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CANADIAN INSTITUTE OF ACTUARIES



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Exam 5

Basic Techniques for Ratemaking and Estimating Claim Liabilities

INSTRUCTIONS TO CANDIDATES

1. This 63.5 point examination consists of 26 problem and essay questions.
2. For the problem and essay questions, the number of points for each full question and part of a question is indicated at the beginning of the question or part. Answer these questions on the lined sheets provided in your Examination Envelope. Use dark pencil or ink. Do not use multiple colors or correction fluid.
 - 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. Anything written in the examination booklet will not 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 17, 2013.

END OF INSTRUCTIONS

EXAM 5, SPRING 2013

1. (2 points)

Given the following information for an insurance company that writes 24-month term policies:

Policy Group	Effective Date	Expiration Date	Number of Vehicles
A	January 1, 2010	December 31, 2011	50
B	July 1, 2010	June 30, 2012	100

All policies within each group have the same effective date.

a. (0.5 point)

Calculate the earned car-years for calendar year 2011.

b. (0.5 point)

Calculate the earned car-years for policy year 2010 evaluated as of December 31, 2010 and as of December 31, 2011.

c. (0.5 point)

Assume Policy Group B cancels on January 1, 2011. Calculate the 2010 policy year written car-years evaluated as of December 31, 2010 and as of December 31, 2011 for Policy Group B.

d. (0.5 point)

Assume Policy Group B cancels on July 1, 2011. Calculate the 2010 and 2011 calendar year written car-years for Policy Group B.

2. (2 points)

Given the following information for an insurance company:

- Proposed effective date of the next rate change is January 1, 2014.
- Rates will be in effect for 1 year.
- All policies have 12-month terms and are written uniformly throughout the year.
- Calendar year 2012 earned premium at current rate level is \$114,208,050.

12 Month Period Ending	Written Premium at Current Rate Level	Written Exposures
December 31, 2011	\$104,500,000	110,000
June 30, 2012	\$113,800,500	121,000
December 31, 2012	\$123,916,100	133,100

a. (1 point)

Utilizing one-step trending, calculate the calendar year 2012 projected earned premium at current rate level for use in calculating the rate change.

b. (0.25 point)

Briefly discuss why a premium trend should be utilized in a rate level indication.

c. (0.25 point)

Briefly discuss why it is inappropriate to use written premium at historical rate levels to determine premium trends.

d. (0.5 point)

The insurance company decides to move all existing business with a \$100 deductible to a \$500 deductible upon renewal during calendar year 2013. Given this new information, discuss whether the true projected earned premium will be higher, lower, or unchanged from that in part a. above.

3. (2.5 points)

An actuary has submitted the following analysis for a rate level indication:

Calendar/ Accident Year	Calendar Year Earned Premium	Accident Year Reported Losses and Paid ALAE	Accident Year Reported Loss and Paid ALAE Ratio
2010	\$1,023,549	\$703,902	68.8%
2011	\$1,086,756	\$773,430	71.2%
2012	\$1,222,930	\$749,249	61.3%

Three Year Average Reported Loss and Paid ALAE Ratio	67.1%
Fixed Expense Provision	11.0%
Variable Expense Provision	15.0%
Underwriting Profit Provision	8.0%
Variable Permissible Loss Ratio	77.0%
Indicated Rate Change	1.4%

Recommend five improvements to the analysis and briefly explain the purpose of each.

4. (3 points)

Given the following information:

- Annual loss trend rate = +4%.
- Rate change history:
 - +3% effective April 1, 2009.
 - +2% effective July 1, 2010.
- All policies have annual terms.
- Calendar year 2012 earned premium = \$50,000.
- Accident year 2012 reported losses at December 31, 2012 = \$4,200.

Percentage of Loss Reported at:	
12 months	10%
24 months	35%
36 months	65%

Selected Ultimate Loss Ratio	
Accident Year 2009	66%
Accident Year 2010	67%
Accident Year 2011	70%

Use the reported Bornhuetter-Ferguson technique to estimate ultimate losses for accident year 2012.

5. (4 points)

A company is reviewing the rate level adequacy. Given the following information for a book of business:

- All policies are annual.
- Current rates have been in effect for three years.
- New rates will be in effect for 18 months beginning on July 1, 2013.
- Annual premium trend = -1%.
- Annual loss trend = +3%.
- Loss adjustment expense provision = 2.5% of loss.
- Historical expense ratios:
 - Fixed = 6%.
 - Variable = 30%.
- Underwriting profit and contingencies provision = 5%.
- Ultimate losses are estimated using the reported development technique.
- On January 1, 2014, the company will reduce agency commissions by 3% of premium.

Calendar Year Ending	Earned Premium (\$000s)
December 31, 2011	\$2,163
December 31, 2012	\$2,120

Accident Year	Reported Losses (\$000s)				
	12 months	24 months	36 months	48 months	60 months
2008	\$780	\$928	\$1,030	\$1,083	\$1,094
2009	\$765	\$921	\$1,004	\$1,053	
2010	\$760	\$920	\$1,012		
2011	\$805	\$966			
2012	\$890				

Calculate the indicated rate change.

6. (2.5 points)

a. (0.5 point)

Contrast the components of IBNR for a claims-made policy and an occurrence policy.

b. (0.5 point)

Explain why a claims-made policy should cost less than an occurrence policy, provided claim costs are increasing.

c. (0.5 point)

Explain why a change in underlying trends will impact the estimated premium for an occurrence policy more than for a claims-made policy.

d. (0.5 point)

Briefly describe the provision that exists to eliminate coverage overlap if an insured switches from an occurrence policy to a claims-made policy, and why an overlap would exist without it.

e. (0.5 point)

Explain why there would be a coverage gap if an insured switches from a claims-made policy to an occurrence policy and what an insurer can do to provide coverage.

7. (3 points)

An actuary is reviewing workers compensation indemnity loss experience for a rate level indication analysis. Given the following information:

- A benefit change having an impact of +5.0% applies to all indemnity losses for accidents occurring after July 1, 2011.
- A benefit change having an impact of +2.0% applies to indemnity losses on policies written after October 1, 2012.
- No other benefit changes are expected within the next few years.
- The annual impact on benefits due to wage inflation has been +2.0% and is expected to continue.
- The proposed effective date for revised loss costs is July 1, 2013.
- Policies are annual.
- Revised loss costs would be in effect for one year.
- Losses occur uniformly throughout the year.

Accident Year	Estimated Ultimate Losses at Pre-July 1, 2011 Benefit Levels (\$000s)
2010	\$1,875
2011	\$1,875
2012	\$2,000

Calculate the 2010, 2011, and 2012 accident year projected ultimate losses to be used in the rate level indication.

EXAM 5, SPRING 2013

8. (3 points)

Given the following information:

- All policies are annual and written on January 1.
- Rate change effective date is January 1, 2013.
- Rate level is reviewed annually.
- Underwriting guidelines were revised on January 1, 2011, substantially changing the composition of the book of business.

Accident Year	Reported Loss & ALAE as of June 30, 2012
2010	\$ 10,000,000
2011	\$ 6,000,000
2012	\$ 1,500,000

Selected Reported Loss & ALAE Age-to-Ultimate Factors										
Month	6	12	18	24	30	36	42	48	54	60
Factor	6.50	2.00	1.55	1.20	1.12	1.08	1.05	1.02	1.01	1.00

Calendar Year Ending	Reported Loss & ALAE		
	Frequency	Severity	Pure Premium
Sep 2009	0.058	\$20,355	\$1,181
Dec 2009	0.059	\$20,125	\$1,187
Mar 2010	0.062	\$20,500	\$1,271
Jun 2010	0.063	\$21,575	\$1,359
Sep 2010	0.063	\$21,388	\$1,347
Dec 2010	0.065	\$19,903	\$1,294
Mar 2011	0.078	\$19,567	\$1,526
Jun 2011	0.078	\$19,238	\$1,501
Sep 2011	0.079	\$19,538	\$1,543
Dec 2011	0.082	\$20,063	\$1,645
Mar 2012	0.081	\$20,050	\$1,624
Jun 2012	0.082	\$19,950	\$1,636

# of Points	Annual Frequency Exponential Fit	Annual Severity Exponential Fit	Annual Pure Premium Exponential Fit
12	15.9%	-1.7%	13.9%
8	16.0%	-1.7%	14.0%
6	4.7%	2.9%	7.7%
4	4.1%	2.5%	6.7%

Calculate the 2010 accident year trended ultimate loss & ALAE to be used in a rate change analysis. Justify any trend selections.

9. (2 points)

An actuary develops an overall indicated rate increase of 4.5% using the following assumptions:

- All expenses are variable.
- Total permissible loss ratio = 65%.
- Profit and contingency provision = 5%.

The actuary's manager asks that the expenses be split into fixed and variable components as follows:

- Fixed = 75% of total expenses.
- Variable = 25% of total expenses.

a. (1.25 points)

Calculate the revised overall rate indication with the new expense split suggested by the actuary's manager.

b. (0.25 point)

Briefly explain why splitting the expenses as described above results in a different indication.

c. (0.5 point)

Identify two reasons an actuary may want to split expenses into fixed and variable components.

10. (2.25 points)

Given the following information for a policy:

- Annual earned premium = \$1,000.
- New business expected loss ratio = 60%.
- Losses expected to decrease \$25 per year.
- New business expenses = \$420.
- Renewal business expenses = \$350.
- Probability of first renewal = 85%.
- Probability of second renewal = 90%.
- Probability of third renewal = 0%.
- Assume an annual discount rate of 3%.

a. (1.75 points)

Calculate the lifetime value of the expected total profit as a percentage of premium.

b. (0.5 point)

Identify two considerations used in the analysis in part a. above that differ from standard actuarial ratemaking techniques.

11. (3.5 points)

An insurance company is researching three new rating variables to include in its homeowners risk classification system. The insurer has determined the following information about the existing book of business:

Credit	Exposures	Pure Premium	Competitor's Rating Plan Factor	Base Class
Excellent	1,500	\$116.67	0.85	No
Good	2,500	\$128.00	1	Yes
Fair	1,000	\$155.00	1.3	No
Total	5,000	\$130.00		

Age of Homeowner	Exposures	Pure Premium	Competitor's Rating Plan Factor	Base Class
Under 30 years	800	\$150.00	0.7	No
30 to 40 years	1,200	\$116.67	1	Yes
Over 40 years	3,000	\$130.00	1.2	No
Total	5,000	\$130.00		

Loss Prevention	Exposures	Pure Premium	Competitor's Rating Plan Factor	Base Class
Fire extinguisher	100	\$100.00	0.9	No
Smoke detector	4,700	\$128.72	1	Yes
None	200	\$175.00	1.5	No
Total	5,000	\$130.00		

- Credit is determined using the credit score for the primary homeowner.
- Age of homeowner is determined using the age of the primary homeowner.
- A homeowner with both a fire extinguisher and smoke detector would be classified with a smoke detector.
- Full credibility claim standard = 400.
- The square root rule is used to determine partial credibility.
- A competitor's rating relativities are used as the credibility complement.
- Frequency for every risk classification = 10%.
- Assume that the insurer can implement only one new rating variable at this time.
- Assume that each variable is independent.

a. (1.5 points)

For each potential rating variable, briefly describe two possible concerns of adding it to a risk classification system.

b. (0.75 point)

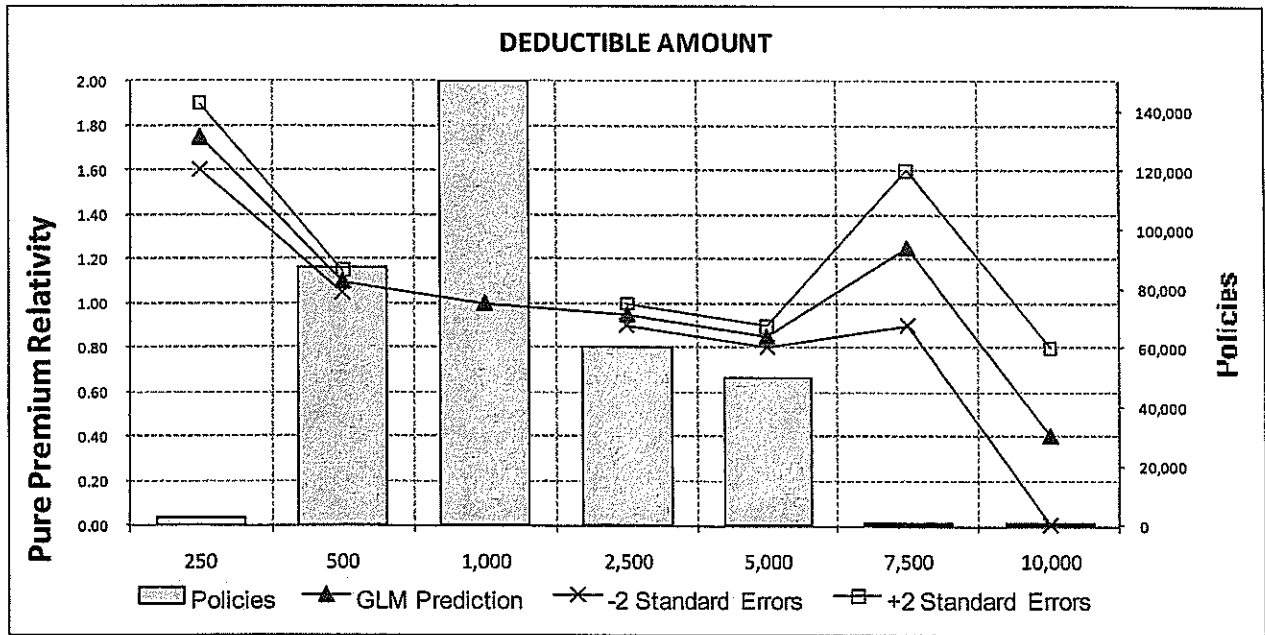
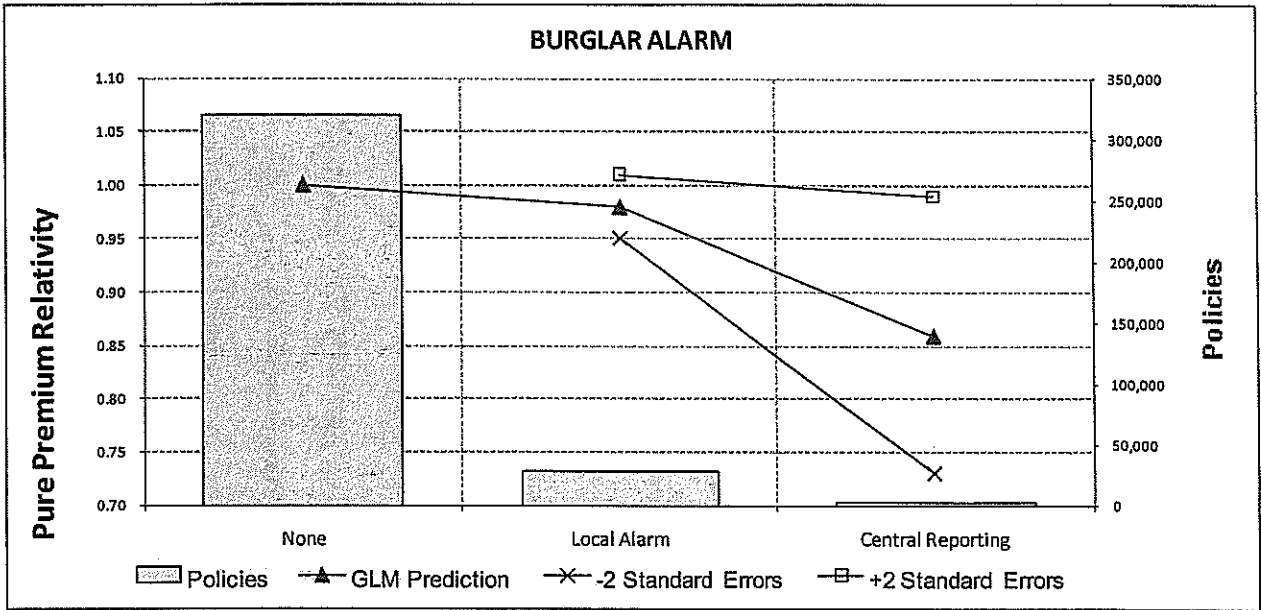
Without performing any calculations, recommend and justify which rating variable the insurer should implement within a risk classification system.

c. (1.25 points)

Develop the indicated credibility weighted rating factors for the variable recommended in part b. above.

12. (3 points)

An insurer is planning to revise burglar alarm and deductible rating plan factors for its Homeowners program. Given the following generalized linear model output:



<QUESTION 12 CONTINUED ON THE NEXT PAGE>

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12. (continued)

Burglar Alarm	GLM Prediction	-2 Standard Errors	+2 Standard Errors	Policies
None	1.00			320,000
Local Alarm	0.98	0.950	1.010	27,500
Central Reporting	0.86	0.730	0.990	2,500

Deductible	GLM Prediction	-2 Standard Errors	+2 Standard Errors	Policies
\$250	1.75	1.60	1.90	2,700
\$500	1.10	1.05	1.15	87,000
\$1,000	1.00			150,000
\$2,500	0.95	0.90	1.00	60,000
\$5,000	0.85	0.80	0.90	50,100
\$7,500	1.25	0.90	1.60	150
\$10,000	0.40	0.00	0.80	50

Propose revised burglar alarm and deductible rating plan factors. Document the relevant analysis and rationale to support the proposal.

13. (2 points)

Given the following for a large deductible commercial general liability policy:

Per occurrence deductible	\$250,000
Loss elimination ratio for a \$250,000 deductible	80%
ALAE/ground up loss ratio	10%
Ground up loss estimate	\$2,000,000
Fixed expenses	\$100,000
Variable expenses as % of premium	12%
Underwriting profit as a % of premium	3%
Deductible processing cost as a % of losses below the deductible	5%
Credit risk as a % of losses below the deductible	2%
Additional risk margin as a % of excess losses	8%

- The insurer will handle all claims, including those that fall below the deductible.
- The insurer will make the payments on all claims and will seek reimbursement for amounts below the deductible from the insured.
- The deductible is for loss only.
- All ALAE is paid by the insurer.

Calculate the premium for the large deductible policy.

14. (1.25 points)

An insurer proposes to increase rates by 6.0% where many individual policy impacts will be above 10%. The insurer proposes a capping rule that will restrict premium changes at the policy level to plus or minus 10.0%.

a. (0.5 point)

Identify two problems that a capping rule may cause for an insurer.

b. (0.75 point)

Explain why an insurer would propose a capping rule in light of the problems identified in part a. above.

15. (2.5 points)

An employer negotiated a workers compensation retrospective policy with an insurer, effective from January 1, 2011 to December 31, 2011. The first adjustment of the retrospective premium occurs six months after the end of the policy period and annually thereafter until the tenth adjustment.

The reported losses during the policy period evaluated as of June 30, 2012 are as follows:

<u>Claim</u>	<u>Reported Losses</u>
#1	\$300,000
#2	\$200,000
#3	\$100,000

The provisions for this retrospective rating plan are as follows:

Minimum retrospective premium ratio	50%
Maximum retrospective premium ratio	150%
Loss Conversion Factor	1.2
Per Accident Loss Limitation	\$150,000
Expense Allowance Excluding Tax Multiplier	25%
Expected Loss Ratio	60%
Tax Multiplier	1.05
Net Insurance Charge	44.6%
Standard Premium	\$540,000

a. (2 points)

Calculate the retrospective premium as of June 30, 2012.

b. (0.5 point)

Discuss what could cause the retrospective premium in part a. above to change for the insured between June 30, 2012 and the tenth adjustment.

EXAM 5, SPRING 2013

16. (1.75 points)

Given the following information:

<u>Accident</u> <u>Half-Year</u>	<u>Cumulative Closed Claim Counts</u>					
	<u>6 Months</u>	<u>12 Months</u>	<u>18 Months</u>	<u>24 Months</u>	<u>30 Months</u>	<u>36 Months</u>
2010-1	4,898	7,349	7,571	7,647	7,647	7,647
2010-2	5,576	6,786	7,487	7,569	7,569	
2011-1	6,580	10,215	10,618	10,724		
2011-2	7,514	9,564	10,953			
2012-1	8,894	13,807				
2012-2	10,265					

<u>Accident</u> <u>Half-Year</u>	<u>Age-to-Age factors</u>				
	<u>6-12</u>	<u>12-18</u>	<u>18-24</u>	<u>24-30</u>	<u>30-36</u>
2010-1	1.500	1.030	1.010	1.000	1.000
2010-2	1.217	1.103	1.011	1.000	
2011-1	1.552	1.039	1.010		
2011-2	1.273	1.145			
2012-1	1.552				

Assume no closed claim count development after 36 months.

a. (1.25 point)

Estimate the ultimate claim count for accident year 2012.

b. (0.5 point)

Briefly discuss two advantages for analyzing this data using accident half-years as opposed to full accident years.

17. (1.25 points)

The following information is available for a self-insured entity:

Accident Year	Case <u>Outstanding</u>	Industry Reported CDF <u>to Ultimate</u>	Industry Paid CDF <u>to Ultimate</u>
2010	\$30	1.005	1.105
2011	\$60	1.035	1.235
2012	\$110	1.120	1.560

a. (0.5 point)

Using a case outstanding development technique, estimate the unpaid claims for accident year 2012 as of December 31, 2012.

b. (0.5 point)

Identify two limitations to the technique used in part a. above.

c. (0.25 point)

Briefly describe a situation when this technique is particularly useful.

18. (2 points)

a. (0.25 point)

Briefly explain the key assumption of the Bornhuetter-Ferguson method.

b. (0.5 point)

Briefly explain how the Bornhuetter-Ferguson method can be considered a credibility-weighted method and how the credibility is calculated.

c. (0.25 point)

Briefly describe one situation where the credibility-weighted assumption underlying the Bornhuetter-Ferguson method may not apply.

d. (0.5 point)

Explain whether the paid or reported Bornhuetter-Ferguson method is more responsive in a situation where claim ratios are increasing.

e. (0.5 point)

Compare and contrast the Cape Cod method and Bornhuetter-Ferguson method by providing one similarity and one difference.

19. (3.25 points)

Given the following information:

Accident Year	Reported as of December 31, 2012		Payroll (\$000)
	Claim Counts	Severities	
2010	1,549	\$22,418	\$63,438
2011	1,455	\$18,730	\$62,893
2012	1,023	\$12,501	\$67,005

As of Month	Reporting Patterns (Reported %)	
	Claim Count	Severities
12	85.0%	43.0%
24	95.0%	67.0%
36	98.0%	83.0%

- The reported claim counts for accident year 2012 are unusually low due to a temporary slowdown of claims being opened.
- Annual frequency trend = -2%.
- Annual severity trend = +5%.
- Annual payroll trend = +4%.

Use an appropriate frequency-severity technique to estimate the IBNR for accident year 2012 at December 31, 2012 and justify all selections.

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20. (3 points)

Given the following information for a line of business:

- Assume no reported claims development past 36 months.
- Annual claim severity trend = +5%.
- Paid claim development method ultimate loss for accident year 2012 = \$10,275,000.
- Reported claim development method ultimate loss for accident year 2012 = \$9,650,000.

Cumulative Paid Claims (\$000s)			
Accident Year	12 Months	24 Months	36 Months
2010	\$2,100	\$6,410	\$8,300
2011	\$2,210	\$7,000	
2012	\$2,550		

Cumulative Closed Claim Count			
Accident Year	12 Months	24 Months	36 Months
2010	35	75	99
2011	35	80	
2012	40		

Cumulative Reported Claims (\$000s)			
Accident Year	12 Months	24 Months	36 Months
2010	\$5,300	\$7,810	\$8,500
2011	\$5,500	\$8,130	
2012	\$6,000		

Cumulative Reported Claim Count			
Accident Year	12 Months	24 Months	36 Months
2010	80	98	100
2011	79	97	
2012	82		

Outstanding Claims (\$000s)			
Accident Year	12 Months	24 Months	36 Months
2010	\$3,200	\$1,400	\$200
2011	\$3,290	\$1,130	
2012	\$3,450		

Outstanding Claim Count			
Accident Year	12 Months	24 Months	36 Months
2010	45	23	1
2011	44	17	
2012	42		

Fully discuss the considerations in deciding between using the paid or the reported claim development method to estimate ultimate claims for this line of business, and recommend an ultimate loss estimate for accident year 2012.

21. (2 points)

Given the following information as of the December 31, 2011 actuarial valuation:

<u>Accident Year</u>	<u>Ultimate Claims</u>	<u>Reported Claims</u>	<u>Paid Claims</u>
2010	\$1,200	\$280	\$125
2011	\$1,300	\$125	\$75
Total	\$2,500	\$405	\$200

<u>Age in Months</u>	<u>Cumulative Percent Reported</u>	<u>Cumulative Percent Paid</u>
36	40%	12%
24	25%	10%
12	10%	5%

Given the following information as of December 31, 2012:

<u>Accident Year</u>	<u>Reported Claims</u>	<u>Paid Claims</u>
2010	\$470	\$200
2011	\$320	\$175
Total	\$790	\$375

a. (0.5 point)

Based on the 2011 actuarial valuation, calculate expected paid claims for each accident year during calendar year 2012.

b. (0.5 point)

Based on the 2011 actuarial valuation, calculate expected reported claims for each accident year during calendar year 2012.

c. (0.5 point)

Discuss a scenario that explains any differences between actual and expected paid and reported claims as of December 31, 2012.

d. (0.5 point)

Using the scenario discussed in part c. above, justify the selection of a reserving technique for estimating ultimate claims as of December 31, 2012.

22. (3 points)

An actuary is assisting a manufacturing company in reserving its self-insured workers compensation program as of December 31, 2012. The program began on January 1, 1998 and has undergone the following changes in recent years:

- On January 1, 2007, the per-occurrence retention was increased from \$300,000 to \$750,000.
- On January 1, 2010, the company automated some of its production process. As a result, the company replaced a significant portion of its assembly-line staff with sales staff.

The actuary would like to use the following methods and data to estimate ultimate claims as of December 31, 2012:

- Development method using company-specific claim development triangles.
- Expected claims method using payroll as exposure base and the average of the reported and paid claim development projections as initial estimates of ultimate claims.
- Frequency-severity method using company-specific claim count development triangles.

a. (1 point)

Discuss necessary adjustments the actuary should make to the company-specific data to use the development method.

b. (1 point)

Briefly describe four adjustments the actuary should consider making to historical claims and exposures to put them on current levels in the expected claims method.

c. (1 point)

Describe two diagnostic tests the actuary should perform before using the frequency-severity method.

23. (2 points)

Given the following information:

Unadjusted Case Outstanding Claims (\$000s)

Accident Year	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2010	\$10,300	\$21,300	\$37,500
2011	\$11,400	\$29,400	
2012	\$15,600		

Open Claim Counts

Accident Year	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2010	1,030	1,420	1,500
2011	1,140	1,470	
2012	1,200		

Unadjusted Cumulative Paid Claims (\$000s)

Accident Year	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2010	\$2,575	\$15,975	\$30,000
2011	\$2,850	\$18,200	
2012	\$3,900		

Selected annual severity trend = +5%

a. (1.5 points)

Calculate the adjusted cumulative reported claim triangle using the Berquist-Sherman case outstanding adjustment technique.

b. (0.5 point)

Discuss whether IBNR estimated using the Berquist-Sherman case outstanding adjustment technique should be higher or lower than IBNR estimated using an unadjusted reported claim development technique.

24. (2.5 points)

Given the following information:

<u>Paid Claims Gross of Salvage & Subrogation</u>				
<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
2009	\$2,000	\$2,400	\$2,500	\$2,500
2010	\$2,100	\$2,300	\$2,400	
2011	\$2,100	\$2,400		
2012	\$2,500			

<u>Paid Salvage & Subrogation</u>				
<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
2009	\$98	\$166	\$250	\$250
2010	\$105	\$163	\$240	
2011	\$107	\$170		
2012	\$75			

- Assume no development after age 48.
- Ultimate claims for accident year 2012 = \$2,985.

a. (0.75 point)

Using a development approach, estimate the ultimate salvage and subrogation for accident year 2012.

b. (1.5 points)

Using a ratio approach, estimate the ultimate salvage and subrogation for accident year 2012.

c. (0.25 points)

Briefly discuss which approach, the development or ratio approach, to select in recommending an ultimate salvage and subrogation estimate for accident year 2012.

25. (2.25 points)

Given the following information for a portfolio written on claims-made policy form:

Calendar Year	Paid ULAE	Paid Claims	Year-End Outstanding Case Reserve	Year-End Outstanding IBNR
2009	\$409	\$3,625	\$7,575	\$6,250
2010	\$476	\$5,875	\$10,450	\$7,500
2011	\$614	\$7,950	\$13,750	\$8,750
2012	\$761	\$10,375	\$16,500	\$10,625

Claim amounts include ALAE.

a. (1.5 points)

Calculate a ULAE provision as of December 31, 2012 using the Kittel adjustment.

b. (0.5 point)

Explain the purpose of the Kittel adjustment.

c. (0.25 point)

Briefly explain a shortcoming of the classical method that is not addressed by the Kittel adjustment.

26. (2 points)

An actuary is conducting a reserve review for a line of business and calculates the following:

Accident Year	Claims as of December 31, 2012		Projected Ultimate Claims					
			Development Method		BF Method		Frequency-Severity	
	Reported	Paid	Reported	Paid	Reported	Paid	Claim Count and Severity Technique	Disposal Rate Technique
2009	\$76,700	\$75,800	\$77,501	\$77,483	\$77,758	\$78,022	\$77,474	\$77,817
2010	\$104,000	\$98,100	\$113,782	\$113,828	\$113,374	\$113,165	\$112,669	\$106,363
2011	\$107,200	\$55,100	\$130,379	\$94,770	\$127,393	\$102,646	\$132,743	\$107,447
2012	\$58,100	\$20,400	\$120,014	\$89,600	\$121,397	\$115,159	\$123,383	\$93,012

a. (1.5 points)

Suggest a reason for the disparity between the estimates of ultimate claims for accident year 2011 and propose diagnostic tests that would verify the assumption.

b. (0.5 point)

Determine what steps the actuary should take to determine the most appropriate methodology to project ultimate claims for accident year 2011.

Exam 5

Basic Techniques for Ratemaking and Estimating Claim Liabilities

QUESTION	POINT VALUE OF QUESTIONS	(a)	(b)	(c)	(d)	(e)	(f)	(g)
1	2	0.5	0.5	0.5	0.5			
2	2	1	0.25	0.25	0.5			
3	2.5							
4	3							
5	4							
6	2.5	0.5	0.5	0.5	0.5	0.5		
7	3							
8	3							
9	2	1.25	0.25	0.5				
10	2.25	1.75	0.5					
11	3.5	1.5	0.75	1.25				
12	3							
13	2							
14	1.25	0.5	0.75					
15	2.5	2	0.5					
16	1.75	1.25	0.5					
17	1.25	0.5	0.5	0.25				
18	2	0.25	0.5	0.25	0.5	0.5		
19	3.25							
20	3							
21	2	0.5	0.5	0.5	0.5			
22	3	1	1	1				
23	2	1.5	0.5					
24	2.5	0.75	1.5	0.25				
25	2.25	1.5	0.5	0.25				
26	2	1.5	0.5					
TOTAL	63.5							

Exam 5 Question #1

1. a. For CY2011, A Earned $\frac{1}{2}$ exposures = $50 \times 2 \times \frac{1}{2} = 50$
B also earns $\frac{1}{2}$ exposures = $100 \times 2 \times \frac{1}{2} = 100$
CY2011 Earned Exposures = $50 + 100 = 150$

- b. Evaluated as of 12/31/2010
A earned = $50 \times 2 \times \frac{1}{2} = 50$
B earned = $100 \times 2 \times \frac{1}{4} = 50$
Total earned exposures = $50 + 50 = 100$

Evaluated as of 12/31/2011
A earned $50 \times 2 = 100$
B earned $100 \times 2 \times \frac{3}{4} = 150$
Total earned exposures = $100 + 150 = 250$

- c. Evaluated as of 12/31/2010
B written exposures = $100 \times 2 = 200$

Evaluated as of 12/31/2011
B written exposures = $100 \times 2 - 100 \times 2 \times \frac{3}{4} = 50$

- d. CY2010 B written exposures = $100 \times 2 = 200$
CY2011 B written exposures = $-100 \times 2 \times \frac{1}{2} = -100$

Exam 5 Question #2

a.	Dec 31 2011	950 ↙	-1%	select semiannual trend at -1%
	June 30 2012	940.5 ↙	-1%	
	Dec 31 2012	931		

Trend period: 1/1/2012- 7/1/2014

Avg. written dates.
2.5 yrs (5 half years)

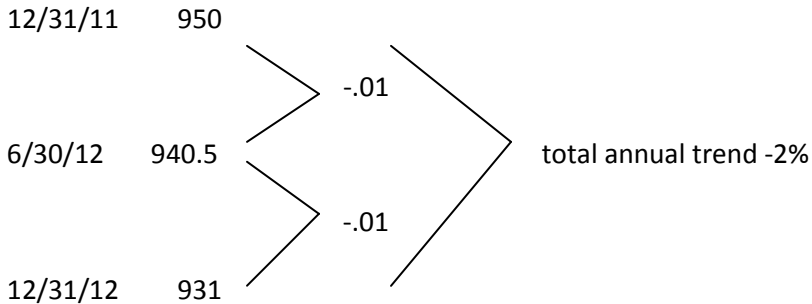
$$114,208,050 ([1 - .01])^5 = 108,610,779$$

OR

Trend period 1/1/12 to 7/1/14 2.5 yrs

CY 2012 Earned from @CRL * Trend^{2.5} = Projected EP

AVG WNT @ CRL



$$\text{Projected 2012 EP @ CRL} = 114,208,050 * 0.98^{2.5} = 108,583,017.3$$

- b. It takes into account changes in exposure distributions, for what is expected to occur when rates are in effect.

OR

Premium trend accounts for the gradual shift in the book of business for things such as inflation or mix of business

- c. Using historical rates would cause a double-counting effect in the trend calculation

OR

Using written premium at historical rate leads to determine premium trend would include rate changes in the selected trend number, when we don't necessarily expect those rate changes to continue into the future.

- d. This change would cause premiums to go lower because fewer losses would be paid. The true projected premium is lower than that calculated above.

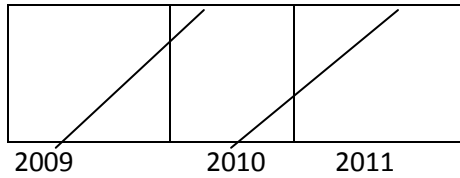
OR

The true projected earned premium will be longer because a higher deductible gives the insured a discount on premium.

Exam 5 Question #3

1. Adjust the earned premium to current rate level. This will avoid an indication that ignores past rate changes and provides a better projection of future loss ratios.
2. Determine a loss trend and apply to the Loss + ALAE. This will create a better projection of future losses if there is an ongoing or past change in frequency or severity of losses
3. Develop losses to ultimate. The rate must account for all losses from the policies, not just the ones that have been reported thus far. Ignoring IBNR will create an inadequate rate.
4. Include a ULAE load. The rate must provide for all costs associated with the transfer of risk so it must include adjustment expenses that are not allocated to specific claims
5. Use a volume-weighted average of loss ratios. 2012 has significantly more premium than past years and will be more responsive to changes in the book so it should be given more weight.

Exam 5 Question #4



For 2009: On-level factor: $\frac{1.03 \times 1.02}{9/32 \times 1.03 + 23/32 \times 1} = 1.0418$

For 2010: On-level factor: $\frac{1.03 \times 1.02}{\frac{1}{32} \times 1 + \frac{1}{8} \times 1.03 \times 1.02 + \frac{27}{32} \times 1.03} = 1.0184$

For 2011: On-level factor $\frac{1.03 \times 1.02}{\frac{1}{8} \times 1.03 + \frac{7}{8} \times 1.03 \times 1.02} = 1.00246$

Uses the average 2009-2011 ratio as the expected loss ratio

$$\frac{1}{3} \left(66\% \times \frac{1.04^2}{1.0418} + 67\% \times \frac{1.04^2}{1.0184} + 70\% \times \frac{1.04}{1.00246} \right) = 71.68\%$$

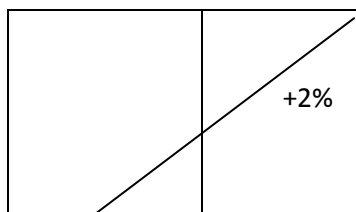
For 2012: $50,000 \times 71.68\% \times (1 - 10\%) + 4200 = 36456$

OR

BF ULT. Losses = 4200 + [% unrept @ 12/31/12 x LR x EP]

2011 ULT loss ratio = $\frac{2011 \text{ Loss} + LAE}{2011 EP}$

2010 2011



On level factor for 2011 EP = $\frac{1.02}{1 (1/8) + 1 (7/8)} = 1.002$

2011 LR adj for 2012 = $.7 \frac{1.04}{1.002} = .727$

BF ULT Loss for 2012 = 4200 + .727(.9) 50,000

= 36,915

$$\text{Indicated Rate Change} = \frac{LR + F}{I - V - Q_r} - 1 = \frac{0.633288 + 0.06}{1 - 0.28 - 0.05} - 1 = +3.476\%$$

$$LR = \frac{1,271,943.715 + 1,366,387.864}{2,093,490.054 + 2,072,597.876} = \frac{0.63328}{\square}$$

1/3 period

2/3 period

↑

↑

$$V \text{ approx in forecast period} = \frac{07.01.2013 - 31.12.2013 \times 0.30 + 01.01.2014 - 31.12.2014 \times 0.27}{07.01.2013 - 31.12.2014}$$

$$= 1/3(0.3) + 2/3(0.27) = 0.28$$

OR

	12-24	24-36	36-48	48-60
	Rpt	Loss Dev	Δ	
08	1.19	1.11	1.05	1.01
09	1.20	1.09	1.049	
10	1.21	1.1		
11	1.2			
Sel	1.2	1.1	1.05	1.01
To ULT	1.400	1.167	1.0605	1.01

CY	Loss	LDF	Trend Fact	LAE	Trended Dev Losses'
2011	966,000	1.167	1.03 ^{3.25}	1.025	1,272,017
2012	890,000	1.400	1.03 ^{2.25}	1.025	1,364,978

Prem

(1/1/12 - 4/1/14)

CY	EP	Trend	Trended Ep	LR
2011	2,163,000	.99 ^{3.25}	2,093,490	.6076
2012	2,120,000	.99 ^{2.25}	2,072,598	.6586

Avg: .6331 ↓

Ind Change

$$\frac{.6331+.06}{0.67} = 1.0345$$

Ind Change

+ 3.45%

$$\text{PLR } 7/1/13 - 1/1/13 = 1 - .3 - .05 = .65$$

$$1/1/14 - 12/31/14 = 1 - .27 - .05 = .68$$

$$\text{WTD } 1/3 (.65) + 2/3 (.68) = .67$$

Exam 5 Question #6

- a. Occurrence Policy has both pure IBNR + IBUER, CM policy only has IBNER

OR

CM has no pure IBNR @ report year end because all claims in the report have been reported (by def.), development is limited to IBNER. Occurrence policies will see development due to both pure IBNR + IBNER, since policies can be reported long after they occur.

- b. Claims made policy has a much shorter period of time between the coverage trigger and the settlement date- not as much impacted by loss cost increase.

OR

Occurrence policies incur liability for claims that occur now but are reported much later so inflation/loss trend accumulates on these costs whereas CM policies incur liability for claims reported @ today's cost levels.

- c. With occurrence policy, claims are covered that are reported much further out into the future. These loss trends will therefore have a greater impact on the losses covered by an occurrence policy - more impact of inflation/loss trends

OR

Occurrence policy can have losses reported much later, trends have leverage on future costs than current costs → Δ in trend affects occurrence more than CM.

- d. Retroactive date= losses only covered by CM policy if they occur after retro date

		Lag		
		0	1	2
Report Year	10	L(10,0)	L(10,1)	L(10,2)
	11	L(11,0)	L(11,1)	L(11,2)
	12	L(12,0)	L(12,1)	L(12,2)

Occurrence policy in 10 would cover losses on shaded diagonal. CM policy in 11, without a retro date would cover entire row=overlap on L (11,1)

OR

Apply retroactive date to the new CM policy to limit coverage to losses that occur after such a date.

A=occ. Policy covg

B= CM covg w/o adj

<u>LOG</u>				
year	0	1	2	3
11	A			
12	B	A/B	B	B
13		↑	A	
"		(Over Lap)		A

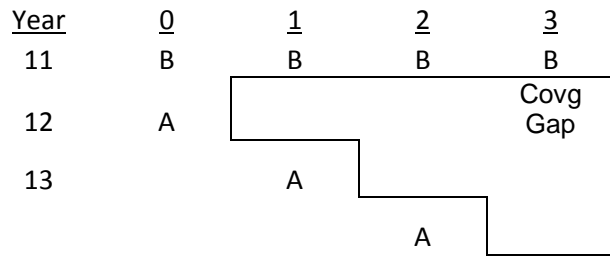
(previous years as well if avg covg provided before 2011)

- e. Use Extended reported period Endorsement = provides coverage for losses that occurred when CM coverage effective, but reported after expiration of last CM policy.

CM policy in 10 covers entire row. Occurrence policy in 11 covers diagonal = L(11,0) and L (12,1).
 No coverage for L(11,1) or L(11,2) or L(12,2).

		Lag		
		0	1	2
Report Year	10	L(10,0)	L(10,1)	L(10,2)
	11	L(11,0)	L(11,1)	L(11,2)
	12	L(12,0)	L(12,1)	L(12,2)

OR



Purchase tail coverage to cover during gap

Exam 5 Question #7

Proposed effective date 7/1/2013 for annual pols in effect 1 year to avg loss date of 7/1/2014

AY	Loss (000)	Trend	Benefit Changes*	ULT Losses (0001)
2010	1,875	$(1.02)^4$	$(1.05)(1.02) = 1.071$	2,173.7
2011	1,875	$(1.02)^3$	$(1.05)(1.02)$	2,131.0
2012	2,000	$(1.02)^2$	$(1.05)(1.02)$	2,228.5

*since all losses are reported at pre July 2011 benefit levels all years need both the 2% and 5% adjustment

Exam 5 Question #8

Use 2-part trend since historical trend is different due to changing book of business. Assume 6-month reporting periods for trend period selection.

$$\text{Historical trend period} = 7/1/2010 - 4/1/2012 = 1.75$$

$$\text{Projected trend period} = 4/1/2012 - 7/1/2013 = 1.25$$

$$\text{Historical trend selection: freq} = 16\% \text{ sev} = -1.7\%$$

Use 8 point trends for both frequency and severity, this will account for the change in the book of business

$$\text{Future trend selection: freq} = 4.1\% \text{ sev} = 2.5\%$$

Used 4 point trends for frequency and severity since this includes the period after the mix of business changed and should be indicative of future patterns.

$$2010 \text{ AY trended Ult Loss} + \text{ALAE} = 10,000,000 \times 1.12 \times (1.16 \times .983)^{1.75} \times (1.041 \times 1.025)^{1.25}$$

Used 30 month CDF-ULT factor 1.12

$$= \$15,282,922$$

Exam 5 Question #9

a. $PLR = .65 = 1 - V - Q$ $V = .3 \rightarrow$ *current total expense*

Fixed % = $.75(.3) = .225$

Variable % = $.25(.3) = .075$

$1.045 = \frac{\text{Loss Ratio}}{.65}$

Loss ratio = $.67925$

Revised Indication = $\frac{.67925 + .225}{1 - .075 - .05} = 1.0034$

3.34% Increase

- b. Splitting expenses into fixed + variable accounts for the fact that certain expenses are a set amount for each risk, regardless of premium size. Depending on ratio of fixed vs variable, indication will differ due to fixed included on top off equation added to loss ratio.

OR

Allows fixed expenses to be added in with the loss of ratio and the revised permissible loss ratio to be higher which lowers indication.

OR

Because fixed expenses are not changing with premium they are a set in stone percentage. That's why we add them to the LR rather than include it in the permissible ratio.

- c. 1) Assuming all variable expenses when some are truly fixed will over charge high premium risks and under charge low premium risks.

2) Fixed expenses may be affected by trend, so separating allows us to apply trend factors to get more accurate expense load.

OR

1) including fixed and variable expenses together could distort your indication

2) Including them together could cause you to undercharge small premium policies and overcharge large premium policies.

OR

1) because some expenses do not vary with premium and in order to correctly account for it, it should be fixed.

2) Also it helps better track expenses and understand expenses

Exam 5 Question #10

a.

Duration	(1) Premium	(2) Loss	(3) Expense	(4) Persistency	(5) Cumulative Persistency	(6) Discount Factor	(7)=[(1) - (2) - (3)] x (5) / (6) PV of Profit	PV of Premium
1	\$1,000	\$600	420	100%	100%	1.000	-20	1,000
2	1,000	575	350	85%	85%	1.030	61.89	825.24
3	1,000	550	350	90%	76.5%	1.0609	72.11	721.09

Profit/premium = $\$114 / \$2,546.33 = 4.477\%$

b. i) standard actuarial ratemaking techniques typically do not consider persistency, the likelihood of and insured renewing his policy.

ii) Standard actuarial ratemaking techniques only consider premium and losses for the period in which rates will be in effect, not over the lifetime of the insured with the insurer.

Exam 5 Question #11

Credit: -Lacks causality as is correlated with loss exposure; however, difficult to show causality
 -Invades privacy of insureds

Age: -Lacks controllability since insured cant control their age
 -The indicated relativities from the insurer’s data differ significantly from competitor relativities. (e.g. Ind Under 30 Rel > 1.00)

Loss Prevention:

- Difficult and expensive to verify as it is subject to manipulation from the insureds
- Non sensical deifinition. Why would someone with both a fire extinguisher and a smoke detector be rated higher than someone with just a fire extinguisher

a. I would recommend credit score as score as a variable.

- significant loss cost differentiation
- objective definition
- Easy and inexpensive to verify and administer
- Social concerns are not sufficient to prevent using this variable (assuming it is legal to do so)

Credit	PP	Ind Rel	Comp Rel	Z
Excellent	116.67	0.8975	0.8374	61.24%
Good	128.00	0.9846	0.9852	79.06%
Fair	155.00	1.1923	1.2808	50.00%
	130.00	1.000	1.000	

Ex: $\frac{116.67}{130} = 0.8975$

Ex: $\frac{0.85}{1.015} = 0.8374$

EX: 61.24% = $\sqrt{\frac{1500 \times 0.1}{400}}$
 $(\sqrt{\frac{reg \times exp}{400}})$

@Base
Cred Wgtd Rel
0.888
1.000
1.256

$$\frac{(2) \times (4) + (3) \times [1 - (4)]}{(2) \times (4) + 3 \times [1 - (4)]}$$

EX: *For good*

Exam 5 Question #12

Burglar Alarm- Relatively low volume and wide confidence interval for both Local Alarm and Central Reporting groups. The Local Alarm std errors suggest its not significantly different than the None category (the confidence interval encompass the relativity for none). Central reporting has very few exposures and large standard errors. I would recommend this variable not be used (1.00 factor for all groups).

Deductible :

250	500	2500	5000	7500	10000
1.50	1.000	0.95	0.85	0.75	0.65

1. 250 not enough data

2. 500, 1000, 2500, and 2000: fit very well and sufficient data factor directionally also make sense. Use indicated factors.

3. 7500: reversal should be lower than 5,000

10,000: indicated factors are too small, may be due to sparse data judgmentally select 0.65.

7500: Select the average factors of 5,000 and 10,000

Exam 5 Question #13

$$\text{LER} = .0$$

$$\text{ALAE} = .1$$

$$L = 2M$$

$$\text{ALAE}\$ = .1 \times (2,000,000) = 200,000$$

$$\text{Loss} = (1 - .8) \times (2,000,000) = 400,000$$

$$\text{Fee for handle ded: } .8 \times (2,000,000) \times .05 = 80,000$$

$$\text{Credit Risk} = .8 \times (2,000,000) \times .02 = 32,000$$

$$\text{Risk Margin} = (1 - .8)(2,000,000)(.08) = 32,000$$

$$\frac{L + E_L + \text{Ded Fee} + \text{Credit Risk} + \text{Risk Margin} + F}{1 - V - Q} = 992,941.176\$$$
$$\frac{400,000 + 200,000 + 80,000 + 32,000 + 100,000}{1 - .12 - .03} = 992,941.176\$$$

Exam 5 Question #14

- a.
1. Insurer will not be charging what they should be to keep the fundamental insurance equation in balance and earn their target underwriting profit.
 2. Systems limitations-need to program this rule into computer systems. Can get complicated as to what gets capped and what doesn't and how this changes the rating algorithm

OR

1. May cause need for premium transition
2. Insurer may not get all the rate needed

OR

1. Can cause rates to be inadequate
2. Can be subject to adverse selection

- b.
- May have a concern that they will not retain policyholders if they raise rates substantially at renewal-may cause insureds to shop- Also might be regulation reasons-restrictions on the amount of rate increase a policyholders can see at each renewal

OR

Keep customers from getting shocked at renewal and shopping.

OR

An insurer would propose a capping rule in light of the problems in (a) to maximize the retention. An insurer might be able to get an increase in rate in the future which will make rates adequate again. The more profitable business they retain the more profits they will enjoy in the long run.

Exam 5 Question #15

a) Basic Premium = $(0.25 - (1.2 - 1)(0.60) + 0.446) 540,000 = 311,040$

Retro Premium = $(400,000(1.2) + 311,040)1.05 = 830,592$

Before min/max

Max Retro Premium is $1.5(540,000) = 810,000$

So the final retrospective premium is 810,000

- b) The retro premium could decrease from the max cap if reports losses develop downward or if claims are closed with no payment.

Exam 5 Question #16

- a. There appears to be a seasonal pattern in the age-to-age factors that causes differences between XXX-1 and XXX-2 half years.

I would select a separate pattern for each half year (-1 and -2) using simple all year averages.

	6-12	12-18	18-24	24-30	30-36	36-vlt
Sel (-1)	1.535	1.035	1.010	1.000	1.000	1.000
Sel (-2)	1.245	1.124	1.011	1.000	1.000	1.000

$$\text{ULT count AY 2012} = 13,807(1.035)(1.01) + 10,265(1.245)(1.124)(1.011) = 28,956$$

- b. Allows for recognition of seasonal patterns in claims development

Allow for better recognition of growing portfolio as average accident date shifts.

OR

ADV 1: Since there is a pretty clear seasonality effect based on the ATA values that vary significantly by period, using this type of analysis captures these differences to produce a more accurate development projection.

ADV 2: Using shorter time frames such as half year can also help the accuracy of projection during times of greatly increasing exposure (due to higher granularity). This could be useful here, since the claims closed down the 6 and 12 month columns are increasing noticeably, which may be due in part to an exposure increase.

OR

1. Because of the developmental seasonality it helps to pick different patterns for the different half years'
2. The counts appear to be increasing at a decent rate. When counts are increasing like this it could mean an increase in exposures. Splitting the years into half-years better deals with the changing average date of loss that accompanies rapidly increasing exposures.

Exam 5 Question #17

a. Case O/S development factors 2012 = $\frac{(1.12 - 1) \times 1.56}{1.56 - 1.12} + 1 = 1.425$

Unpaid claim = $110 \times 1.425 = 156.75$

- b. 1) Industry benchmark CDF often prove to be inaccurate for a particular insurer
2) Analysis can be distorted by large losses in case outstanding

OR

Industry benchmarks aren't accurate or don't apply to this self insured entity
- Paid CDFs might be highly leveraged → subject to inaccurate estimates

- c. This technique is useful when no other technique is available because the only information the self-insured has is case O/S.

Exam 5 Question # 18

- a. Key assumption: Losses reported (paid) to date do not tell you anything about the losses that are yet to be reported (paid)
(Unpaid) Unreported losses are better estimated based on an a priori initial expected ultimate.

OR

Assumes the actuary's a priori estimate is a better indicator of unpaid/unreported claims than experience to date

- b. The method is considered a cred weighted method of the Development Method and Initial Expected.

Z (Dev Method) + (1- Z) Initial Expected Ultimate

Z

$$= \text{The percent reported to date} = \frac{1}{\text{cumulative dev. factor}} = \frac{1}{CDF}$$

From development method

OR

Cred weighting of Development and Expected Claim techniques, The weight is based on % paid (or % rptd.)

I.E: $B-F \text{ Ult} = \% \text{ paid} * \text{Dev Ult} + (1 - \% \text{ paid}) * \text{Exp Cl. Ult}$

- c. On a pattern that goes above 100% reported or paid You'll see this on lines with salvage + subrogation or short tailed lines with strong case reserves. The % reported amount (2) cannot go above 1 in credibility theory. Therefore, in this situation, in theory, the method shouldn't be used.

OR

Would not apply if % paid is greater than 100% (Violates credibility definition)

- d. The reported method would be more responsive because the development method is responsive to increasing claim ratios, and the reported BF method will give more weight to the development method early on since % Rpt is often greater than % paid.

OR

Rptd is more responsive, since % rptd is usually greater than % paid, thereby putting more weight on the developed emerging exp. And less on the a priori estimate

- e. Similarity- CC (Cape Cod) and BF methods both assume the unreported amount should be based off of another estimate and not developed as in the development technique. In other words, they both assume that experience to date in an AY doesn't tell you everything about future development.

Difference: The two methods calculated the "initial expected" ultimate differently. The BF method relies on an a priori selected loss ratio and the CC method calculates the LR (or PP) using the losses to date divided by the "used up" premium. Therefore the CC method is more responsive.

OR

Both methods are cred weighting of Dev & Exp Claims but B-F initial exp loss ratio is an a priori estimate, while Cape Cod determines IELR using reported losses & used-up premium

Exam 5 Question #19

Because 2012 frequency is off, severity is probably also impacted (smaller claims open faster), so 2012 will not be used in the calculation.

	Counts	CDF	Trend	Trend +Dev counts (a)
2010	1549	1/.98	.98 ²	1518.02
2011	1455	1/.95	.98	1500.95

	Sev	CDF	Trend	Trend+ Dev sev (b)
2010	22418	1/.83	(1.05) ²	29778.13
2011	18730	1/.67	1.05	29352.99

Exposure	Trend		Trended Exp (c)
63438	(1.04) ²	=	68614.54
62893	(1.04)	=	65408.72

$$\text{Trended PP} = \frac{(a) - (b)}{(c)}$$

2010 658.81

2011 673.57

Sel avg 666.19

ULT 2012

$$= \text{Sel PP} \times \text{payroll}(\$100)$$

$$666.19 \times 67005 = 44,638,060.95$$

$$\text{IBNR} = 44,638,060.95 - (1023) \times 12501$$

$$= \$31,849,537.95$$

OR

ULT claims	Trended		Trended Payroll
1549/0.98	1.0192²	= 1642	63,438 x 1.04² = 68,615
1455/0.95	1.0192¹	=1561	62,893 x 1.04¹ = 65,409
1023/0.85	1.0192⁰	=1204	67,005 x 1.04⁰ = 67,005

Freq trend= Claim Trend / Payroll Trend = 0.98 = 1.0192 / 1.04

2010 Freq = 1642/68,615= 0.0239

2011 Freq= 1561/65,409= 0.0239

= Sel 0.0239

ULT trended Severity

22,418/ 0.83 x **1.05²** = **29,778** →All Average Sel= 29,401

18,730/0.67x **1.05** = **29,353**

12,501/0.43x **1.00** = **29,072**

0.0239x **67,005** x **29,401** = **47,083,335 Ult**

47,803,335 - **1023** x **12501** = **34,294,812 IBNR**

Selected Frequency based on 2010 + 2011 because 2012 had a slowdown in claim counts, making it project an inaccurately low ULT claim count.

Severity is still reliable because it is an average number i.e. volume is controlled for Used an all years average for stability.

OR

	Ultimate Claims	Trended Exposure	Frequency
2010	1549 / .98 = 1580	63,438 x 1.04 ²	2.30%
2011	1455 / .95 = 1532	62,893 x 1.04	2.34%

Trended Frequencies

2010 $.023 (.98)^2 = .0221$

2011 $.0234(.98) = .0229$

Simple Average = .0225 = Selected Freq

	Ultimate Severity	Trended Ut sev
2010	$\frac{22418}{.83} = 27010$	29,779
2011	$\frac{18730}{.47} = 27955$	29,353
2012	$\frac{12501}{.43} = 29,072$	29,072
		Simple average= 29,401

Ultimate Claims= 29,401 x .0225 x 67,005

= 44,325,315

IBNR= 44,325,315 - 1,023 · 12,501= 31, 536,792

Since AY 2012 claim counts were subject to an temporary slowdown they were removed from the calculation of the ultimate frequency because using the current report patterns would severely underestimate ultimate freq. for that year. Severity was assumed to be unaffected since there was no mention of a change in claim department methodology, just a slowdown in opening all claims.

Exam 5 Question #20

Check avg. paid severities:

AY		12		24		36
10	1.05	{ 60	1.024	{ 85.47		83.84
11	1.01	{ 63.14		{ 87.5		
12		{ 63.75				

$\sphericalangle = 7000/80$

Avg pd appears to be trending at rate less than 5% For most recent

Could indicated change in settlement practice could be closing more small claims.

Check Avg

Case Outstanding:

$$\text{Avg Case out} = \frac{\text{Out CLM}}{\text{Out CLM Ct}}$$

AY		12		24		36
10	1.05	{ 71.11	1.09	{ 60.87		200
11	1.02	{ 74.77		{ 66.47		
12		{ 76.19				

Avg. case outstanding increased by less than 5% per year at 12 months and greater than 5% per year at 24 months. Could indicate a change in type of claim being closed at the pd.

Look at closed to reported of ratio: Closed Ct/Rep Ct

AY	12	24	36
10	.4375	.7653	.99 \sphericalangle
11	.4430	.8247	=99/100
12	.4878		

Closed to report count ratio appears to be increasingly, indicating a speed up in claim settlement. Since there is a speed up in settlement and avg. pd severity is trending at rate lower than 5%, it appears the insurer is closing more small claims quickly.

Avg rep clm

Ay		12		24		36
10	1.05	{ 66.25	1.05	{ 79.69		85
11	1.05	{ 69.62		83.81		
12		73.17				

Avg. Rep. CLM increasing at steady rate of 5%.

Due to the diagnostics and explanations above, I would select the reported dev method ultimate of \$9.65 mil.

Exam 5 Question #21

a.	Ultimate-Paid	% unpaid	developed in CY 2012
2010	1075	90%	$(1075 / (.9)) (12\% - 10\%) = 23.89$
2011	1225	95%	$\left(\frac{1225}{.95}\right) (.1 - .05) = 64.47$

OR

Yr	Ult Paid	% pd	%pd age+12	% pd in age	EXP paid in 2012
2010	1200	.1	.12	.02	24
2011	1300	.05	.1	.05	65
	(1)	(~)	(3)	(3)-(2)	89

OR

Expected paid claims in CR 2012

- AY 2010 = $125 \left(\frac{1}{.10} \div \frac{1}{.12} - 1 \right) = 25$
- AY 2011 = $75 \left(\frac{1}{.05} \div \frac{1}{.1} - 1 \right) = 75$

b.

	Ultimate-Reported	% unreported	
2010	920	.75	$\left(\frac{920}{.75}\right) (4 - .25) = 184$

OR

I would use a reported dev. technique as it is not affected by decrease in settlement lag.

OR

I would suggest using the expected claims technique because you can judgmentally adjust the expected claims ration up due to the shift.

Exam 5 Question 22

- a. If possible, the actuary should restate the historical triangles to a \$300k retention (one triangle) and to a \$750K retention (a separate triangle) in order to remove the distortion that the change in retention would otherwise create. The actuary should then review these triangles separately and select LDFs to be applied to the appropriate retention by year.

Or

The actuary should adjust the claims data to be used in development method since the retention was increased from \$300,000 to \$750,000. The increase in retention will increase the claims reported and paid. Therefore, claims data before 2007 should be adjusted to current level before applying the development method. In addition, the change from assembly-line to sales will have an impact to the claims. Less injury will be expected when the company automated some of its production process. Hence, claims data before 2010 should be adjusted.

- b. -Adjust the losses so they are on the 750,000 retention level by using ILFS.
-Adjust losses to account for the change in workers. Sales staff will have fewer losses (injuries) than assembly staff
-Adjust the exposures to account for inflation.
-Adjust the losses to account for benefit changes related to inflation. As the workers get raises, the losses will increase.

OR

1. Cap the historical claims, select large loss load
2. Apply loss trend
3. Apply benefit level change adjustment
4. Apply exposure trend

- c. Look at the avg severity amount → claims/closed counts. The change in per occurrence retention could have an effect on severity.

-Look at frequent triangle → claims/exposures. Change in production could have significant increases on frequency.

OR

1. Paid to reported claim counts to determine if there were any changes in claim settlement rate.
2. Average case outstanding per open claim to see if there were any changes in case outstanding adequacy.

Exam 5 Question #23

a. Avg case = Case/Open 13/1.05=12.38

Adj Avg Case (\$000)

	<u>12</u>	<u>24</u>	<u>36</u>
2010	11.791	19.048	25
2011	12.381	20	
2012	12		

(\$000) *Adj Rept = (Adj Avg Case x Open) + Paid*

	<u>12</u>	<u>24</u>	<u>36</u>
2010	14,720.12	43,022.62	67,500
2011	16,964.29	47,600	
2012	19,500		

b. Original Avg Case

<u>12</u>	<u>24</u>	<u>36</u>
10	15	25
10	20	
13		

Adj Avg Case amounts are higher than original avg case amounts so adjusted case will ↑ resulting in ↑ reported amounts in earlier years, and lower LDFS, thus less IBNR. Unadjusted would overstate so adjusted will be lower than unadj.

OR

Whether the B/S case OS method produces higher or lower IBNR depends on how the trend in case reserves relates to the selected severity trends. If the case trend is higher, the adjusted amount will be higher in the B/S than development method. This will lead to lower CDFs, and lower IBNR amounts. Vice Versa if the trend in case OS is lower than the select severity trend.

Exam 5 Question #24

a) Paid S&S ATA

Select all year weighted avg.

<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>48-ULT</u>
1.6097	1.4894	1.000	1.000

e.g. $1.6097 = (166 + 163 + 170) / (98 + 105 + 107)$

2012 ult S&S = $(75) (1.6097) (1.4894) = 179.81$

b) Ratio SS/Paid

	<u>12</u>	<u>24</u>	<u>36</u>	<u>48</u>	<u>ULT ratio</u>
09	0.049	0.069	0.1	0.1	0.1
10	0.05	0.071	0.1		0.1
11	0.051	0.071			$0.071(1.429) = 0.10$
12	0.03				$0.03(1.4701)(1.429) = 0.06$

→ select 0.1

Select all yr weighted avg of ratios:

<u>12-24</u>	<u>24-36</u>	<u>36-48</u>
1.407	1.429	1

AY2012 S&S ult= $(2985)(0.1)=298.5$

c. Ratio approach provides more stability, less subject to leveraging at early maturities

Exam 5 Question #25

a.

<u>CY</u>	<u>PD ULAE</u>	<u>Pd claims</u>	<u>Reported claims</u>	<u>Ratio</u>
09	409	3625	17450	.0388
10	476	5875	23825	.0320
11	614	7950	30450	.0320
12	<u>761</u>	<u>10,375</u>	<u>37,500</u>	<u>.0318</u>
	2260	27,825	109,225	.0330

Selected CY 09-12 Avg

Unpaid ULAE= .0330 (50% (16500 +10625))= 447.6

- 1) Pd ULAE/Avg (Pd claims and reported claims)
- 2) Pd claims + case ols +IBNER
 \simeq (assuming "year-end O/S IBNR" = IBNER)

OR

	Pd ULAE	Pd	Reported = Paid + Δ case + IBNR
09			5875+(10450-7575)+(7500-6250)=
10	476	5875	10000
11	614	7950	12500
12	761	10375	15000

	ULAE / Avg(paid, reported)	
10	476/((5875+10000)/2)	=.05997
11		=.06000
12		=.06000
		.0600 avg select

$$.06 \times .5 \times 16500 + .06 \times 10625 = 1132.5$$

IBNR

- b. It accounts for ULAE on reported but not yet paid claims. It is an adjustment to the classical technique. It is useful for cases like this where there is growing business + it is not steady state.
- c. A short coming of the classical method is the assumption that 50% of the ULAE is incurred when claims are opened and 50% of the ULAE is closed. This is not addressed by the kittel method. The problem is that the 50%-50% assumption is inflexible and doesn't distinguish between the cost of closing a claim and maintaining a claim.

OR

When inflation affects paid ULAE and claims differently

OR

Both assume 50% of ULAE is paid on opening and 50% on closing. This assuming is not always true.

Exam 5 Question #26

- a. Perhaps case outstanding adequacy was strengthened for AY 2011, with no change in payment pattern. Thus the DFM (reported) is applying too-high DFs to reported losses and coming up with too high estimate of ultimate. If severity in the F-S technique includes reported losses' severity, then this will similarly produce a high result.

To verify produce triangles of average paid and average case OS. Look for a jump between 2010 and 2011 @24 months that is larger than the average increase in pd avg down the columns.

OR

A slowdown in the settlement pattern could have caused the differences as it would have applied the historic CDF's to a lower paid amount at early maturities.

-This could be tested by looking at the paid-to-reported claims ratios and the closed count-to-reported count if these ratios decrease for a given maturity for new accident years, this would support the reason.

- b. Discuss these questions with claims dept manager, and examine payment patterns to make sure they are consistent. If so, use a paid DFM or BF.

OR

The actuary should confirm there was a change to the settlement pattern and check if there were changes to the case strength. If there were changes the data could be adjusted using the Berquist Sherman technique the actuary should talk to the claims department to get insight into the process.