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## Exam 5

### Basic Techniques for Ratemaking and Estimating Claim Liabilities

4 HOURS

#### INSTRUCTIONS TO CANDIDATES

1. This 59.75 point examination consists of 23 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.
  - Write your Candidate ID number and the examination number, 5, at the top of each answer sheet. 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

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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.
  - Verify that you have received the reference materials:
    - Insurance Services Office, Inc., Personal Automobile Manual (Effective 6-98), General Rules 1-6.
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.

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

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

All extra answer sheets, scrap paper, etc. must be returned to the supervisor for disposal.
9. Candidates must not give or receive assistance of any kind during the examination. Any cheating, any attempt to cheat, assisting others to cheat, or participating therein, or other improper conduct will result in the Casualty Actuarial Society and the Canadian Institute of Actuaries disqualifying the candidate's paper, and such other disciplinary action as may be deemed appropriate within the guidelines of the CAS Policy on Examination Discipline.
10. The exam survey is available on the CAS Web Site in the "Admissions/Exams" section. Please submit your survey by May 14, 2014.

**END OF INSTRUCTIONS**

EXAM 5, SPRING 2014

1. (3.5 points)

An insurance company writes annual policies. The history of rate changes is as follows:

Effective Date	Overall Rate Change
January 1, 2010	+4.2%
March 1, 2011	+0.3%
January 1, 2012	-1.7%
June 1, 2013	+1.0%

a. (1 point)

Calculate the on-level factor to current rate level for calendar year 2011 earned premium, assuming all policies are written uniformly throughout the year.

b. (2 points)

Assume that 25% of policies are written on the first day of the year and the remaining policies are written evenly throughout the year. Calculate the on-level premium factor to current rate level for policies in-force on February 1, 2012.

c. (0.5 point)

Assuming all policies are written uniformly throughout the year, and without performing additional calculations, discuss the effect on the on-level premium factor for calendar year 2011 if the policy term was 2 years instead of annual.

EXAM 5, SPRING 2014

2. (3.25 points)

A workers compensation insurance company uses the following data for ratemaking:

Year	Industry Loss Cost Premium (\$000)	Annual Payroll Level Change	Historical Average Experience Modification Factor
2011	2,100	2.5%	0.99
2012	2,500	2.0%	0.98
2013	2,600	1.0%	0.97

Year	Reported Indemnity Claims (\$000)	Annual Impact on Indemnity Claims Due to Benefit Level Changes	Indemnity Development Factor to Ultimate	Projected Ultimate Medical-Only Claims (\$000)
2011	850	2.0%	1.20	735
2012	670	1.5%	1.80	834
2013	460	0.5%	2.70	900

- Expected future wage level change = 1.5% per year.
- Expected effect on indemnity claims due to future benefit level changes = 1.0% per year.
- Projected average experience modification factor = 0.98.
- Projected LAE percentage (as a percent of losses) = 15.0%.
- Assume no other loss cost inflation other than indemnity benefit level changes.

Calculate the projected ultimate loss & LAE ratio for year 2015.

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EXAM 5, SPRING 2014

3. (2.25 points)

For a single personal auto policy with an annual policy term:

- $A$  = Calendar year 2013 written exposures as of December 31, 2013.
- $B$  = Calendar year 2012 earned exposures + calendar year 2013 earned exposures as of February 1, 2013.
- $C$  = Calendar year 2013 unearned exposures as of February 1, 2013.
- $D$  = In-force exposures as of February 1, 2013.
- $A < 0 < B < C < D$ .
- Exposure is earned uniformly throughout the policy term.
- This policy cancels mid-term.

a. (1 point)

Provide the range of valid effective dates for this policy.

b. (0.5 point)

Provide the range of valid dates of the mid-term cancellation for this policy.

c. (0.75 point)

Demonstrate that it would never be possible to have  $A < 0 < B < C < D$  if  $B$ ,  $C$ , and  $D$  were as of July 1, 2013 instead of February 1, 2013.

EXAM 5, SPRING 2014

4. (2 points)

A product manager is proposing to revise rates in the scenarios described below. As an actuary, briefly assess the approach taken in each scenario and, if necessary, recommend an adjustment.

a. (0.5 point)

The loss provision in the indicated rate for next year is calculated as historical reported loss divided by exposure.

b. (0.5 point)

The indicated rate for next year is calculated using projected losses and loss adjustment expenses based on historical experience. In the next month, the company will be revising its underwriting guidelines, increasing the minimum deductible from \$500 to \$1,000.

c. (0.5 point)

The indicated rate for a classification is calculated based on one year of historical data that includes 25 earned car years.

d. (0.5 point)

The indicated rate change is calculated using the ratio of developed, trended historical losses capped at \$100,000 to on-level total earned premium. Loss trend factors and loss development factors are determined using data limited to \$100,000. The company has a significant number of claims in excess of \$100,000.

EXAM 5, SPRING 2014

5. (6.5 points)

A countrywide insurer's rate filing for a state contains the following:

- All policies are annual.
- The filed rates are planned to be in effect for policy year 2015.
- There was a rate change of +7.5%, effective 7/1/2013. The prior rate change before that was in 2009.
- Loss trend is 3% annually.
- ULAE as a ratio of loss and ALAE = 10%.
- Profit and contingencies provision = 5%.
- Variable expense ratio = 20%.
- The company purchased new software in 2010 to assist with the processing of claims.
- Use an average of 2012 and 2013 for the rate level indication.

Calendar Year	Earned Premium (\$000)
2012	1,250
2013	1,400

Accident Year	Reported Loss and ALAE (\$000)
2012	750
2013	500

Calendar Year	Current Level Average Policy Premium	Fixed Expense Ratio
2009	\$500	10%
2010	\$520	23%
2011	\$540	15%
2012	\$560	12%
2013	\$583	10%

Accident Year	Reported Loss and ALAE Development Factors				
	12-24 Months	24-36 Months	36-48 Months	48-60 Months	60+ Months
2006	1.45	1.35	1.10	1.02	1.00
2007	1.50	1.30	1.15	1.08	1.00
2008	1.40	1.35	1.10	1.03	1.00
2009	1.50	1.30	1.08	1.02	
2010	1.85	1.15	1.10		
2011	1.75	1.15			
2012	1.80				

All Year Average	1.61	1.25	1.11	1.04	1.00
5 Year Average	1.66	1.23	1.11	N/A	N/A
3 Year Average	1.80	1.20	1.09	1.04	1.00
Average Excluding High/Low	1.60	1.25	1.10	1.03	1.00

a. (5.5 points)

Calculate the indicated rate change. Justify the selections of premium trend, all development factors, and the fixed expense ratio.

b. (1 point)

The chief actuary is concerned about the credibility of company data in this state and would like to begin using credibility weighting with the company's countrywide loss costs. Assess this approach, considering two desirable qualities of a credibility complement.

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EXAM 5, SPRING 2014

6. (2.5 points)

An auto insurance company is designing a risk classification system. The actuary has determined that the number of hours a driver sleeps each night is a predictive rating variable. Recommend whether the company should include this variable in their risk classification system. Justify this recommendation with respect to four relevant considerations.

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EXAM 5, SPRING 2014

7. (2.25 points)

Given the following information:

Limit	Premium	Increased Limits Factor
\$100,000	\$1,000,000	1.00
\$250,000	\$500,000	2.00
\$500,000	\$400,000	2.75
\$750,000	\$300,000	3.25
\$1,000,000	\$200,000	3.50
TOTAL	\$1,900,000	

a. (0.5 point)

Given that the losses capped at \$250,000 are \$1,500,000, calculate a complement of credibility for the losses in the layer between \$500,000 and \$750,000.

b. (1.25 points)

Assume that the expected total limits loss ratio is 65%. Using the limits analysis approach, calculate the complement of credibility for the layer between \$500,000 and \$750,000.

c. (0.5 point)

Provide two criticisms of using the limits analysis approach to develop a complement of credibility.

EXAM 5, SPRING 2014

8. (2.25 points)

A private passenger auto insurance company uses only two rating variables: territory and gender. The distribution of earned exposures is:

Earned Exposures		
Territory	Gender	
	Male	Female
1	180	120
2	500	500
3	350	150

Territory	Loss and LAE
1	\$11,127
2	\$51,335
3	\$32,983

Territory	Current Relativity
1	0.750
2	1.000
3	1.125

Gender	Current Relativity
Male	1.000
Female	0.800

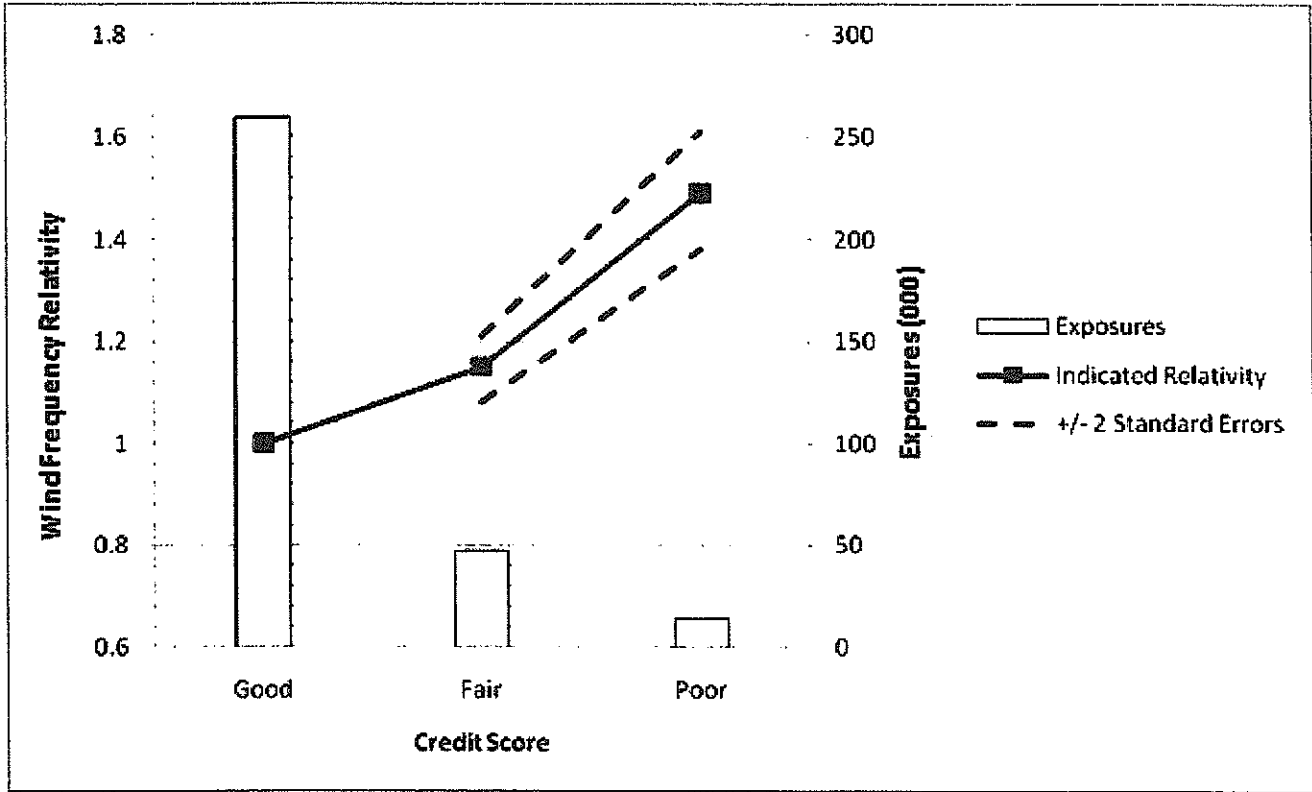
- Assume no adjustments are made to the relativities for expense considerations.
- Assume territory 2 remains the base territory.

For a revenue neutral overall change, calculate an indicated relativity change for policyholders in territory 3, accounting for any distortion that gender rating may cause.

9. (2 points)

An insurer is considering using credit score to further segment its homeowners book of business. The insurer has developed a generalized linear model to evaluate different variables' contribution to expected frequency of wind claims.

The following diagnostic chart displays the results of a countrywide analysis performed on one year of data from a generalized linear model:



Using the generalized linear model output, as well as other considerations, justify whether the insurer should add credit score to the homeowners rating plan for the wind peril.

EXAM 5, SPRING 2014

10. (2.25 points)

A company is implementing a recently approved private passenger automobile rate revision. The indicated rate change was 20% while the requested rate change was 8%.

a. (0.75 point)

Briefly describe three reasons the company may have decided to propose a rate increase substantially lower than the indicated rate change.

b. (0.5 point)

Briefly discuss two actions the company could take to offset the pricing shortfall.

c. (1 point)

Calculate the proposed base rate to achieve the overall 8% rate increase assuming no change in any rate differentials. Use the following information from the company's rate filing:

Multiplicative Rating Factor 1 (R1)	Exposures (000)	Rate Differential
1	150	1.350
2	500	1.000
3	100	0.990
Overall	750	1.069

Multiplicative Rating Factor 2 (R2)	Exposures (000)	Rate Differential
A	250	0.870
B	300	1.250
C	200	1.000
Overall	750	1.057

Additive Discount	Exposures (000)	Rate Differential
Yes	450	0.050
No	300	0.000
Overall	750	0.030

- Current average premium per vehicle = \$450.
- Indicated rate change = 20%.
- Requested rate change = 8%.
- Fixed expense per vehicle = \$35.

Vehicles are rated as follows:

$$P_P = [B * R_1 * R_2 * (1 - D) + A_P]$$

Where  $P_P$  = Proposed policy premium

B = Base rate

$R_1$  = Multiplicative Rating Factor 1

$R_2$  = Multiplicative Rating Factor 2

D = Additive Discount

$A_P$  = Additive Per Exposure Expense Fee

EXAM 5, SPRING 2014

11. (2 points)

A large commercial insured purchased a retrospectively rated annual policy to cover its workers compensation exposure in 2014. The first computation of the retrospective premium will occur on April 1, 2015, based on the following information and provisions:

Limited Reported Losses valued as of April 1, 2015:	\$200,000
Standard Premium:	\$695,000
Net Insurance Charge	0.181
Minimum retrospective premium ratio:	75%
Maximum retrospective premium ratio:	125%
Loss Conversion Factor:	1.08
Expense Allowance (excludes tax multiplier):	15%
Tax Multiplier:	1.04
Expected Loss Ratio:	62%

a. (1.5 points)

Calculate the retrospective premium for this policy as of April 1, 2015, including any necessary adjustments for minimum and maximum premium provisions.

b. (0.5 point)

Briefly describe two elements that the basic premium is intended to cover for a retrospectively rated policy.

EXAM 5, SPRING 2014

12. (1 point)

An insurance company has the following information available for the four different geographic regions within the same line of business:

<u>Region</u>	<u>Earned Exposures by Accident Year</u>			<u>Ultimate Claim Counts by Accident Year</u>		
	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>
1	21,900	22,560	22,125	2,075	2,143	2,010
2	2,575	2,460	2,520	126	124	125
3	18,000	17,460	17,800	880	895	877
4	4,450	10,720	27,500	227	580	1,330

<u>Region</u>	<u>Observed Average Age to Age Paid Claim Development Factors</u> (Age in Months)				
	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>48-60</u>	<u>60-Ult</u>
1	7.67	3.07	1.75	1.30	1.10
2	3.20	1.70	1.28	1.10	1.06
3	3.19	1.73	1.31	1.12	1.04
4	4.10	2.28	1.52	1.05	1.03

Justify an appropriate grouping of the regional data for estimating the insurer's unpaid claims for the total book of business.

EXAM 5, SPRING 2014

13. (3 points)

An insurance company has reported the following information:

Accident Year	As of Date	Reported Claims (\$000)
2011	December 31, 2011	25,000
2011	December 31, 2012	45,000
2011	December 31, 2013	56,250
2012	December 31, 2012	30,000
2012	December 31, 2013	51,000
2013	December 31, 2013	21,000

Assume there is no development beyond 36 months.

a. (1.5 points)

Calculate the ultimate claims for accident year 2013 using the reported claim development technique.

b. (0.5 point)

State two assumptions of the reported claim development technique.

c. (1 point)

For each assumption identified in part b. above, identify and briefly describe an alternative technique that may be utilized when the assumption does not hold.

EXAM 5, SPRING 2014

14. (2.75 points)

The actuary for an insurer has estimated the following results for accident year 2013 as of December 31, 2013:

- Percentage unpaid at 12 months = 80%.
- Accident year 2013 case outstanding = \$22,000.
- Ultimate claims estimate based on the reported claim development technique = \$102,500.
- Ultimate claims estimate based on the paid claim development technique = \$95,000.
- Ultimate claims estimate based on the expected claims technique = \$100,000.

a. (1.25 points)

Estimate ultimate claims using the reported Bornhuetter-Ferguson technique for accident year 2013 as of December 31, 2013.

b. (0.5 point)

Identify two situations when the ultimate claims estimate from the reported claim development technique will equal the ultimate claims estimate from the reported Bornhuetter-Ferguson technique.

c. (1 point)

Identify two situations when the Bornhuetter-Ferguson technique is preferable to the claim development technique and briefly explain why.



EXAM 5, SPRING 2014

15. (2.75 points)

Given the following data as of December 31, 2013:

Accident Year	Earned Premium (\$000)	On-level Earned Premium Factors	Reported Claims (\$000)	Reported Development Factor to Ultimate
2010	1,100	1.35	700	1.10
2011	1,300	1.30	750	1.40
2012	1,400	1.20	500	1.70
2013	1,800	1.00	750	2.00

- Annual pure premium trend: 5%.
- Bornhuetter-Ferguson expected claims ratio: 57%.

a. (0.5 point)

Calculate the accident year 2013 IBNR using the Bornhuetter-Ferguson technique as of December 31, 2013.

b. (1.75 points)

Calculate the accident year 2013 IBNR using the Cape Cod technique as of December 31, 2013.

c. (0.5 point)

Briefly explain whether the Bornhuetter-Ferguson or the Cape Cod technique is more appropriate in the following scenarios:

- i. Decrease in underlying claims ratio.
- ii. Thin or volatile data.

EXAM 5, SPRING 2014

16. (2.75 points)

An insurance company writes general liability insurance and purchases excess-of-loss reinsurance. On January 1, 2013, the insurance company implemented a new reserving process which resulted in a large increase in the average case outstanding for claims occurring in 2013.

The following information is available as of December 31, 2013:

Accident Year	Revenue (\$000)	Reported Claim Counts	
		Ground-Up	Excess of Reinsurance Attachment Point
2011	3,400	1,750	220
2012	3,500	1,700	140
2013	3,600	1,500	90

Reported Claim Count Development  
Factor to Ultimate  
(prior to operational change)

Age (months)	Ground-Up	Excess of Reinsurance Attachment Point
36-Ult	1.000	1.500
24-Ult	1.040	2.500
12-Ult	1.200	6.000

- Annual revenue trend: 3%.
- Annual total frequency trend: 2%.
- Annual excess frequency trend: 5%.

Calculate the insurer's ultimate claim counts that do not exceed the attachment point for accident year 2013.

EXAM 5, SPRING 2014

17. (2 points)

The actuary has observed that the adequacy of case outstanding is increasing for an insurer. Describe how each of the following would be influenced by this change and briefly explain why:

- i. Reported Claim Development Technique
- ii. Expected Claim Technique
- iii. Reported Bornhuetter-Ferguson Technique
- iv. Reported Cape Cod Technique

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EXAM 5, SPRING 2014

18. (4 points)

An insurance company has the following claims information as of December 31, 2013:

Cumulative Paid Claims (\$000s)

Accident Year	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2011	1,000	1,500	1,815
2012	1,020	1,530	
2013	1,040		

Cumulative Reported Claims (\$000s)

Accident Year	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2011	1,100	1,650	1,815
2012	1,220	1,830	
2013	1,340		

Case Outstanding Claims (\$000s)

Accident Year	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2011	100	150	0
2012	200	300	
2013	300		

Cumulative Open Claim Counts

Accident Year	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2011	1,000	1,100	1,155
2012	1,000	1,100	
2013	1,000		

Cumulative Closed Claim Counts

Accident Year	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2011	900	1,080	1,155
2012	900	1,080	
2013	900		

- No development occurs beyond 36 months.
- There are no partial payments.

Estimate ultimate claims for accident year 2013 using two reserving techniques that are consistent with a diagnostic review of the data.

EXAM 5, SPRING 2014

19. (1.75 points)

Given the following information as of December 31, 2013:

<u>Calendar Year</u>	<u>Earned Premium (\$000)</u>	<u>On-Level Earned Premium (\$000)</u>
2010	5,044	5,000
2011	6,278	6,000
2012	6,895	6,500
2013	8,000	8,000

Reported Claims (\$000)

<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
2010	665	1,426	2,616	3,118
2011	915	1,828	3,140	
2012	890	1,840		
2013	904			

- Annual claims trend = - 2%.
- Assume no development beyond 48 months.

Estimate ultimate claims for accident year 2013 using the expected claims technique.

EXAM 5, SPRING 2014

20. (2.25 points)

Given the following data as of December 31, 2013:

Incremental Paid Claims Gross of Salvage and Subrogation (\$000)			
Accident Year	<u>0-12 months</u>	<u>12-24 months</u>	<u>24-36 months</u>
2011	4,000	1,000	500
2012	4,500	1,125	
2013	5,000		

Incremental Received Salvage and Subrogation (\$000)			
Accident Year	<u>0-12 months</u>	<u>12-24 months</u>	<u>24-36 months</u>
2011	800	950	450
2012	900	1,609	
2013	1,250		

- Assume no development beyond 36 months of age for either paid claims or salvage and subrogation.

Estimate the ultimate salvage and subrogation for accident year 2013 using a ratio approach.

EXAM 5, SPRING 2014

21. (1.5 points)

An actuary is tasked with estimating legal expense reserves as of December 31, 2013 for an insurance company's general liability line of business.

The following information is available:

- The company recently began dedicating more legal resources to defend claims at earlier stages in the claim cycle in an attempt to reduce ultimate claim costs.
- Prior to this claims initiative, the company had a relatively stable claim history.
- Paid legal expenses are tracked separately and are considered allocated claim adjustment expenses for the company.

a. (0.5 point)

Describe a potential challenge of using the paid development technique to estimate unpaid allocated claim adjustment expenses for this company.

b. (0.5 point)

Describe a potential challenge of using a paid ALAE-to-paid claims only ratio technique to estimate unpaid allocated claim adjustment expenses for this company.

c. (0.5 point)

Comment on whether using a frequency-severity technique is appropriate to estimate legal expense reserves for this company.

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EXAM 5, SPRING 2014

22. (3.5 points)

The following information is available for an insurance company:

<u>Month</u>	<u>Paid Development Factors to Ultimate</u>	<u>Reported Development Factors to Ultimate</u>
12-Ult	2.22	1.54
15-Ult	1.82	1.33
18-Ult	1.50	1.25
21-Ult	1.35	1.18
24-Ult	1.25	1.11

Accident year 2013 as of March 31, 2014:

- Reported claims: \$2,200
- Paid claims: \$1,650
- Selected ultimate claims: \$3,000

Accident year 2013 as of May 31, 2014:

- Reported claims: \$2,500
- Paid claims: \$1,875

a. (1.25 points)

Considering the data through March 31, 2014, compare the cumulative expected reported claims to the actual reported claims as of May 31, 2014 for accident year 2013.

b. (1.25 points)

Considering the data through March 31, 2014, compare the cumulative expected paid claims to the actual paid claims as of May 31, 2014 for accident year 2013.

c. (0.5 point)

Given the results calculated in parts a. and b. above, describe a situation in which the actuary would revise the March 31, 2014 estimate of ultimate claims.

d. (0.5 point)

Given the results calculated in parts a. and b. above, describe a situation in which the actuary would not revise the March 31, 2014 estimate of ultimate claims.



EXAM 5, SPRING 2014

23. (1.75 points)

Given the following information as of December 31, 2013:

Accident Year	Selected Ultimate Claims	Reported Claims	Paid Claims
2013	\$1,150	\$500	\$250

Age in Months	Selected Cumulative Percent Reported	Selected Cumulative Percent Paid
36	100%	100%
24	80%	55%
12	A	20%

- The expected reported claims for accident year 2013 during calendar year 2014 are \$433.
- The expected paid claims for accident year 2013 during calendar year 2014 are \$394.

a. (0.75 point)

Calculate "A", the selected cumulative percent reported at 12 months.

b. (1 point)

Assume that the actual paid and reported claims for accident year 2013 in calendar year 2014 are equal to the expected paid and reported claims for accident year 2013 in calendar year 2014.

Calculate the unpaid claim estimate for accident year 2013 as of December 31, 2014 using the case outstanding development technique.

## Exam 5

## Basic Techniques for Ratemaking and Estimating Claim Liabilities

QUESTION	POINT VALUE OF QUESTIONS	(a)	(b)	(c)	(d)	(e)	(f)	(g)
1	3.50	1.00	2.00	0.50				
2	3.25							
3	2.25	1.00	0.50	0.75				
4	2.00	0.50	0.50	0.50	0.50			
5	6.50	5.50	1.00					
6	2.50							
7	2.25	0.50	1.25	0.50				
8	2.25							
9	2.00							
10	2.25	0.75	0.50	1.00				
11	2.00	1.50	0.50					
12	1.00							
13	3.00	1.50	0.50	1.00				
14	2.75	1.25	0.50	1.00				
15	2.75	0.50	1.75	0.50				
16	2.75							
17	2.00							
18	4.00							
19	1.75							
20	2.25							
21	1.50	0.50	0.50	0.50				
22	3.50	1.25	1.25	0.50	0.50			
23	1.75	0.75	1.00					
TOTAL	59.75							

## EXAM 5 SPRING 2014 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.
- 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.
- Generally, candidates were fairly well prepared for this exam. However, candidates should be cautious of relying solely on study manuals, as some candidates lost credit for failing to provide basic insights that were contained in the syllabus readings.

### EXAM STATISTICS:

- Number of Candidates: 785
- Available Points: 59.75
- Passing Score: 42.5
- Number of Passing Candidates: 305
- Raw Pass Ratio: 38.85%
- Effective Pass Ratio: 41.90%

EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

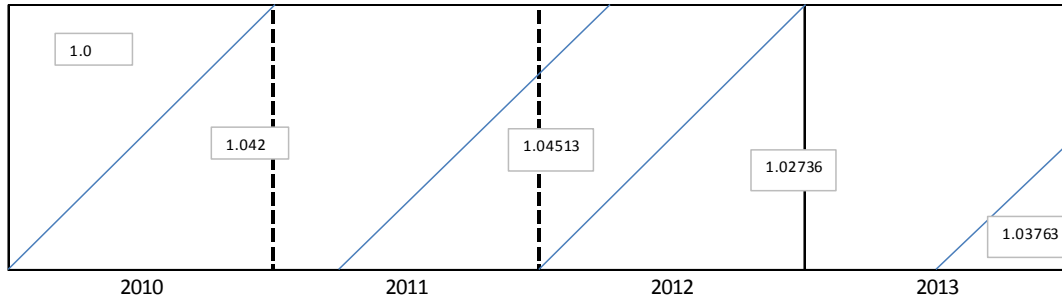
QUESTION: 1

TOTAL POINT VALUE: 3.5

LEARNING OBJECTIVE(S): A3

SAMPLE/ACCEPTED ANSWERS:

Part a: 1 point



OLF for CY 2011 Earned Premium

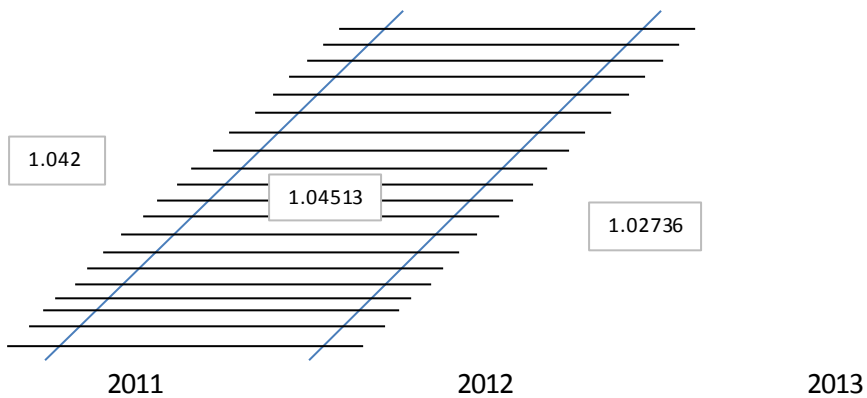
$$= \frac{1.03763}{(5/6)(5/6)(1/2)(1.04513) + (1-25/72)(1.042)}$$

$$= 1.03763/1.04309$$

$$= 0.99477$$

\*Candidates may ignore the +4.2% rate change that exists in both the numerator and denominator and still receive full credit.

Part b: 2 points



## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

OLF for Inforce policies on Feb 1, 2012

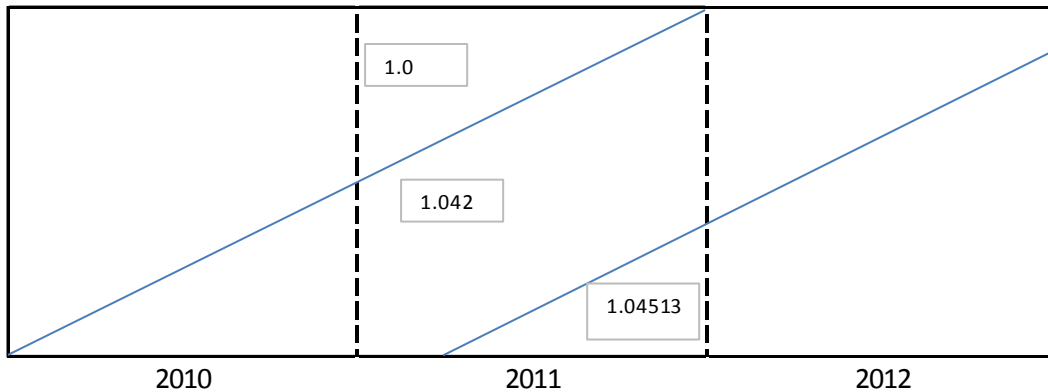
$$= \frac{1.03763}{(0.75)(1/12)(1.042) + (10/12)(0.75)(1.04513) + 0.25(1.02736) + (0.75)(1/12)(1.02736)}$$

$$= 1.03763/1.03938$$

$$= 0.99832$$

\*Candidates may ignore the +4.2% rate change that exists in both the numerator and denominator and still receive full credit.

**Part c:** 0.5 point



The portion of "1" comes in and the portion of 1.04513 decreases. Thus the OLF increases.

### EXAMINER'S REPORT:

#### General Commentary

- Candidates were expected to be able to calculate on-level factors to re-state various premiums at the current rate level, using the parallelogram method. This includes calculations for calendar year premium and in-force premium, and also incorporating special earning patterns.
- Overall, candidates performed as expected on this question. While most candidates scored at least 1/3 of the possible points, there was a fairly even distribution of scores between 1/3 of the credit and full credit.
- Part b. required the candidates to incorporate special earning patterns and the use of in-force premium rather than a calendar year premium. A large number of candidates struggled to incorporate the special earning pattern (25% of policies written on January 1<sup>st</sup>). A large number of candidates struggled to calculate the average rate level for in-force premium. Some candidates, rather than calculating an on-level factor using average rate levels, attempted to multiply the premiums by the rate changes that have not yet been fully earned.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Part a

- Candidates were expected to be able to calculate on-level factors to re-state calendar year premium at the current rate level, using the parallelogram method.
- Candidates were expected to be able to use the parallelogram method to calculate weights of different rate levels earned in a calendar year, and use them to calculate the on-level factor necessary to re-state the calendar year premium at the current rate level.
- The most common errors in part a. were assuming the March 1st rate change was  $\frac{1}{4}$  of the way through the year, and calculation errors.

### Part b

- Candidates were expected to be able to calculate on-level factors to re-state in-force premium at the current rate level, using the parallelogram method. This includes calculation to incorporate a special earning pattern.
- Candidates were expected to be able to use the parallelogram method to calculate weights of different rate levels for in-force premium (including the special earning pattern), and use them to calculate the on-level factor necessary to re-state the in-force premium at the current rate level.
- A large number of candidates struggled to incorporate the special earning pattern (25% of policies written on January 1st). A large number of candidates struggled to calculate the average rate level for in-force premium. Some candidates, rather than calculating an on-level factor using average rate levels, attempted to multiply the premiums by the rate changes that have not yet been fully earned.

### Part c

- Candidates were expected to be able to articulate how a change to the policy term (2-year policies vs. annual) would change the on-level factor without performing additional calculations.
- Candidates were expected to state that the on-level factor would increase and give correct rationale as to why (the average rate level in 2011 would decrease).
- The most common error made in part c was that candidates ignored the impact of the 1/1/2010 rate change (+4.2%). Occasionally, candidates erroneously responded about future rate changes having an impact.

**EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

**QUESTION: 2**

**TOTAL POINT VALUE: 3.25**

**LEARNING OBJECTIVE(S): A3, A4**

**SAMPLE/ACCEPTED ANSWERS:**

Premium:

Year	Premium	Payroll chg	Mod	Trend	Total
2011	2100	X 1.02 x 1.01	X .98 / .99	X 1.015 <sup>2</sup>	= 2206.296
2012	2500	X 1.01	X .98 / .98	X 1.015 <sup>2</sup>	= 2601.318
2013	2600		X .98 / .97	X 1.015 <sup>2</sup>	= 2706.199
Total					= 7513.813

Loss & LAE:

Year	Loss	Benefit chg	Dev	Trend	Total Indem	Medical	LAE	Total
2011	850	X 1.015 x 1.005	X 1.2	X 1.01 <sup>2</sup>	= 1661.39	+ 735	= x 1.15	= 2065.849
2012	670	X 1.005	X 1.8	X 1.01 <sup>2</sup>	= 1236.392	+ 834	= x 1.15	= 2380.951
2013	460		X 2.7	X 1.01 <sup>2</sup>	= 1266.964	+ 900	= x 1.15	= 2492.009
Total								= 6938.809

$6938.809/7513.8153 = 92.35\%$

Note: For the trending adjustments, a trending period of either 2.0 or 2.5 years was considered acceptable, as long as the same trending period was used for both calculations.

**EXAMINER'S REPORT:**

The candidate was expected to know how to adjust historical data to current level and then to expected future benefit levels. For premiums, this included an adjustment to reflect the current payroll level, the current experience modification level, and an adjustment for expected future wage levels. For losses, this included loss development and adjustments to current and future benefit levels (for indemnity claims). The candidate was also expected to incorporate medical claims (without development or trend), select a reasonable (adjusted/trended) loss ratio for the future, and apply a loading for LAE.

In general, candidates struggled with the number of required adjustments to bring historical results to current and projected levels; this question involved a synthesis of various learning objectives. Most candidates were able to apply the given loss development factors to the historical indemnity data and make proper adjustments for expected future trend (on both premium and losses). The required adjustments to bring historical data to *current* benefit/payroll levels and make an adjustment for the change in the experience mod level were the most challenging; most candidates failed to calculate the appropriate adjustments in columns (2) and (11) above.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Common mistakes included:

- Including current year's payroll level change in the benefit level adjustment
- Multiplying the historical and future experience mods to determine the current year's experience mod adjustment
- Calculating future benefit levels by trending each historical year for different periods (i.e., trending 2011 for 4 years, 2012 for 3 years, etc.)
- Trending or developing the medical claim data (which was already at ultimate)
- Failing to apply the LAE loading to the combined medical and indemnity ultimates
- Failing to select a going-forward loss ratio



## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 3

TOTAL POINT VALUE: 2.25

LEARNING OBJECTIVE(S): A2

SAMPLE/ACCEPTED ANSWERS:

**Part a:** 1 point

*Sample 1:*

Policy is effective in 2012 since  $A < 0$ . Since  $C > B$  and this is an annual term there must be no less than 6 months left in the policy term on 2/1/13. Valid range 8/2/12 – 12/31/12. 8/2/12 was used since C strictly greater than B.

*Sample 2:*

8/2/2012 – 12/31/2012

Had to be written in 2012 as 2013 written expo negative due to cancel (not just less than 1)

Had to be less than 6 months prior to 2/1/13 as unearned expo > earned at 2/1/13

*Sample 3:*

More exposure unearned at 2/1/13 than earned before 2/1/13.

Policy Canceled before 12/31/13

Written before 12/31/12

Possible effective dates 8/2/12 – 12/31/12

**Part b:** 0.5 point

*Sample 1:*

Must be written no later than Dec 31, 2012 => latest cancellation date = Dec 30, 2013

Inforce at Feb 1, 2013 => earliest cancellation date = Feb 2, 2013

So Feb 2, 2013 through Dec 30, 2013

*Sample 2:*

$D > 0$ ,  $C > 0$ , so needs to be cancelled after Feb 1st, 2013.

$A < 0$ , so needs to be cancelled by 12/31/2013

Valid cancellation dates = Feb 2nd, 2013 -> December 31st, 2013

*Sample 3:*

Has to be cancelled after 2/1/2013, but before policy ends and before end of 2013. 2/2/13 – 12/31/13

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

**Part c:** 0.75 point

*Sample 1:*

If B,C,D were as of 7/1/2013 and given the policy was written in 2012 ( $A < 0$ ) and cancelled in 2013 but was still in effect on 7/1/2013 ( $D > 0$ ): then B, total portion of the policy earned as of 7/1/2013 is  $\geq 1/2$ . In that case, C (portion of policy unearned) cannot be greater than B, since  $B + C = 1$ .

*Sample 2:*

To satisfy D and A under the new conditions, the policy must be written between 7/2/12 and 12/31/12. However this would break the requirement of  $B < C$ . Trying to satisfy  $B < C$  in this scenario would mean that the policy needs to be written any time after Jan 2nd, 2013 but then that would break the requirement of  $A < 0$ . Not possible to satisfy the new requirements with what we're given.

*Sample 3:*

Because of A, the policy has to be written in 2012 and cancelled in 2013. Therefore, by 7/1/13 at least half of the exposures are earned making the statement  $B < C$  invalid.

### **EXAMINER'S REPORT:**

#### **General Commentary**

Many candidates skipped this question or received little partial credit. Candidates needed a comprehensive understanding of Written, Earned, Unearned and In-Force Exposures. The difficulty in this question lies in the need to quickly comprehend and synthesize the provided information to apply the given restraints to deduce the possible dates.

#### **Part a**

Successful candidates were able to identify the pertinent pieces of information to correctly identify the start and end date of the possible range. Often candidates missed vital pieces of information to determine one of the end points of the range. For example, often candidates correctly identified 8/2/12 as the correct begin date of the possible range but failed to interpret that  $A < 0$  limits the range to 12/31/12. A very common error was the failure to correctly interpret the inequality  $B < C$  to recognize that 8/2/12 and not 8/1/12 was the correct start date. This mistake was not heavily penalized if candidates demonstrated the correct logic in determining a range.

#### **Part b**

Candidates often incorrectly interpreted "mid-term cancellation" to mean the exact mid-point of the policy term causing them to determine 6/30/13 or 7/1/13 as the last possible cancellation date. Many times candidates incorrectly entered 2/1/13 as the beginning of the cancellation range when the question clearly states that the policy is still in-force on 2/1/13.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Part c

This question seemed to be the most challenging to the candidates. The most common mistakes on this part involved a lack of support. For example, candidates would recognize that the policy will be more than 50% earned as of 7/1/13 without mentioning that  $A < 0$  constrains the policy effective date to CY 2012.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 4

TOTAL POINT VALUE: 2

LEARNING OBJECTIVE(S): A6

SAMPLE/ACCEPTED ANSWERS:

**Part a:** 0.5 point

- I would use developed to ultimate and trended losses, divided by trended exposures. Untrended and historical losses and exposures will not give an accurate loss cost for the projected period in which the rates will be in effect.
- Ok to use loss/exp if doing pure premium method but losses should be trended and fully developed. If not, rates will be distorted. (understated)

**Part b:** 0.5 point

- Loss, LAE provision will be overstated since increase in min deductible will lead to fewer covered losses. Restate historical losses and LAE with \$1000 min deductible.
- The indicated rate is based on historical losses projected to future level. If the trend used to project the losses already incorporates the expected change of deductibles, then no adjustment is needed.
- Should evaluate the appropriateness of the deductible factors used. If correct, the trend should not be a problem.

**Part c:** 0.5 point

- Data has low credibility due to low number of exposures. Extend experience period to include more than one year to increase credibility.
- Include more relevant data from benchmarks such as ISO or use competitor's info to calculate a complement of credibility. The 25 earned car years and 1 year of historical data is not enough to provide a stable and accurate forecast for future experience.
- There is insufficient data to produce a credible classification (both in terms of number of car and in terms of number of year). The classification can be pooled with other similar, larger groups to form a more statistical significant group.

**Part d:** 0.5 point

- The losses above \$100,000 still need to be added back in as a large loss load. If the analysis excludes these large losses all together, then losses will be underestimated and rates will be inadequate.
- Since the company has a significant number of claims in excess of \$100,000, we should use uncapped historical losses data to calculate the indication rate. The capped data does not reflect the true experience, and the rate might be too low by using the capped data.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

- I would use the higher capping than 100K. The goal of ratemaking is to include as many losses as possible into the project process as long it doesn't introduce too much volatility. I would increase the capping and for the "shock" losses above a higher capping say 250K or 500K. I would add an ILF factor or large loss load.

### EXAMINER'S REPORT:

#### General Commentary

Candidates were expected to use knowledge from the CAS "Statement of Principles Regarding Property and Casualty Insurance Ratemaking" and "Basic Ratemaking" to provide an assessment of the product manager's analysis and recommend an adjustment if needed in each sub part.

#### Part a

Candidates were expected to assess that using unadjusted historical data will not produce an accurate prospective estimate of the rate being calculated. Candidates were expected to suggest adjusting losses by an appropriate trend and developing losses to ultimate.

Full credit was also given for stating that this used the pure premium method and providing the appropriate adjustment.

Candidates generally did well recommending the appropriate adjustments needed for this analysis. Most candidates who lost credit on this question did not give an appropriate assessment of the product manager's proposal.

The most common errors were:

- Providing the appropriate adjustments, without completing the assessment portion of the question.
- Stating that the historical experience needs to be brought to the current level instead of the prospective level.
- Recommending adjusting the data for prior rate changes. Since the question clearly indicates exposures are used, not premium, historical rate changes do not need to be accounted for in the indication calculation.

Most candidates also appropriately stated that the exposures need to be trended if the exposure base is inflation sensitive; however credit was not subtracted for not including this piece since exposures do not always need to be trended depending on the line of business being rated.

#### Part b

Candidates were expected to assess that, with the increased deductible, losses would be overstated in the future period. Candidates should have recommended adjusting the historical experience for the deductible change. Candidates could also receive full credit for giving a complete discussion on no change being necessary if the deductible relativities are priced appropriately.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Most candidates who lost credit on this question did not give an appropriate assessment of the product manager's proposal.

A few of the common suggested adjustments that were not given credit include:

- Adjustments to premium but no comment on losses
- The only recommendation being to use policy year data
- Recommending to use ILFs instead of deductible factors

Many candidates said that policy year data should be used. While this was not wrong, it was not relevant for the question since this would only be applicable if the minimum deductible change occurred in the past, not will be occurring in the future. No credit was given or taken away for commenting on using policy year data. The subpart starts with "The indicated rate." This suggests a pure premium approach, which uses exposure instead of premium. However, no credit was given or taken away for commenting on adjusting premium. This is different from part a, where loss divided by exposure was explicitly stated in the question.

### Part c

Candidates were expected to assess that the data given was not credible enough to be used on its own. They should have recommended a specific way to adjust this data given the lack of credibility.

Most candidates received full credit for this subpart. Candidates who lost credit on this question generally did not give a specific credibility complement. Others misread the question to be using 25 years of historical experience.

A few of the common recommendations that were given credit for being a complement of credibility or adding to the given data include:

- More years of experience
- Industry/benchmark data
- Larger group/class
- External/outside data
- Internal data

Answers that were not given credit include:

- Complement of credibility (without giving an example similar to the above)
- Other data
- More data
- Increased data volume

### Part d

Candidates were expected to assess that not including the losses would make the rate inadequate. They should have recommended including the losses above the cap in some way, either through a large loss

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

provision, or using uncapped losses. Alternatively, candidates could have stated that the methodology was okay assuming that a large loss provision was also included.

Candidates generally provided an appropriate adjustment for this subpart.

Appropriate assessments include:

- Stating that the rate will be inadequate/understated.
- Detailed discussion on why the \$100,000 limit may be inappropriate since a capping level should be selected to include as much data as possible while reducing volatility introduced from large losses.

The most common mistakes on this question were:

- No appropriate assessment of the project manager's proposal.
- Recommending increasing the cap, but not taking into account losses that were still above the increased cap.
- Adding in losses above the cap, but also moving the earned premium down to the \$100,000 level as this would now overstate the indication.
- Commenting on how trends and development based on limited data are not appropriate for uncapped data, without assessing that the rate will be inadequate and that the excess losses need to be accounted for somehow.

EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION: 5

TOTAL POINT VALUE: 6.5

LEARNING OBJECTIVE(S): A3, A4, A5, A6, A12

SAMPLE/ACCEPTED ANSWERS:

Part a: 5.5 points

*Sample 1:*

Premium

2012:  $1250 * (1.075/1.00) * 1.04^{3.5} = 1541$

2013:  $1400 * (1.075 / ((1/8) * 1.075 + (7/8))) * 1.04^{2.5} = 1645$

Trend using CL APP = 4%

Trend period 7/1/## to 1/1/2016

Losses

2012:  $750 * 1.30295(24\text{-ult}) * 1.03^{3.5} (\text{loss trend}) * 1.1 (\text{ULAE}) = 1192$

2013:  $2.3453 * 10.3^{2.5} * 1.1 = 1389$

Trend 7/1/## to 1/1/2016

Age to age

12-24: 1.8 – used 3 yr. avg because of new software impact (past no longer ind. of future or similar)

24-36: 1.15 – 2009 and prior is different due to new software

36-48: 1.10 – used avg x Hi/Low as experience seems to be similar even with software change

48-60: 1.03

60-Ult: 1.00 – no tail

Fixed Expense

-exclude 2010 (likely high due to new software)

-simple avg = 11.75%

LR 2012: 0.774

LR 2013: 0.844

Avg: 0.809

Ind =  $(0.809 + 0.1175) / (1 - .05 - .2) - 1 = 23.5\%$

*Sample 2 (fixed expense):*

There is a spike in fixed expense in 2010 due to purchase of new software. Thus select avg (2011-2013) to prevent distortion.

$(0.15 + 0.12 + 0.10) / 3 = 0.123$



## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

**Part b:** 1 point

*Sample 1:*

Using large groups containing subject experience for rate indications makes sense, so long as the state data does not represent a large portion of CW loss cost so that there is some independence in complement. Also CW data is usually available, easy to compute

*Sample 2:*

Two qualities to assess approach by:

- A. Independence from base statistic – depending on how large the state is by volume of business compared to CW it may be mostly independent, but not completely independent as CW includes the state.
- B. Bias – If state loss costs are systematically different from CW then this complement of credibility is biased as the CW complement will not reflect this systematic difference.

*Sample 3:*

One criterion is availability of complement data. Using countrywide loss costs would meet this since it seems we have this data. Another criterion is easy to compute. Again using countrywide loss costs are a fairly easy metric to compute compared to some other complements like Harwayne's method. This meets this criterion.

*Sample 4:*

Should confirm complement is easy to compute and statistically independent.

- 1. Ease of computation makes it easier to explain to a regulator, who has final approval on a rate change. Also a complement that is easy to compute will cost the company less.
- 2. It should be statistically independent from the data used to calculate the rate change so as not to distort the indication.
- Using company countrywide loss costs satisfies 1 above (assuming company has the ability to obtain countrywide data easily) but not 2 (since the countrywide data would also include this state). I would remove this state from the countrywide data and then calculate the complement.

*Sample 5:*

A credibility complement should be unbiased: CW may be biased compared to the state, but can be adjusted if the direction and amount is known. Acceptable.

Should have logical relationship to the loss data. CW is logical as it is the same line of business and company, just for more regions than the state. Acceptable.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### EXAMINER'S REPORT:

#### Part a

Premium: The candidate was expected to be able to bring premiums to current rate level using the parallelogram method and to select and apply a one-step premium trend. A common error was incorrectly calculating the premium trend period.

Loss: The candidate was expected to be able to select loss development factors and develop losses to ultimate and to apply one-step trending to losses. The most common error was not taking into account changing development patterns for the 24-36 month period.

Fixed expense: The candidate was expected to make an appropriate selection for the fixed expense provision. To receive credit the candidate needed to exclude the extraordinary historical ratio caused by the new claims software. Common mistakes were omitting the justification for the selected ratio and using all historical years to calculate the provision.

Indication: The candidate was expected to calculate the rate level indication. To receive credit the candidate needed to calculate the projected loss ratio and, with the calculated fixed expense provision and the given variable expense and profit provisions, determine the indicated rate level change. A common mistake was omitting the provided ULAE provision from the calculation.

#### Part b

The candidate was expected to understand desirable qualities of a credibility complement and to evaluate the use of countrywide data with respect to each of the two qualities. A common mistake was correctly identifying two desirable qualities but neglecting to assess the use of countrywide data.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 6

TOTAL POINT VALUE: 2.5

LEARNING OBJECTIVE(S): A8

### SAMPLE/ACCEPTED ANSWERS:

#### *Sample 1:*

1. This would be hard to obtain and verify. You would have to rely on self-reporting which would be subject to unintentional mis-measurement or would encourage moral hazard and people would lie about it. Once they report it, it would be very difficult to verify. On this criteria, I would not recommend it.
2. Privacy- information about sleeping habits would be considered a personal and unnecessarily intrusive question. People may be reluctant to discuss such matters with an insurance company. This criteria would not recommend it.
3. This would seem to have a causal relationship to auto losses. People would be able to understand that not sleeping can increase the risk of losses. So from this standpoint, it would seem ok.
4. Controllability- People will be more accepting if they can control to some extent what level of rating variable they belong to. Because you can adjust the hours you sleep, using this criteria, it may be more accepted.

Overall I would not use this rating variable. The privacy and moral hazard issues would outweigh the benefits.

#### *Sample 2:*

I do not recommend this for four reasons:

1. It will be perceived by some insureds as an invasion of privacy.
2. It is not feasible to verify- it's easy for insureds to lie about it.
3. It's hard to obtain data on it as # hours slept per night is not often recorded by individuals, let alone reported.
4. It's an ambiguous measure- hours in bed? Hours with eyes closed? What if insured gets up for drink of water?

#### *Sample 3:*

1. Statistical - It has been determined that sleep is a predictive rating variable, so it must be statistically significant, but could lack some credibility for groups at the high and low ends and could be difficult to be homogenous if people get more or less sleep every night.
2. Operational - Hours of sleep is well defined and objective, however it would be difficult to verify and if was left to the policyholder to report it could be manipulated to save money.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

3. Social - Hours sleep could be perceived as a privacy issue by the policyholders, it could also lack some controllability depending on the policyholder's family or financial situation.
4. Legal - Would need to check if this rating variable would be allowed by state law.

Due to the operational issues with verification and the social issues of privacy, I would NOT recommend using this rating variable in the risk classification system.

### EXAMINER'S REPORT:

Candidates needed to know criteria for evaluating rating variables that are considered for use in a risk classification system. They did quite well on this question, and many valid arguments were made about many different considerations. Some common mistakes were:

- Not making it clear that causality is important from a social perspective, but isn't necessary and cannot be proven by the company.
- Arguing that the variable lacks statistical significance, even though the question states that the actuary found it to be predictive.
- Listing "difficult to verify" and "easy to manipulate" as two separate considerations (they'd only get credit for the first, as they were considered the same).
- Forgetting to make a final recommendation about the variable.
- Stating that # hours of sleep is not an objective measure without providing any support.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 7

TOTAL POINT VALUE: 2.25

LEARNING OBJECTIVE(S): A9

SAMPLE/ACCEPTED ANSWERS:

**Part a:** 0.5 point

*Sample 1:*

$$\text{Complement} = (3.25 - 2.75) / 2.00 * \$1,500,000 = \$375,000$$

*Sample 2:*

$$CC = 3.25 / 2 * \$1,500,000 - 2.75 / 2 * \$1,500,000 = \$2,437,500 - \$2,062,500 = \$375,000$$

**Part b:** 1.25 points

*Sample 1:*

$$\text{Complement} = 0.65 [ 300,000 ((3.25 - 2.75) / 3.25) + 200,000 ((3.25 - 2.75) / 3.5) ] = \$30,000 + \$18,571 = \$48,571$$

*Sample 2:*

$$\text{Complement} = 0.65 [ \$400,000 ((2.75 - 2.75) / 2.75) + \$300,000 ((3.25 - 2.75) / 3.25) + 200,000 ((3.25 - 2.75) / 3.5) ] = \$0 + \$30,000 + \$18,571 = \$48,571$$

**Part c:** 0.5 point

Accepted answers included any one of the following:

- Assumes the same expected loss ratio for all levels
- Not logically related to the losses in the layer
- Biased
- Inaccurate
- Volatile and thin data in the upper layers may not be reliable
- Takes time to compute
- Losses below the attachment point may not be clearly related to losses above the attachment point
- Does not use actual losses in calculating the complement – could be inaccurate
- Distribution of excess losses may be very different from the loss distribution underlying the ILFs
- Relies on industry factors that may not apply to the company

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### EXAMINER'S REPORT:

#### Part a

- Candidate was expected to apply the equation defined by the method in the article and apply it correctly. Most candidates received full credit.
- Full credit was given to candidates that used the correct ILFs to calculate the complement and then multiplied that ratio by the uncapped losses
- Common errors made by candidates:
  - Multiplying the correct ILF ratio by premium instead of losses
  - Using the incorrect ILFs (ILFs from the wrong layers)
  - Simple calculation error while correct ILFs and losses were used

#### Part b

- Candidate was expected to use the equation defined by the method in the article and apply it correctly.
- Candidates needed to know the methodology from the article and correctly incorporate each of the layers above \$500,000, knowing that limits at or below \$500,000 have no contribution to the layer of \$500,000-\$750,000. Candidates were not required to document the equation for full credit so long as they showed support for their calculation.
- Common errors made by candidates:
  - Including \$500K limit and/or below and applying a non-zero contribution to the \$500-\$750K layer
  - Failing to include both the \$750K and \$1M limit in the calculation
  - Applying an incorrect ELR (60% instead of 65% for example)
  - Including the correct limits in the calculation, but using a wrong ILF in the calculation
  - Multiplying the ELR by losses instead of premium
  - Multiplying ELR by total premium rather than for just the affected limits

#### Part c

- The candidate was expected to state two distinct criticisms of the limits analysis approach, which was to be applied in part b. Only about half of the candidates got at least partial credit.
- Explanations or justifications for any of the criticisms were not required, except regarding statements regarding inaccuracies about the methodology inputs, which could be a generic criticism of any methodology.
- Many candidates stated criticisms of specific methodologies to determine ILF's, as discussed in Werner & Modlin, Chapter 11, rather than criticisms of the limits analysis approach. While general criticisms of ILF's were accepted, since they are a component of the limits analysis approach, criticisms that only applied to a specific methodology to determine ILF's were not accepted. For example, an accepted answer was that higher limits tend to have thin and/or volatile data, which can generally lead to inaccurate ILF's regardless of the methodology.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

However, an unacceptable answer was that frequency or insured behavior is assumed to be the same for all limits, because it does not apply to the GLM approach for determining ILF's & thus does not generally apply to the ILF's used in the limits analysis approach.

Although the methodology assumes the same expected loss ratio for each limit, most candidates omitted the word "expected", and it was not required to be mentioned to get credit for that criticism. However, stating that the actual loss ratio can be different is not sufficient for credit, as that is not an assumption of the methodology.

Criticisms stating that either the ILF's or the ELR's must be accurate without stating why they might be inaccurate were not accepted, since any methodology would require that its particular inputs be accurate. Examples sufficient for credit include: ILF's may be inaccurate due to thin data in the upper layers, and using the same ELR for every limit may cause inaccuracies because it is generally unrealistic to expect every limit to have the same expected loss ratio. However, simply stating that either the ILF or ELR must be accurate is insufficient for credit.

**EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

**QUESTION: 8**

**TOTAL POINT VALUE: 2.25**

**LEARNING OBJECTIVE(S): A9**

**SAMPLE/ACCEPTED ANSWERS:**

*Sample 1:*

Territory	Loss & LAE	Adj Exp	PP	Ind Rel	Ind Rel to Base
1	11,127	276	40.315	0.6953	0.7068
2	51,335	900	57.039	0.9837	1.0
3	32,983	470	70.177	1.2102	1.2303
	95,445	1,646	57.986		

Adj Exp = Male Exp (1.0) + Female Exp (0.8)

PP = (Loss + LAE)/Adj Exp

Ind Rel = PP/(total PP)

Ind Rel to Base = Ind Rel/ territory 2 Ind Rel

Territory 3 indicated relativity change:

$1.2303/1.125 - 1 = 9.36\%$

*Sample 2:*

territory	adjusted exposures	pure prem	IR	IR @ base
1	$180(1) + 120(.8)$ = 276	$11,127/276 =$ 40.32	.6953	.707
2	$500(1) + 500 (.8)$ = 900	57.04	.984	1
3	$350(1) + 150(.8)$ = 470	70.18	1.21	1.23
		57.99		

Territory 3 indicated rel change =  $1.23 - 1.125 = .105$



## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Sample 3:

	(1)	(2)	(3)	(4)	(5)
Ter	Adj Exposure	LC	Ind Rel	Adj Cur Rel	Neutral Rate Change
1	276	\$40.32	0.6952	0.7547	- 7.9%
2	900	57.04	0.9836	1.0062	+ 2.2%
3	470	70.18	1.2101	1.1320	+ 6.9%
	1646	57.99	1.0	1.0	0%

(6) Avg Cur Rel = 0.9938

(6) Current rel weighted by (1)

(2) Loss & LAE / (1)

(3) (2)/\$57.99

(4) current Rel / 0.9938

(5) (3)/(4) – 1

### EXAMINER'S REPORT:

- The candidates needed to know how to use the adjusted pure premium method to calculate the indicated relativity change by territory or to calculate the overall revenue neutral rate change by territory.
- Most candidates were able to calculate the indicated relativities correctly, but many failed to calculate the relativity change, failed to calculate the revenue neutral rate change, or calculated the base rate offset incorrectly.
- Candidates used many different acceptable approaches to calculating the indicated relativity change or the indicated revenue neutral rate change, and were able to arrive at the same correct answers. Many of these differences were due to rebalancing at different points in the problem.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 9

**TOTAL POINT VALUE: 2 points**

**LEARNING OBJECTIVE(S): A9**

**SAMPLE/ACCEPTED ANSWERS:**

*Sample 1:*

The GLM analysis shows that credit score is a statistically significant variable for wind frequency. All levels have standard errors close to the indicated relativity and moving in the same direction. For the poor level, both standard errors are higher than the fair level, which suggest these levels are significantly different. The poor level does not have a lot of volume (around 5% of total volume), thus it is not very credible compared to the other two levels. This has to be taken into account when selecting relativities.

This variable is objective, well-defined, easy to verify, and cannot be manipulated. Therefore, it is very practical to use it and it is recommended for this criteria.

The insured can improve her credit score with time, thus she would have the power to control this in the future and has a financial incentive to do so. Socially, this variable is not always well perceived as insured often lack of understanding of its relation to expected loss. Also, it may make insurance more unaffordable if poor credit risks are significantly overcharged.

Overall, strong predictive power and easiness of use of this variable outweigh potential shortcomings, therefore it is suggested that it is used.

*Sample 2:*

Reasons to add:

- No overlap of standard error ranges → indicated difference is statistically significant
- Large indicated relativity → relativity for "poor" is almost 1.5, not implementing could result in underpricing these risk, adverse selection
- Easy to verify by credit check

Concerns:

- Analysis only performed on one year of data, could be highly influenced by anomalies or shock losses
- Low exposures for "fair" and "poor" → relatively low credibility
- No logical relationship between credit and wind losses (no clear causality)

I would not add this variable to the rating plan. Mainly because we do not know if our data is reliable after only one year. I would recommend waiting a few years first, then running the GLM again.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### EXAMINER'S REPORT:

- The candidate was expected to know how to interpret GLM output as provided in the question. In addition, the candidate was expected to provide qualitative arguments in support of or against their recommendation.
- On the whole, many candidates struggled with this question. While most were able to interpret much of the GLM output appropriately, some didn't include qualitative considerations (in addition to the statistical GLM output) . Given the question was worth two points, a full explanation should incorporate several sentences/points to receive full credit.
- This question was challenging because it asked the candidate to interpret data that could easily be used to either support or reject use of the rating variable. Similarly, much of the qualitative criteria could be used to either support or reject the variable. Given the question was worth two points, candidates were to provide a full discussion to support the recommendation; many candidates did not provide sufficient justification to receive full credit.
- Common errors included:
  - Discussing an intuitive/causal link between credit score and wind losses being an advantage to implementing the variable
  - Not providing a well-rounded response, including some candidates not acknowledging any faults of their recommendation
  - Some candidates didn't provide a recommendation
  - Some candidates provided a vague response (for example, saying the variable was statistically significant, credible, or socially unacceptable without additional support why these were true/untrue)

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 10

TOTAL POINT VALUE: 2.25

LEARNING OBJECTIVE(S): A10

SAMPLE/ACCEPTED ANSWERS:

Part a: 0.75 point

Answers receiving full credit include:

- Regulatory reasons. Examples:
  - There may be regulatory restrictions that don't allow companies to take over an 8% change.
  - May be subjected to a maximum rate increase from DOI.
  - If a rate change of 20% was allowed, the company may be required to notify policyholders who are having a rate increase of x% or more. This could impact renewals, and the added cost of this may not be worth it.
  - Regulators may not agree with an underlying assumption used in the rate indication and suggest a different assumption that produces a lower rate indication.
  - Might require public disclosure or press conference to implement a 20% change.
- Operational reasons. Examples:
  - It may be costly to implement the whole rate change in the system, especially if the rates change substantially.
  - The rate increase may require a major change to rating systems and the company does not have resources to do that at this time.
- Customer impacts/retention reasons. Examples:
  - Company may not want to lose policyholders who would be prompted to shop for lower rates if rate increases excessively.
  - Perhaps they want to keep the rate change at below double digits to avoid customers from shopping around, and they'll increase rates more next year.
- Competitive/marketing reasons. Examples:
  - They may want to remain competitive to target new business.
  - For competitive reasons, the company may decide to limit the amount of a rate increase.
- Longer term pricing reasons. Examples:
  - Lifetime value of customer – perhaps the future value of writing customers now outweighs the value of implementing the full rate change.
  - Asset Share Pricing used – long term profitability has been predicted, so although rates may produce a net loss this renewal, could be profitable in the future if policies are retained.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Part b: 0.5 point

Answers receiving full credit include:

- Expense reductions. Examples:
  - Can lower the expenses, such as less advertising or lowering wages of employees.
  - They can reduce expenses to try and make up for the shortfall.
  - Decrease expenses (fixed or variable).
- Loss cost reductions (exceeding premium reductions). Examples:
  - The company could offer incentives to educate drivers about safety features or courses and attempt to decrease losses that way.
  - The company could try and reduce overall coverage without taking an offsetting rate change.
  - Implement better safety incentives for insureds to help control losses.
- Increase investment income. Example:
  - Adopt a more aggressive investment strategy.
- Reduce underwriting profit target. Example:
  - Accept a lower profit provision to balance the fundamental insurance equation.
- Legal action. Example:
  - By legal actions to challenge regulations
- Shift to more profitable business. Examples:
  - Focus on marketing to groups that are appropriately priced; avoid underpriced groups.
  - Change underwriting guidelines to write more profitable business.

### Part c: 1 point

$$\text{Proposed Base Rate} * 1.069 * 1.057 * (1-0.030) + 35 = 450 * 1.080$$

$$\text{Proposed Base Rate} = 411.48$$

### EXAMINER'S REPORT:

#### Part a

- Learning Objective A10 says the candidate should be able to “describe the process for implementing rates to achieve an organization’s goals.” This part requires the candidate to identify considerations that a company would evaluate when taking less than a full indicated rate change.
- The part requires three correct examples to obtain full credit.
- Candidates generally performed very well on this part. A majority received full credit.
- Common errors made by candidates:
  - The candidate provided an example that should be incorporated into the indication itself. For example, a one-time catastrophic loss or an atypical expense should be

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

adjusted in the indication determination rather than taking a subjectively lower rate increase.

- Company's management decided to take less rate was not an acceptable answer without any explanation as to why (i.e. retention or marketing considerations).
- Some candidates stated that a variable could not be used, but this did not sufficiently explain why the company wouldn't take the full overall indicated rate change.
- Some candidates provided renewal rate capping as a response. However, rate capping would not lower the overall requested rate change, just delay its effects.
- Some candidates implied that choosing a lower rate change would reduce the risk of adverse selection. However, inadequate rates actually increase the risk of adverse selection.

### Part b

- Learning Objective A10 says the candidate should be able to "describe the process for implementing rates to achieve an organization's goals", specifically "non-pricing solutions." This part requires the candidate to identify ways to offset the shortfall between the requested rate increase and the indicated.
- The part requires two correct examples to obtain full credit.
- Candidates generally performed very well on this part. A majority received full credit.
- Common errors made by candidates
  - The candidate equated relative riskiness of an insured with relative profitability. For example, a high risk insured doesn't necessarily imply that the insured is unprofitable.
  - Spreading out the indicated rate change over multiple periods was not an acceptable response. This does not offset the rate need, only delays achieving the indicated rate. Note – this was an acceptable answer for part (a).
  - Reducing coverage without recognition of impact on premium. For example, if deductible relativities are priced equitably, then raising deductibles would result in an offsetting premium reduction and no change in overall profitability.

### Part c

- Learning Objective A10 says the candidate should be able to "describe the process for implementing rates to achieve an organization's goals", specifically "rating algorithms", "rating variables and differentials, and "calculation of final base rates." This part requires the candidate to calculate the new base rate to achieve the desired rate increase.
- The candidate needed to calculate the new base rate to receive full credit. This involved determining how the rate differentials would impact the base rate in order to achieve the proposed premium.
- Candidates generally performed very well on this part. A majority received most or full credit.
- Common errors made by candidates
  - Some candidates erroneously used the \$450 current average premium per vehicle as the current base rate.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

- Many candidates manually calculated the overall rate differentials for each rating factor even though this was not necessary. No points were lost for this, but this cost the candidates time.
- Some candidates applied the 8% rate change to the current base rate rather than the current average premium.
- The formula provided directs the candidate to subtract the additive discount, but many candidates added it instead.
- A significant portion of the candidates skipped this part, even if they answered the other parts in this question.

**EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

**QUESTION: 11**

**TOTAL POINT VALUE: 2 points**

**LEARNING OBJECTIVE(S): A12**

**SAMPLE/ACCEPTED ANSWERS:**

**Part a:** 1.5 points

*Sample 1:*

Basic Premium =  $(15\% - .62\% * (1.08 - 1) + .181) * 695,000 = 195,573$   
converted losses =  $200000 * 1.08 = 216,000$

==> retro rates =  $(195,000 + 216,000) * 1.04 = 428,035.92$

max retro prem =  $1.25 * 695,000 = 868,750$

min retro prem =  $.75 * 695,000 = 521,750$

==> retro premium as of 4/1/15 = 521,250

*Sample 2:*

min =  $.75 * (695,000) = 521,250$

max =  $1.25 * (695,000) = 868,750$

Basic Premium =  $0.15 - 0.62(1.08 - 1) + .0181(0.62)(1.08) <==$  assuming the net insurance is a ratio  
= 0.2216

Converted losses =  $200,000 (1.08) = 216,000$

Retro Premium =  $(0.2216(695000)+216000)(1.04)$   
= 384,812

Final retro premium is [521,250] subject to minimum

Note: This solution was only given credit if the candidate explicitly stated the assumption that the net insurance is a ratio.

*Sample 3:*

basic P. =  $(0.15 - 0.62(1.08 - 1.0) + 0.181) * 695,000$   
= 195,573

Converted Losses =  $200000 * 1.08 = 216000$

Retro P =  $(216000 + 195573) * 1.04 = 428035.95$

Min Premium =  $695000 * 0.75 = 521250$



## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Since Retro P < min premium, then the min premium applies.

*Sample 4:*

$$RL = 200000, 2 \cdot 10^5$$

$$CL = (2 \cdot 10^5) \cdot 1.08 = 216000$$

$$BP = (.181 + 15 - .62(1.08 - 1)) \cdot 695000 = 195573$$

$$(CL + BP) TM = \text{prem} = 428035.95 \text{ [min} = 521250]$$

*Sample 5:*

$$\text{Expenses provided through LCF} = 0.62 \cdot (1.08 - 1) = 0.05$$

$$\text{Basic Premium} = 695000 \cdot (0.15 - .05 + 0.181) = 195295$$

Retro Premium calculation

$$= (195295 + 200000 \cdot 1.08) \cdot 1.04 = 427747$$

$$427747$$

----- = 62% of standard premium

$$695000$$

But 62% is less than 75% which is the minimum ratio.

$$\text{So answer is } 0.75 \cdot 695000 = [521250]$$

**Part b:** 0.5 point

*Sample 1:*

It is intended to cover non-tax, non-loss related expenses, such as the following:

1. Underwriting expenses
2. Costs associated with limiting premium at the maximum, and savings associated with meeting the minimum premium requirement.

Note: The phrase "non-tax, non-loss related expenses" was required to receive full credit under this solution.

*Sample 2:*

Basic premium is intended to cover u/w profit and expense excluding those provided through loss conversion factor, excluding premium tax.

Basic premium is intended to provide for net cost associated with limiting retro premium within maximum and minimum values.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### *Sample 3:*

1. Expenses excluding expense already covered in the loss conversion factor.
2. Insurance charge due to adjusting the retro premium to max/min, which would create savings or shortfalls.

### *Sample 4:*

1. basic premium covers the cost of limiting the retro premium by a min and max
2. covers expenses except for the ones that vary with the loss (and do not include the tax).

### *Sample 5:*

One element is the net insurance charge which is equal to the savings the insured received by having a limit on the maximum amount of premium minus the guaranteed reserve the insurer receives for having a minimum premium. The second limit is the expense allowance minus the ELR\* LCF. This is equal to the administrative of the policy besides LAE because that is already taken into account by converting reported losses.

### *Sample 6:*

1. Basic premium covers the company's target profit and the expenses excluding the expense due to LCF.
2. Basic premium covers U/W expenses and profit provision. It also covers the net cost of limiting the premium to the max and min

Note: if the candidate just mentioned "U/W expenses", the answer would have been wrong. The candidate needed to mention "profit provision" or "less other expenses" to get credit for "U/W expenses"

## **EXAMINER'S REPORT:**

### **General Commentary**

- The candidate was expected to know basic retrospective rating formulas and components of the basic premium
- Candidates performed pretty well on the problem. The majority of candidates received most, if not all, credit.
- Candidates commonly missed points when calculating the basic premium in part a and missed points in part b entirely or for only mentioning U/W expenses

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Part a

- The candidate was expected to know the basic retrospective rating formulas
- To obtain full credit, the candidate was expected to plug the numbers into the formula and calculate the final retro premium applying the min/max
- Common errors made by candidates:
  - Netting the already netted insurance charge (most common)
  - Other formula errors
- Most candidates performed very well on this part

### Part b

- The candidate was expected to know components of the basic premium
  - Target U/W Profit and expenses excluding expenses provided by the loss conversion factor and tax multiplier
  - Cost of limiting the retrospective premium to be between the min and max premium.
- To obtain full credit, the candidate was expected to give 2 of the components mentioned above.
- Common errors made by candidates:
  - Just mentioning expenses (and not including profit or excluding other expenses)
- Candidates performed more poorly on part b than a. Many more left b blank as opposed to a.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 12

**TOTAL POINT VALUE: 1 point**

**LEARNING OBJECTIVE(S): B1**

### **SAMPLE/ACCEPTED ANSWERS:**

Region 4 is growing (can be seen in increase in earned exposure and inc. ultimate clm counts). Should be grouped on its own because growth will affect ult. The development is also not similar to region 1, 2 or 3.

Combine 2 & 3: 2 might be too small to stand on its own; both regions appear to be stable (no growth trend) and the development trends similarly.

Region 1 on its own as it appears credible on its own and its development is higher than the other regions at all valuations.

### **EXAMINER'S REPORT:**

- Candidates were expected to explain why regions 1 & 4 should remain ungrouped and regions 2 & 3 should be grouped. For region 1, acceptable reasons included the large size/credibility of the region and the difference in loss development from the other regions. For region 4, acceptable reasons included recognition of the extreme growth in the region and the difference in loss development from the other regions. For the combination of regions 2 & 3, candidates were expected to recognize the obvious similarity in development patterns. In addition, they were expected to recognize another rationale for grouping: either reflecting on the lack of credibility for region 2 or the stability in exposure and/or claim count distribution (or growth) across the accident years. Vague answers about a region being “different” or “unusual” without reference to how the region was different or unusual were not given credit.
- Approximately half of the candidates received full credit for this question, and nearly two-thirds of candidates scored 0.75 or better. There were two common areas that caused errors:
  - Many candidates calculated frequencies based on the given claim counts and exposures. They often used similar frequencies as a rationale for grouping, even though that point is irrelevant. One can encounter two regions with similar frequencies but different development patterns (such as with region 4 vs. 2/3) – one would not want to group those regions, despite the similar frequencies.
  - A number of candidates believed that region 4 should be grouped with regions 2 & 3 because of “similar development patterns” coupled with a concern with 4’s credibility. Their interpretation of the development patterns was curious as the factors are not truly similar. It seems that candidates were stretching to find a way to augment low volumes in the earlier accident years. They latched onto regions 2 & 3 as the closest match, from a development perspective. Most of these did not recognize the effect of

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

region 4's growth on their decision but even those who did express concern about that, chose to ignore it for the sake of "credibility."

- There were a few candidates who made mistakes in their numbering of the regions. They might describe region 1 accurately and then later describe region 4 accurately but call it region 1 by accident. So long as the rationale was solid and it was obvious that they had the written equivalent of a "typo", full credit was still granted.
- Aside from blank papers, very few candidates misunderstood what was being asked. In general, the candidates were quite thorough in explaining their rationale, even when that rationale was essentially flawed. There were no candidates who simply listed the groupings with no explanation for why they chose those groups. Note that if there had been such answers, no credit would have been granted without any explanation for why the candidate chose those groups.

EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION: 13

TOTAL POINT VALUE: 3 points

LEARNING OBJECTIVE(S): B2, B3

SAMPLE/ACCEPTED ANSWERS:

Part a: 1.5 points

This was a "calculation" question. The responses below give examples of a thorough response with all necessary components as well as a very efficient response that still illustrates full knowledge of the required steps. The first response uses a simple average and the second response uses a volume weighted average. These were the only two averages used by candidates that were accepted.

Sample 1:

Cumulative Reported Claims (000s)

AY	12	24	36
2011	25,000	45,000	56,250
2012	30,000	51,000	
2013	21,000		

Age to Age Factors

AY	<u>12-24</u>	<u>24-36</u>	<u>36-Ult</u>
2011	1.8	1.25	
2012	1.7		
Selected (2 Yr Avg)	1.75	1.25	1.00
Cumulative	2.188	1.25	1.00

$$\text{AY 2013 Ult Claims} = 21,000 \times 2.188 = 45,938$$

Sample 2:

Triangle Reported (000's)

AY	<u>12</u>	<u>24</u>	<u>36</u>
11	25	45	56.25
12	30	51	
13	21		

$$\text{Ult 2013} = 21,000 \times (45+51) / (25+30) \times 56.25 / 45 \times 1.00 = 45,818.20$$

2 yr volume wtd link ratio

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Part b: 0.5 point

Answers receiving full credit include:

- Assumes that claims will develop the same way into the future as they did in historical period.
- The past is indicative of the future.
- It assumes a stable mix of claims
- Stable case reserve adequacy
- Claims handling & processing has not changed.
- Claims observed in an immature AY tells something about claims yet to be observed.
- Consistent mix of policy limits and deductibles throughout the experience period.

### Part c: 1 point

Answers receiving full credit include:

- If you do not believe losses will continue to develop in the future consistent with historical development, you could use the expected claims technique as it uses an a priori assumption of ultimate losses and does not rely on losses paid to date.
- Use expected loss method. When selecting ELR, make sure ELR is corresponding to the new mix of claim type.
- Could use the paid development method since it will be unaffected by a change in case reserves.
- The Berquist-Sherman method for case outstanding adjustments should be used. Historical case outstanding is adjusted based on the level of case reserves after the changes, from which adjusted reported claims are derived and the reported development method is performed on the adjusted claims.
- BF method can be used when reported claims are not related to IBNR. BF method assumes that IBNR is more closely related to expected claims, independent of reported losses.  $IBNR = \% \text{ unreported loss} \times \text{Expected Loss}$
- Use expected claims method. The unpaid claims rely on a priori estimate. I can select a new a priori loss estimate for new policy limit.

### EXAMINER'S REPORT:

#### Part a

Candidates were expected to have knowledge about the full process for reported claim development method. The scores were generally very high with the majority of the candidates receiving full credit. Common errors were a failure to recognize the tail factor and "calculator errors."

#### Part b

Candidates were expected to be able to list at least two assumptions of the reported claim development method. There were many assumptions listed throughout chapter seven of the Friedland text. There were many answers that were accepted. The majority of candidates received full credit. There were a

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

few candidates that gave responses referring to when the reported claim development method does not work well -- these items are not all necessarily synonymous with or related to an assumption, so not all of these responses were accepted.

### **Part c**

Candidates were expected to know two of the many alternative methods or techniques. Accepted responses included valid methods (to address the violation of the part b assumption) and either a.) why it was an improvement over the reported claim development technique or b.) a description of the method. Candidates struggled more with this part than part a. or part b. The majority of candidates were able to identify methods but were less successful at providing valid descriptions. Common errors include an omission of a description after identification of a method or simply restating part b.



## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 14

TOTAL POINT VALUE: 2.75 points

LEARNING OBJECTIVE(S): B3

SAMPLE/ACCEPTED ANSWERS:

**Part a:** 1.25 points

Paid Claims=(1-% Unpaid)\*Ultimate Paid Claims

$(1-0.8)*(95,000) = 19,000$

Incurred Claims = 19,000 + 22,000 = 41,000

% unreported =  $1 - (41,000/102,500) = 0.6$

BF Ultimate Claim =  $41,000 + 0.6 * 100,000 = 101,000$

**Part b:** 0.5 point

Answers receiving full credit include:

- For accident years, when the % unreported is 0, the reported BF will equal the reported claim development technique  
*or*
- When the CDF = 1 or when CDF<1 and use 1.
  
- When actual losses to date are equal to expected losses to date  
*or*
- When actual cumulative losses are equal to expected cumulative losses  
*or*
- When the actual loss ratio to date is equal to the expected loss ratio to date

**Part c:** 1 point

Answers receiving full credit include:

- Highly leveraged LDF: For some long tail line of business, the LDFs can become so big that the ultimate claim estimate can vary greatly. The BF technique mitigates this by relying more on expected claims for early years.
- When the data is volatile, thin or both. BF technique is less influenced by fluctuations in actual data since it relies on expected claims for IBNR calculation.
- If operating in new line of business, can use benchmark LDFs usage of expected LR and reflect actual experience.
- In early maturities, BF is preferable since large or unusual (CAT) claims will distort the claim development method while BF is based on expected a priori added to the actual which will be more stable

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

- In case of strengthening the case reserves, the development method will be very affected and project ultimate claims that are too high. The BF technique, because it is weighted with the expected claims will also tend to overstate ultimate claims but not by as much as the development method.

### EXAMINER'S REPORT:

#### Part a

- Candidates were expected to know how to calculate the BF method
- Common errors made by candidates:
  - Assumed 80% paid instead of 20% paid
  - Did not calculate a reported CDF
  - Used 80/20 as the reported % and not as the paid

#### Part b

- Candidates were expected to understand and communicate when the two methods are equal
- Two scenarios were needed for full credit
- Common errors made by candidates:
  - Many candidates mistakenly restated the question in answer form

#### Part c

- Candidate was expected to identify two situations where the BF technique is preferable to the reported claim development technique and briefly explain why. Have a basic understanding of when the BF is most useful
- Common errors made by candidates:
  - Situation without an explanation
  - Gave same "situation" twice

EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION: 15

TOTAL POINT VALUE: 2.75 points

LEARNING OBJECTIVE(S): B3

SAMPLE/ACCEPTED ANSWERS:

Part a: 0.5 point

$$\% \text{ unreported} = 1 - \frac{1}{2} = 50\%$$

$$.5 \times .57 \times 1800 = 513,000$$

Part b: 1.75 points

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year	OLEP	%Rep	Used Up Premium (2) x (3)	Reported Claims	Trend	Trended Claims (5)x(6)
10	1100x 1.35 = 1485	91%	1350	700	1.05^3	810
11	1690	71%	1207	750	1.05^2	827
12	1680	58%	988	500	1.05^1	525
13	1800	50%	900	750	1.00	750
Total			4445			2912

$$\text{ECR} = 2912/4445 = 65.5\%$$

$$\text{IBNR} = 1800 * .5 (\% \text{ unreported}) * .655 = 590,000$$

Part c: 0.5 point

- Cape Cod is better since it uses reported claims to derive the ECR, it will capture the change in the claims ratio, while B-F will not.  
*or*
- B-F is more appropriate as we can make a selection to account for the decrease in underlying claims ratio. The Expected Claims Ratio calculated by Cape Cod will be too high.
- B-F is better; if the data is volatile, it's better to use an a priori estimate of the claims ratio (B-F), rather than calculating ECR from the data (CC)

EXAMINER'S REPORT:

Part a

- Candidate was expected to know how to compute a B-F estimate for IBNR, given all the necessary inputs for the calculation.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

- The majority of candidates scored full credit, with nearly all candidates scoring at least half of the points; overall candidates scored very well.
- All inputs needed for the calculation were given; no special assumptions or considerations related to the B-F method were present in the question statement
- Common mistakes included:
  - Calculation errors
  - Deriving ultimate loss instead of IBNR

### Part b

- Candidate was expected to know how to compute a Cape-Cod estimate for IBNR, given all the necessary inputs for the calculation.
- Overall candidates scored well; approximately one-third received full credit, and nearly all candidates scored at least half of the available points.
- Candidates commonly struggled with being given a "Pure Premium" trend. Many applied the trend to Earned Premium.
- Most errors revolved around trend and loss development; candidates failed to trend losses, trended premium instead, or developed losses to ultimate. Less common was incorrectly selecting the ECR, calculation errors, and giving Ultimate Loss instead of IBNR. Even less common were mistakes with the concept of "Used-Up Premium"

### Part c

- Candidate was expected to know whether B-F or Cape-Cod would yield better estimates of IBNR under two different scenarios
- The majority of candidates scored full credit, with nearly all candidates scoring at least half of the points; overall candidates scored very well.
- Scenarios were commonplace examples in CAS exam literature
- Candidates typically lost points for failing to provide enough support for the method selected

**EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

**QUESTION: 16**

**TOTAL POINT VALUE: 2.75 points**

**LEARNING OBJECTIVE(S): B3, B4**

**SAMPLE/ACCEPTED ANSWERS:**

*Sample 1:*

It's safe to use the ground-up claim counts and ldf in 2013 to calculate the ultimate 2013 ground up claims, since CDF-ult was developed prior to change.

Ult Ground-up counts:  $1500 \times 1.2 = 1800$

For excess level, the rpt claims count is distorted for 2013 due to case strengthening. I will use trended 2011 and 2012 experience.

	Revenue	Trend	Clm Cts	LDF	Freq Trend	Proj Freq = (3) x (4) / [(1) x (2)] x (5)
	(1)	(2)	(3)	(4)	(5)	
2011	3400	$1.03^2$	220	1.5	$1.05^2$	0.101
2012	3500	1.03	140	2.5	1.05	0.102

Average Selected: 0.1015

Excess claim counts =  $3600 \times 0.1015 = 365$

The claim counts not exceeding attachment point is  $1800 - 365 = 1435$

*Sample 2:*

Ground-Up

Excess

$1750 \times 1.0 \times 1.02^2 =$	1821	$220 \times 1.5 \times 1.05^2 =$	364
$1700 \times 1.04 \times 1.02 =$	1803	$140 \times 2.5 \times 1.05 =$	367.5
$1500 \times 1.20 \times 1 =$	1800	$90 \times 6.0 \times 1 =$	540

$364 / 1821 = .2$

$367.5 / 1803 = .2038$

Avg .2017 (exclude 2013)

$1800 \text{ Ult } 2013 \text{ ground-up} \times .2019 = 363.4 \text{ excess}$

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

1436.6 below attachment point

### EXAMINER'S REPORT:

This question was somewhat challenging as it asked for candidates to consider the impact of a change in reserving process and how it impacts claim count development differently for ground-up vs. excess claims. Candidates needed to recognize that using a straightforward development method would not be appropriate for counts above the attachment point and that instead they needed to use the second frequency development approach. In order to receive full credit, candidates needed to use the two older accident years (2011 and 2012) to project the excess claims for 2013 as the reported excess claims were overstated due to the reserving change.

Candidates performed as expected on this question. The majority of the candidates recognized the need to use the second frequency development approach. Roughly half of the candidates that attempted the question properly recognized the need to use the two older years to project 2013 excess claim counts.

The most common mistake the candidates made was using all three years to project the 2013 excess claim counts. These candidates generally performed the second frequency development method fairly accurately but failed to consider which years to use given the change in case reserving process given. Another common mistake was that candidates recognized the need to trend the payroll, but never actually used the trended payroll in the second frequency development approach. Some candidates simply took the average claim counts across the years without regard for change in exposure (revenue).

A fair number of candidates derived an alternative approach where rather than determining the excess and ground-up frequencies (which requires trended payroll), they instead determined the ratio of excess to ground-up claim counts for 2011 and 2012 and then applied this ratio to the 2013 ground-up claim counts to derive the 2013 excess claim counts. Full credit was given for this approach when done accurately.

There appeared to be some confusion around the definition of frequency trend given in the question. The majority of candidates viewed frequency trend as defined in the Friedland text where the trend in exposure is not included, however a fair number of candidates assumed frequency trend included the underlying trend in payroll as is often the case in every day actuarial work. Credit was given for both approaches.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 17

TOTAL POINT VALUE: 2 points

LEARNING OBJECTIVE(S): B4

### SAMPLE/ACCEPTED ANSWERS:

- Reported Development method
  - This technique will overstate IBNR because the CDF will be higher and it is multiplied by a reported loss that is at a higher level.
- Expected Claim Method
  - This technique will produce accurate IBNR since it is based on an a priori estimate of future claims. Change in case adequacy will not change its result
- Reported Bornhuetter-Ferguson
  - This technique will overstate IBNR because increased case adequacy will produce higher CDFs which will then result in higher % unreported. This will give a higher IBNR estimate.
  - Overestimate but less than reported development method, since it is the weighted average of reported development and expected claim method.
- Reported Cape Cod
  - This technique will overstate IBNR for the same reason as BF method: the higher CDFs will give a higher % unreported and lower % reported which will overstate IBNR.
  - Overestimated since method uses the ECR which is calculated by the ratio of reported claims and used up premium. Reported claims overestimated and ECR overestimated.

### EXAMINER'S REPORT:

- As this is a fundamental part of unpaid claim estimates, candidates were expected to score very well and generally did so on this question. Over half of exam takers scored full credit on this question.
- When candidates lost credit, it was typically for not providing rationale to their answers. Other candidates confused the a priori nature of the expected claims method with the first half of the Cape Cod method that determines an ELR based on current reported claim activity.
- Some candidates seem to have focused on the concept of the Bornhuetter-Ferguson as a credibility-weighted average of development and expected claims, but were unclear on the mechanics of the method, confusing changes in credibility weights with increases and decreases in the ultimate loss projected by the technique.
- Some candidates noted the triangle should be adjusted, without specifying the nature of the adjustment or what the adjustment was intended to correct.

EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION: 18

TOTAL POINT VALUE: 4 points

LEARNING OBJECTIVE(S): B5

NOTE FROM THE EXAMINATION COMMITTEE:

The phrase "Cumulative Open Claim Counts" as printed in the exam was intended to read "Cumulative Reported Claim Counts." In grading the question, graders accounted for all possible interpretations of the "Cumulative Open Claim Counts" triangle, including:

- Candidates treating it as being the "Open Claim Counts" triangle
- Candidates treating it as being the "Cumulative Reported Claim Counts" triangle

SAMPLE/ACCEPTED ANSWERS:

Sample 1:

avg paid = paid claims / closed cnt

	12	24	36	
11	1,111	1,389	1,571	--> 2% yr to yr change
12	1,133	1,417		2% 2%
13	1,156			2%

closed cnt /total cnt

	12	24	36	
11	0.474	0.485	0.5	--> Consistent
12	0.474	0.485		
13	0.474			

avg case o/s = case/open

	12	24	36	
11	0.1	0.136	0	--> very large yr to yr changes --> above inflation it would seem.
12	0.2	0.272		
13	0.3			

Claim Settlement & payments seem stable so paid development method works.  
Claim counts very stable - didn't show triangle, but equal down each column  
So will use a FxS method with developed counts and developed paid



**EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

Severity

		12 - 24	24 - 36	
	11	1.5	1.21	
	12	1.5		
paid dev factors --> using weighted avg	A:A	1.5	1.21	
	A:U	1.815	1.21	1

Ult = 1040 x 1.815 = 1,887,600

Closed Cnt

AY	12	24	36
11	900	1080	1155
12	900	1080	
13	900		

Sel	12-24	24-36	36-ult	
A:A =	1.2	1.069	1	--> based on st avg
A:U =	1.283	1.069	1	

avg paid A:A tri --> see 1st page for avg paid triangle

AY	12-24	24-36	36-ult
11	1.25	1.131	
12	1.251		
13			

Sel A:A =	1.25	1.131	1	--> st avg
A:U =	1.414	1.131	1	

ult count = 900 x 1.283 = 1155

ult sev = 1.156 x 1.414 = 1.635

ult claims = ult count x ult sev = 1155 x 1.635 = 1,888,425

**EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

Sample 2:

AVG Case Per Open

12		24		36
1000	>	7500	>	0
2000	>	15000	>	2
3000	>			1,5

←

$= 300000 / (1100 - 1080)$

\*Assume cumulative open claim counts should be cumulative reported Claim Counts esp if no development after 36 months, Reported = Closed Counts and none open @ 36 months & no case @ 36 months.

AVG Paid Per Closed

12		24		36
1111,11	>	1388,89	>	1571,428
1133,33	>	1416.67	>	1,02
1155,56	>			1,02

←

$= 1530000 / 1080$

Closed Claim Cnts: Report

12	24	36	
0,9	0,98	1	
0,9	0,98	1	
0,9			--> indicates no claim settlement increases /speed up in payment.

average case per open is increasing at a greater rate than average paid per closed indicating increased case strengthening.

Use Reported Berquist Sherman method w/ 2% severity trend from paid trend rate.

Adjusted Case Per Open

12	24	36
2883,5	14705	0
2941.176	15000	
←		
$= 3000 / 1.02$	3000	

Use BS to adjust all diagnos of reported triangle to current level of case adequacy.

Adjusted Rep triangle (\$000s)

12	24	36
1288,4	1794,1	1815
1314	1830	
1340		

→  $2941.174 * 100 / 1000 + 1020$

100 is open counts, 1020 is paid \$.

link ratios

12-24	24-36	36-ult	select volume wtd averages
1,3926	1,0116		1

2013:  $1340 * 1.3926 * 1.0116 = \$1887.857K$

Use Paid Development method b/c it is not affected by changes in case.

12-24	24-36	36 to ult
1,5	1,21	1

2013:  $1040 * 1.5 * 1.21 = 1887.6K$

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### EXAMINER'S REPORT:

The methods that can be applied in this question are:

1. Berquist-Sherman method to adjust case reserve adequacy
2. Paid development method
3. Frequency-Severity (paid) method 1
4. Frequency-Severity (paid) method 3.

Candidates were expected to identify the increase in case adequacy pattern in the data. From there, it was expected that the candidate would use the B-S method. Candidates were also expected to point out the stability in the claim counts or disposal rates. In order for the candidates to receive credit, it was expected that they would first calculate diagnostics from the data, interpret it and link that to the use of the appropriate method based on the diagnostic given.

This question is considered to be a bit challenging because the candidate needs to understand multiple reserving techniques in order to calculate the diagnostics and choose the correct method.

Most candidates selected the Berquist-Sherman method and the paid development method.

Some candidates used the right methods but didn't provide enough diagnostics to support the selected methods.

In utilizing the Berquist-Sherman method to adjust the case reserves, almost all the candidates knew to trend the average case outstanding from the current level to previous years. Most candidates correctly calculated and identified the paid severity trend as the right trend. A common error for some candidates was to use the reported severity trend, average outstanding trend, or some arbitrary trend.

In the paid development method, since the LDFs are stable and the calculations are simple, almost all candidates received full credit when selecting this method.

A small group of candidates selected the Frequency-Severity (FS) methods. Most received full credit for using the paid FS, although some of them incorrectly used the reported severity instead. Some were confused by the severity of cumulative paid losses and the severity of incremental paid amount at each age. Almost all candidates calculated the claim counts correctly if they did select this method.

The reported LDFs are stable coincidentally which leads a few candidates to wrongly select the reported development method. Very few candidates incorrectly selected the case outstanding method.

Overall, candidates performed well on this question; despite the printed error in the question itself, most candidates treated the reported count triangle as intended.

**EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

**QUESTION: 19**

**TOTAL POINT VALUE: 1.75 points**

**LEARNING OBJECTIVE(S): B3**

**SAMPLE/ACCEPTED ANSWERS:**

*Sample 1:*

Age-to Age	12-24	24-36	36-48
2010	2.144	1.835	1.192
2011	1.998	1.718	
2012	2.067		
Average	2.070	1.777	1.192

2013 Level:

2010 LR =	$(3118 * 0.98^3)/5000 = 0.587$
2011 LR =	$(3140 * 1.192 * 0.98^2)/6000 = 0.599$
2012 LR =	$(1840 * 1.777 * 1.192 * 0.98)/6500 = 0.588$
Average =	0.591 = 2013 LR

$$8,000,000 * 0.591 = 4,730,666.667$$

*Sample 2:*

AY	(1) OLEP	(2) Claims	(3) CDF to Ult	(4) Trend	(2x3x4) CR
10	5000	3118	1	.98^3	0.587
11	6000	3140	1.192	.98^2	0.599
12	6500	1840	(1.769)(1.192)	.98^1	.0585
Selected: (st. Avg)					.059

	12-24	24-36	36-48
Selected Ult. Factor (wtg. Avg)	2.062	1.769	1.192

$$\text{AY 13 Ult Claims} = \text{EP} * \text{Selected Ratio}$$

$$= (8,000,000)(.59) = 4,722,667$$

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### EXAMINER'S REPORT:

The candidate was expected to understand how to apply the expected claims technique to estimate ultimate claims. To apply the technique, the candidate was expected to know how to develop age-to-age factors, cumulative development factors, correctly apply the development method and trend to reported claims, and determine an appropriate expected claims ratio (loss ratio).

This was a standard expected claims technique question and candidates generally scored well. Candidates generally lost credit by failing to calculate claims ratios by accident year, by including 2013 in determining the selected claims (loss) ratio, for using a technique other than the expected claims technique or for math errors. The 2013 cumulative development factor is highly leveraged and the resulting claim (loss) ratio is not in line with prior years, so it is not appropriate to be considered. Claim (loss) ratios by accident year are needed to determine if any trends exist over time and to determine an appropriate selection.

**EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

**QUESTION: 20**

**TOTAL POINT VALUE: 2.25 points**

**LEARNING OBJECTIVE(S): B6**

**SAMPLE/ACCEPTED ANSWERS:**

	<b>Cumulative Paid</b>		
	12	24	36
2011	4,000	5,000	5,500
2012	4,500	5,625	
2013	5,000		

	<b>A-A</b>		
	12	24	36
2011	1.25	1.10	1.00
2012	1.25		
A-A	1.25	1.10	1.00

	<b>A-U</b>		
	12	24	
	1.375	1.1	
Ult Loss	6,875	(5,000 * 1.375)	

	<b>Cumulative S&amp;S</b>		
	12	24	36
2011	800	1,750	2,200
2012	900	2,509	
2013	1,250		

	<b>Paid to Paid</b>		
	12	24	36
2011	0.200	0.350	0.400
2012	0.200	0.446	
2013	0.250		

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

	<b>A-A</b>		
	12	24	36
2011	1.75	1.14	1.00
2012	2.23		
A-A	1.99	1.14	1.00

	<b>A-U</b>	
	12	24
	2.274	1.143
Ult S&S	<b>3,909</b>	$(6,875 * 0.25 * 2.274)$

### EXAMINER'S REPORT:

This question covered standard material from the text and followed a similar format and presentation. Candidates were required to develop losses to ultimate, and also to be able to apply the Ratio Approach.

Candidates did very well on this question. The most common mistakes included forgetting to develop losses to ultimate and calculator errors.

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### QUESTION: 21

**TOTAL POINT VALUE: 1.5 points**

**LEARNING OBJECTIVE(S): B7**

**SAMPLE/ACCEPTED ANSWERS:**

**Part a:** 0.5 point

Answers receiving full credit include:

- Historically the defense ALAE was spread out over a longer period of time. The development ratio calculated from these will be too large for the new front-loading of legal expenses. Until new defense strategy is reflected in experience long enough to generate accurate ALAE CDFs, ALAE development method will overstate unpaid ALAE.
- As the company changed the way claims are being handled, i.e. more resources at the beginning of the claim cycle, we will expect there will be more paid ALAE at the earlier development period. Using paid development technique to estimate unpaid ALAE will then overstate the unpaid ALAE (historically stable pattern is applied to larger ALAE-to-date), even if we do expect the ult ALAE to be higher due to this initiative.

**Part b:** 0.5 point

Answers receiving full credit include:

- Initial ALAE at early maturities will be higher. Expect ultimate claims to decrease due to increase in litigation. Ultimate estimated ALAE to paid claims ratio will be distorted by these two effects. Initial ALAE to paid is higher than usual
  - Developed to higher ultimate ALAE to paid ratio
  - Apply ratio to lower ultimate paid
  - Questionable ultimate effect
- The historical paid ALAE to paid claim ratios will again show too long of a development CDF. At early maturities ratio will be lower than now and development factors will be too large. Moreover, the effect of the new strategy may reduce ultimate claims, so we would expect a changing ultimate ALAE to claim ratio as well.
- Prior to the initiative, we can expect stable ALAE-to-paid claims ratio. However, the initiative will likely result in higher paid ALAE and lower ultimate claim paid. Here we will see the ratio produced will be higher as compared to historical position. Again, the higher ratio will then be multiplied with the development factors and depending on the accuracy of ultimate claim paid estimated, the unpaid ALAE may be overstated as well.



## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Part c: 0.5 point

Answers receiving full credit include:

- Frequency should remain mostly unchanged. May see additional claims with no pay due to better, faster defense, lowering overall frequency.  
Ultimate severity of ALAE expense may remain steady, just incurred at earlier stages.  
It may be appropriate to use the frequency severity technique, if proper adjustments are made to available data for operational changes and both frequency and severity are monitored on an ongoing basis.
- I do not think using a frequency-severity technique would be appropriate to estimate ultimate ALAE for the company. Frequency and severity technique works best when there is stable claims practices and mix of business and consistent claims definition. TO estimate the upcoming ALAE using frequency & severity technique would be inappropriate as changes to claims settling have recently begun and this will result in inaccurate ultimate and inaccurate ALAE reserves.
- Yes. Claim counts will be stable because the change will not affect the number of claims being reported. The change in severity will have the isolated change in legal practices which we can incorporate into the estimate.

### EXAMINER'S REPORT:

#### General Commentary

- The candidate is expected to have a thorough understanding of the development method for ALAE and the ratio method, as well as a fairly strong understanding of the strengths and weaknesses of these techniques.
- Candidates did not generally score well on this question, though the majority was able to get partial credit.

#### Part a

Overall, candidates did well on this part. Many received full credit and most received at least partial credit.

- The candidate was expected to have a thorough understanding of the development method for ALAE.
- For full credit the candidate should recognize that the historical development factors are not appropriate for estimating future development and explain why.
- Common errors:
  - Many candidates answered this question for loss instead of ALAE
  - Many candidates did not recognize that the historical pattern was no longer appropriate

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Part b

Overall, candidates did not do as well on this part. Most received partial credit with some receiving full credit.

- The candidate was expected to have an understanding of the ratio method for ALAE, recognizing:
  - the current ALAE-to-loss ratio is higher than the historical ratio
  - the historical development factors are not appropriate for estimating future ratio development
  - the new initiative may impact the estimate of ultimate loss, which would distort the ultimate ALAE under this method.
- Common errors:
  - Pointing out issues with the method, but not connecting them to the situation stated in the question
  - Many candidates did not reference that the historical pattern was no longer appropriate
  - Providing an insufficient discussion of the issue
  - Responding for the **ULAE** ratio method.

### Part c

Overall, candidates struggled on this part. Many received partial or no credit, with very few full credit responses.

- This method was not specifically addressed in the text for ALAE. However, the candidate was expected to have an understanding of all loss methods, and be aware that they can be applied to ALAE.
- For full credit the candidate should address both frequency and severity in relation to the situation specified in the question. Both responses for or against using the frequency-severity method were given credit, as long as there was sufficient explanation provided.
- Common errors:
  - Many candidates answered this question for loss instead of ALAE
  - Many candidates referenced only frequency or severity, not both.
  - Pointing out issues with the method but not connecting them to the situation stated in the question.
  - Suggesting other methods, without explaining why the frequency-severity method would not be appropriate.

EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION: 22

TOTAL POINT VALUE: 3.5 points

LEARNING OBJECTIVE(S): B8

SAMPLE/ACCEPTED ANSWERS:

Part a: 1.25 points

Sample 1:

Age	Reported CDF	Reported %
12	1.54	64.94%
15	1.33	75.19%
18	1.25	80%
21	1.18	84.75%
24	1.11	90.09%

As of 3/31/14 IBNR = 3000 - 2200 = 800

Linear interpolated reported % at month 17:  $75.19\% + (80\% - 75.19\%) * \frac{2}{3} = 78.49\%$

@17 CDF = 1.276

Expected loss 3/31~5/31:  $800 * \frac{78.4\% - 75.19\%}{1 - 75.19\%} = 103.51$

Cumulative expected as of 5/31: 2200 + 103.51 = 2303.51

Actual as of 5/31: 2500

Difference: 2303.51 - 2500 = -196.49

Sample 2:

3/31 = 15 months

5/31 = 17 months

Unreported at 3/31/14 = 3000 - 2200 = 800

Expected reported between 3/31 and 6/30

$$800 * \frac{1/1.25 - 1/1.33}{1 - 1/1.33} = 155$$

So for 5/31, expect  $\frac{2}{3}$  of this = 103

Actual reported = 2500 - 2200 = 300

Significantly more reported than expected

Sample 3:

AY 13

Reported from March 31 - May 31: +300

March 31, 2014 = 15 months

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

May 31, 2014 = 17 months

Assume linear interpolation

Expected emergence = Ultimate \* {% reported @ May 31, 2014 - % reported @ March 31, 2014}

$$\text{Expected} = 3000 * \{1.25^{-1} - 1.33^{-1}\} * \frac{2}{3} = 96.24$$

Difference = 203.76

*Sample 4:*

Let's assume that between maturities 15 months and 18 months, claims emergence is uniform (since we are not given 17 -Ult CDFs)

$$\text{Expected claims emergence from 15-18: } 2200 * \frac{1.33}{1.25} = 140.8$$

$$\text{from 15-17: } \frac{2}{3} * 140.8 = 93.8667$$

Expected reported claims @5/31/14:  $2200 + 93.8667 = 2293.87$

Actual = 2500

More claims were reported than expected by 206.13

**Part b:** 1.25 points

*Sample 1:*

<u>Age</u>	<u>Paid CDF</u>	<u>Paid %</u>
12	2.22	45.05%
15	1.82	54.95%
18	1.5	66.67%

As of 3/31/14 Unpaid =  $3000 - 1650 = 1350$

Linear interpolated paid % at month 17:  $54.95\% + (66.67\% - 54.95\%) * \frac{2}{3} = 62.76\%$

$$\text{Expected loss paid 3/31~5/31: } 1350 * \frac{62.76\% - 54.95\%}{1 - 54.95\%} = 234.04$$

Cumulative expected as of 5/31:  $1350 + 234.04 = 1884.04$

Actual as of 5/31: 1875

Difference:  $1884.04 - 1875 = 9.04$

*Sample 2:*

Unpaid at 3/31/14 =  $3000 - 1650 = 1350$

Expected paid between 3/31 and 6/30

$$1350 * \frac{1/1.5 - 1/1.82}{1 - 1/1.82} = 351$$

So for 5/31, expect  $\frac{2}{3}$  of this = 234

Actual reported =  $1875 - 1650 = 225$

Actual paid slightly lower than expected but mostly in line

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Sample 3:

AY 13

Paid from Mar 31 – May 31: +225

March 31, 2014 = 15 months

May 31, 2014 = 17 months

Assume linear interpolation

Expected emergence = Ultimate \* {% paid @ May 31, 2014 - % paid @ March 31, 2014}

Expected =  $3000 * \{1.5^{-1} - 1.82^{-1}\} * \frac{2}{3} = 234.43$

Difference = 9.43

### Sample 4:

Assume claim settlement uniform between 15 - 18

Expected claims emergence from 15-18:  $1650 * \frac{1.82}{1.5} = 352$

Expected Paid Claims @5/31/14:  $1650 + \frac{2}{3} * 352 = 1884.67$

Actual = 1875

Fewer claims paid than expected by 9.67

### Part c: 0.5 point

Answers receiving full credit include:

- If it was found that the higher than expected reported claims was due to actual changes in underlying loss ratio that just hadn't yet shown up in the data at 15 months then the actuary should change the estimate of 2013 ultimate.
- If there was an influx of claims explaining the increase (such as unusually stormy season) would have to adjust the ultimates to reflect the expected increase in ultimate claims.
- It could be a large loss reported but not paid. Since this is not anticipated, increase estimate.
- If you think there has been a material change causing reported to come in higher than expected such as change in laws to increase minimum limits which may not show in paid claims immediately (will show in reported before paid) we may want to increase our ultimate to reflect the higher ultimate implied by actual reported emergence.

### Part d: 0.5 point

Answers receiving full credit include:

- Actuary would not revise the estimate if there was a change in case reserve philosophy (strengthening). Paid losses (actual) were in line with expected, and reported increase is due to case strengthening with no expected impact on ultimate settlement value.
- Claims reporting pattern change but no impact on ultimate settlement (ie more reported earlier)

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

- If there was a change in the claims department to get claims into the system quicker (claims in transit was previously higher) there would be no reason to change the ultimate.

### EXAMINER'S REPORT:

#### General Commentary

- Candidates were expected to perform an actual versus expected calculation, including interpolation of loss development factors, and interpret the results, citing examples of scenarios that may cause such results
- Candidates generally performed well on parts a & b and did not perform as well on parts c & d. Parts a & b required relatively straightforward calculations (with the added complexity of interpolation) while parts c & d were more open-ended.

#### Parts a & b

- Candidates were expected to understand actual versus expected formulae, including the calculation of accident year age and interpolation of loss development factors.
- Multiple methods of calculating expected reported and paid were accepted as correct calculations.
- Candidates generally performed well on these parts of the question. Common mistakes included:
  - Using the incorrect loss development factors (incorrect ages or confusing paid and reported)
  - Not interpolating the loss development factors or interpolating incorrectly
  - Mistakes in applying the actual versus expected formula
  - Failing to compare actual and expected results

#### Parts c & d

- Candidates were expected to interpret the results derived in parts a & b and identify logical scenarios that may explain those results and whether an actuary would consider modifying original selected ultimate claims.
- Candidates did not perform well on these parts of the question. Common mistakes included:
  - Identifying changes in case adequacy or claim settlement during the quarter as situations to revise ultimate estimated claims (as opposed to situations to leave ultimate estimated claims as originally selected since changes in operations do not necessarily change the ultimate claims value)
  - Identifying deteriorating loss ratio or unexpected large loss(es) as situations to leave ultimate estimated claims as originally selected (as opposed to situations to revised ultimate estimated claims)
  - Speaking to the results from a & b incorrectly:
    - Citing case reserve weakening when part a showed higher actual reported than expected

## **EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT**

- Citing changes in settlement process/speed when part b showed actual paid close to expected

EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION: 23

TOTAL POINT VALUE: 1.75 points

LEARNING OBJECTIVE(S): B8

SAMPLE/ACCEPTED ANSWERS:

Part a: 0.75 point

$$\text{IBNR} = 1150 - 500 = 650$$

$$433 = 650 \left( \frac{0.8 - A}{1 - A} \right)$$

$$0.66615 = \frac{0.8 - A}{1 - A}$$

$$0.66615 - 0.66615A = 0.8 - A$$

$$0.33385A = 0.13385$$

$$A = 0.40$$

Part b: 1 point

Sample 1:

$$= \text{Case} \left( \frac{(\text{Reported CDF} - 1)(\text{Paid CDF})}{\text{Paid CDF} - \text{Reported CDF}} \right) + 1$$

$$= ((500 + 433) - (250 + 394)) \left( \frac{\left( \frac{1}{0.8} - 1 \right) \left( \frac{1}{0.55} \right)}{\frac{1}{0.55} - \frac{1}{0.8}} + 1 \right)$$

$$= (289)(1.8)$$

$$= \$520.20$$

Sample 2:

$$\text{Reported as of 12/31/2014} = 500 + 433 = 933$$

$$\text{Paid as of 12/31/14} = 250 + 394 = 644$$

$$\text{Case reserve as of 12/31/14} = 933 - 644 = 289$$

$$\text{Unpaid} = 289 \left( 1 + \frac{\text{IBNR}}{\text{CASE}} \right)$$



## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

$$= 289 \left( 1 + \frac{\text{Unreported \%}}{\text{Reported \%} - \text{Paid \%}} \right)$$

$$= 289 \left( 1 + \frac{1-0.8}{0.8-0.55} \right)$$

$$= 520.2 \text{ Unpaid}$$

### EXAMINER'S REPORT:

#### General Commentary

- Candidates were tested on actual vs. expected development concepts, as well as the IBNR to case outstanding reserving technique
- Approximately half of the candidates scored full credit on part a, and approximately one-third of candidates scored full credit on part b.
- For part b., a majority of the candidates were familiar with the formula, most of them citing it correctly. However, under 20% received full credit. Points deducted were usually based on incorrect calculations, use of wrong data (such as at the wrong evaluation age), or formulaic errors.
- Part a. required some thought, as it was backing into an original selection rather than starting with the selection and calculating a subsequent result. Part b. was a straightforward calculation, using an evaluation where all of the inputs had been supplied.

#### Part a

- The candidate was expected to know how to apply expected emergence to determine percent reported, which is a variation on standard actual vs. expected calculations
- Candidates were expected to use reported at 12 months, expected reported emergence for the 12-24 month period, and the current IBNR to solve for the percent reported at 12 months
- Candidates took a variety of approaches:
  - The sample answer (full credit)
  - An alternative approach in which they calculated percent of ultimate based on emergence of incurred losses to bring from A at 12 months to 80% at 24 months. This earned partial credit as it did not include any reference to IBNR
  - Another alternative approach which calculated based on difference between A and 80% using the selected ultimate. This earned partial credit as it was based on ultimate loss and not the IBNR.
  - A simple calculation of reported loss divided by ultimate loss – this scored minimal credit since it was using an ultimate selection to imply a percent reported rather than calculating a selected percent reported. In addition, it made the assumption that ultimate loss was based solely upon reported loss development
  - Typically, points deducted were predicated on the approach taken, with relatively few instances of calculation errors

## EXAM 5 SPRING 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

### Part b

- The candidate was expected to know the case outstanding development technique and be able to apply it. This was explicitly stated in the question.
- The candidate was expected to know the formula for the technique, and substitute the appropriate values.
- Common mistakes included:
  - Omitting the "+1" factor in the formula, in essence calculating IBNR and not unpaid
  - Calculating case outstanding incorrectly, either by using incorrect periods, using incremental 12-24 instead of cumulative, or some other method
  - Using incorrect development factors, particularly that at age 12 and not age 24
  - Attempting to solve the problem by replicating the tables in Friedland's Approach #1, but not recognizing the correct method of utilizing the Unpaid / Case Outstanding calculation