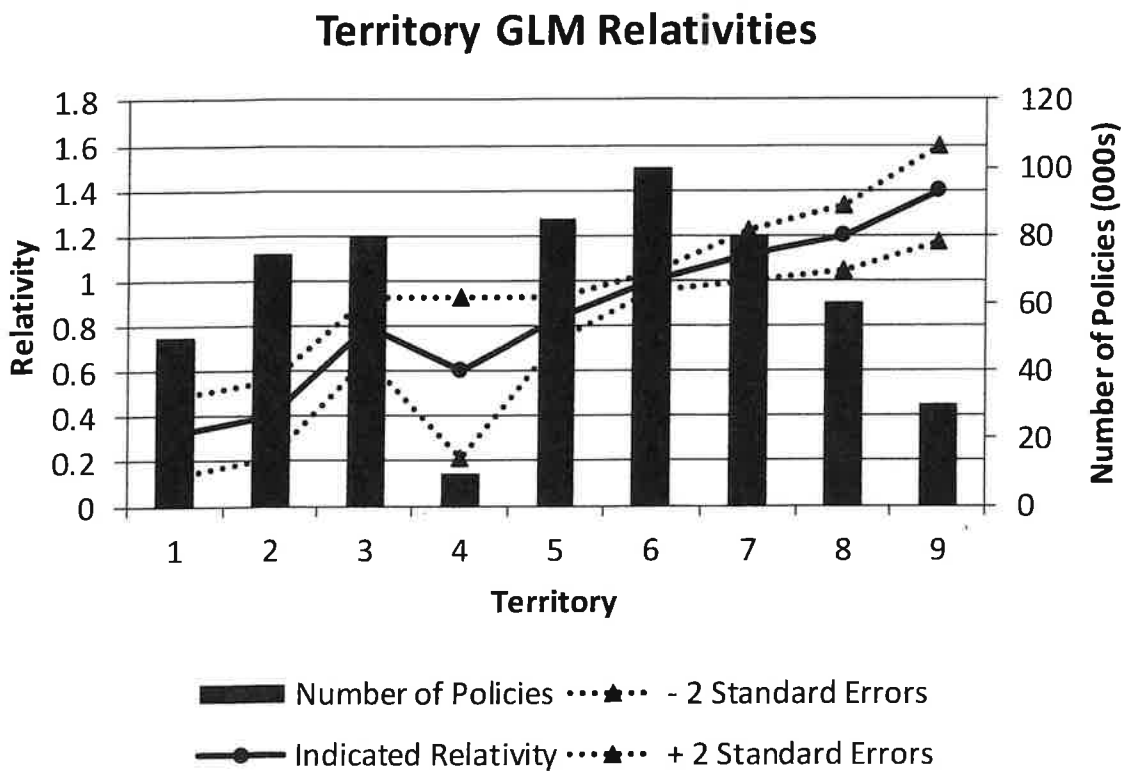
b. (1.25 points)

Calculate territory relativities using the adjusted pure premium method, keeping territory 2 as the base level.

CONTINUED ON NEXT PAGE

11. (1.5 points)

The output of a generalized linear model (GLM) analysis on relativities for pure premium by territory is shown below:



- Chi-Square Percentage (entire variable) = 0.1%.

a. (0.5 point)

Explain whether the GLM output supports including territory as a rating variable.

b. (0.75 point)

Briefly describe three benefits of using multivariate methods over univariate methods for classification ratemaking.

c. (0.25 point)

Briefly describe how spatial smoothing can be used to improve territory relativity estimates.

CONTINUED ON NEXT PAGE

12. (1.75 points)

Given the following information for an insurance company:

Limit of Liability	Current Increased Limits Factor	Indicated Increased Limits Factor
100,000	1.00	1.00
250,000	2.20	2.20
500,000	2.50	2.75
750,000	2.75	3.00
1,000,000	2.90	3.00

- The indicated increased limit factors are based on the company's own loss experience.
- Losses limited to $100,000 have been consistent over time.
- Expected losses limited to $100,000 = $500,000,000.

a. (0.75 point)

Compare the expected losses for the excess layer between $500,000 and $1,000,000 based on the current increased limits factors and the indicated increased limits factors.

b. (0.5 point)

Assess the appropriateness of implementing the indicated increased limits factors.

c. (0.5 point)

The company wishes to offer policy limits exceeding $1,000,000 in the future. Propose an approach to calculating increased limits factors for the higher limits and briefly describe an implementation challenge the company may encounter.

CONTINUED ON NEXT PAGE

13. (2.25 points)

Given the following information:

Territory	Current Premium ($000)	Current Territory Factor	Indicated Territory Factor
1	90	0.80	0.70
2	300	1.00	1.00
3	260	1.15	1.10
Total	650		

Management requires achieving the following objectives with the upcoming rate change:

- Target an overall rate level increase of 10%.
- Revise territorial relativities to the indicated relativity, while capping the overall rate impact to any territory at 13%.
- Territory 2 remains the base territory.

Calculate the territorial relativities that will be implemented with the rate change.

CONTINUED ON NEXT PAGE

14. (1.5 points)

Given the following information about a homeowners insurance loss:

- Face amount of policy = $300,000.
- Value of property = $500,000.
- Coinsurance penalty = $22,000.
- Indemnity payment = $84,000.
- There is no deductible.

a. (0.5 point)

Calculate the required coinsurance percentage.

b. (1 point)

Identify two homeowners insurance to value initiatives insurers could implement and briefly describe how each initiative encourages insurance to full value.

CONTINUED ON NEXT PAGE

15. (4.75 points)

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

Accident Year	Cumulative Reported Loss & ALAE ($000)
2014	5,615
2015	4,315
2016	2,745

Calendar Year	Earned Premium ($000)
2014	10,800
2015	11,250
2016	12,375

Selected Reported Loss & ALAE Age to Age Factors		
12-24	24-36	36-48
2.089	1.368	1.070

- All policies are annual.
- Exposures are written evenly throughout each calendar year.
- Annual loss and ALAE trend = 5%.
- Annual premium trend = 4%.
- There has been one rate change in the past five years: +5%, effective July 1, 2015.
- Fixed expense ratio = 15%.
- Variable expense ratio = 25%.
- Profit and contingencies provision = 5%.
- ULAE provision = 6% of loss and ALAE.
- Rates are to be in effect for one year.
- There is no loss development beyond 48 months.

a. (0.5 point)

Calculate the ultimate losses and ALAE for each accident year using the loss development technique.

b. (0.75 point)

Calculate the ultimate losses and ALAE for each accident year using the Bornhuetter-Ferguson technique using an expected loss and ALAE ratio of 56%.

c. (0.5 point)

Briefly justify an appropriate ultimate loss and ALAE selection from parts a. and b. above for accident years 2014 through 2016.

d. (3 points)

Calculate the indicated rate change for policies effective July 1, 2017 using the ultimate loss and ALAE selections from part c. above, assuming full credibility.

CONTINUED ON NEXT PAGE

16. (1.25 points)

An insurer has the following book of insurance policies and claim experience as of December 31, 2016:

Policy Number	Policy Effective Date	Policy Term (in Months)	Gross Written Premium
1	January 1, 2015	12	12,000
2	June 1, 2015	6	7,000
3	August 1, 2015	12	10,000
4	February 1, 2016	12	15,000
5	May 1, 2016	6	8,000

Claim Number	Accident Date	Claim Report Date	Gross Paid Claims	Gross Case Reserves	Reinsurance Recoveries
1	September 1, 2015	October 1, 2015	2,000	0	0
2	November 1, 2015	January 1, 2016	3,000	1,000	500
3	March 1, 2016	March 1, 2016	1,000	2,000	0
4	July 1, 2016	September 1, 2016	4,000	0	1,000

a. (0.5 point)

Calculate the calendar year 2016 gross earned premium.

b. (0.25 point)

Calculate the gross unearned premium as of December 31, 2016.

c. (0.5 point)

Calculate the reported claims net of reinsurance recoveries for accident year 2016 as of December 31, 2016.

CONTINUED ON NEXT PAGE

17. (1.5 points)

The following information is available for a private passenger automobile insurer:

- The insurer started writing business five years ago.
- External data from other private passenger automobile insurers is used to supplement the insurer's data in estimation of unpaid claims.
- Unpaid claims have been estimated historically on a combined bodily injury and property damage basis.
- Internal data shows that the bodily injury claims take longer to reach ultimate than the property damage claims.

Internal management has asked the reserving actuary to begin estimating reserves separately for bodily injury and property damage claims using only internal data.

a. (0.75 point)

Fully discuss an argument to support this proposed change.

b. (0.75 point)

Fully discuss an argument against this proposed change.

CONTINUED ON NEXT PAGE

18. (3.25 points)

Given the following claim experience:

Accident Half-Year	Reported Claim Counts Excluding Claims Closed with No Payment as of (months)					
	6	12	18	24	30	36
2014-1	3,700	3,515	3,508	3,504	3,504	3,504
2014-2	4,000	3,800	3,792	3,788	3,788	
2015-1	3,800	3,610	3,603	3,599		
2015-2	3,700	3,515	3,508			
2016-1	3,900	3,705				
2016-2	4,100					

Accident Half-Year	Reported Severity ($) Excluding Claims Closed with No Payment as of (months)					
	6	12	18	24	30	36
2014-1	4,600	4,637	4,614	4,609	4,609	4,609
2014-2	4,900	5,023	4,998	4,993	4,993	
2015-1	4,400	4,435	4,413	4,409		
2015-2	4,800	4,920	4,895			
2016-1	4,600	4,637				
2016-2	4,500					

- There is no development in counts or severity beyond 36 months.

a. (2.25 points)

Calculate ultimate claims for accident year 2016 using a frequency-severity technique.

b. (0.5 point)

Explain why the downward development observed in the claim count triangle in part a. above may occur.

c. (0.5 point)

Discuss a diagnostic that can be used to test for seasonality.

CONTINUED ON NEXT PAGE

19. (2.25 points)

Given the following information as of December 31, 2016:

Accident Year	Cumulative Reported Claims ($000) as of (months)			
	12	24	36	48
2013	10,000	15,000	18,000	19,800
2014	11,000	16,500	19,800	
2015	12,650	18,975		
2016	14,500			

Accident Year	Cumulative Paid Claims ($000) as of (months)			
	12	24	36	48
2013	4,000	10,000	15,000	18,000
2014	4,400	11,000	16,000	
2015	4,840	12,100		
2016	5,324			

Accident Year	Reported Claims Development Technique Ultimate Claims ($000)
2013	20,790
2014	22,869

a. (1 point)

Calculate the ultimate claims for accident years 2015 and 2016 as of December 31, 2016, using the reported claims development technique.

b. (0.5 point)

Produce a diagnostic that shows an operational change in the insurer's history. Briefly describe a scenario that could result in the observed diagnostic.

c. (0.75 point)

Briefly describe an issue that could arise for each of the following parties that relies on accurate unpaid claims estimates if unpaid claims are understated by the insurer.

i. Investors
ii. Regulators
iii. Internal management

CONTINUED ON NEXT PAGE

20. (3 points)

Given the following information about an insurance company's workers compensation book of business as of December 31, 2016:

Accident Year	Payroll ($00)	Reported Claims ($000)	Indicated Ultimate Claim Counts	Selected Ultimate Severity
2013	306,000	15,450	2,300	7,000
2014	313,000	17,000	2,400	7,500
2015	318,000	14,625	2,500	not provided
2016	325,000	11,000	not provided	not provided

- Annual inflation rate for payroll = 2%.
- Annual claim count trend = 1%.
- Annual severity trend = 8%.
- The cumulative reported claims development factor at 12 months = 1.8.

a. (1.75 points)

Select and briefly justify an ultimate frequency estimate for accident year 2016.

b. (0.5 point)

Select an appropriate ultimate severity estimate for accident year 2016.

c. (0.75 point)

Calculate accident year 2016 ultimate claims using a Bornhuetter-Ferguson technique that blends the reported development technique with the frequency-severity technique.

CONTINUED ON NEXT PAGE

21. (1.25 points)

Given the following information:

Accident Year	On-Level Earned Premium ($000)	Cumulative Reported Claims ($000)	Reported CDF to Ultimate
2014	750	500	1.100
2015	800	475	1.250
2016	1,000	400	1.550

- A legislative change effective January 1, 2016 is expected to reduce claims costs by 20% for claims occurring after the effective date.

Estimate ultimate claims for accident year 2016 using the Cape Cod technique.

CONTINUED ON NEXT PAGE

22. (2 points)

Given the following data as of December 31, 2016:

Accident Year	Industry Cumulative Reported Claims ($000) as of (months)			
	12	24	36	48
2013	500,000	800,000	900,000	950,000
2014	400,000	750,000	880,000	
2015	450,000	750,000		
2016	500,000			

Accident Year	Industry Case Outstanding ($000) as of (months)			
	12	24	36	48
2013	200,000	300,000	50,000	0
2014	150,000	250,000	80,000	
2015	170,000	300,000		
2016	230,000			

Accident Year	Self-Insured Company Case Outstanding ($000) as of December 31, 2016
2013	0
2014	80
2015	250
2016	400

- There is no development after 48 months.
- Industry cumulative reported claims development factor at 12 months = 2.100.

a. (1.5 points)

Calculate an accident year 2016 unpaid claim estimate for the company.

b. (0.5 point)

Identify two potential limitations of the approach used in part a. above.

CONTINUED ON NEXT PAGE

23. (2.25 points)

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

Accident Year	Incremental Closed Claim Counts as of (months)			
	48	60	72	84
2010	60	25	15	5
2011	60	30	15	
2012	100	25		
2013	80			

Accident Year	Incremental Paid Claims ($000) as of (months)			
	48	60	72	84
2010	1,400	2,500	2,000	400
2011	1,600	1,100	600	
2012	2,800	1,900		
2013	2,100			

- Selected annual severity trend = 5%.
- Trended tail severity at 72 months at the accident year 2016 cost level = $114,000.
- Trended tail severity at 84 months at the accident year 2016 cost level = $107,000.

a. (1.5 points)

Calculate the trended tail severities at maturity ages 48 months and 60 months at the accident year 2016 cost level.

b. (0.75 point)

Discuss at which maturity age the data should be combined for the purpose of selecting an incremental tail severity to be used in a frequency-severity method for this insurance company.

CONTINUED ON NEXT PAGE

24. (2.5 points)

Given the following data:

Accident Year	Paid Claims ($000) as of (months)			
	12	24	36	48
2013	1,100	1,650	1,815	1,815
2014	1,210	1,820	2,005	
2015	1,335	2,005		
2016	1,470			

Accident Year	Reported Claims ($000) as of (months)			
	12	24	36	48
2013	1,540	1,980	1,888	1,815
2014	1,694	2,184	2,060	
2015	1,869	2,306		
2016	1,911			

Accident Year	Closed Claim Counts as of (months)			
	12	24	36	48
2013	550	825	908	908
2014	578	867	954	
2015	605	908		
2016	635			

Accident Year	Open Claim Counts as of (months)			
	12	24	36	48
2013	165	83	18	0
2014	173	87	19	
2015	181	91		
2016	191			

Accident Year	Paid Claims to Reported Claims Ratio as of (months)			
	12	24	36	48
2013	71.4%	83.3%	96.2%	100.0%
2014	71.4%	83.3%	97.1%	
2015	71.4%	87.0%		
2016	76.9%			

Accident Year	Closed to Reported Counts Ratio as of (months)			
	12	24	36	48
2013	76.9%	90.9%	98.1%	100.0%
2014	77.0%	90.9%	98.0%	
2015	77.0%	90.9%		
2016	76.9%			

Accident Year	Average Paid Claim Severity ($) as of (months)			
	12	24	36	48
2013	2,000	2,000	1,999	1,999
2014	2,093	2,099	2,096	
2015	2,207	2,208		
2016	2,315			

Accident Year	Average Case Outstanding ($) as of (months)			
	12	24	36	48
2013	2,667	3,976	4,033	0
2014	2,798	4,184	3,158	
2015	2,950	3,305		
2016	2,309			

- There are no partial payments.
- There is no development after 48 months.

a. (2 points)

Estimate the accident year 2016 IBNR using the Berquist Sherman case outstanding adjustment.

b. (0.5 point)

Propose and briefly justify another appropriate technique for developing the accident year 2016 IBNR.

CONTINUED ON NEXT PAGE

25. (2 points)

The following information is available for an insurer as of December 31, 2016:

Accident Year	Cumulative Gross Reported Claims ($000) as of (months)			
	12	24	36	48
2013	2,757	5,570	6,880	7,047
2014	2,345	4,104	5,121	
2015	2,639	4,677		
2016	2,802			

Accident Year	Cumulative Reported Claims ($000) Ceded to Excess of Loss Treaty as of (months)			
	12	24	36	48
2013	0	745	1,332	1,332
2014	0	0	402	
2015	154	328		
2016	0			

Accident Year	Cumulative Paid Claims ($000) Net of Excess of Loss Treaty
2013	5,102
2014	3,834
2015	2,840
2016	1,385

- There is no reported claims development beyond 48 months.
- For each of accident years 2013 through 2015, the insurer maintained a stop loss reinsurance limit that applies after an excess of loss treaty.
- The stop loss limits are:

Accident Year	Stop Loss Limit ($000)
2013	5,000
2014	5,000
2015	5,000
2016	None

Calculate the unpaid claims net of all reinsurance for all accident years using the reported claims development technique.

CONTINUED ON NEXT PAGE

26. (2 points)

Given the following information:

Accident Year	Cumulative Paid Claims ($000) as of (months)			
	12	24	36	48
2013	750	1,125	1,350	1,485
2014	2,000	3,000	3,600	
2015	2,500	3,750		
2016	3,000			

Accident Year	Calendar Year Paid ULAE ($000)
2013	220
2014	220
2015	330

- Case reserves at December 31, 2016 = $3,500,000.
- IBNR reserves at December 31, 2016 = $1,000,000.
- The four-year weighted average ULAE to loss ratio = 10%.
- No business was written prior to 2013.

a. (0.5 point)

Estimate the unpaid ULAE using the classical technique.

b. (1 point)

Calculate the paid ULAE to paid claims ratio for calendar year 2016.

c. (0.5 point)

Assess the reasonableness of the unpaid ULAE estimate from part a. above.

CONTINUED ON NEXT PAGE

27. (1.5 points)

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

- Company management strengthened outstanding case reserves on all open claims during 2016.
- Four unusually large claims that occurred in 2015 have been paid and closed. There are no other large losses in the company's history.
- No adjustments were made to historical claim development factors.

Briefly assess the appropriateness of each reserving technique provided for each accident year below.

a. (0.5 point)

Accident year 2013:

i. Paid development technique.
ii. Reported development technique.

b. (0.5 point)

Accident year 2014:

i. Disposal rate frequency-severity technique.
ii. Reported Bornhuetter-Ferguson technique.

c. (0.5 point)

Accident year 2015:

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

CONTINUED ON NEXT PAGE

28. (1 point)

Given the following ultimate claim ratio estimates based on reported claims as of December 31, 2016:

Accident Year	Development Technique	Bornhuetter-Ferguson Technique	Frequency-Severity Technique
2012	61.9%	61.9%	61.9%
2013	61.6%	60.3%	61.2%
2014	61.8%	57.1%	61.7%
2015	61.5%	52.4%	61.8%
2016	72.4%	50.7%	61.7%

- The initial expected loss ratio used in the Bornhuetter-Ferguson technique is the same in all accident years.
- There has been no change to the mix of business written by the company.
- The company has not experienced any unusually large losses.

a. (0.5 point)

Assess the selected claim development factors used in the techniques.

b. (0.5 point)

Assess the initial expected loss ratio used in the Bornhuetter-Ferguson technique.

END OF EXAMINATION

Exam 5
Basic Techniques for Ratemaking and Estimating Claim Liabilities

23-Oct-17

POINT VALUE OF QUESTIONS

QUESTION	VALUE OF QUESTON	SUB-PART OF QUESTION (a)	(b)	(c)	(d)	(e)	(f)	(g)
1	1.50	1.00	0.50					
2	2.00	1.50	0.50					
3	1.50	0.50	0.50	0.50				
4	1.50	1.00	0.50					
5	2.00	2.00						
6	2.00	1.50	0.50					
7	2.00	0.75	0.25	0.25	0.75			
8	2.25	1.50	0.75					
9	1.75	0.50	0.50	0.75				
10	1.75	0.50	1.25					
11	1.50	0.50	0.75	0.25				
12	1.75	0.75	0.50	0.50				
13	2.25	2.25						
14	1.50	0.50	1.00					
15	4.75	0.50	0.75	0.50	3.00			
16	1.25	0.50	0.25	0.50				
17	1.50	0.75	0.75					
18	3.25	2.25	0.50	0.50				
19	2.25	1.00	0.50	0.75				
20	3.00	1.75	0.50	0.75				
21	1.25	1.25						
22	2.00	1.50	0.50					
23	2.25	1.50	0.75					
24	2.50	2.00	0.50					
25	2.00	2.00						
26	2.00	0.50	1.00	0.50				
27	1.50	0.50	0.50	0.50				
28	1.00	0.50	0.50					
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	55.75							

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: 752
- Available Points: 55.75
- Passing Score: 37
- Number of Passing Candidates: 301
- Raw Pass Ratio: 40.03%
- Effective Pass Ratio: 42.94%

QUESTION 1	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE: A2**
SAMPLE ANSWERS	
Part a: 1 point	

Sample 1

First trend to avg. written date of 2016Q4 – 11/15/2016

2nd trend to avg wrt date – 7/1/2018 which is 1.5 + 1.5/12 = 1.625

CY	Step 1	Step 2	Trend Factor
2014	242/210	$0.98^{1.625}$	1.115
2015	242/220	$0.98^{1.625}$	1.064
2016	242/235	$0.98^{1.625}$	0.997

Sample 2

Step 1 Trend factors:

CY	Step 1 Trend Factor	Step 1 Trend Period
2014	240/210 = 1.143	1/1/2014 to 7/1/2016
2015	240/220 = 1.091	1/1/2015 to 7/1/2016
2016	240/235 = 1.021	1/1/2016 to 7/1/2016

Step 2 Trend factor:

CY	Step 2 Trend Factor	Step 2 Trend Period
2014	$(1\text{-}2\%)^2$ = .9604	7/1/2016 to 7/1/2018 = 2 yrs
2015	$(1\text{-}2\%)^2$ = .9604	7/1/2016 to 7/1/2018 = 2 yrs
2016	$(1\text{-}2\%)^2$ = .9604	7/1/2016 to 7/1/2018 = 2 yrs

Total Trend factor:

CY	Step 1	X	Step 2	= Total
2014	240/210	X	.9604	1.0976
2015	240/220	X	.9604	1.0477
2016	240/235	X	.9604	0.9808

Sample 3

EP trend from mid of every calendar year to mid of Q4 2016 (step 1), from mid of 2016Q4 to Jan 1, 2019 (step 2).

2014 $236/210 * (1\text{-}2\%)^{2.125} = 1.077$

2015 $236/220 * (1\text{-}2\%)^{2.125} = 1.028$

2016 $236/235 * (1\text{-}2\%)^{2.125} = 0.962$

Sample 4
First trend period: 7/1/AY → 7/1/2016
Second trend period: 7/1/2016 → 1/1/2019 → 2.5 years

	first step trend	second step trend	trend Factor
2014	235/210 = 1.119	$0.98^{2.5}$ = 0.951	1.064
2015	235/220 = 1.068	$0.98^{2.5}$ = 0.951	1.016
2016	235/235 = 1	$0.98^{2.5}$ = 0.951	0.951

Sample 5
Look at calendar year year-over-year changes to EP & WP

CY	EP	WP
2014		
2015	+4.8%	+5.6%
2016	+6.8%	+7.1%

Looking at 4Q16 averages compared to CY would mean looking at 7/1/XX vs 11/15/XX avg. I will use an average of all 4 data points for retro trend which is 6.1%. Projected trend is -2% so I will use that for prospective.

Retro trend from 7/1/XX – 7/1/2016
Prosp trend from 7/1/2016 – 1/1/2019 → 2.5 yrs

CY	Trend Factor
2014	$(1.061)^2$ $(0.98)^{2.5}$ = 1.0683
2015	$(1.061)^1$ $(0.98)^{2.5}$ = 1.0087
2016	$(1.061)^0$ $(0.98)^{2.5}$ = 0.9507

Part b: 0.5 point

Any two from the following sample responses:

- A shift towards geographic regions with lower average premiums, resulting in decreasing average premiums
- Insureds tend to choose lower policy limit in the future
- Insureds tend to choose higher deductible in the future
- A shift in the mix of business towards classes with lower premiums
- Aging insureds receiving lower age factors in premium calculation
- Obtain another insurer with lower average premium
- An underwriting shift to focus on writing better risks (which typically have lower rates) could shift the mix of business and lower average premiums
- Deflation (rather than inflation) could cause negative premium trend for inflation-sensitive exposure bases

EXAMINER'S REPORT

Candidates were expected to understand how to determine premium trend factors and the circumstances that can cause changes in the average premium level.

Part a

Candidates were expected to calculate premium trend factors for each year using two-step trending. Several approaches were accepted for the current trend factor based on the data provided in the question, and candidates were expected to calculate the appropriate projected premium trend period based on their selected approach.

Common errors included:

- Using written premium in the denominator to calculate the first step trend factor.
- Projecting to an average earned date when the first step trend factor trended to an average written date, and vice versa.
- Selecting a historical annual premium trend that was much too high or too low based on the data provided if using a selected trend to calculate first step trend factor.
- Calculating the premium trend factor for only one year.
- Calculating the projected premium instead of the premium trend factor.

Part b

Candidates were expected to provide two distinct, reasonable explanations for why premium at current rate level may have negative trend.

Common errors included:

- Not providing enough detail (e.g. "change in limits" or "mix of business shift" without commentary on directionality of shift).
- Mentioning negative rate changes (either during the experience period or in the future). Premium trends should be analyzed at current rate level.
- Mentioning shrinking or growing book size without focus on average premium
- Explanations for why loss costs or expenses may have negative trend.
- Stating that a decrease in the inflation rate would lead to negative premium trend. A decrease in the inflation rate is not the same thing as a negative inflation rate (i.e. deflation), which is a valid explanation if the exposure base is inflation-sensitive.

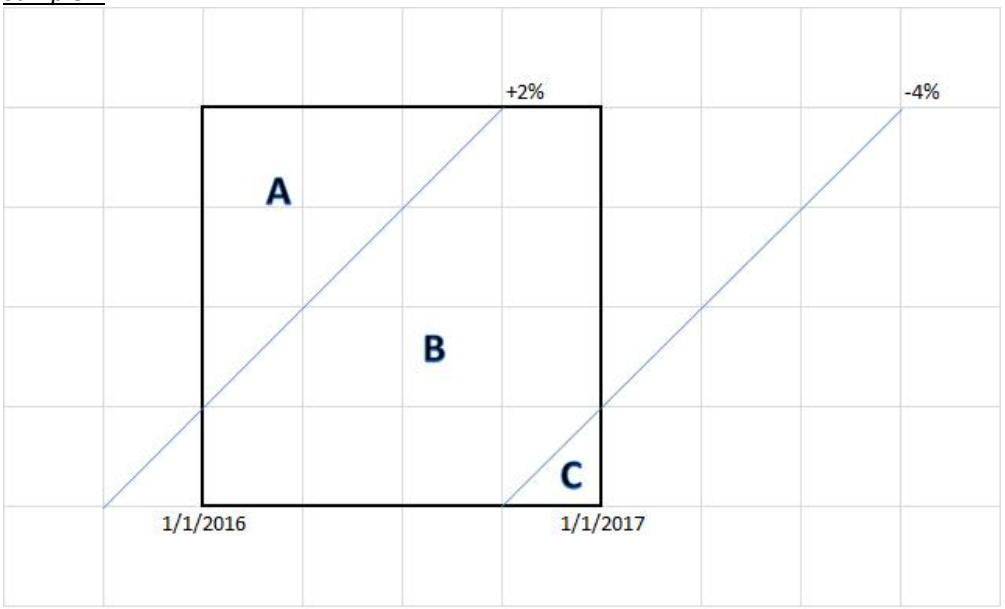
QUESTION 2

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): A2, A5**

SAMPLE ANSWERS

Part a: 1.5 points

Sample 1



CY16 Rate Level Calculations:

Area	***Area/Weight***	***Rate Level***
A	$(3/4)^2 * (1/2) = 9/32 = 0.28125$	1.05
B	1 – A – C = 1 - 0.28125 - 0.03125 = 11/16 = 0.6875	1.05*1.02 = 1.071
C	$(1/4)^2 * (1/2) = 1/32 = 0.03125$	1.05*1.02*0.96 = 1.02816

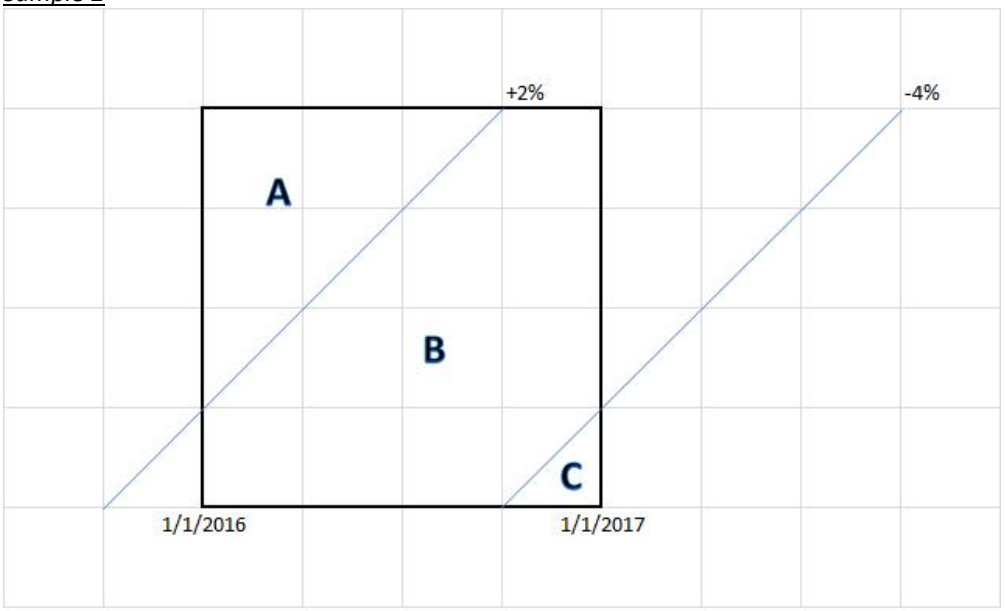
CY16 Average Rate Level (ARL) = 0.28125*1.05 + 0.6875*1.071 + 0.03125*1.02816 = 1.063755
CY16 Current Rate Level (CRL) = 1.05*1.02*0.96 = 1.02816
CY16 On-Level Factor (OLF) = CY16 CRL / CY16 ARL = 1.02816 / 1.063755 = 0.966538

Projected Premium Calculations:

CY	***EP @ CRL (or OLEP)***	***Trend***	***Proj EP @ CRL***
14	14,775 (*given*)	$1.02^{4.25} = 1.087804$	16,072
15	17,622 (*given*)	$1.02^{3.25} = 1.066475$	18,793
16	22,000 * CY16 OLF = 22,000 * 0.966538 = 22,264	$1.02^{2.25} = 1.045563$	22,233
Tot			57,098 (in 000s)

Notes:
Proj EP @ CRL = EP @ CRL * Trend (*ex. 14,775 * $1.02^{4.25}$ = 16,072*)
Trend period from 7/1/CY to 10/1/18

Sample 2



CY16 Rate Level Calculations:

Area	***Area/Weight***	***Rate Level***
A	$(9)^2$ * (1/2) / 144 = 9/32 = 0.28125	1.00
B	1 – A – C = 1 - 0.28125 - 0.03125 = 11/16 = 0.6875	1.02
C	$(3)^2$ * (1/2) / 144 = 1/32 = 0.03125	1.02*0.96 = 0.9792

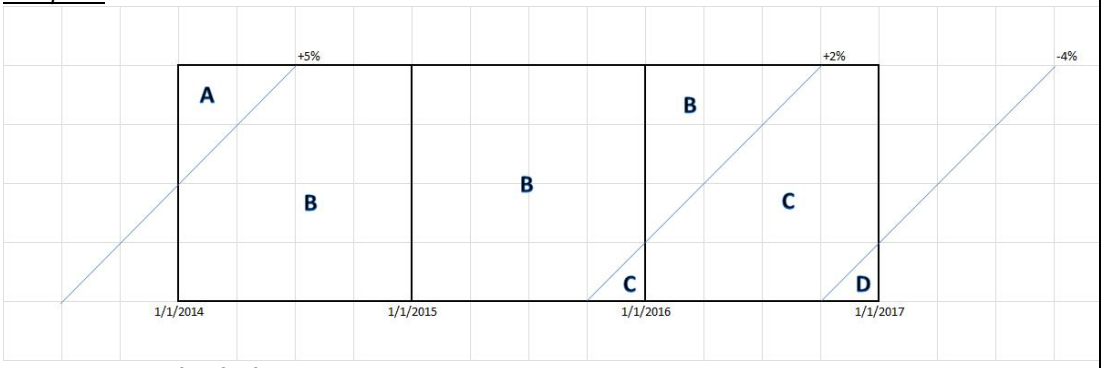
CY16 Average Rate Level (ARL) = 0.28125*1.00 + 0.6875*1.02 + 0.03125*0.9792 = 1.0131
CY16 Current Rate Level (CRL) = 1.02*0.96 = 0.9792
CY16 On-Level Factor (OLF) = CY16 CRL / CY16 ARL = 0.9792 / 1.0131 = 0.966538

Projected Premium Calculations:

CY	***EP @ CRL (or OLEP)***	***Trend***	***Proj EP @ CRL***
14	14,775 (*given*)	$1.02^{4.25}$ = 1.087804	16,072
15	17,622 (*given*)	$1.02^{3.25}$ = 1.066475	18,793
16	22,000 * CY16 OLF = 22,000 * 0.966538 = 22,264	$1.02^{2.25}$ = 1.045563	22,233
Tot			57,098 (in 000s)

Notes:
Proj EP @ CRL = EP @ CRL * Trend (*ex. 14,775 * $1.02^{4.25}$ = 16,072*)
Trend period from 7/1/CY to 10/1/18

Sample 3



CY14 Rate Level Calculations:

Area	***Area/Weight***	***Rate Level***
A	$(1/2)^2 * (1/2) = 1/8 = 0.125$	1.00
B	1 – A = 1 - 0.125 = 7/8 = 0.875	1.05

CY15 Rate Level Calculations:

Area	***Area/Weight***	***Rate Level***
B	1 – C = 1 - 0.03125 = 31/32 = 0.96875	1.05
C	$(1/4)^2 * (1/2) = 1/32 = 0.03125$	1.05*1.02 = 1.071

CY16 Rate Level Calculations:

Area	***Area/Weight***	***Rate Level***
B	$(3/4)^2 * (1/2) = 9/32 = 0.28125$	1.05
C	1 – A – C = 1 - 0.28125 - 0.03125 = 11/16 = 0.6875	1.05*1.02 = 1.071
D	$(1/4)^2 * (1/2) = 1/32 = 0.03125$	1.05*1.02*0.96 = 1.02816

Current Rate Level (CRL) = 1.05*1.02*0.96 = 1.02816

CY14 Average Rate Level (ARL) = 0.125*1.00 + 0.875*1.05 = 1.04375
CY15 Average Rate Level (ARL) = 0.96875*1.05 + 0.03125*1.071 = 1.05065625
CY16 Average Rate Level (ARL) = 0.28125*1.05 + 0.6875*1.071 + 0.03125*1.02816 = 1.063755

CY14 On-Level Factor (OLF) = CY16 CRL / CY16 ARL = 1.02816 / 1.04375 = 0.985063
CY15 On-Level Factor (OLF) = CY16 CRL / CY16 ARL = 1.02816 / 1.05065625 = 0.978588
CY16 On-Level Factor (OLF) = CY16 CRL / CY16 ARL = 1.02816 / 1.063755 = 0.966538

Projected Premium Calculations:

CY	*EP*	*EP @ CRL (or OLEP)*	*Trend*	*Proj EP @ CRL*
14	15,000	15,000*0.985063 = 14,776	$1.02^{4.25}$ = 1.087804	16,073
15	18,000	18,000*0.978588 = 17,615	$1.02^{3.25}$ = 1.066475	18,786
16	22,000	22,000*0.966538 = 22,264	$1.02^{2.25}$ = 1.045563	22,233
Tot				57,092 (in 000s)

Notes:
EP @ CRL = EP * OLF (*ex. 15,000 * 0.985063 = 14,776*)
Proj EP @ CRL = EP @ CRL * Trend (*ex. 14,775 * $1.02^{4.25}$ = 16,072*)
Trend period from 7/1/CY to 10/1/18

Part b: 0.5 point

Projected Loss Ratio = Projected Ultimate Loss & LAE / Projected EP @ CRL
= 40,000,000 / 57,098,000 = 0.70055

Indicated Rate Change = (LR + F) / (1 – V – Q) – 1
= (0.70055 + 0.08) / (1 – 0.2 – 0.05) – 1
= 0.0407 (or 4.07%)

EXAMINER'S REPORT

Candidates were expected to understand how to utilize each piece of the information provided to bring premiums to current rate level (via on-leveling) and apply trend to calculate projected premium. As a final step, the candidate is expected to determine the indicated rate change as a result of the projected premium.

Part a

Candidates were expected to understand the impacts of the historical rate changes on the calendar years and determine the average rate level for CY16. This required candidates to utilize the parallelogram method. Candidates needed to display an understanding of utilizing the average rate level and the current rate level to bring earned premium for CY16 to current rate level. Candidates could utilize a similar approach for CY14 and CY15, though the earned premium at current rate level for each was provided in the question instructions.

Candidates were then expected to understand how the annual premium trend would impact each of the calendar years and apply trend appropriately to project the earned premium at current rate level to the projection period where rates would be in effect.

Common errors included:

- Trending all earned premium grouped together across the CYs or not correctly understanding the starting and/or ending points in the one-step trend. Sometimes a

two-step trend was applied. The most common mistake made by candidates was in the trend step.

- Failing to realize that there were two rate changes that impacted the average rate level in CY16. The 10/1/15 rate change was often ignored in building the average rate level calculation.
- Calculating weights assigned to each of the different rate levels within CY16 incorrectly.
- Calculating the on level factors for CYs 2014 and 2015 incorrectly and carrying this forward through the solution, even though the EP @ CRL was given for these years.

Part b

Candidates were expected to utilize the projected premium from part (a) to calculate the indicated rate change using a loss ratio method.

Common errors included:

- Misreading question information and applying the fixed expense provision as an LAE load (LR * 1.08 instead of LR + 0.08) in the numerator
- Applying an incorrect trend within this part (for example, applying a factor of $1.02^{1.25}$ or $1.02^{2.25}$ to the 2014-2016 total EP or EP @ CRL)

QUESTION 3

TOTAL POINT VALUE: 1.5 | **LEARNING OBJECTIVE(S): A2**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

i) Calendar Year 2015 EP = 200 x (6/12) + 240 x (9/12) + 260 x (12/12) + 280 x (6/12) = $680
ii) Calendar Year 2015 WP = 260 x (12/12) + 280 x (12/12) = $540

Sample 2

i) Calendar Year 2015 EP = 200 x (.5) + 240 x (.75) + 260 x (1) + 280 x (.5) = $680
ii) Calendar Year 2015 WP = 260 + 280 = $540

Part b: 0.5 point

Sample 1

i) Policy Year 2015 EP = 260 + 280 x (.75) = $470
ii) Policy Year 2015 WP = 260 + 280 x (.75) = $470

Sample 2

i) Policy Year 2015 EP = 260 + 280 x (9/12) = $470
ii) Because it is as of 31/12/2016, premium is fully developed and
Policy Year 2015 EP = Policy Year 2015 WP = $470

Sample 3

i) Policy Year 2015 EP = 260 + 280 x (1-3/12) = $470
ii) Assuming no premium audit:
Policy Year 2015 EP = Policy Year 2015 WP = $470

Part c: 0.5 point

Any one of the following sample responses for advantages

- Premium and losses are fixed at the end of the calendar year
- Calendar year data will not develop into the future
- Once the calendar year is over, data is ready to be used
- CY aggregation does not have any development which makes it easy to use for the financial statements and other year-end statements
- Premium and losses are readily available
- Data is fixed at the end of the year so there is no uncertainty in the values. There is nothing to estimate once the year is over
- There is no report lag in calendar year aggregation
- Easy to obtain since it is needed for financial statement
- Data can be reconciled easily with financial data
- This information is typically collected for other financial reporting so it represents no additional expense to aggregate the data this way for ratemaking purposes

Any one of the following sample responses for disadvantages

- Calendar year data aggregation has a poor match of claims to premium
- Mismatch between premium and losses
- CY data does a poor job of estimating true loss and premium information as it does not develop
- It is not as accurate as policy year. If a policy cancels, it will not show in the financials until the calendar year report of the year of the cancellation
- Should not be used when there is shift in business such as shift in deductibles
- No development since it is fixed at the end of the period so cannot be used to calculate IBNR
- Because there is no development of CY data, it is not useful for developing ultimate claims estimate
- Calendar year data aggregation cannot reflect the true experience of premium earned and loss occurrence
- Mismatch in timing between premium and losses

EXAMINER'S REPORT

Candidates were expected to demonstrate knowledge of definitions and differences of the aggregation methods (calendar year, policy year, accident year), and how to calculate written premium vs earned premium

Part a

Candidates were expected to be able to calculate the EP and WP under the calendar year aggregation method

Common errors included:

- Calculating only one of the two (EP or WP) properly
- Excluding policy A ($200 x 6/12) in the calculation of the EP

Part b

Candidates were expected to be able to calculate the EP and WP under the policy year aggregation method

Common errors included:

- Miscalculating the number of months cancelled under policy D for both the calculation of the EP and WP

  e.g. Policy Year 2015 EP = 260 + 280 x (10/12) = $493

  Policy Year 2015 WP = 260 + 280 x (10/12) = $493
- Not recognizing that the WP and EP should be equal
- Calculating the EP and WP incorrectly

Part c

Candidates were expected to be able to demonstrate their understanding of the calendar year and policy year method by stating one advantage and one disadvantage of the CY method

Common incorrect responses for the advantage included:

- Easy to compare with losses
- Uses most recent data [more details were expected to prove understanding]
- Easy to use [more details were expected to prove understanding]
- Calendar year is not so commonly used in the industry, so many benchmarks are not used/useful in CY aggregation
- Development doesn't take as long as underwriting aggregation [the data doesn't develop faster – the method just ignores the development of the data written in the calendar year]
- There is no development beyond 12 months so no need to develop [there is no 12 months of development for all policy written in the calendar year]
- May not be accurate reflection of the actual data [more details were expected to prove understanding]
- Calendar year data does not develop [more details were expected to prove understanding]
- The data was developing faster

Common incorrect responses for the disadvantage included:

- Takes longer to become available
- May not be accurate reflection of the actual data [more details were expected to prove understanding]
- Calendar year data does not develop [more details were expected to show understanding]
- Loss data at the calendar year level is not correlated with exposures
- It can't reflect policies losses results since CY policies consist of all in-force policies and there is a large report lag of claims [candidates were expected to know the difference between earned, written and in force policies]

QUESTION 4

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

SAMPLE ANSWER 1

Part a: 1 point

Sample 1

i: $200 * (1.03)^3 + 175 * (1.03)^4 + 125 * (1.03)^5 = 560.42$

ii: $200 * (1.03)^5 + 125 * (1.03)^5 = 434.73$

Sample 2

	Rpt Lag			
RY	0	1	2	
2013	200	175	125	x1.03 (loss cost trend)
2014	206	180	128.8	
2015	212	185.7	132.6	
2016	218.5	191.2	136.6	B
2017	225	196.9	140.7	
2018	231.8	202.8	144.9	I
	ii			

Total loss cost per expos in 2013
= 200/0.4 = 500

i) 218.5 + 196.9 + 144.9 = 560.3

ii) 231.8 + 202.8 = 434.6

Part b: 0.5 point

Sample 1

The occurrence policy would need tail coverage.

Would need to add $175 * (1.03)^3 + 125 * (1.03)^3 + 125 * (1.03)^4$ to 560.42 = 1028.93

Sample 2

The customer requires coverage for the new 2016 occurrence policy (Answer a,i. $560.3) and coverage for lagged reports from 2014 and 2015.

$560.3 + 191.2 + 136.6 + 140.7 = 1028.8

EXAMINER'S REPORT

Candidates were expected to demonstrate knowledge of organizing data using calendar year, accident year, and report year information. They were expected to trend loss costs to different time periods and to calculate coverage costs based on different policy characteristics. Candidates were expected to understand both claims-made and occurrence coverage and how to aggregate losses by report year and report year lag.

Part a

Candidates were expected to aggregate loss costs given report year information for an occurrence policy. Candidates were also expected to calculate claims-made loss costs and understand how a retroactive date impacts coverage.

Common errors included:

- Trending incorrectly based on time periods and/or reporting lags.
- Failing to calculate the reporting lag correctly across occurrence periods.
- Failing to recognize that the loss cost given in the problem was only for one occurrence and one report year. Some candidates struggled with calculating full report period costs, given the report period costs for one occurrence period.

Part b

Candidates were expected to demonstrate knowledge of organizing data using calendar year, accident year, and report year information. The candidates were expected to trend loss costs to different time periods and calculate coverage costs based on different policy characteristics.

Common errors included:

- Miscalculating the tail portion of coverage.
- Failing to acknowledge that complete coverage would consist of the occurrence policy and the tail coverage.

QUESTION 5

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): A2, A3, B3**

SAMPLE ANSWERS

Sample 1

Accident Year	Trended Ult Reported Loss
2012	$1{,}500 * 1.05 * 1.03^4 = 1{,}772.676$
2013	$1{,}925 * 1.1 * 1.03^3 = 2{,}313.849$
2014	$1{,}749 * 1.2 * 1.03^2 = 2{,}226.617$
Total	6,313.142

Accident Year	Earned Premium	CRLF	OLEP
2012	3,000	1.05^4	3,646.52
2013	3,500	1.05^3	4,051.69
2014	3,300	1.05^2	3,638.25

Accident Year	Loss Ratio
2012	48.6%
2013	57.1%
2014	61.2%
All Year Avg	55.6%

BF formula:
2,470 + 55.6% * 3,800 * (1-1/1.4) = 3,074.1

Sample 2

Accident Year	Trended Ult Reported Loss
2012	$1{,}500 * 1.05 * 1.03^4 = 1{,}772.676$
2013	$1{,}925 * 1.1 * 1.03^3 = 2{,}313.849$
2014	$1{,}749 * 1.2 * 1.03^2 = 2{,}226.617$
Total	6,313.142

Accident Year	Avg. Rate Level	On-level Factor	On-level EP
2012	$0.5 * 1.0 + 0.5 * 1.05$	1.24515	3,735.45
2013	$0.5 * 1.05 + 0.5 * 1.05^2$	1.18586	4,150.51
2014	$0.5 * 1.05^2 + 0.5 * 1.05^3$	1.12939	3,726.98
2015	$0.5 * 1.05^3 + 0.5 * 1.05^4$	1.07561	3,441.952
2016	$0.5 * 1.05^4 + 0.5 * 1.05^5$	1.02439	3,892.682
	Current Rate Level = 1.05^5	Total '12-'14	11,612.947

ECR = 6,313.142/11,612.947 = .5436

BF formula:
2,470 + .5436 * 3,892.682 * (1 – 1/1.4) = 3,074.589

Sample 3

Accident Year	Earned Premium	CRLF	OLEP	Loss	CDF	Trend	Ult Loss	Loss Ratio
2012	3,000	1.2452	3,735.46	1,500	1.05	1.03^4	1,772.68	0.47455
2013	3,500	1.1859	4,150.51	1,925	1.1	1.03^3	2,318.85	0.5587
2014	3,300	1.294	3,726.99	1,745	1.2	1.03^2	2,226.62	0.59743
			11,612.96				6,313.14	.54363

BF Formula:
2,470 + 3,800 * .54363 * (1 – 1/1.4) = 3,060.22

EXAMINER'S REPORT

Candidates were expected to understand how to develop losses to ultimate, on-level premium, and trend losses to the appropriate time period. Answers that either brought premium to the *current* 2016 rate level or the *average* 2016 rate level were both awarded credit.

Additionally, candidates were expected to select a loss ratio and apply the Bornhuetter-Ferguson method correctly. If reasoning/assumptions were stated then the candidate could select any loss ratio from accident years 2012-2014 (weighted average, straight average, exclude certain years, etc.) to apply to the BF method and receive credit.

Common errors included:

- On-leveling or trending to the wrong dates
- Not applying development factors to losses
- Only providing IBNR portion of BF calculation rather than the ultimate loss
- Selecting a loss ratio not based on 2012-2014

QUESTION 6

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

NOTE FROM THE SYLLABUS AND EXAMINATION COMMITTEE

It was not the intention of this question to have the cutoff for the minimum/maximum to land in the middle of the given wage bands. Because of this ambiguity, reasonable assumptions, including assuming all workers in a band earn the average or a uniform distribution of workers across the band were accepted.

SAMPLE ANSWERS

Part a: 1.5 points

Sample 1

Min before change = 0.5(1500) = 750
Max before change = 1.25(1500) = 1875
Min after change = 0.75(1500) = 1125
Max after change = 1500

	[A]	[B]	[C]	[D]
Ratio	#workers	Average weekly wage per worker	Pre-Change Benefit	Post-Change Benefit
<50%	150	725	750	1125
50-75%	100	1100	880	1125
75-100%	95	1450	1160	1160
100-125%	50	1750	1400	1400
>125%	45	4800	1875	1500
Total	440	1500		

B = (Total Weekly Wages) / A
C = min(max(0.8 x B, 750), 1875)
D = min(max(0.8 x B, 1125), 1500)

Pre-change total benefits = sumproduct(A,C)
= (750 x 150) + (880 x 100) + (1160 x 95) + (1400 x 50) + (1875 x 45)
= $465,075
Post-Change total benefits = $528,950
Direct impact of benefit changes = (528,950/465,075) – 1 = **+13.73%**

Sample 2

Ratio to SAWW	# Workers	Curr Ben	Proposed
<0.5	150	750(150) = 112500	1125(150)
0.50-0.75	100	81150 = 81150	1125(100)
0.75-1.0	95	0.8(137,750) = 110200	108537.5
1.0-1.25	50	0.8(87500) = 70,000	0.8(87500)
>1.25	45	1875(45) = 84375	45(1500)
Total	440	458,575	527,287.5

SAWW = Total Wages/# Workers = 600,000/440 = 1500

Current comp = 0.8 x SAWW
Min = 0.5 x SAWW (1500 x 0.5 = 750) received by 0.5/0.8 -> ≤ 0.625
Max = 1.25 x SAWW (1.25 x 1500 = 1875) rec'd by 1.25/0.8 -> ≥ 1.5625

Since don't have ratio to SAWW broken at btwn 50-62.5 and 62.5-75, will allocate workers evenly into two buckets:
50-75%: 50 get min, 50 get 80% weekly wages
50(750) + 0.5(0.8)(110,000) = 81,500

Proposed comp =0.8 x SAWW
Min = 0.75(1500) = 1125 rec'd by 0.75/0.8 -> ≤ 0.9375
Max = 1.00(1500) = 1500 rec'd by 1.25/0.8 -> ≥ 1.25 x SAWW
Since don't have broken out will assume even split in ratio
Will allocate (95)(0.5)(1125) + (0.5)(0.8)(137750) = 108537.5

Impact to Company A = prop/curr = 527287.5/458575 = 1.149 or 14.98%

Part b: 0.5 point

Sample 1

- higher wage workers will avoid WC time off if possible
- more claims for lower benefit beneficiaries

Sample 2

- because of the raised minimum I would expect more low wage workers to submit claims and duration of healing to increase (less incentive to come back)
- because of the lower max benefit I would expect less high wage workers to submit claims and if they do, to come back to work sooner

EXAMINER'S REPORT

Candidates were expected to demonstrate knowledge of the impact on losses of law changes. Part a. focused on direct impacts on losses, and part b. on indirect impacts

Part a

Candidates were expected to calculate minimum and maximum benefits, determine benefit wages for each band, and then calculate total benefits by multiplying the benefit wage by the number of workers in each band and summing. This needed to be done for current and proposed benefit structures, and then total proposed and current benefits can be compared to determine a percent change.

Common errors included:

- applying min/max benefits incorrectly
- not applying the 0.8 factor to go from wage to benefit wage
- determining the benefit change as the difference between current and proposed benefits, rather than a percent change.

Part b

Candidates were expected to list two indirect effects of the benefit changes from part a.

A common mistake was mentioning the indirect impact of a min or max benefit change without also saying among which workers we would expect to see such an effect.

QUESTION 7

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): A4, A5**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1

U/W Expense Ratio = (3000 + 300 + 1000)/25000 + 2500/20000 = 0.297

Sample 2

Expense	Fixed	Variable
Agent Comm.	0%	3000/25000 = 12%
Other Acquis.	300/25000 = 1.2%	0%
Tax	0%	1000/25000 = 4%
General	2500/20000 = 12.5%	0%
Total	13.7%	16%

U/W Expense Ratio = 13.7% + 16% = 29.7%

Part b: 0.25 point

Sample 1

Operating Expense Ratio = U/W Expense Ratio + LAE/Premium = 29.7% + 1200/20000 = 35.7%

Sample 2

LAE Ratio = 1200/20000 = 6%

Operating Expense Ratio = U/W Expense Ratio + LAE Ratio = 13.7% + 16% + 6% = 35.7%

Part c: 0.25 point

Sample 1

Total PLR = 1 – U/W Expense – Profit = 1 – 0.297 – 0.05 = 0.653

Sample 2

Fixed Expense Ratio = 300/25000 + 2500/20000 = 0.137

Variable Expense Ratio including LAE = (3000 + 1000)/25000 + 1200/20000 = 0.22

100% = (TPLR + Fixed)/(1 – Variable – Profit) = (TPLR + 0.137)/(1 – 0.22 – 0.05)

TPLR = 0.593

Sample 3

Total Permissible Loss Ratio = 1 – Operating Ratio – Profit = 1 – 35.7% – 5% = 59.3%

Part d: 0.75 point

Sample 1

Variable Expense = 0.297 – 300/25000 – 2500/20000 = 0.16

Fixed Expense = 0.297 – 0.16 = 0.137
Indicated Rate Change = (0.65 + 0.06 + 0.137)/(1 – 0.16 – 0.05) – 1 = 0.07215 = 7.215%

Sample 2
Fixed Expense = 300/25000 + 2500/20000 = 0.137
Variable Expense = 0.297 – 0.137 = 0.16
Indicated Rate Change = (0.65 + 0.137)/(1 – 0.16 – 0.05) – 1 = –0.38%

Sample 3
Fixed Expense Ratio = 300/25000 + 2500/20000 = 0.137
Variable Expense Ratio including LAE = (3000 + 1000)/25000 + 1200/20000 = 0.22
Indicated Rate Change = (0.65 + 0.137)/(1 – 0.22 – 0.05) = 1.07808 or 7.808%

Sample 4
Indicated Rate Change = (65% + 300/25000 + 2500/20000)/(1–(4000/25000 + 1200/20000)–5%)-1
= (65% + 1.2% + 12.5%)/(1 – (16% + 6%) – 5%) – 1
= 78.7%/73% – 1
= 7.81%

EXAMINER'S REPORT

Candidates were expected to calculate the underwriting expense, operating, and total permissible loss ratios using the correct premium base and to calculate the indicated rate change using the premium-based projection method.

Multiple solutions were allowed, including:

1. Using LAE as a variable expense (as opposed to a loss expense) in the permissible loss ratio and indicated rate change calculations in parts c and d.
2. Excluding LAE in the calculation of the indicated rate change in part d.

Part a

Candidates were expected to calculate the agent commission, other acquisition cost, and premium tax & licensing fee ratios using written premium and the general expense ratio using earned premium and to calculate the underwriting expense ratio including all 4 expenses.

Common errors included:

- Using the wrong premium base to calculate one or more of the expense ratios without an appropriate assumption.
- Excluding one or more of the expenses in the total underwriting expense ratio calculation.

Part b

Candidates were expected to calculate the operating expense including all underwriting expenses as well as the LAE ratio to earned premium.

Common errors included:

- Using the written premium to calculate the LAE ratio.
- Excluding one or more of the expenses in the operating ratio calculation.
- Including profit in the operating ratio instead of the LAE ratio.

Part c

Candidates were expected to calculate the total permissible loss ratio. The calculation could or could not include LAE in the total permissible loss ratio depending on how LAE was treated throughout the problem.

Common errors included:

- Calculating the variable permissible loss ratio instead of the total permissible loss ratio.
- Not subtracting out profit from the total permissible loss ratio.

Part d

Candidates were expected to calculate the indicated rate change as either a factor or percentage of premium. Candidates were also expected to know that the premium-based projection method was appropriate given the information in the problem.

Common errors included:

- Using the all-variable expense method.
- Using the wrong premium bases to calculate the fixed and variable expense ratios.
- Multiplying the given loss ratio by 1+LAE/EP instead of adding the LAE/EP ratio.
- Mixing up which expenses were fixed vs. which were variable.
- Excluding the profit provision.

QUESTION 8

TOTAL POINT VALUE: 2.25 | **LEARNING OBJECTIVE(S): A5, A6**

SAMPLE ANSWERS

Part a: 1.5 points

Sample 1

Year	Loss Cost+LAE	Fixed Expense	Variable Expense
1	350 x 1.1 = 385	50	0.18P
2	1.1 x 350 x 1.03 = 396.55	6	0.18 x 1.04P

Premium	Profit	Net Cost
P	0.06P	P – 0.06P – 0.18P – 385 – 50 = 0.76P – 435
1.04P	0.06 x 1.04P	1.04P – 0.0624P – 0.1872P – 402.55 = 0.7904P – 402.55

0.76P – 435 + 0.8/1.05(0.7904P – 402.55) = 0
0.76P – 435 + 0.602P – 306.70 = 0
Premium = 544.57

Sample 2

	1	2
PP	350	360.5
FX	50	6
LAE	35	36.05
	435	402.55

(435 + 402.55 x 0.8/1.05)/(1 – 0.18 – 0.06) = 975.93
975.93 = X (1 + 0.8 x 1.04/1.05)
X = 544.49

Sample 3

	Pure Premium	fixed expense	retention ratio	discount rate	lae factor
2018	350	50	1	1	1.1
2019	350 x 1.03 = 360.5	6	80%	0.95	1.1

	Adj pure prem	adj fixed expense
2018	385	50
2019	301.4	4.56
Total	686.4	54.56

(686.4 + 54.56)/(1 – 18% – 6%) = 974.9
P + P x 1.04 x 80% x 0.95 = 974.9
P = 544.5

Part b: 0.75 point

Sample 1

1. A rate is an estimate of the expected value of future costs
   -Life time value looks at future costs and profit

2. A rate provides for all costs associated with the transfer of risk
   -Life time value looks at the current cost and how future profit makes up for that
3. A rate provides for all costs with an individual risk transfer
   -same as 2, but looking at individual policies
4. A rate is reasonable and not excessive, inadequate, or unfairly discriminatory if it is an actuarially sound estimate of the expected value of all future costs associated with an individual risk transfer
   -life time value takes future and current data into consideration

Sample 2

Life time value analysis considers all current and future expected costs over the life time of the policy. It allows the actuary to incorporate assumptions about retention ratio and difference in loss experience between new and renewal business to assess the present value of all future expected costs for the life time and the insured with insurer and not just on average. This can help make the rate more equitable and fair.

Sample 3

1. Life time value analysis prices to cover expected costs over the life time of a policy, so it meets this principle from a long term view
2. Life time value analysis prices according to the overall cost of transfer of risk in aggregate, as it prices to be profitable over all policies in the long term, thereby covering cost of risk transfer
3. Life time value analysis prices according to individual transfer of risk, as prices are set according to the expected individual cost of a policy over the policy's life time
4. Life time value analysis is not unfair or discriminatory as it is based on actuarial analysis including assumptions of persistency

EXAMINER'S REPORT

Candidates were expected to understand premium calculations consisting of all components including loss cost, LAE, fixed expenses, variable expenses and profit load including how the loss cost trend, retention ratio, discount factor and premium trend are applied on each component.

Candidates were also expected to know the statement of principles on ratemaking and to be able to connect the real life example with the principles.

Part a

Candidates were expected to know how to apply an LAE factor on loss cost to get pure premium, the required premium calculation formula, and how to apply loss trend, retention, discount factor and premium trend on 2nd year premium and premium components.

Common errors included:

- Not including LAE into loss cost
- Not applying retention ratio or discount on 2nd year indicated present value premium

- Not applying retention ratio or discount on fixed expenses
- Including premium trend in 2nd year indicated present value premium calculation
- Not including premium trend when calculating the 1st year premium

Part b

Candidates were expected to know the principles of statement for ratemaking and how to connect the real life ratemaking example to these principles.

Common errors included:

- Knowing the principles but not being able to connect with the real life example
- Knowing what the real life example does for ratemaking but not being able to connect with principles

QUESTION 9	
TOTAL POINT VALUE: 1.75	**LEARNING OBJECTIVE(S): A1, A7**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1
Hours worked.

Any two of the following three:

- It's proportional to the expected risk, as more hours nurses worked, more prob to cause accidents.
- It's easy to get from the employee system of hospital. So it's practical and objective, and easy to get and verify.
- Historical precedence: Hours worked is a common exposure base.

Sample 2
Number of nurses employed.

Any two of the following three:

- Proportional to expected loss: It makes sense that the more employees the hospital has, the more opportunity there is for a prof liab loss.
- Practical: This is clearly defined and should be easy to verify w/ HR.
- Considerate of historical precedence: Many insurers currently use # of professionals in a professional liab. Product.

Part b: 0.5 point

Any two of the following three:

Affordability – It's not good because younger nurse may be less experienced and their premiums will be higher. But they may earn less salaries since they are less experienced.

Causality – There is no causality between the age of the nurse and the likelihood of error they might make. Since some nurse may be older but they may just start the nursing career. Hence it's not causal to the expected loss. OR – Appropriate b/c it's easy to see causal relationship, that younger, inexperienced nurses are more likely prone to medical errors, and it increases public acceptance of the var.

Controllability – Age is not controllable since one cannot pick his/her age.

Privacy – Not appropriate b/c it violates privacy; nurses might feel their privacy violated by disclosing their ages against their will. OR – Age is okay given the consideration of privacy since there are many places that have and use the info: It's commonly used in insurance already.

Part c: 0.75 point

Competitor: Will charge correct rate for each class: $500 for Cardiac, $200 for General

Sample 1
Competitor

Competitor	Start	End	True Cost
Cardiac	100	100 x (1 – 0.2) =80	$500
General	100	120	$200

Insurer	Start	End	True Cost
Cardiac	100	100 + 20 = 120	$350
General	100	100 x (1 – 0.2) = 80	$350

Profit = 120 x (350 – 500) + 80 x (350 – 200) = -6,000

Sample 2

	# policy	change to # policy	# after renewal
Cardiac	100	+ 100 x 20%	120
General	100	+ 100 x 20%	80

Start: 2 x 100 x 350 = 70,000
Renewal: (120 + 80) x 350 – (120 x 500 + 80 x 200) = -6,000

After one renewal cycle the company will lose $6,000

EXAMINER'S REPORT

Candidates were expected to have a general knowledge of the criteria for an appropriate exposure base and the appropriateness of a rating variable in relation to social criteria.

Common errors included:

- Selecting characteristics that are not appropriate as an exposure base
- Commenting on the appropriateness of a characteristic as a rating variable and not as an exposure base
- Mistakenly using rate for loss cost
- Not calculating the impact on profit

Part a

Candidates were expected to know how to select an appropriate exposure base, and provide rationale for the selection.

Common errors included:

- Providing age, gender, or specialty as an exposure base.
- Listing a criterion for determining the appropriateness of an exposure base with no other explanation related for the specific exposure base.
- Commenting on the appropriateness of a characteristic as a rating variable and not as an exposure base. For instance stating "Legal – It should be legal to use this characteristic."

Part b

Candidates were expected to identify and explain two social criteria and the appropriateness of the age of a nurse as a rating variable.

A common mistake was to provide comments on the appropriateness of age as rating variable based on criteria that were not social criteria.

Part c

Candidates were expected to understand the impact of anti-selection on the number of insureds and the resulting impact to profit.

Common errors included:

- Showing a change in only one category of nurse (cardiac or general)
- Using an incorrect true cost
- Not calculating the impact on profit
- Discussing anti-selection without any calculations

QUESTION 10

TOTAL POINT VALUE: 1.75 | **LEARNING OBJECTIVE(S): A8**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

Univariate relativities do not adjust for exposure correlations. In this data, the class distributions are not the same in each territory.

Sample 2

Univariate indicated relativities cannot fully correct for exposure correlations between variables. Assuming "territory" and "class" are the only two variables in this model, there is exposure correlation between them. For example, most of Territory 1 is made up of Class A risks, which have a lower relativity. This is being "double-counted" in the Territory 1 factor, which is why it is too low.

Part b: 1.25 points

Sample 1

Terr 1 Adj Expos = 150(.85) + 70(1.15) + 110 = 318
Terr 2 Adj Expos = 105(.85) + 115(1.15) + 110 = 331.5
Terr 3 Adj Expos = 70(.85) + 180(1.15) + 125 = 391.5

Territory	Adj EE	PP	Ind Rel	Ind Rel @ Base
1	318	11,572	0.5167	0.4795
2	331.5	24,133	1.0775	1.0000
3	391.5	29,722	1.3270	1.2316

Sample 2

	(1)	(2)	(3)=(1)*(2)	(4)	(5)=(4)/(3)	(6)=(5)/(5 terr2)
Terr	Expos	Class Wtd Exp Adj	Adj Expos	Loss + ALAE (000s)	Ind PP	Ind Rel to Base (Terr 2)
1	330	0.964	318	3,680	11,572.33	0.48
2	330	1.005	332	8,000	24,096.39	1
3	375	1.044	392	11,636	29,683.67	1.232
Total			1042			

(2) Terr 1 ex: [150(0.85) + 70(1.15) + 110(1.00)] / 330 = 0.964

EXAMINER'S REPORT

Candidates were expected to identify assumptions of the univariate and adjusted pure premium methods and then apply the adjusted pure premium method to the provided data.

Part a
Candidates were expected to identify that the univariate indicated relativities assume a uniform distribution of exposures across other rating variables. Candidates were also expected to demonstrate that this assumption is violated in the data provided. A common mistake was identifying that univariate indicated relativities generally assume a uniform distribution but not discussing this assumption relative to the earned exposure distribution in the data provided.
Part b
Candidates were expected to use the adjusted pure premium method to develop indicated territorial relativities. This includes adjusting exposures for the average class factor by territory, calculating the adjusted pure premiums and relativities, and calculating final relativities keeping the same base territory. A common mistake was applying the average class factor by territory incorrectly, resulting in incorrect adjusted exposures within the territory.

QUESTION 11	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): A8**
SAMPLE ANSWERS	
Part a: 0.5 point	

Sample 1:
Yes, the GLM supports including territory as a rating variable because the chi-square percentage indicates a strong correlation for territory and expected losses. Also, the different relativities by territory accompanied by narrow confidence intervals in most territories suggests that policies should be rated differently by territory.

Sample 2
I believe the GLM output supports territory as a rating variable. The chi-square % is below the necessary threshold, which supports adding it. We see the tight error bands at each level and a clear upward trend in relativity and a great deal of lift between levels. My suggestion would be to consider grouping terr 4 with terr 3 given the lack of data and wider standard error bands.

Sample 3
YES, the GLM supports including territory as a rating variable. Standard errors are narrow, we can see an upward trend in the indicated relativity, chi-square % is also small meaning this variable is statistically significant.

Part b: 0.75 point

Any three of the following:

- Multivariate models allow for interaction between rating variables (univariate models do not)
- Consider all variables simultaneously & attempts to account for exposure correlation
- They produce model diagnostics which tell us about the appropriateness of fit of the model
- They attempt to focus on the "signal" rather than the "noise"

Part c: 0.25 point

Sample 1:
Two methods of spatial smoothing include distance-based and adjacency-based. Often, defined territories are so granular that very little data exists. Spatial smoothing allows one to have more data, and thus more credibility, when analyzing these granular territories. Both methods stated above incorporate neighboring territory data (based on distance away or adjacency) which will most likely lead to more narrow confidence intervals and more refined relativities. I would recommend spatial smoothing to get a finer relativity for territory 4 in the GLM output.

Sample 2:
Spatial smoothing can credibility-weight the territory's experience with the experience of surrounding territories. The further away from the territory, the less weight is given.

Sample 3:
Spatial smoothing can credibility-weight the territory's experience with the experience of surrounding territories. The further away from the territory, the less weight is given.

EXAMINER'S REPORT

Candidates were expected to interpret GLM output, understand the fundamentals of univariate and multivariate relativity analyses, and describe how spatial smoothing is used for developing territory indications.

Part a

Candidates were expected to be able to interpret the output of a GLM. They needed to correctly identify that territory should be included as a rating variable and provide at least one reason to justify why territory is an appropriate rating variable in the context of a multivariate analysis.

Common errors included:

- Concluding that territory should NOT be included as a rating variable
- Providing incorrect justification to why territory should be included as a rating variable

Part b

Candidates were expected to provide three benefits of multivariate models over univariate.

Common errors included:

- Not providing 3 distinct reasons. For example, if the candidate referenced correcting for exposure correlation and distributional bias as two separate reasons, credit was only given for one of those responses.
- Only providing 2 responses

Part c

Candidates were expected to discuss how spatial smoothing uses information from nearby territories to improve the territory relativity estimates.

Common errors included:

- No response. Candidates left part c blank more frequently than the other parts.
- Discussing boundary redefinition or clustering rather than spatial smoothing

QUESTION 12	
TOTAL POINT VALUE: 1.75	**LEARNING OBJECTIVE(S): A8, A9**
SAMPLE ANSWERS	
Part a: 0.75 point	
Current Losses = 500M x (2.9 – 2.5) = 200M Indicated Losses = 500M x (3.0 – 2.75) = 125M The company's experience was better than expected for this layer.	
Part b: 0.50 point	
Any of the following: • The company did not experience any losses greater than $750,000, but the current ILFs suggest this is possible. If they plan to offer limits above $750,000, their pricing with the indicated ILFs will likely be inadequate. • Indicated ILFs are not appropriate since the ILF for 750k = ILF 1M. This means the company will not be charging any additional premium for increased coverage which is not appropriate. • Indicated ILFs are not appropriate since the ILF for 750k = ILF 1M. This is likely due to lack of data in the higher layers, so these ILFs are not very credible.	
Part c: 0.50 point	
Any of the following for the approach: • Curve fitting will use the company's own experience, and if properly implemented, considers an appropriate charge for the higher layers without loss experience. • Use Industry ILFs or Industry benchmarks for policies with limit greater than $1M. • Credibility weight company ILFs with Industry ILFs/Benchmarks. • Calculate the ILFs for policies with limit greater than 1M using ground up / uncensored loss data. • Simulate losses in excess of $1M and calculate ILFs using the simulated loss data for new policy limits. Any of the following for the implementation challenge: • The challenge with curve fitting is that curve selection is not trivial, and the behavior of the largest losses is difficult to model. • Curve fitting fit may be impacted by the lack of losses in higher layers if the company's data is censored at the policy limit. • The company may have a challenge implementing any solution due to the lack of loss data in higher layers or due to censored losses due to policy limits. This could cause results that aren't very credible. • The company may be challenged with allocating additional capital due to the additional risk of higher limit policies. • The company may be challenged with purchasing additional reinsurance due to the risk of writing more higher limit policies.	

EXAMINER'S REPORT

Candidates were expected to demonstrate their knowledge of how different limits of liability are priced using ILFs. This question expected that candidates understand how ILFs are used in pricing, and what they represent in terms of the underlying expected losses in each layer.

Part a

Candidates were expected to be able to calculate the losses in the 500k-1M layer based on both the current and indicated ILFs and show some type of comparison between the expected loss amounts. In order to receive full credit candidates needed to show, or make mention of the difference between current and indicated losses.

Common errors included:

- Only calculating the losses in the layer for both current and indicated ILFs, but not attempting to compare the losses. (Eg. Indicated losses were less than current by $75M).
- Not comparing current vs. indicated losses.
- Only calculating the expected losses in the layer for one of either current or indicated ILFs.
- Calculating the losses for an incorrect layer.
- Using an incorrect formula to calculate losses expected in the layer.

Part b

Candidates were expected to notice that the Indicated ILFs for 750K and 1M limits were equal to each other and therefore inappropriate, as well as to explain either what the cause or effect of this was.

Some candidates did try to assess the indicated ILFs without noticing that the 750k and 1M limit ILFs were equal. Candidates that assessed the indicated ILFs as appropriate did not receive credit unless they were able to comment on the inappropriateness of having equal ILFs for two separate limits.

Common errors included:

- Not identifying the 750K and 1M being equal
- Not offering a cause or effect of the two ILFs being equal

Part c

Candidates were expected to show an understanding of how to calculate ILFs for a limit of liability that was not previously offered by the insurance company, along with an implementation challenge the company would face with offering a new higher limit of liability.

Candidates only received full credit if they explained how their offered approach actually led to the calculation of new ILFs. For example, "Use industry ILFs" or "Credibility weight Insurer ILFs with Industry ILFs" were acceptable responses, however "Use Industry data" was not specific enough. Also some candidates did simply state "Use GLMs" as an approach, but did not clarify how ILFs could be calculated using GLMs, or how this approach was beneficial to pricing new limits being offered.

Common errors included:

- Offering only an approach and not a challenge / offering only a challenge and not an approach
- Not offering an approach specific enough to demonstrate how ILFs were calculated for new limits
- Not offering a challenge relating to implementation of new higher limit policies.
- Offering an incorrect explanation of curve fitting.

QUESTION 13	
TOTAL POINT VALUE: 2.25	**LEARNING OBJECTIVE(S): A8**
SAMPLE ANSWERS	

Sample 1

Weighted change due to relativity modifications:

[(.7/.8)(90) + (1.0/1.0)(300) + (1.1/1.15)(260)] / 650 = 0.9653

Off-balance: 1/.9653 = 1.036

Overall Uncapped Territorial Changes:
T1: .(.7/.8) x 1.036 x 1.1 – 1 = -0.29%
T2: (1.0/1.0) x 1.036 x 1.1 – 1 = +13.95%
T3: (1.1/1.15) x 1.036 x 1.1 – 1 = +9.0%

T2 Must be capped at +13%

Premium Shortfall due to T2 capping = (.1395 - .13) x 300 = 2.85

Premium Adjustment to T1 and T3 to cover shortfall:

1.0 + 2.85 / [(1 – .0029) x 90 + (1.09) x 260] = 1.0076

Adjustment to base rate: (1.13) / (1.1395) = 0.992

Final Total Adjustment to T1 and T3: 1.0076 / 0.992 = 1.016

Final Relativities:

T1: 0.7 x 1.016 = .7113
T2: 1.0 <- - - Base Level
T3: 1.1 x 1.016 = 1.118

Sample 2

Weighted average:

[90(.875) + 300 (1.0) + .9565 (260)] / 650 = 0.9653

Off-balance: 1.0359

Overall Change Impact:
T1: 0.875 x 1.0359 x 1.1 – 1 = 0.9971
T2: 1 x 1.0359 x 1.1 – 1 = 1.1395
T3: 0.9565 x 1.0359 x 1.1 – 1 = 1.0900

Since T2 impact exceeds 13%, we need to cap it.

Territory	New Premium	Capped Prem (13% Max)
1	90 x .9971 = 89.74	89.74 + (341.85 – 339) x 24% = 90.42
2	341.85	339
3	283.40	283.40 + (2.85) x (1 – 24%) = 285.57

89.74 / (89.74 + 283.40) = 24%

Territory	Capped Impact
1	90.42 / 90 = 1.0047
2	1.13
3	1.0983

Territory	Capped Indicated Terr Factor	Rebased
1	1.0047 x .8 = 0.804	0.711
2	1.13 x 1.0 = 1.13	1.00
3	1.0983 x 1.15 = 1.263	1.118

EXAMINER'S REPORT

Candidates were expected to develop uncapped relativities (or premiums) for each territory and determine the required adjustments in order to achieve an overall +10% rate change without any territory receiving a total adjustment of more than +13%. These adjustments then needed to be converted into final territorial relativities.

Common errors included:

- Inaccurate weighting of initial relativity changes
- Failing to adjust the territorial relativities by 0.992 to reflect the capping in T2
- Applying the total indicated changes to the incorrect relativities in the final step of the calculation

QUESTION 14	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): A10**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

84000 + 22000 = 106k loss

$$\frac{300k}{500k \times (\text{ratio})} = \frac{84k}{106k}$$

Coinsurance = .757

Sample 2

$$\frac{84}{84 + 22} = \frac{300}{500r}$$

r = 75.7%

Part b: 1 point

Any two of the following:

- Provide guaranteed replacement cost if insured to value
- Property Valuation Software: Insurers can analyze their inforce homeowners portfolio through a property valuation software to identify underinsured properties and inform our customers.
- Perform home inspections and make compulsory for insured to insure homes to full value
- Inflation Guard – Including an inflation guard in the rating program would automatically increase coverage, say 5%, each year. This encourages insurance to value because coverages automatically increase each year with inflation.
- Marketing - Keep the homeowners aware of the benefit of insurance to value
- Educate the insureds on the benefits of being insured to value (that is they would be fully indemnified after a loss)
- education – teach consumers that underinsuring their homes puts them at risk in case of large or total losses
- Coinsurance clauses limit payments on partial losses which incentivizes insuring to value to avoid the coinsurance penalty.

EXAMINER'S REPORT

Candidates were expected to understand the coinsurance formula and demonstrate knowledge of methods to resolve insurance to value coverage issues.

Part a

Candidates were expected to demonstrate how to calculate the required coinsurance percentage given other information about the policy and loss.

Common errors included:

- Using the Indemnity payment as the amount of loss.
- Providing only the apportionment ratio rather than the required coinsurance percentage.
- Failing to show all calculations for the amount of loss, apportionment ratio, coinsurance requirement and/or required coinsurance percentage.

Part b

Candidates were expected to demonstrate knowledge of insurance to value coverage issues by providing two different initiatives that an insurer could reasonably implement that would encourage insurance to full value. They were also expected to be able to explain how each initiative would encourage insurance to full value.

Common errors included:

- Describing an initiative without explaining how it encourages insurance to full value.
- Providing an underwriting initiative that depends on foreknowledge of home replacement value, which is generally unknown without a loss or some sort of initiative to first determine the home replacement value.
- Providing a rating initiative that not only depends on foreknowledge of home value, but would also depart from the actuarial standard that a rate be based on an estimate of future costs, not as an inducement for a particular insured behavior.
- Describing the impact of limits on total losses, which is a basic policy feature that is designed to limit loss exposure for the insurer rather than encourage insurance to full value.
- Describing the impact of underinsurance on the insurer and/or insured rather than providing an initiative to help prevent it.

QUESTION 15

TOTAL POINT VALUE: 4.75 | **LEARNING OBJECTIVES: A2, A3, A4, A5, B3, B8**

SAMPLE ANSWERS

Part a: 0.5 point

AY	Reported Loss+ALAE	CDF	Ultimate Loss+ALAE = Reported Loss+ALAE * CDF
2014	5615	1.07	6008
2015	4315	1.464	6317
2016	2745	3.058	8394

Part b: 0.75 point

AY	EP	Expected Loss+ALAE = 56% * EP	CDF	% Unreported = 1 - 1 / CDF	Unreported Loss+ALAE = % Unrep * Exp Loss	Reported Loss+ALAE	Ultimate Loss+ALAE = Unrep + Rep
2014	10800	6048	1.070	6.5%	393	5615	6008
2015	11250	6300	1.464	31.7%	1997	4315	6312
2016	12375	6930	3.058	67.3%	4664	2745	7409

Part c: 0.5 point

Any two of the following:

- Results for 2014 and 2015 are similar, select either technique (or an average)
- Selected B-F method because 2016 is immature
- 2016 CDF is highly leveraged, selected BF method
- B-F is more stable
- B-F is credibility weighted between loss development and expected loss ratio
- B-F method is not responsive to the loss ratio increase so I selected the development method
- Rate change causes the expected loss ratio used in the B-F method to be inappropriate, selected development method
- Both methods overstate the ultimate but the development method more so, used B-F method
- Calculating loss ratios and concluding that they are different than the given ELR, which makes the B-F method inappropriate

Part d: 3 points

Using Bornhuetter-Ferguson method:

AY	EP	Average Rate Level	On-Level Factor	Premium Trend	On-Level Trended EP
2014	10800	1.000	1.050	1.04^4	13268
2015	11250	1.006	1.044	1.04^3	13213
2016	12375	1.044	1.006	1.04^2	13470
					39951

Trend from average earned date of CY 7/1/YY to average earned date of prospective period 7/1/2018
Trend from average accident date of CY 7/1/YY to average accident date of prospective period 7/1/2018 for loss

AY	Ultimate Loss+ALAE	Loss Trend	Trended Ultimate Loss+ALAE	Ultimate Trended Loss+ALAE Ratio	Ultimate Trended Loss+LAE Ratio
2014	6008	1.05^4	7306	55.1%	58.4%
2015	6312	1.05^3	7309	55.3%	58.6%
2016	7409	1.05^2	8172	60.7%	64.3%
			22787	57.0%	60.5%

(Candidates can select any reasonable Ultimate Trended Loss+LAE Ratio)

Indication = [(60.5% +15%) / (1 – 25% – 5%)] – 1 = 7.8%

Using Development Method:

AY	EP	Average Rate Level	On-Level Factor	Premium Trend	On-Level Trended EP
2014	10800	1.000	1.050	1.04^4	13268
2015	11250	1.006	1.044	1.04^3	13213
2016	12375	1.044	1.006	1.04^2	13470
					39951

Trend from average earned date of CY 7/1/YY to average earned date of prospective period 7/1/2018
Trend from average accident date of CY 7/1/YY to average accident date of prospective period 7/1/2018 for loss

AY	Ultimate Loss+ALAE	Loss Trend	Trended Ultimate Loss+ALAE	Ultimate Trended Loss+ALAE Ratio	Ultimate Trended Loss+LAE Ratio
2014	6008	1.05^4	7306	55.1%	58.4%
2015	6317	1.05^3	7315	55.4%	58.7%
2016	8394	1.05^2	9259	68.7%	72.8%
			23880	59.8%	63.4%

(Candidates can select any reasonable Ultimate Trended Loss+LAE Ratio)

Indication = [(63.4% +15%) / (1 – 25% – 5%)] – 1 = 12.0%

EXAMINER'S REPORT

Candidates were expected to develop losses using both the loss development and Bornhuetter-Ferguson techniques. They were expected to know the strengths and weaknesses of these techniques, and when it would be appropriate to use each. They were also expected to be able to calculate the basics of ratemaking including, on-level, trend, and expense factors.

Part a

Candidates were expected to calculate and apply a cumulative development factor.

Common errors included:

- not applying cumulative development factors
- trending the losses when it was not asked for

Part b

Candidates were expected to use the Bornhuetter-Ferguson method to estimate ultimate losses.

A common mistake was on-leveling and/or trending the premium used in the expected loss calculation.

Part c

Candidates were expected to select a method of loss development for each year and provide a justification of each selection.

Common errors included:

- not making a selection
- not having two distinct justifications

Part d

Candidates were expected to calculate on-level factors and trend factors with the appropriate trend periods. They were expected to apply these to the premium and ultimate selected losses to develop loss ratios. A selected loss ratio then had to be adjusted by expenses to develop an indicated rate need.

Common errors included:

- miscalculating average rate level factors
- determining trend period incorrectly
- not applying trend or ULAE to losses

QUESTION 16	
TOTAL POINT VALUE: 1.25	**LEARNING OBJECTIVES: A2, B6**
SAMPLE ANSWERS	
Part a: 0.5 point	
0 for policies 1 and 2 Policy 3: 10K x 7/12 = 5,833 Policy 4: 15K x 11/12 = 13,750 Policy 5: 8K x 100% = 8,000 Total = 27,583	
Part b: 0.25 point	
Policy 4 only: 15K x 1/12 = 1,250	
Part c: 0.5 point	
0 for claims 1 and 2 Claim 3: 1000 + 2000 = 3000 Claim 4: 4000 – 1000 = 3000 Total = 6000	
EXAMINER'S REPORT	
Candidates were expected to perform calculations for premium (earned and unearned) and reported loss net of reinsurance.	
Part a	
Candidates were expected to determine which policies had premium earnings in the period, determine the appropriate earnings ratio, and calculate earned premium. Common errors included: • assuming that all policies had earnings in 2016 • incorrect proration of one or more of the policies (for example, a ratio of 5/12 for policy 3 instead of 7/12)	
Part b	
Candidates were expected to determine which policies had unearned premiums as of the period end, determine the appropriate remaining policy term, and calculate the amount. Common errors included: • incorrect policies • incorrect proration terms	

Part c

Candidates were expected to determine which claims occurred in the policy term and calculate reported loss, net of reinsurance.

Common errors included:

- use of paid loss without case reserves
- incorrect claims used in calculation
- showing only the recoveries

QUESTION 17

TOTAL POINT VALUE: 1.5 | **LEARNING OBJECTIVES: B1**

SAMPLE ANSWERS

Part a: 0.75 point

Any three of the following:

- As the internal data shows that there is a difference between the BI and PD claims, separating the claims will yield more accurate estimates.
- If the distributions of claim type are changing over time, then continuing to produce on a combined basis will produce inaccurate results.
- Internal data may be very different from industry data with respect to mix of business, claim handling practices, development patterns, etc. and using internal data only may improve accuracy of the reserves; relying on internal data only will increase homogeneity of data used in reserve analysis.
- Claim accuracy will improve pricing of products and improve competitive edge
- Will be able to more accurately and with greater ease diagnose changing patterns/trends for individual claim type

Part b: 0.75 point

Any three of the following:

- The company only started writing five years ago, so true emergence may not have been borne out, especially for a long tailed line like bodily injury.
- Company has been supplementing with external data so it's very likely that internal data may not be credible on its own.
- Further break-down of the data to individual claim type may further compromise any credibility in the data, leading to inaccurate and volatile estimates.
- The benefit in the possibly more accurate results are not offset by the additional work and resources required to conduct additional reserve analyses.
- Key financial metrics used by investors/shareholders could be misleading if there are drastic swings in the reserve estimates.

EXAMINER'S REPORT

Candidates were expected to demonstrate general knowledge with respect to: homogeneity and credibility of data, fundamentals of different types of insurance, types of data and their sources, understanding of 'development patterns', etc.

Candidates were expected to demonstrate advantages and disadvantages for BOTH separating Auto Claims by claim type with respect to a reserve analysis, and moving from supplementing internal with external data to analyzing with internal data only.

Part a

Candidates were expected to demonstrate an understanding of the advantages/benefits that come from: separately analyzing PD vs BI claims with respect to a reserve analysis, AND those that come from reliance only on the company's internal data.

Common errors included:

- Only addressing the claim type split, or the internal vs external data component, but not both.
- Only responding with an acknowledgment that BI vs PD claims develop differently, as the question states, but fail to appropriately tie that to accuracy of the reserve estimate or other diagnostics/conclusions that may be drawn from evaluating claim types separately.
- Broadly assuming that insurers writing business for 5 years results in fully credible internal data, even by claim type. Candidates who responded with this, generally contradicted this statement in part b (appropriately), acknowledging 5 years is too immature, especially for BI claims to be fully reliant on internal data.

Part b

Candidates were expected to demonstrate an understanding of the disadvantages/drawbacks that come from: separately analyzing PD vs BI claims with respect to a reserve analysis, AND those that come from reliance only on the company's internal data.

Common errors included:

- Only addressing the claim type split, or the internal vs external data component, but not both.
- Generalization of 'lack of credibility;' there were opportunities to mention both lack of credibility for internal data only due to immaturity of company data, as well as credibility lost by further splitting down to claim type level, which would have received additional credit.
- Mentioning the possibility of claims not being able to be broken out, but the question has already stated that internal data is down to this grain since differences in development patterns have been recognized.

QUESTION 18

TOTAL POINT VALUE: 3.25 | **LEARNING OBJECTIVES: B2, B3**

SAMPLE ANSWERS

Part a: 2.25 points

Sample 1

Reported Claim Count Age to Age

	6-12	12-18	18-24	24-30	30-36
2014-1	.95	.998	.999	1.0	1.0
2014-2	.95	.998	.999	1.0	
2015-1	.95	.998	.999		
2015-2	.95	.998			
2016-1	.95				
Selected	.95	.998	.999	1.0	1.0
CDF	.947	.997	.999	1.0	1.0

Severity Age to Age

	6-12	12-18	18-24	24-30	30-36
2014-1	1.008	.998	.999	1.0	1.0
2014-2	1.025	.998	.999	1.0	
2015-1	1.008	.998	.999		
2015-2	1.025	.998			
2016-1	1.008				
1st half sel	1.008	.995	.999	1.0	1.0
1st half CDF	1.002	.994	.999	1.0	1.0
2nd half sel	1.025	.995	.999	1.0	1.0
2nd half CDF	1.01885	.994	.999	1.0	1.0

201601 = 3705 x .997 x 4637 x .994 = 17,025,773
201602 = 4100 x .947 x 4500 x 1.01885 = 17,801,500
Total = 34,827,273

Sample 2

CC

AHY	6-12	12-18	18-24	24-30	30-36
14-1	3515/3700 = .95	.998	.999	1.00	1.00
14-2	.95	.998	.999	1.00	
15-1	.95	.998	.999		
15-2	.95	.998			
16-1	.95				

						Tail
Selected	.95	.998	.999	1.00	1.00	1.00
Cumul	.947	.997	.999	1.00	1.00	1.00

AHY	Rept Claim Cnt	CDF	Ult CC
2016-1	3705	.997	3694
2016-2	4100	.947	3883

Sev

AHY	6-12	12-18	18-24	24-30	30-36
14-1	4651/4600 = 1.008	.995	.999	1.00	1.00
14-2	1.025	.995	.999	1.00	
15-1	1.008	.995	.999		
15-2	1.025	.995			
16-1	1.008				

						Tail
H1 selected	1.008	.995	.999	1.00	1.00	1.00
H1 cumul	1.002	.994	.999	1.00	1.00	1.00
H2 selected	1.025	.995	.999	1.00	1.00	1.00
H2 cumul	1.019	.994	.999	1.00	1.00	1.00

AHY	Rept Sev	Ult Sev	Ult CC	Ult Claims
2016-1	3705	4609	3694	17025646
2016-2	4100	4586	3883	17807438
				34833084

Sample 3

Rptd Claim Counts – Dev Factors

AHY	6	12	18	24	30
2014-1	.95	.998	.999	1.00	1.00
2014-2	.95	.998	.999	1.00	
2015-1	.95	.998	.999		
2015-2	.95	.998			
2016-1	.95				
Sel	.95	.998	.999	1.00	1.00
CDF	.9472	.997	.999	1.00	1.00

AHY Ult Counts

2016-1 3705(.997) = 3694

2016-2 4100(.9472) = 3884

Rptd Sev – Dev Factors

First Half	6	12	18	24	30
2014	1.008	.995	.999	1.0	1.0
2015	1.008	.995	.999		
2016	1.008				
Sel	1.008	.995	.999	1.0	1.0
CDF	1.002	.994	.999	1.0	1.0

Rptd Sev – Dev Factors

Second Half	6	12	18	24	30
2014	1.025	.995	.999	1.0	1.0
2015	1.025	.995	.999		
Sel	1.025	.995	.999	1.0	1.0
CDF	1.019	.994	.999	1.0	1.0

AHY Ult Sev

2016-1 4637(.994) = 4609

2016-2 4500(1.019) = 4586

AY 2016 Ult Claims = 3694(4609) + 3884(4586)
= 34,837,670

Part b: 0.5 point

Sample 1
Since claim counts exclude claims closed with no payment, a claim that is reported early on that ultimately has no payment is removed from the claim counts so there is a decrease in number of claims.

Sample 2
Due to the exclusion of claims closed w/o pay. These will be in triangle when open, but will fall out when they close, thus showing downward dev.

Sample 3
Reported claim counts exclude claims closed with no payments. As long as some claims are opened and then closed without payment, and those claim counts are more than incremental new claim counts, downward dev would happen.

Part c: 0.5 point

Sample 1
To test for seasonality, evaluate closed to reported claim counts at half years. The ratios will be lower in seasons with slower claim payment & higher with faster claim payment.

Sample 2
Diagnostic that can test seasonality is implied frequency. For example claim/exposure, may be frequent increase during the winter months because of weather conditions and decrease during summer months. This could be seen with frequency over time.

Sample 3
A diagnostic can be a tringle of monthly or quarterly reported claim counts % of AY total reported claim counts to see if some months or quarters see a higher percentage than others.

Sample 4
Reported to closed counts – should increase during the "in season times". For example, for boat owners coverage, more claims will be reported during the seasonal times when boats are in use and expect claims to close at a consistent rate.

EXAMINER'S REPORT

Candidates were expected to demonstrate knowledge regarding development techniques, recognition of seasonality in data, and calculation of ultimate claims as the product of ultimate claim counts times ultimate severity. Candidates were expected to explain the downward development observed in the given claim count triangle. Candidates were also expected to discuss a diagnostic that could be used to test for seasonality.

A common mistake included failing to recognize and reflect the seasonality of the given severity data in their calculations.

Part a

Candidates were expected to calculate ultimate claims for accident year 2016 by multiplying ultimate claim counts times ultimate severity, and summing across each of the 2016 accident half-years.

Ultimate claim counts for each accident half-year can be calculated through application of the chain ladder method on the given reported claim count triangle.

Ultimate severity can be calculated through application of the chain ladder method on the given reported severity triangle. Given that the data was on an accident half-year basis, candidates were expected to recognize the seasonal differences in severity development for the first half of an accident year compared to the second half, and to select separate development patterns for projecting half year severities to ultimate in order to reflect this. Selecting a single development pattern by taking a straight average of severity development factors across all accident half-years would not be appropriate, as this would fail to reflect the seasonality of the data in the ultimate projections.

Common errors included:

- Selecting a single development pattern for severity and applying it to all accident half-years, as opposed to selecting different development patterns for the first half and second half of an accident year in order to reflect seasonal differences.
- Summing the ultimate claim counts and summing the ultimate severities for each of the 2016 accident half-years, and calculating ultimate claims as the product of the two. Since severity is an average, summing the first half and second half severities to obtain the severity for the full accident year is not appropriate. This essentially double-counts the severity, resulting in ultimate claims that are drastically overstated.
- Calculating ultimate claims for only a half accident-year for 2016, as opposed to for both accident half-years and then summing to obtain the 2016 total.
- Using the age 6 reported claim count and reported severity paired with 6-ult cumulative development factors in projection of ultimate for accident half year 2016-1. Age 12 amounts and 12-ult development patterns should have been used.

Part b

Candidates were expected to recognize that the reported count triangle excluded claims closed without payment. Candidates should have explained how these types of claims would be present in the reported count at earlier maturities, but as time progressed, these claims would drop from the reported count, causing downward development.

A common mistake included discussing causes of downward development in claims, rather than claim counts, such as case reductions or salvage.

Part c

Candidates were expected to discuss a diagnostic that can be used to test for seasonality. Candidates should have provided a diagnostic that would be relevant for such testing, including discussion on finer levels of data aggregation than annual (i.e. monthly, quarterly, semi-annually), in addition to how the diagnostic should be applied and interpreted.

Common errors included:

- Providing example diagnostics that would not adequately identify seasonality
- Failing to highlight that diagnostics must be on a basis more granular than annual
- Simply stating a diagnostic but providing no discussion

QUESTION 19

TOTAL POINT VALUE: 2.25 | **LEARNING OBJECTIVES: B1, B2, B3**

SAMPLE ANSWERS

Part a: 1 point

Sample 1

Reported Link Ratios

AY	12-24	24-36
2013	1.5	1.2
2014	1.5	1.2
2015	1.5	

36-ult = 22869/19800 = 1.155

LDF	12-24	24-36	36-ult
Age-to-age	1.5	1.2	1.155
Age-to-Ult	2.079	1.386	1.155

2015 ult = 18,975,000 * 1.386 = 26,299,350
2016 ult = 14,500,000 * 2.079 = 30,145,500

Sample 2

All year weighted average used to calculate LDF's:

12-24	24-36	36-48	48-ult
1.5	1.2	1.1	20790/19800 = 1.05

12-ult	23-ult	36-ult	48-ult
2.079	1.386	1.155	1.05

Ult claims for AY2015 = 18,975 * 1.386 =26,299.4
Ult claims for AY2016 = 14,500 * 2.079 = 30,145.5

Part b: 0.5 point

Sample 1

Cumulative Paid on Reported

AY	12	24	36	48
2013	0.4	0.667	0.833	0.9091
2014	0.4	0.667	0.808	
2015	0.3826	0.638		
2016	0.3672			

Case reserve adequacy has increased.

Sample 2

Cumulative Paid on Reported

AY	12	24	36	48
2013	0.4	0.667	0.833	0.9091
2014	0.4	0.667	0.808	
2015	0.3826	0.638		
2016	0.3672			

From the paid-to-reported claim ratios above, we can see it decreased from year 2015. The company may have applied tighter claims rules from 2015.

Part c: 0.75 point

Sample 1

i) Investors will be given overstated profit so that potential investors will invest in the company based on overstated profit

ii) Regulators may limit the target profit to lower target based on the overstated profit

iii) Internal management may take wrong expanding decisions based on the overstated profits

Sample 2

i) Regulators could think business is more profitable than it truly is, hence invest more money and in fact they wouldn't if they knew the true profit

ii) Regulators won't come in to help if the insurer is insolvent as they don't know the inadequacy in reserves

iii) Management won't take measures to improve performance as they think the business is still on track.

EXAMINER'S REPORT

Candidates were expected to understand how to develop ultimate losses using triangles, how triangles can be used as a means to identify internal/operational changes, and how under-reserving could impact different aspects of a company.

Part a

Candidates were expected to know how to calculate ultimate losses for 2015 and 2016 based on reported losses triangles.

Common errors included:

- Applying LDFs to paid losses to calculate ultimate losses
- Not including a tail factor (some assumed tail factor to be 1)

Part b

Candidates were expected to produce a triangle of paid/reported ratio, to identify the lowering ratios, and to understand why such a situation could happen.

Common errors included:

- Producing the right diagnosis (lower settlement rate), but providing a wrong scenario (weakening case reserve strength)
- Producing a case reserve triangle to show reserve strengthening

Part c

Candidates were expected to demonstrate consequences of under-reserving on people in different roles.

Common errors included:

- Confusing regulators with credit agencies, and provided answers that the regulators would "downgrade", "de-grade" the company
- Providing answers that were logically wrong (e.g. investment return looked better than it actually is so investors might leave)
- Providing answers that were vague (e.g. investors will be unhappy)
- Discussing the importance of having appropriate reserve estimates as opposed to the issues of having understated reserves

QUESTION 20	
TOTAL POINT VALUE: 3	**LEARNING OBJECTIVE(S): B3**
SAMPLE ANSWERS	
Part a: 1.75 points	

Sample 1

Trend Period
2013 – 3 years of trend, 2014 – 2 years of trend, and 2015 – 1 year of trend

Trend Payroll
2013: 1.02^3 x 306,000 = 324,730
2014: 1.02^2 x 313,000 = 325,645
2015: 1.02^1 x 318,000 = 324,360

Trend Claim Counts
2013: 1.01^3 x 2,300 = 2,370
2014: 1.01^2 x 2,400 = 2,448
2015: 1.01^1 x 2,500 = 2,525

Divide Trended Claim Counts by Trended Payroll
2013: 2,370 / 324,730 = 0.0073%
2014: 2,448 / 325,645 = 0.0075%
2015: 2,525 / 324,360 = 0.0078%

Select .0078%: there is an increasing trend so select most recent to be responsive to increasing frequency.

Sample 2

AY	Payroll Trend	Claim count Trend	Trended Freq (CC/payroll)*(CC trend/payroll trend)
2013	$(1.02)^3$	$(1.01)^3$	.000073
2014	$(1.02)^2$	$(1.01)^2$	.000075
2015	(1.02)	(1.01)	.000078

Since there is increase in frequency, I select average of last 2 years to respond to the change.
Select .0000765

Sample 3

AY	Claim Count	Count Trend	Payroll	Payroll trend	Freq Ult and trended
13	2300	1.01^3	306000	1.02^3	.0000730
14	2400	1.01^2	313000	1.02^2	.0000752
15	2500	1.01^1	318000	1.02^1	.0000778

I would select a 3 year average (.00753%): although the frequency appears to be slightly increasing, 3 years of data is not enough to make a judgment so I will average all 3 years.

Part b: 0.5 point

Trend Severity and make selection
2013: 7,000 x 1.08^3 = 8,818
2014: 7,500 x 1.08^2 = 8,748

Take two-year average: 8,783

Part c: 0.75 point

Calculate Frequency – Severity Ultimate using selections from parts a & b

2016 Payroll x Frequency Selections x Severity
325,000 x 0.00765 x 8,783 = 22,264,905

Calculate B-F Ultimate using actual reported , and F-S ultimate x % unreported

11,000,000 + (1 – 1/1.8) x 22,264,905 = 20,895,513.33

EXAMINER'S REPORT

Candidates were expected to demonstrate knowledge of the Frequency – Severity technique, which includes the correct calculation of frequency using trended counts and a trended exposure base. Candidates were expected to know the correct trend periods, and then trend counts, exposures and severities to the correct time period. Lastly, the candidate needed to show they could correctly apply the B-F approach using actual reported, and the amount unreported using the F-S ultimate and the percentage unreported, which was calculated using the 12 month-to-Ultimate LDF.

Part a

Candidates were expected to trend payrolls and claim counts for each accident year to 2016 level using the inflation percentages provided in the question. The candidates were also expected to calculate the frequencies for each year using the trended counts divided by trended payroll, and identify the increasing frequency trend. Lastly, candidates were expected to select a frequency trend and provide some justification for the selection.

Common errors included:

- Not justifying the frequency selection
- Attempting to calculate/justify the given trend percentages vs. using the given information to calculate frequency
- Not trending the claim counts and/or payroll

Part b

Candidates were expected to trend the 2013 and 2014 ultimate severity selections to 2016, and then take an average for the severity selection.

Common errors included:

- Only using one year for selection vs. both years
    - Candidates were expected to use both years since one year is not sufficient for a severity selection
- Attempting to calculate severities for other years where ultimate severity selections were not given in the question.
    - There was not enough information to calculate the 2015 ultimate severity
- Using the 12-to-ultimate LDF to calculate an estimate for the 2016 severity
    - Using this LDF and estimated ultimate claims from part (a) was not accepted, as the severity selection should be done separate from and not using the selected frequency.

Part c

Candidates were expected to use their answers from part a and b to calculate the F-S ultimate for accident year 2016, using the 2016 exposure base (payroll). Candidates were then expected to apply the B-F method by multiplying the F-S ultimate by the % unreported using the LDF given in the question, and then add on the actual reported.

Common errors included:

- Incorrectly calculating the frequency severity ultimate, where the most common mistake was not using the correct units, e.g. converting reported in to thousands, or incorrectly converting payroll from the question
- Incorrect application of the B-F approach, e.g. incorrectly calculating the percent unreported using the LDF, or applying the percent reported to the F-S ultimate

QUESTION 21

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

SAMPLE ANSWERS

Sample 1

$$\text{CC ELR} = \frac{500 * 0.8 + 475 * 0.8 + 400}{750 * (1/1.1) + 800 * (1/1.25) + 1{,}000 * (1/1.55)} = 1{,}180/1{,}967 = 0.6$$

AY 2016 Ult = 400 + 0.6 * 1,000 * (1 – 1/1.55) = 612.9

Sample 2

AY	Adjusted Reported Claims	CDF	Ultimate Losses	OLEP
2014	500 * (1-20%) = 400	1.1	440	750
2015	475 * (1-20%) = 380	1.25	475	800
2016	400	1.55	620	1,000
Total			1,535	2,550

CC ELR = 1,535 / 2,550 = 60.2%

Ult Claims for AY 2016 = 400 + 1,000 * 60.2% * (1 – 1/1.55) = 613.6

EXAMINER'S REPORT

Candidates were expected to know the mechanics and assumptions associated with the Cape Cod estimation technique. Candidates were expected to adjust the reported claims for a legislative change.

Common errors included:

- Not adjusting the reported claims for legislative change or not using the correct reform factor by accident year. For example, using a 1.20 reform factor or a 0.80 reform factor for accident year 2016. The correct reform factors are 0.80 for accident years 2014 and 2015 and 1.00 for accident year 2016.
- Not properly deriving the Cape Cod expected claim ratio by developing the reported claims to ultimate while also using the used up premiums.
- Not properly deriving the Cape Cod expected claim ratio by either not calculating used-up premiums or not developing losses to ultimate.
- Selecting an expected claim ratio rather than using aggregated losses and used up premiums for the Cape Cod claim ratio calculation.
- Using the incorrect formula for the ultimate claims calculation. For example, obtaining the ultimate claims by simply multiplying the Cape Cod expected claim ratio by the earned premium.

QUESTION 22	
TOTAL POINT VALUE: 2	**LEARNING OBJECTIVE(S): B3**
SAMPLE ANSWERS	
Part a: 1.5 points	

Sample 1

AY	**12**	**24**	**36**	**48**
2013	300,000	500,000	850,000	950,000
2014	250,000	500,000	800,000	
2015	280,000	450,000		
2016	270,000			

AY	**12**	**24**	**36**
2013	1.667	1.700	1.118
2014	2.000	1.600	
2015	1.607		
Sel = avg	1.758	1.650	1.118
CDF	3.242	1.844	1.118

$$\square\square\square\square\square\square = 1 + \frac{(2.1-1)(3.242)}{3.242-2.1} = 4.1228$$

OR

$$\square\square\square\square\square\square = \frac{1-(1/3.242)}{\square\frac{1}{2.1}\square-(\frac{1}{3.242})} = 4.1228$$

2016 unpaid claims (000s) = 4.1228 (400) = 1649.107

Sample 2

Paid triangle = Rpt – CO ($000)

AY	12	24	36	48
13	300,000	500,000	850,000	950,000
14	250,000	500,000	800,000	
15	280,000	450,000		
16	270,000			

AY	Remaining in case 12-24	24-36	36-48
13	300k/200k=1.5	0.167	0
14	1.67	0.32	
15	1.765		
Average	1.64	0.2435	0

AY	Paid on Case		
13	1	1.167	2
14	1.67	1.2	
15	1		
Sel Avg	1.22	1.1835	2

	12	24	36	48
AY 2016 Remaining in case	400,000	400,000 * 1.64=656,000	159,736	0
Paid on case	N/A	400000(1.22)=488,000	776,376	319,472

Sum = 1,583,848

Part b: 0.5 point

Any two of the following:

- The industry factors may not be representative of this individual company
- The industry factors at early maturities are highly leveraged and may produce volatile unpaid claim estimates
- Not useful in estimating pure IBNR
- Large loss in case outstanding will distort the estimation

EXAMINER'S REPORT

Candidates were expected to understand both the assumptions and mechanics behind the case outstanding technique, as well as how to apply the technique to derive unpaid estimates of a given accident year.

Part a

Candidates were expected to understand how to apply the case outstanding technique using industry data and correctly applying the case outstanding factor to internal company case reserves to estimate unpaid losses.

Common errors included:

- Calculation errors in deriving the paid loss triangle, paid loss triangle age-to-age factors, and paid 12 to ultimate cumulative development factor.
- Calculation errors in deriving the case reserve development factors and incremental paid on prior case reserve factors.
- Incorrectly calculating the case outstanding factor in sample response 1 due to errors in the candidate's formula (forgot +1 at the end, etc...).

Part b

Candidates were expected to know the assumptions underlying the case outstanding reserving technique. Candidates also were expected to recognize the limitations of using industry data.

Common errors included:

- Stating the case outstanding method does not account for IBNR when it really does not account for pure IBNR in future estimates.
- Providing too broad of an industry comparison with the self-insured company without tying the response to the case outstanding process. E.g. "Industry data may be biased"

QUESTION 23	
TOTAL POINT VALUE: 2.25	**LEARNING OBJECTIVE(S): B3**
SAMPLE ANSWERS	
Part a: 1.5 point	

Sample 1

Trended Tail Severity @ 48 Months:
∑ trended incremental paid claims 48+ / ∑ incremental closed claim counts 48+

Numerator: $(1,400 + 2,500 + 2,000 + 400) \times (1.05)^6 + (1,600 + 1,100 + 600) \times (1.05)^5 + (2,800 + 1,900) \times (1.05)^4 + (2,100) \times (1.05)^3 = 20,798.22$

Denominator: $(60 + 25 + 15 + 5) + (60 + 30 + 15) + (100 + 25) + (80) = 415$

Trended Tail Severity @ 48 Months = 20,798.22 x 1000 / 415 = **$50,116.**

Trended Tail Severity @ 60 Months:
Numerator: $(2,500 + 2,000 + 400) \times (1.05)^6 + (1,100 + 600) \times (1.05)^5 + (1,900) \times (1.05)^4 = 11,045.61$

Denominator: $(25 + 15 + 5) + (30 + 15) + (25) = 115$

Trended Tail Severity @ 60 Months = (11,045.61) x 1,000 / 115 = **$96,049.**

Sample 2

Trended Tail Severity @ 60 Months:

Use tail severity @ 72.

$[2,500 \times 1.05^6 + 1,100 \times 1.05^5 + 1,900 \times 1.05^4 + (114,000) \times (15 + 15 + 5)] / [25 + 30 + 25 + 15 + 15 + 5]$ = **$96,118.**

Trended Tail Severity @ 48 Months:
$[1,400 \times 1.05^6 + 1,600 \times 1.05^5 + 2,800 \times 1.05^4 + 2,100 \times 1.05^3 + 96.118 \times (115)] / (60 + 60 + 100 + 80 + 115)$ = **$50,135.**

Sample 3

Incremental Severities

AY	48	60	72	84
2010	23.33	100.00	133.33	80.00
2011	26.67	36.67	40.00	
2012	28.00	76.00		
2013	26.25			

Trended Incremental Severities

AY	48	60	72	84
2010	31.27	134.01	178.68	107.21
2011	34.03	46.80	51.05	
2012	34.03	92.38		
2013	30.39			

Maturity Sum of Trended Incremental Paid

48	9,753	=31.27 x 60 + 34.03 x 60 + 34.03 x 100 + 30.39 x 80
60	7,064	
72	3,446	
84	536	

48	20,798	415	**@48: $50.12**
60	11,046	115	**@60: $96.05**

Part b: 0.75 point

Sample 1

The 48 month incremental claims closed is very high, so the 48 month frequencies and severities appear stable enough to be predictable. In other words, it is best to leave these out of the tail severity calculation so that they can help provide one more data point of development before the tail. The 60-month severities are not credible/stable to provide development information, which is why I would include that in my tail severity instead. This will also increase the volume and stability of the tail.

Sample 2

Trended Incremental Severities

AY	48	60	72	84
2010	31	134	179	107
2011	34	47	51	
2012	34	92		
2013	30			

As calculated in (a) above, the incremental severities are stable at 48. Since there is valuable information here, we should use it. Severities start becoming erratic/jumpy at 60+, so combine here.

Sample 3

There is still a significant amount of claim volume and closed claims in the maturities prior to age 72, so this information is credible and we should use the actual severities in the frequency/severity calculation. At age 72, we have very low claim counts in this maturity and the data is starting to become erratic (i.e., there is a decrease in trended tail severity from 72 to 84 months). Therefore, I would combine at ages 72 and above.

EXAMINER'S REPORT

Candidates were expected to be familiar with the tail severity concept, how to calculate this metric, and to understand at what age data should be combined for the purposes of selecting an incremental tail severity.

Part a

Candidates were expected to calculate the incremental tail severities at 48 and 60 months.

Common errors included:

- Calculating a simple or claim-weighted average severity using only data at age 48 and 60 months
- Calculating the 48 tail severity as the sum of data at 60+ maturity and 60 tail severity as sum of data from 72+ maturity
- Incorporating both the 72 and 84 tail severities into the calculation
- Trending mistakes such as trending data to 2013 (not 2016) or applying trend across accident years at the same maturity (instead of all maturities for the same accident year)

Part b

Candidates were expected to select an appropriate age to combine the data for purposes of selecting an incremental tail severities as well as provide the rationale using company specific data. Candidates should compare and contrast the age before and after their selection.

Common errors included:

- Providing general considerations for when to select a tail, but without providing the actual selection for this company or considering any company specific information
- Selecting the wrong age (48 or 84 are not appropriate)
- Not noticing the stability in severities at age 48

QUESTION 24

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

SAMPLE ANSWERS

Part a: 2 points

Sample 1

Paid Severity Trend

AY	12	24	36
13	4.65%	4.95%	4.85%
14	5.40%	5.20%	
15	4.90%		

Select a judgmental 5% paid severity trend

Adjusted Avg Case O/S

AY	12	24	36	48
13	1995	2998	3008	0
14	2094	3148	3158	
15	2199	3305		
16	2309			

Adjusted Reported

AY	12	24	36	48
13	1995(165)+1100 = 1429	1899	1869	1815
14	1572	2094	2060	
15	1733	2306		
16	1911			

Weighted Avg	12-24	24-36	36-48
LDF	1.330	0.984	0.971

AY 16 Ult = 2,428,000, IBNR = 517,000

Sample 2

Average Paid Severity

		% chg	
AY	12	24	36
13-14	4.7%	5.0%	4.8%
14-15	5.5%	5.2%	
15-16	4.9%		

Average Case Outstanding

		% chg	
AY	12	24	36
13-14	4.9%	5.2%	-21.6%
14-15	5.4%	-21.1%	
15-16	-21.7%		

There is a decrease in average reserve adequacy. I will choose a sev trend of 5% = (4.65% + 5.45% + 4.89%) / 3 to do the adjustment.

Adj Avg Case Outstanding

AY	12	24	36	48
13	1994	2997	3007	0
14	2094	3148	3158	
15	2199	3305		
16	2309			

Adj Case Outstanding = Avg Case Outstanding x Open Claims

AY	12	24	36	48
13	329109	248812	54137	0
14	362319	273843	60002	
15	398028	300755		
16	441019			

Adj Reported Claims = Adj Case Outstanding + Paid Claims (in $1,000,000)

AY	12	24	36	48
13	1.43	1.90	1.87	1.82
14	1.57	2.09	2.06	
15	1.73	2.31		
16	1.91			

	12-24	24-36	36-48	48-Ult
	1.33	0.984	0.973	1
	1.33	0.990		
	1.34			
LDF	1.33	0.987	0.973	1
CDF	1.28			

Ult AY 2016 Claims = 1.28 x 1911K = 2446K
AY 2016 IBNR = 2446K - 1911K = 535K

Part b: 0.5 point

Any one of the following:

- Since the paid development technique is not affected by case reserve changes and the development factors here seem stable, this technique would be appropriate.
- Freq-Sev on Paid data. Paid severity increased at steady 5% per year, close/reported count ratio fairly steady at all maturities.
- You can use ECR method. As long as the underlying ratio has not changed, this will project an accurate IBNR as it is unaffected by changes in case reserve adequacy.

EXAMINER'S REPORT

Candidates were expected to be able to carry out the Berquist-Sherman adjustment, calculate the ultimate losses, and then calculate IBNR. Candidates were also expected to be able to use the provided triangles in order to propose and justify another methodology that could be used appropriately on the data.

Part a

Candidates were expected to evaluate severity and/or average case outstanding trends, use trends to calculate the adjusted average case outstanding, calculate the adjusted reported triangle, and then apply the reported development technique to calculate 2016 IBNR.

Common errors included:

- Reviewing trends in total claims rather than average severity or average case outstanding
- Ignoring trends altogether or trending in the wrong direction
- Applying trend factors to actual average case outstanding instead of a single diagonal

- Treating the adjusted average case outstanding as if it was the total case outstanding
- Attempting to develop adjusted case or average case to ultimate
- Using average case outstanding values as if they were in $000s
- Calculation errors in part of a triangle
- Only calculating Ultimate losses and not IBNR

Part b

Candidates were expected to provide an appropriate method and briefly justify its appropriateness in the presence of changing case reserves. Candidates were expected to be able to properly distinguish between a case reserve change and settlement rate change and how these would affect the diagnostic triangles.

Common errors included:

- Not including a justification
- Attempting to diagnose a change in settlement rates
- Explanations that do not justify the technique's appropriateness in the presence of a case reserve change. For example, choosing the Bornhuetter-Ferguson method on paid data due to highly leveraged development factors.
- Suggesting that the paid to reported ratio for 2016 shows a change in settlement rates and proposing a method that works well with settlement rate changes.
- Confusing the difference between a (frequency or severity) trend, changes in claim experience, and a change in practice. Candidates proposed methods that work well when there are changes in trends or experience rather than when case reserves are changing.

QUESTION 25

TOTAL POINT VALUE: 2 | **LEARNING OBJECTIVE(S): B3, B6**

SAMPLE ANSWERS

Sample 1

Net Reported Claims (= Gross - Ceded XOL)

Accident Year	12	24	36	48
2013	2,757	4,825	5,548	5,715
2014	2,345	4,104	4,719	
2015	2,485	4,349		
2016	2,802			

Age-to-Age Factors

2013	1.750	1.150	1.030	
2014	1.750	1.150		
2015	1.750			
Selected LDF	1.750	1.150	1.030	1.000
Selected CDF	2.073	1.184	1.030	1.000

Accident Year	Net of XOL Incurred	CDF	Net of XOL Ultimate	Stop Loss	Net Ultimate	Net Paid	Net Unpaid
2013	5,715	1.000	5,715	5,000	5,000	5,102	0
2014	4,719	1.030	4,861	5,000	4,861	3,834	1,027
2015	4,349	1.184	5,151	5,000	5,000	2,840	2,160
2016	2,802	2.073	5,808	N/A	5,808	1,385	4,423

Sample 2

Gross Reported Claims

Accident Year	12	24	36	48	Gross Incurred	Gross CDF	Gross Ultimate
2013	2,757	5,570	6,880	7,047	7,047	1.000	7,047
2014	2,345	4,104	5,121		5,121	1.024	5,245
2015	2,639	4,677			4,677	1.278	5,978
2016	2,802				2,802	2.265	6,347

Age-to-Age Factors

2013	2.020	1.235	1.024	
2014	1.750	1.248		
2015	1.772			
Sel LDF	1.772	1.248	1.024	1.000
Sel CDF	2.265	1.278	1.024	1.000

Ceded Reported Claims

Accident Year	12	24	36	48	Ceded Incurred	Ceded CDF	Ceded Ultimate
2013	0	745	1,332	1,332	1,332	1.000	1,332
2014	0	0	402		402	1.000	402
2015	154	328			328	2.328	763
2016	0				0	16.217	0

Age-to-Age Factors

2013	N/A	1.788	1.000	
2014	N/A	N/A		
2015	2.130			
Sel LDF Vol Wtd All Yr -	6.968	2.328	1.000	1.000
Sel CDF	16.217	2.328	1.000	1.000

Accident Year	Net of XOL Ultimate	Stop Loss	Net Ultimate	Net Paid	Net Unpaid
2013	5,715	5,000	5,000	5,102	0
2014	4,843	5,000	4,843	3,834	1,009
2015	5,214	5,000	5,000	2,840	2,160
2016	6,347	N/A	6,347	1,385	4,962

EXAMINER'S REPORT

Candidates were expected to use the reported claims development method to obtain an estimate of ultimate net of an excess of loss treaty, apply the stop loss reinsurance to obtain an estimate of ultimate loss and paid loss net of all reinsurance, and subtract the paid losses to date in order to obtain the unpaid amounts.

Common errors included:

- Not applying the stop loss limitation to either the ultimate losses or the paid losses
- Subtracting undeveloped ceded losses from ultimate developed gross losses
- Capping the net triangle at 5,000 to calculate LDFs and applying those LDFs to AY 2016, which does not have an aggregate stop loss
- Applying a stop loss limitation to AY 2016
- Using the gross LDFs to develop the ceded XOL amounts

QUESTION 26

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

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

$275,000 = .1[$1,000,000 + .5 * $3,500,000]

Sample 2

CY 2013 Paid = 750
CY 2014 Paid = 2000 + 1125 – 750 = 2375
CY 2015 Paid = 2500 + 3000 – 2000 +1350 – 1125 = 3725

CY	Paid Claims	Paid ULAE	ULAE Ratio
2013	750	220	29.3%
2014	2375	220	9.3%
2015	3725	330	8.9%

Select .09 as CY 2013 is out of line compared to the last two years.

$247,500 = .09[$1,000,000 + .5*$3,500,000]

Part b: 1 point

CY	Paid Claims	Paid ULAE	ULAE Ratio
2013	750	220	29.3%
2014	2375	220	9.3%
2015	3725	330	8.9%
2016	4985	x	
Total	11,835	1,183.5	10.0%

1183.5 – 220 – 220 – 330 = 413.5

413.5 / 4985 = 8.3%

Part c: .5 point

Sample 1

The estimate in part a is too high, the ratios have been declining by calendar year since the business is new, so the ratio will be overstated and the estimate will be inappropriate.

Sample 2
No, estimate is inappropriate since the paid ULAE to paid claims ratio is decreasing sharply. The ratios in 2014 – 2016 are all less than 10%

Sample 3
The selected ratio in a was 10% which incorporated all years. 2013 was the 1st year and was much higher than the others, and the ratio appears to be decreasing each year. Therefore the estimate in a is overstated.

Sample 4
I selected 0.0906 = Average(14,15) as the ULAE ratio. CY 2016 ULAE paid = 0.083 < 0.0906. It seems my ULAE unpaid estimate is too high considering the CY 2016 experience. Using a weighted average of 2014 – 2016 ULAE to paid ratio would be a better estimate.

EXAMINER'S REPORT

Candidates were expected to demonstrate knowledge about using the classical technique to estimate unpaid ULAE and when this technique is appropriate.

A common mistake was failing to recognize that calendar year paid claims were the appropriate denominator for the paid to paid ratio in the classical technique.

Part a

Candidates were expected to estimate the unpaid ULAE using the classical technique, demonstrating that the ULAE ratio is applied to 50% of the case reserves and 100% of the IBNR reserves. Candidates were expected to use the given four year average 10% paid to paid ratio, but credit was also awarded to candidates who calculated and selected an appropriate ratio.

Common errors included
- calculation mistakes
- selection an inappropriate ULAE ratio.

Part b

Candidates were expected to determine the calendar year 2016 paid ULAE to paid claims ratio given the information provided.

Common errors included
- confusing accident year and calendar year paid
- not realizing that the 4 year ratio is required to calculate the solution
- Developing losses or ULAE to ultimate

Part c

Candidates were expected to recognize that ULAE ratios were declining over time and comment that the result was not appropriate given the shift in paid to paid ratios over time.

Common errors included

- not referencing the changing paid to paid ratios
- stating that assumptions of the classical method are violated without relating to why that would lead to an unreasonable estimate; for example, stating that the book appears to be growing so this violates the assumption of a steady state, without relating why that leads to an unreasonable result
- Not providing adequate justification for assessment of reasonableness, such as saying it looks reasonable because it's in line with the average

QUESTION 27	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): B3, B4**

SAMPLE ANSWERS

Part a: 0.5 point

Sample Responses for paid development technique

- Will be appropriate as it is not affected by the 2015 claims or case reserve strengthening
- Appropriate for AY 2013, the changes listed should not affect paid 2013 ultimate

Sample Responses for reported development technique

- Reported development would overestimate ultimate due to applying CDFs based on the prior adequacy level to higher reported losses
- Changes in case outstanding may have a small effect but due to this being almost fully developed it should be appropriate
- Will now overstate ultimate because all LDFs at all maturities will be affected by the strengthening of reserves in CY 2016

Part b: 0.5 point

Sample Responses for disposal rate frequency-severity technique

- This will be accurate since it does not rely on case reserves (uses paid data only)
- Appropriate. The settlement rate is unchanged, which is a key requirement of the method. The incremental severities used to calculate reserves for this AY won't be affected by the 2015 large losses. This is a paid technique so it is not impacted by the case reserve adjustment.

Sample Responses for reported Bornhuetter-Ferguson technique

- Reported BF will overstate AY 2014 loss somewhat since it will use historical % unreported to calculate IBNR but % unreported is lower after strengthening.
- Overstated as historical CDFs are too high, so unreported % is too high.

Part c: 0.5 point

Sample Responses for Paid development technique

- Not appropriate. The past LDFs were based on data with no large claims and will be too high. They will be applied to higher than usual paid claims overestimating the ultimate claims.

Sample Responses for Paid Bornhuetter-Ferguson technique

- Paid B-F technique would be appropriate to include the large claims as well as to develop unpaid losses based on a priori estimate
- Selected CDFs will be too high since we assumed lower % paid at 24 months than what happened. Will overestimate AY 2015 ult. Loss but not as much as paid dev method does.

EXAMINER'S REPORT

Candidates were expected to understand the following reserving techniques, including when they do and do not work: paid and reported development methods, disposal rate frequency-severity technique, paid and reported B-F techniques.

A common mistake was to confuse calendar year and accident year impact to the reserving techniques.

Part a

Candidates were expected to understand how large losses in a future year and a change in case reserve practices would impact the paid and reported development methods.

Common errors included:

- Stating that large losses impacted either method. The large losses occur in a future accident year so will have no impact on either method.
- Stating that the reported development method would be *understated*. The change in case reserves would result in an overstatement using the reported development method.

Part b

Candidates were expected to understand how large losses in a future year and a change in case reserve practices would impact the disposal rate frequency-severity technique and the reported BF technique.

Common errors included:

- Stating that large losses impacted either method. The large losses occur in a future accident year so will have no impact on either method.
- Stating that the disposal rate frequency-severity technique is affected by the strengthening of case reserves. This technique uses paid losses only.
- Stating that the reported B-F method would be *understated*. The change in case reserves would result in an overstatement using the reported B-F method.

Part c

Candidates were expected to understand how large losses in the current accident year and a change in case reserve practices would impact the paid development method and paid B-F technique.

Common errors included:

- Stating that the paid development method is not impacted by the large losses.
- Stating that either method is impacted by the change in case reserves. These are paid methods and therefore unaffected by the case reserve changes.
- Stating that the large losses would result in either method being understated.

QUESTION 28	
TOTAL POINT VALUE: 1	**LEARNING OBJECTIVE(S): B8**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1
Development technique for AY 2016 may be leveraged due to immature losses. Thus, the selected development factors from 24 months on are reasonable, but the 12-24 factor could be slightly leveraged.

Sample 2
The development technique appears to have the most anomalous development at age 12-24 in AY 2016, so the 12-24 development factor seems too high. The remaining development factors seem to produce stable results.

Sample 3
The claim development factor appears appropriate except for AY 16. The 12-24 factor appears to be highly leveraged since AY 16 estimate for the development technique is higher than the other 2 methods.

Part b: 0.5 point

Sample 1
The BF method at older maturities approach the development method, so the earlier maturities are giving more weight to expected claims. This, combined with the decrease, implies the initial expected loss ratio is too low.

Sample 2
The ECR used in the BF method appears to be too low. The BF method hangs together with the development and frequency/severity methods for older years and slowly starts to decline as more weight is given to the ECR over the development method in immature years. The estimates for recent years are much lower than the other two methods which doesn't seem reasonable.

EXAMINER'S REPORT

Candidates were expected to assess the assumptions used in various reserving techniques based on ultimate claims ratios by year for different techniques.

Part a

Candidates were expected to recognize that the 12-24 LDFs were high compared to other methods / years by comparing the ultimate claim ratios from the various techniques.

Common errors included:

- mentioning case reserve strengthening as a reason for high ultimates in 2016

- not mentioning LDFs
- comparing the method ultimates as opposed to LDFs
- mentioning that B-F technique used different LDFs than development technique
- assessing the reserve techniques but making no mention of the development factors, as the question requests.

Part b

Candidates were expected to recognize that the initial expected loss ratio was low by comparing B-F results to other techniques or discussing that BF ultimates decrease as more weight is put on the ELR

Common mistakes included:

- saying the ELR was too high
- discussing the LDFs within the BF method instead of the ELR