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Exam 5

Basic Techniques for Ratemaking and Estimating Claim Liabilities

INSTRUCTIONS TO CANDIDATES

1. This 79.75 point examination consists of 37 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.
 - 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 23, 2011.

END OF INSTRUCTIONS

EXAM 5, SPRING 2011

1. (2 points)

Given the following information for a semi-annual ISO Personal Automobile Policy:

- Principal operator is a 16-year-old single male
- Auto is driven to school every day, 10 miles from operator's residence
- Operator is full-time student
 - 3.2 grade point average on a 4-point scale
 - Not in the top 20% of students at his school
- Good student discount is 20%
- Bodily injury and property damage base rate is \$200

Age/Sex/Marriage Status Classification	Multiplicative Rate Factor
Youthful Unmarried Female Operator	1.4
Youthful Married Male Operator	1.2
Youthful Unmarried Male Operator	1.85
Youthful Unmarried Male Owner or Principal Operator	2.1

Use Classification	Multiplicative Rate Factor
Business Use	1.4
Pleasure Use	0.9
Work Less Than 15 Miles Use	1.1
Work 15 or More Miles Use	1.3

- No other rating factors apply

a. (1 point)

Calculate the premium for bodily injury and property damage liability coverage.

b. (0.5 point)

Exactly three months after the policy is sold, the driver moves to a new home that is two miles from school. Assuming all other policy characteristics remain consistent with part a above, determine the impact of the mid-term adjustment for the remaining three months.

c. (0.5 point)

Exactly four months after the policy is sold, the driver has an accident that results in a change to the driving record sub-classification. Assuming all other policy characteristics remain consistent with part a above, determine the impact of the mid-term adjustment for the remaining two months.

2. (1.5 points)

An insurer is considering changing the exposure base used to price personal auto from earned car years to annual miles driven. Evaluate the merits of this change based on each of three different criteria of a good exposure base.

3. (1.25 points)

Given the following:

- Each policy insures only one car
- Policies are earned evenly throughout the year

Policy	Effective Date	Original Expiration Date	Cancellation Date
A	February 1, 2009	July 31, 2009	
B	May 1, 2009	October 31, 2009	
C	August 1, 2009	January 31, 2010	
D	November 1, 2009	April 30, 2010	January 31, 2010
E	January 1, 2010	June 30, 2010	
F	July 1, 2010	December 31, 2010	

a. (0.25 point)

Calculate the written car years in calendar year 2010.

b. (0.25 point)

Calculate the written car years in policy year 2010.

c. (0.25 point)

Calculate the earned car years in calendar year 2010.

d. (0.25 point)

Calculate the earned car years in policy year 2010.

e. (0.25 point)

Calculate the number of in-force policies as of January 1, 2010.

4. (1.5 points)

Company ABC began writing annual personal automobile policies on January 1, 2010, using the following rating structure:

- Policy Premium = Base Rate x Class Factor + Policy Fee
- Base Rate = \$1,000
- Policy Fee = \$50

Class	Class Factor
Teens	2.00
Adults	1.00

On July 1, 2010, the company increased the base rate to \$1,100 and revised the class factor for adults to 0.90.

Company ABC writes 10 policies per quarter, each with an effective date of the beginning of the quarter. The company writes an even distribution of teen and adult classes each quarter.

a. (1 point)

Calculate the calendar year 2010 earned premium.

b. (0.5 point)

Calculate the on-level factor that applies to the calendar year 2010 earned premium to bring premiums to current rate level.

5. (2.25 points)

Given the following information:

- Policy term: six months
- Proposed rates in effect: January 1, 2012, to June 30, 2013
- Selected projected premium trend: 5%

Calendar Year	Average Earned Premium at Current Rate Level	Average Written Premium at Current Rate Level
2009	\$375	\$380
2010	\$390	\$395

a. (2 points)

Calculate the total premium trend factor for each of calendar years 2009 and 2010 using two-step trending.

b. (0.25 point)

Briefly discuss when it is appropriate to use two-step trending.

EXAM 5, SPRING 2011

6. (2.5 points)

Given the following information for claims associated with annual homeowners policies written in 2007:

Claim Number	Accident Year	Report Year	Transaction Date	Loss Payment	Case Reserve Balance
1	2007	2007	April 1, 2007	\$100	\$300
1	2007	2007	July 1, 2008	\$200	\$600
1	2007	2007	June 1, 2009	\$500	\$0
2	2007	2008	May 1, 2008	\$500	\$200
2	2007	2008	July 1, 2009	\$200	\$0
3	2008	2008	August 1, 2008	\$50	\$200
3	2008	2008	March 1, 2009	\$100	\$50
3	2008	2008	July 1, 2010	\$200	\$0

a. (0.5 point)

Calculate the calendar year 2008 incurred losses.

b. (0.5 point)

Calculate the accident year 2008 incurred losses, evaluated at December 31, 2009.

c. (0.5 point)

Calculate the policy year 2007 incurred losses, evaluated at December 31, 2009.

d. (0.5 point)

Calculate the report year 2008 incurred losses, evaluated at December 31, 2009.

e. (0.5 point)

Briefly describe one advantage and one disadvantage associated with using policy year losses for ratemaking.

7. (1 point)

Fully explain the overlap fallacy between loss development and loss trend.

8. (1.25 points)

Given the following information:

	Calendar Year 2010
Written premium	\$280.00
Earned premium	\$308.00
Commissions	\$33.60
Taxes, licenses and fees	\$9.80
General expenses	\$36.96
LAE ratio (to loss)	8.2%
Combined ratio	100%

Calculate the 2010 operating expense ratio.

9. (6.75 points)

Given the following information for a book of business:

- Policies have a six month term
- Rate change history:
 - -3% effective October 1, 2008
 - +6% effective January 1, 2010
- Annual premium trend = 1.5%
- Annual loss trend = 2.2%
- Proposed rates will be in effect for one year beginning on October 1, 2011
- Unallocated loss adjustment expense provision = 3.2% (of loss and ALAE)
- Fixed expense ratio = 5.6%
- Variable expense ratio = 24.0%
- Underwriting profit and contingencies provision = 3.5%
- Rates developed based on calendar/accident year 2009 and 2010

Calendar Year Ending:	Earned Premium (000s)
December 31, 2009	\$110,865
December 31, 2010	\$128,973

Accident Year	Incurred Losses and ALAE (000s)				
	12 months	24 months	36 months	48 months	60 months
2006	\$44,860	\$51,589	\$56,748	\$57,315	\$57,315
2007	\$47,985	\$54,703	\$60,720	\$61,327	
2008	\$51,384	\$59,606	\$64,970		
2009	\$60,735	\$69,845			
2010	\$76,094				

a. (2 points)

Calculate the projected calendar year earned premium at current rate level for calendar years 2009 and 2010.

b. (4.25 points)

Calculate the indicated rate change.

c. (0.5 point)

Assume the 2009 incurred loss and ALAE amount includes an additional \$25,000,000 in losses attributable to a single weather event. Discuss an appropriate strategy for including this information in the indicated rate change calculation.

10. (1.5 points)

Identify whether the loss ratio or pure premium ratemaking method is preferable in each of the following scenarios. Briefly explain each answer.

a. (0.5 point)

A company introduced two new rating variables within the past year.

b. (0.5 point)

A company is entering a new line of business.

c. (0.5 point)

A company writes a commercial product with multiple exposure bases.

11. (2.75 points)

Given the following information for State X:

- Only two insurance companies write automobile policies
- Total expected costs (including expenses) per policy are the same for 2010 and 2011
- All policies are annual policies effective January 1
- 10% of class 1 risks shop for new insurance every year
- 20% of class 2 risks shop for new insurance every year
- All insureds who shop always select the carrier with the lowest rate

2010 Policy Year		Company A				Company B			
Class	Total Insureds	# Insureds	Expected Costs	2010 Rates	2011 Rates	# Insureds	Expected Costs	2010 Rates	2011 Rates
1	10,000	5,000	100	150	100	5,000	100	150	150
2	10,000	5,000	200	150	200	5,000	200	150	150
Total	20,000	10,000	150	150		10,000	150	150	

Company A will introduce a new rating variable effective January 1, 2011, that segments the market into two 2 classes. The 2011 rate levels will be consistent with the expected costs associated with each class of business.

Company B will not be changing rates on January 1, 2011. Company B uses one rate level for all insureds.

a. (1.5 points)

Calculate the total profit for Company A and Company B for Policy Year 2011.

b. (0.5 point)

Company A's goals were to improve profitability and increase market share. Briefly explain whether the goals were achieved.

c. (0.25 point)

Provide one recommendation to Company A to help achieve its goals of improved profitability and increased market share.

d. (0.5 point)

Describe the impact of Company A's action on Company B.

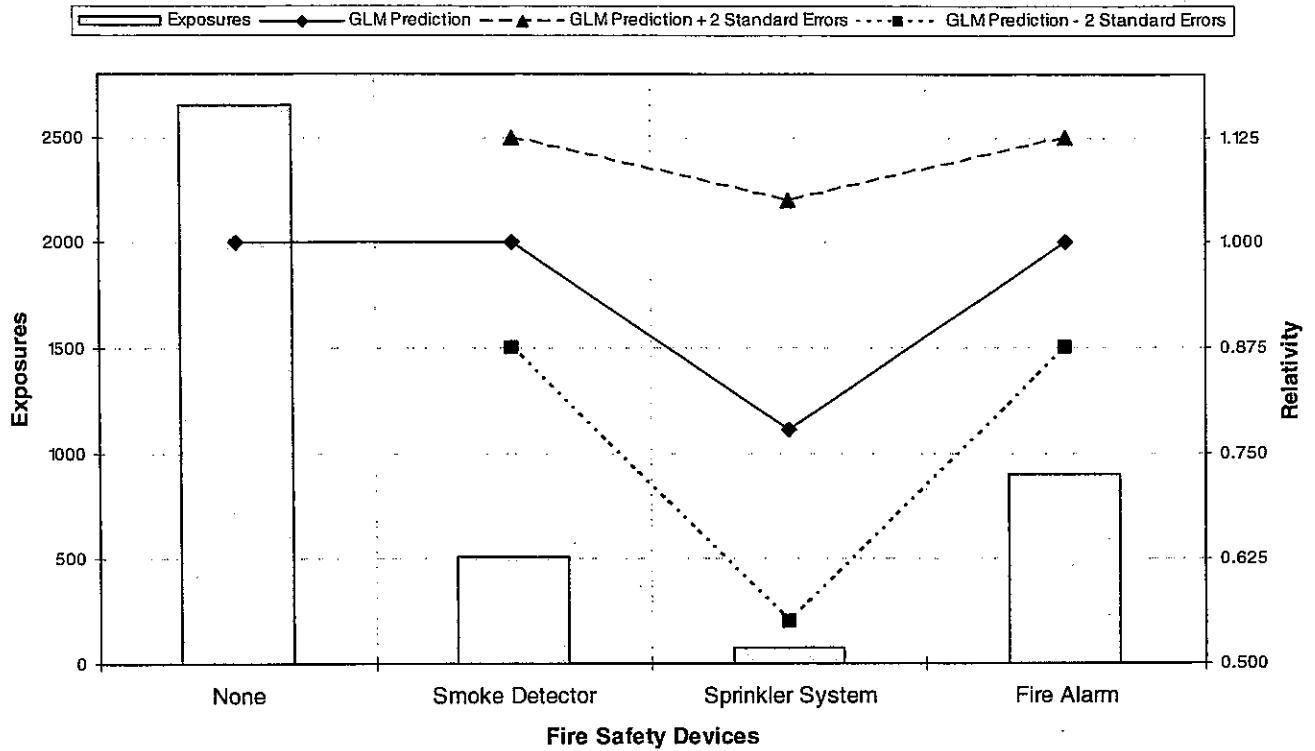
12. (1 point)

Describe two primary purposes of risk classification.

13. (1 point)

A company applied generalized linear modeling to its homeowners data. A graph of indicated relativities and their standard errors for a fire safety device rating variable is shown below.

Evaluate the effectiveness of the variable in the model.



14. (1.5 points)

Given the following information:

Deductible	Reported Claim Counts	Net Reported Losses	Net Reported Losses Assuming \$750 Deductible	Net Reported Losses Assuming \$1000 Deductible
Full coverage	990	\$1,347,000	\$772,000	\$605,000
\$250	2,770	\$5,167,000	\$4,024,000	\$3,505,000
\$500	4,360	\$9,198,000	\$8,244,000	\$7,345,000
\$750	1,350	\$3,230,000	\$3,230,000	\$2,926,000
\$1,000	500	\$1,692,000	Unknown	\$1,692,000
Total	9,970	\$20,634,000		

a. (1 point)

Use the loss elimination ratio approach to deductible pricing to calculate the credit associated with moving from a \$750 deductible to a \$1,000 deductible.

b. (0.5 point)

An assumption of the loss elimination ratio approach is that claim behavior will be the same for each deductible. Describe why this assumption may not hold in practice.

15. (3 points)

Given the following information:

Territory	Earned Exposures	Developed Incurred Loss and ALAE Total for Accident Years 2009 and 2010	Current Relativity
A	20,000	\$500,000	1.00
B	5,000	\$125,000	0.95
C	15,000	\$250,000	1.25
Total	40,000	\$875,000	

- The effective date for the proposed rate change is January 1, 2012 and rates will be in effect for one year.
- Average date of loss is January 1, 2010.
- All policies are annual.
- Full credibility standard = 11,050 exposures

On a statewide basis, annual pure premium trends have been holding steady at 0%. However, due to fraudulent claim behavior, pure premiums are expected to trend at different rates throughout the state as follows:

Territory	Annual Pure Premium Trend
A	-5%
B	0%
C	10%
Total	0%

This fraudulent behavior is expected to continue into the foreseeable future.

a. (2.75 points)

Assuming Territory A is the base territory, calculate the credibility-weighted indicated relativities to the base territory.

b. (0.25 point)

Briefly describe a reason multivariate classification techniques are preferred over univariate classification techniques when performing territorial relativity analyses.

16. (1.75 points)

Workers compensation insurers often offer a premium discount for large premium dollar accounts. Given the following expense information for workers compensation policies:

Premium Range	Expense Percentage by Type:			
	Production	General	Taxes	Profit
\$0 - \$7,500	14%	10%	3%	5%
\$7,500 - \$75,000	10%	8%	3%	5%
\$75,000 - \$200,000	7%	6%	3%	5%
\$200,000 & above	5%	4%	3%	5%

Calculate the total amount of premium discount for a policy with premium of \$180,000.

17. (1 point)

Given the following data:

Claim Number	Loss Amount
1	\$10,000
2	\$15,000
3	\$30,000
4	\$35,000

- Basic limit = \$25,000
- Total limits severity trend = 10%

Calculate the excess loss trend.

18. (1.25 points)

An insurance company is planning to implement new rates and expects the following:

Premium Range	Policy Count	Avg Premium at Proposed Rates
\$0-\$50	26	\$35
\$51-\$100	34	\$80
\$101-\$200	45	\$150
\$201-\$500	150	\$300

The resulting base rate from the proposal is \$100.

a. (0.75 point)

Calculate the new base rate that achieves a revenue-neutral impact if the company were to implement a minimum premium of \$100.

b. (0.5 point)

Explain the purpose of a minimum premium.

19. (2.5 points)

The owner of a parking lot is looking to purchase workers compensation insurance for herself and her employees. The insured has enough prior experience to be eligible for an NCCI experience rating modification factor. Given the following characteristics of the policy:

- The insured has a dedicated return-to-work program that makes it eligible for a 15% premium discount.
- The expense constant is \$250.
- Actual primary losses in the experience period = \$47,000
- Actual excess losses in the experience period = \$10,000
- Expected primary losses = \$75,000
- Expected excess losses = \$15,000
- Primary credibility = 0.5
- Excess credibility = 0.1
- Exposures and applicable rates for the insured are as follows:

Class Code	Payroll	Rate per \$100 of Payroll
8392 - Auto Parking Lot	\$2,500,000	4.1
8742 - Salespersons	\$500,000	0.5
8810 - Clerical Office Employees	\$1,000,000	0.3

a. (1 point)

Calculate the experience rating modification factor.

b. (0.75 point)

Calculate the standard premium.

c. (0.75 point)

Calculate the final premium for the insured.

20. (3.5 points)

Given the following information:

- Company cost of capital is 8%
- No premium or loss trend

	Class A	Class B
Annual premium	\$800	Unknown
Present value of losses (1st year)	\$550	\$650
Present value of losses (2nd year)	\$550	\$650
Variable expense ratio (1st year)	20%	24%
Variable expense ratio (2nd year)	12%	20%
Fixed expense (1st year)	\$42	\$50
Fixed expense (2nd year)	\$20	\$30
Probability of annual termination	15%	40%

a. (0.5 point)

Using a one-year period, calculate the premium for class B if the same profit loading is targeted for all classes.

b. (1.25 points)

Using a two-year period, calculate the return on sales for class A.

c. (1.75 points)

Using a two-year period, calculate the premium for class B that would achieve the same return on sales as calculated in part b above.

21. (2 points)

A large insurer is considering combining data from a long-tailed, low-frequency line of business with data from a short-tailed, high-frequency line of business to estimate unpaid claims.

Identify and briefly discuss four characteristics of the data that should be considered before combining these lines of business.

22. (2.25 points)

Given the following claim detail (000s):

<u>Claim</u>	<u>Accident Date</u>	<u>Paid During 2008</u>	<u>Case Reserve at Year End 2008</u>	<u>Paid During 2009</u>	<u>Case Reserve at Year End 2009</u>	<u>Paid During 2010</u>	<u>Case Reserve at Year End 2010</u>
1	March 3, 2008	\$225	\$190	\$250	\$0	\$0	\$0
2	July 18, 2008	\$150	\$500	\$0	\$500	\$230	\$270
3	December 1, 2008			\$105	\$75	\$75	\$25
4	March 1, 2009			\$200	\$200	\$150	\$100
5	October 3, 2009			\$320	\$280	\$200	\$0
6	November 3, 2009			\$0	\$100	\$50	\$100
7	April 12, 2010					\$45	\$55
8	June 28, 2010					\$500	\$500

a. (1.25 points)

Construct the cumulative accident year reported loss development triangle as of December 31, 2010.

b. (0.5 point)

Describe a situation in which it is preferable to use accident year data for estimating unpaid claims rather than report year data.

c. (0.5 point)

Describe a situation in which it is preferable to use report year data for estimating unpaid claims rather than policy year data.

23. (1 point)

Given the following data as of December 31, 2010:

Accident Year	<u>Reported Claims (000s)</u>			
	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
2007	\$500	\$554	\$586	\$592
2008	\$448	\$470	\$512	
2009	\$312	\$346		
2010	\$426			

Accident Year	<u>Paid Claims (000s)</u>			
	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
2007	\$85	\$200	\$500	\$570
2008	\$81	\$225	\$472	
2009	\$59	\$175		
2010	\$85			

Fully discuss whether the data indicates a speed-up in claim closure.

24. (3.5 points)

Given the following claim data as of December 31, 2010:

Accident Year	<u>Cumulative Reported Claims (000s)</u>				
	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>	<u>60 Months</u>
2006	\$105	\$265	\$340	\$375	\$380
2007	\$100	\$275	\$360	\$390	
2008	\$116	\$285	\$375		
2009	\$122	\$310			
2010	\$128				

- No development is expected after 60 months.
- Use an all-year straight average for all factor selections.
- Accident year 2009 paid claims as of December 31, 2010 = \$250,000

a. (1.5 points)

Use the reported development technique to estimate the unpaid claims for accident year 2009.

b. (0.5 point)

Calculate the expected reported claims for accident year 2010 during the next 12 months.

c. (0.75 point)

State three assumptions underlying the reported development technique.

d. (0.25 point)

Briefly describe when a tail factor may be needed to estimate unpaid claims under the reported development technique.

e. (0.5 point)

Briefly describe two approaches to determine a tail factor.

25. (2.5 points)

Given the following information as of December 31, 2010:

<u>Accident Year</u>	<u>Earned Premium</u>	<u>Paid Claims</u>	<u>On-Level Earned Premium Factors</u>
2007	\$21,000,000	\$11,700,000	1.093
2008	\$22,050,000	\$8,200,000	1.061
2009	\$23,152,500	\$4,900,000	1.030
2010	\$23,525,000	\$1,900,000	1.000

<u>Paid Loss Development Factors</u>				
<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>48-60</u>	<u>60-Ult</u>
2.400	1.800	1.500	1.200	1.020

- Loss trend is 4% per year

a. (2.25 points)

Use the expected claim technique to estimate ultimate claims for accident year 2010.

b. (0.25 point)

Briefly describe a disadvantage of the expected claim technique.

26. (2.5 points)

Given the following information as of December 31, 2010:

<u>Incremental Closed Claim Counts</u>			
<u>Accident Year</u>	<u>72 Months</u>	<u>84 Months</u>	<u>96 Months</u>
2003	2,000	2,000	1,000
2004	3,000	2,000	
2005	3,000		

<u>Incremental Paid Claims (000s)</u>			
<u>Accident Year</u>	<u>72 Months</u>	<u>84 Months</u>	<u>96 Months</u>
2003	\$20,000	\$28,000	\$25,000
2004	\$33,000	\$36,000	
2005	\$36,000		

- Selected annual severity trend = 10%

a. (2 points)

Use the volume-weighted average to estimate the trended tail severity for maturity ages of 72 months and older.

b. (0.5 point)

Briefly describe two considerations in selecting the maturity age at which to combine data for estimating a tail factor.

27. (3 points)

Given the following information as of December 31, 2010:

<u>Accident Year</u>	<u>Earned Premium</u>	<u>Claims Reported</u>	<u>Selected CDF to Ultimate</u>
2008	\$950,000	\$510,000	1.050
2009	\$975,000	\$520,000	1.120
2010	\$1,000,000	\$450,000	1.300

a. (1 point)

Use the Bornhuetter-Ferguson technique and an expected claims ratio of 60% to estimate the IBNR for accident year 2010.

b. (1.5 points)

Use the Cape Cod technique to estimate the IBNR for accident year 2010.

c. (0.5 point)

Describe the primary difference between the Bornhuetter-Ferguson technique and the Cape Cod technique.

28. (1.75 points)

Given the following:

<u>Cumulative Total Closed Claim Counts</u>				
<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
2007	550	700	800	840
2008	700	855	925	
2009	625	800		
2010	675			

<u>Cumulative Claim Counts Closed with No Payment</u>				
<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
2007	30	80	105	120
2008	55	105	130	
2009	35	60		
2010	40			

<u>Accident Year</u>	<u>Projected Ultimate Severity per Claim Closed with Payment</u>
2007	\$3350
2008	\$3400
2009	\$3275
2010	\$3450

- Assume no further closed claim development after 48 months.
- Use an all-year volume-weighted average for all factor selections.

Use the frequency-severity technique to estimate the ultimate claim amount for accident year 2010.

29. (1.25 points)

Given the following data as of December 31, 2010:

<u>Case Outstanding (000s)</u>			
<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2008	\$1,200	\$1,100	\$450
2009	\$1,500	\$1,350	
2010	\$1,650		

<u>Incremental Paid Claims (000s)</u>			
<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2008	\$1,500	\$960	\$650
2009	\$1,700	\$1,200	
2010	\$2,000		

- Selected ratio of case outstanding to previous case outstanding:

<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
0.90	0.40	0.00

- Selected ratio of incremental paid claims to previous case outstanding:

<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>
0.80	0.60	1.05

- Assume no further closed claim development after 48 months

a. (1 point)

Use the case outstanding development technique to estimate the ultimate claims for accident year 2009.

b. (0.25 point)

Briefly describe when the case outstanding development technique is appropriate.

30. (2.5 points)

Given the following data for a line of business as of December 31, 2010:

Accident Year	<u>Average Case Reserves on Open Claims</u>				
	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>	<u>60 Months</u>
2006	\$10,000	\$12,000	\$15,000	\$22,000	\$35,000
2007	\$10,300	\$12,360	\$15,450	\$28,600	
2008	\$10,609	\$12,731	\$20,085		
2009	\$10,927	\$16,550			
2010	\$14,205				

Accident Year	<u>Average Cumulative Paid on Closed Claims</u>				
	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>48 Months</u>	<u>60 Months</u>
2006	\$5,000	\$6,000	\$7,500	\$11,000	\$16,000
2007	\$5,150	\$6,180	\$7,725	\$11,330	
2008	\$5,305	\$6,365	\$7,957		
2009	\$5,464	\$6,556			
2010	\$5,628				

a. (1 point)

Fully discuss whether the reported claim development technique is appropriate to estimate unpaid claims for this line of business.

b. (1 point)

Fully discuss whether the paid claim development technique is appropriate to estimate unpaid claims for this line of business.

c. (0.5 point)

Discuss whether the expected claim technique is appropriate to estimate unpaid claims for this line of business.

31. (3.75 points)

Given the following data as of December 31, 2010:

<u>Cumulative Paid Claims (000s)</u>				<u>Case Outstanding (000s)</u>			
<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2008	\$3,816	\$9,771	\$18,518	2008	\$21,936	\$31,920	\$27,424
2009	\$3,600	\$11,292		2009	\$26,334	\$28,648	
2010	\$6,268			2010	\$31,042		

<u>Cumulative Reported Claims (000s)</u>				<u>Open Claim Counts</u>			
<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>	<u>Accident Year</u>	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months</u>
2008	\$25,752	\$41,691	\$45,942	2008	1,828	1,900	1,522
2009	\$29,934	\$39,940		2009	1,540	1,600	
2010	\$37,310			2010	1,660		

- Annual severity trend = 10%
- 36-to-ultimate reported tail factor = 1.050
- Use all-year volume-weighted average for development factor selection

a. (2.75 points)

Use the Berquist-Sherman technique for case reserve adequacy to estimate the ultimate claims for all accident years.

b. (0.25 point)

Briefly describe the purpose of the Berquist-Sherman case reserve adjustment.

c. (0.75 point)

Discuss whether changing the annual severity trend given above from 10% to 5% would produce a higher or lower ultimate claims estimate under the Berquist-Sherman technique for case reserve adequacy.

32. (3 points)

Given the following data as of December 31, 2010:

<u>Cumulative Paid Claims Gross of Salvage and Subrogation</u>				
Accident Year	<u>12 months</u>	<u>24 months</u>	<u>36 months</u>	<u>48 months</u>
2007	\$12,200	\$13,260	\$13,280	\$13,280
2008	\$12,180	\$13,300	\$13,320	
2009	\$12,880	\$14,040		
2010	\$11,980			

<u>Cumulative Received Salvage and Subrogation</u>				
Accident Year	<u>12 months</u>	<u>24 months</u>	<u>36 months</u>	<u>48 months</u>
2007	\$3,074	\$4,670	\$4,720	\$4,746
2008	\$3,098	\$4,558	\$4,602	
2009	\$3,180	\$4,732		
2010	\$2,858			

- Assume no further development after 48 months.
- Use all-year simple averages for all factor selections.

Use a ratio approach to estimate ultimate salvage and subrogation recoveries.

33. (1.5 points)

Given the following information:

Accident Year	<u>Gross Reported Claims (000s)</u>			
	<u>12 months</u>	<u>24 months</u>	<u>36 months</u>	<u>48 months</u>
2006	\$55,963	\$62,679	\$66,439	\$66,439
2007	\$57,584	\$62,191	\$65,922	\$65,922

Accident Year	<u>Net Reported Claims (000s)</u>			
	<u>12 months</u>	<u>24 months</u>	<u>36 months</u>	<u>48 months</u>
2006	\$50,367	\$50,870	\$51,125	\$51,125
2007	\$37,430	\$40,424	\$42,849	\$42,849

- Insurer has either a quota share reinsurance contract or an excess of loss reinsurance contract in place each accident year.

a. (1 point)

Analyze the gross and net reported claims data to determine which type of reinsurance was purchased for each accident year. Explain your reasoning.

b. (0.5 point)

Briefly explain how the selection of tail factors for both net and gross reported claims should be impacted by the presence of an excess of loss reinsurance contract.

34. (1.75 points)

Given the following data as of December 31, 2010:

<u>Paid Claims Only (excludes expense)</u>				
<u>Accident Year</u>	<u>12 months</u>	<u>24 months</u>	<u>36 months</u>	<u>48 months</u>
2007	\$55,683	\$68,489	\$76,486	\$77,685
2008	\$62,489	\$75,495	\$82,168	
2009	\$69,791	\$80,489		
2010	\$75,187			

<u>Paid ALAE</u>				
<u>Accident Year</u>	<u>12 months</u>	<u>24 months</u>	<u>36 months</u>	<u>48 months</u>
2007	\$2,985	\$4,288	\$5,217	\$5,609
2008	\$3,581	\$4,968	\$5,908	
2009	\$3,979	\$5,289		
2010	\$4,315			

- Accident year 2010 ultimate paid claims estimate = \$101,535
- Assume no further development after 48 months.
- Use all-year simple averages for all factor selections.

a. (1.5 points)

Use the paid ALAE-to-paid claims only additive method to estimate ultimate ALAE for accident year 2010.

b. (0.25 point)

Briefly describe an advantage of using a ratio approach to estimate ultimate ALAE.

35. (2 points)

Given the following information as of December 31, 2010:

Calendar <u>Year</u>	Paid <u>ULAE</u>	Ultimate Reported <u>Claims</u>	Paid <u>Claims</u>
2007	\$2,000	\$21,000	\$2,100
2008	\$2,750	\$21,500	\$12,650
2009	\$4,500	\$35,000	\$22,650
2010	\$5,500	\$40,000	\$30,100

- 40% of ultimate ULAE is spent on maintaining claims.
- 60% of ultimate ULAE is spent on opening claims.
- Ultimate value of claims for 2007 through 2010 = \$117,500

Use the Conger-Nolibos expected claim method to estimate the unpaid ULAE.

36. (3 points)

An insurance company uses both the reported claim development method and the paid claim development method to estimate unpaid claims for its automobile liability business.

a. (0.5 point)

A state enacts legislation creating a court that specializes in hearing insurance liability claims to combat a backlog of liability cases in the regular court system. Briefly describe the expected impact of the legislation on the estimated unpaid claims in this state for each method.

b. (0.5 point)

A state enacts tort reform legislation that places caps on non-economic damages awarded in automobile liability lawsuits. Briefly describe the expected impact of the legislation on the estimated unpaid claims in this state for each method.

c. (0.5 point)

To gain market share, company management is focusing on writing \$1,000,000 policy limits whereas previously policies were written with \$500,000 policy limits. Briefly describe the expected impact of this strategic change on the estimated unpaid claims for each method.

d. (1.5 points)

For each scenario described in parts a, b, and c above, discuss a diagnostic test that would indicate whether the expected impact of the change is present in the data.

EXAM 5, SPRING 2011

37. (1.75 points)

The following table summarizes the estimated IBNR from various estimation techniques for four different books of business.

<u>Estimation Technique</u>	<u>Book A</u>	<u>Book B</u>	<u>Book C</u>	<u>Book D</u>
Development – Reported	\$610	\$495	\$450	\$806
Development – Paid	\$610	\$250	\$923	\$645
Expected Claims	\$14	\$250	\$450	\$811
Bornhuetter-Ferguson – Reported	\$445	\$453	\$450	\$809
Bornhuetter-Ferguson – Paid	\$161	\$250	\$781	\$745

a. (0.5 point)

The true IBNR for Book A is \$610. Based on the estimated IBNR for each method shown, discuss a change in Book A that would explain the discrepancies between the estimates and the true IBNR.

b. (0.5 point)

The true IBNR for Book B is \$250. Based on the estimated IBNR for each method shown, discuss a change in Book B that would explain the discrepancies between the estimates and the true IBNR.

c. (0.5 point)

The true IBNR for Book C is \$450. Based on the estimated IBNR for each method shown, discuss a change in Book C that would explain the discrepancies between the estimates and the true IBNR.

d. (0.25 point)

For Book D, briefly discuss a next step the actuary should take to understand the difference in results.

Exam 5

Basic Techniques for Ratemaking and Estimating Claim Liabilities

May 4, 2011

POINT VALUE OF QUESTIONS

QUESTION	VALUE OF QUESTION	SUB-PART OF QUESTION						
		(a)	(b)	(c)	(d)	(e)	(f)	(g)
1	2.00	1.00	0.50	0.50				
2	1.50							
3	1.25	0.25	0.25	0.25	0.25	0.25		
4	1.50	1.00	0.50					
5	2.25	2.00	0.25					
6	2.50	0.50	0.50	0.50	0.50	0.50		
7	1.00							
8	1.25							
9	6.75	2.00	4.25	0.50				
10	1.50	0.50	0.50	0.50				
11	2.75	1.50	0.50	0.25	0.50			
12	1.00							
13	1.00							
14	1.50	1.00	0.50					
15	3.00	2.75	0.25					
16	1.75							
17	1.00							
18	1.25	0.75	0.50					
19	2.50	1.00	0.75	0.75				
20	3.50	0.50	1.25	1.75				
21	2.00							
22	2.25	1.25	0.50	0.50				
23	1.00							
24	3.50	1.50	0.50	0.75	0.25	0.50		
25	2.50	2.25	0.25					
26	2.50	2.00	0.50					
27	3.00	1.00	1.50	0.50				
28	1.75							
29	1.25	1.00	0.25					
30	2.50	1.00	1.00	0.50				
31	3.75	2.75	0.25	0.75				
32	3.00							
33	1.50	1.00	0.50					
34	1.75	1.50	0.25					
35	2.00							
36	3.00	0.50	0.50	0.50	1.50			
37	1.75	0.50	0.50	0.50	0.25			
TOTAL	<u>79.75</u>							

Question 1

- a) Base rate = \$200
Youth, unnamed, male, principal op: mult = 2.1
10 mi/day: work <15 mi: mult = 1.1
Full-time, 16y/o, 3.2 GPA: disc = 20%
Prem = $200 * 2.1 * 1.1 * (1-.2) = \369.6
- b) “new policy” use class = pleasure use, mult = 0.9
Prem = $200 * 2.1 * 0.9 * (1-.2) = \302.4
Total prem = $\frac{1}{2} (369.6 + 302.4) = \336
→ Decr. $369.6 - 336 = \$33.6$
- c) According to ISO PAM part 4.3 (page G-3), a policy shall not be changed mid-term to effect a chg in driving record sub-class, so no impact from part a.

Question 2, Answer A

Car year to annual miles driven, 3 criteria:

- 1) Proportional to expected loss:
Should select variable with the most direct relationship to loss. Should adjust based on modifications to exposure of the risk to a loss.
Annual miles driven seems a better choice, since the more you drive, the more at risk you are to have a loss.
- 2) Practical: Should be objective, well-defined, and relatively easy to obtain and verify.
Miles driven are objective and a well-defined exposure, but can be expensive to send inspectors to verify odometer. Also, if ask client, it is subject to moral hazard.
- 3) Historical precedent: Car years have historically been used. Changing to miles driven could cause:
-significant variation in premium
-need to modify systems
-need to collect new data (cost of survey or inspections)

Based on the 3 criterias, the costs of implementing this new structure and practical issues overweight the benefits of the 1st one. Should keep earned car years as exposure base.

Question 2, Answer B

→ Exposure base should be,

- 1) proportional to loss
- 2) practical (verifiable, objective, easy to admin)
- 3) Have historical precedence

→ Annual miles driven satisfies 1 in that it is proportional to loss. More miles driven \propto more exposure.

→ Annual miles driven does not satisfy 2 in that it is difficult to verify and can be easily manipulated.

→ Annual miles driven does not satisfy 3 since it hasn't been used in the past. Changing the exposure base may cause prem. swings. Also, the data needed may not be readily available to create a database.

Question 3

Policy	(a)	(b)	(c)	(d)	(e)
A	0	0	0	0	0
B	0	0	0	0	0
C	0	0	1/12	0	1
D	-1/4	0	1/12	0	1
E	1/2	1/2	1/2	1/2	1
F	1/2	1/2	1/2	1/2	0

Full policy = 1/2 car year (semi annual)

(a) [transaction] = .75

(b) 1

- (c) 14/12
- (d) 1
- (e) 3

Question 4, Answer A

- a) 10 pols = 5 adult and 5 teens each quarter
 Quarter 1: Adult = $1000 * (1) + 50 = 1050 \times 5 = 5,250$
 Teens = $1000 * (2) + 50 = 2050 * 5 = 10,250$
 Quarter 2: same as quarter 1
 Quarter 3: Adult = $1000 * (.99) + 50 = 1040 \times 5 = 5,200$
 Teens $1100 * (2) + 50 = 2250 * 5 = 11,250$
 Quarter 4: same as quarter 3
 2010 earned premium =
 $(5250 + 10250) + (5250 + 10250) * .75 + (5200 + 11250) * .5 + (5200+11250) * .25$
 $= 15500 + 11625 + 8225 + 4112.50$
 $= 39,462.50$
- b) EP for 2010 if all @ CRL = $(5200 + 11250)(1 + .75 + .5 + .25) = (16450)(2.5) = 41,125$
 OLF = $41,125/39,462.5 = 1.0421286$

Question 4, Answer B

- a) Q1: $(100 * 2 + 50) * 5 + (1000 * 1 + 50) * 5 = 15500$
 Q2: $15500 * 3/4 = 11625$
 Q3: $[(1100 * 2 + 50) * 5 + (1100 * .9 + 50) * 5] * 1/2 = 16450 * 1/2 = 8225$
 Q4: $16450 * 1/4 = 4112.5$
 EP = $15500 + 11625 + 8225 + 4112.5 = 39462.5$
- b) $16450 * (1 + 3/4 + 1/2 + 1/4) = 41125$
 On level factor = $41125/ 39462.5 = 1.042$

Question 5, Answer A

- a) two-step trending = premium trend factors
 -CY2009
 Step 1 trend = $(\text{AvgWP@CRL Latest period}) / (\text{HistoricalAvgEP@CRL}) = 395/375 = 1.05333$
 Step 2 trend = Start 7/1/10, End 10/1/12
 Step 2 trend period from 7/1/10 - 10/1/12 = 2.25 years
 Step 2 trend = $(1.05)^{2.25} = 1.116$
 → CY2009 total premium trend factor = $(1.0533)(1.05^{2.25}) = 1.1756$
 -CY2010
 Step 1 trend = $395/390 = 1.0128$ (see above formula)
 Step 2 trend = trend from 7/1/10 – 10/1/12 = 2.25 years
 → CY2010 Total premium trend factor = $(1.0128)(1.05^{2.25}) = 1.1303$
- b) It is appropriate to use two step trending when the historical trend and the prospective trend are different.

Question 5, Answer B

a)

	(1)	(2)	(3) = (2)/(1)	(4)
CY	Avg EP	2010 Avg.WP		Premium Trend
2009	375	395	1.0533	$1.05^{2.25}$
2010	390	395	1.0128	$1.05^{2.25}$

2nd step trend period is from 7/1/2010 to 9/30/2012 which is 2.25 years.

CY	(5) = (3)x(4)
2009	1.1755
2010	1.1303

b) When future premium trend are different from current trend, we can not use one-step trend, we need to use 2-step trend instead.

Question 6

- a) $200 + 600 - 300 + 500 + 200 + 50 + 200 = 1,450$
- b) $50 + 100 + 50 = 200$
- c) $100 + 200 + 500 + 500 + 200 + 50 + 100 + 50 = 1700$
- d) $500 + 200 + 50 + 100 + 50 = 900$
- e) Advantage: True match between premiums and losses

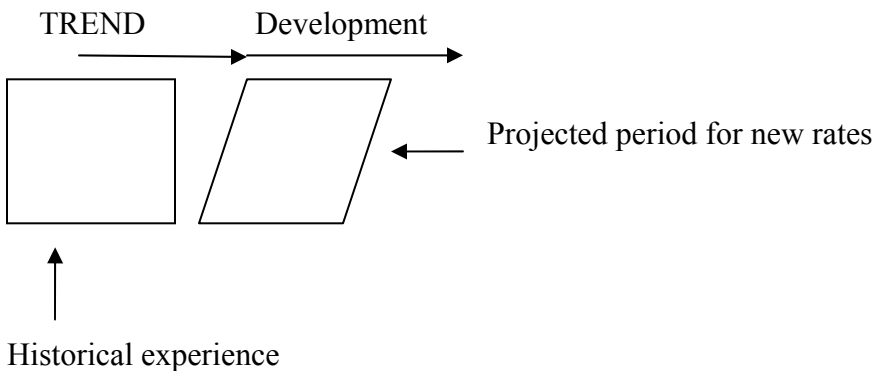
Disadvantage: Extended development. It takes longer to develop.

Question 7, Answer A

There is no overlap when developing loss and trending loss. Trending loss will trend loss from the midpoint of experience period to the midpoint of the exposure period. Developing loss will develop loss from the midpoint of the exposure period to the ultimate.

Question 7, Answer B

The overlap fallacy between loss development and trend clarifies that there actually is no overlap, or double-counting, between the two adjustments. Trend brings historical losses to the projected cost level/ environment of the future period, whereas development brings these losses to their ultimate settlement value. The graph below demonstrates this:



Question 8, Answer A

Combined ratio = Loss Ratio + LAE / EPremium + UW Expense Ratio

OER = LAE / Premium + UW Expense Ratio

UW Expense Ratio = TaxesLicFee / WP + Comm / WP + General / EP

= $(9.80 + 33.6) / 280 + 36.96 / 308 = .275$

$1 = L / EP + .082L / EP + .275$; since $.082 = LAE / L$, $LAE = .082L$

$\Rightarrow .725 * 308 / 1.082 = L$

$L = 206.377$

$LAE = 16.923$

$$\text{OER} = 16.923 / 308 + .275 = .32994$$

Question 8, Answer B

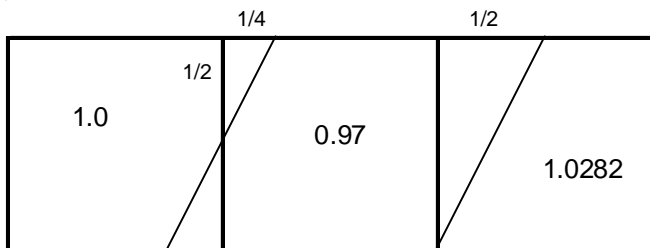
Combined ratio = Loss Ratio + OER
 = LR * (1 + LAE ratio) + U/W Expense Ratio
 $100\% = \text{LR} * (1 + 8.2\%) + 33.60 + 9.80 / 280 + 36.96 / 308$
 $\text{LR} = 67\%$
 $\text{OER} = \text{Combined Ratio} - \text{Loss Ratio} = 33\%$

Question 8, Answer C

Underwriting expense ratio = $33.60 / 280 + 9.8 / 280 + 36.96 / 308 = 0.275$
 Combined ratio = Loss Ratio (1 + 0.082) + UW Expense / Written premium
 $\text{UW Expense} / \text{Written Premium} = 33.60 + 9.8 + 36.96 / 280 = 0.287$
 Combined ratio = $\text{LR}(1.082) + 0.287$
 $\rightarrow \text{LR} = 0.65896$
 So... $1 = 0.65896 + \text{LAE} / \text{Earned premium} + 0.287$
 $\rightarrow \text{LAE} / \text{Earned Premium} = 0.054$
 So operating expense ratio = $0.054 + 0.275 = 0.329$

Question 9, Answer A

a)



2009 on level factor = $1.0282 / [1 / 16(1) + .97(15 / 16)] = 1.058$
 2010 on level factor = $1.0282 / [1/4 (.97) + 3/4 (1.0282)] = 1.014$
 2009 premium = $110865 * 1.058 * 1.015^3 = 122,653$
 2010 premium = $128973 * 1.014 * 1.015^2 = 134,731$

↓
 Trend from Avg written of 4/1/10 to 4/1/12 or 2 years

b)

	12-24	24-36	36-48	48-60
	1.15	1.1	1.01	1
	1.14	1.1	1.01	
	1.16	1.09		
	1.15			
Selected	1.15	1.1	1.01	1
ATU	1.278	1.111	1.01	1

2009 losses: $69845 * 1.111 * 1.022^3 (1.032) = 85483$
 2010 losses: $76094 * 1.278 * 1.022^2 (1.032) = 104824.5$

↓
 Trend from 7/1/2010 to 7/1/2010 or 2 years
 $.739 + .056 / 1 - .24 - .035 = 1.09655 - 1 = 9.66\%$

$$\frac{\text{LR}}{\text{ULAE}} = \frac{.097}{.778} = \boxed{.125}$$
 Weighted $\boxed{.739}$ (ULAE)

c) Given that 25 m is a large proportion of the incurred to date losses of \$69,845,000, I would exclude this loss and include a CAT load based on a cat model or longer term historical average of cat losses instead.

Question 9, Answer B

a)

$$OLF_{09} = 1.0282 / 1000 * (\frac{1}{2} * \frac{1}{2} * \frac{1}{4}) + 0.97 * (1 - 0.0625) = 1.05795$$

$$OLF_{10} = 1.0282 / 0.97 * (\frac{1}{2} * 1 * \frac{1}{2}) + 1.0282 * (1 - .25) = 1.01435$$

	(1)	(2)	(3)	(4)	(5)	(6) = (1)*(2)*(5)
CY	EP	OLF	Trend From	Trend To	Trend Factor	Trended on-level EP
2009	110,865	1.05795	4/1/09	4/1/12	1.015 ³	122,648
2010	128,973	1.01435	4/1/10	4/1/12	1.015 ²	134,778
						257,426

(3) = avg. written date of policies earned in calendar year

(4) = avg. written date of projection period

b)

Weighted avg	12-24	24-36	36-48	48-60
LDF	1.150	1.100	1.010	1.000
To Ultimate	1.27765	1.111	1.010	1.000

	(1)	(2)	(3)	(4)	(5)	(6)	(7) = (1)*(2)*(3)*(6)	
CY	Loss & ALAE	LDF	ULAE Load	Trend From	Trend To	Trend Factor	Trended Ultimate Loss & LAE	LR
2009	69,845	1.111	1.032	7/1/09	7/1/12	1.022 ³	85,483	0.69699
2010	76,094	1.27765	1.032	7/1/10	7/1/12	1.022 ²	104,796	0.7775
							18,279	0.7392

$$\text{Indicated change} = [LR + F / (1 - V - Q)] - 1 = [0.7352 + 0.056 / (1 - 0.24 - 0.035)] - 1 = +9.677\%$$

c) This amount is a catastrophic loss and will distort indications. It should be excluded from the analysis and an appropriate catastrophe load should be incorporated based on separate analysis.

Question 10

- Pure premium because bringing historical prem to CRL with the new variables may be difficult.
- Pure premium because there is no existing rate to which an indicated change can be applied.
- Loss ratio because an accurate & consistent exposure measure will be difficult to calculate.

Question 11

- Class 1: 10% switch from B to A (500 policies)
Class 2: 20% switch from A to B (1000 policies)
A: $5500 * (100-100) + 4000 * (200-200) = 0$
B: $4500 * (150-100) + 6000 * (150-200) = -75,000$
- No. profit will always be zero as long as rates are equal to costs. Market share decreased. They lost more customers than they gained.
- It should increased rates on Class 1, but not to 150 or more. It will attract business AND be profitable!
- Company B will lose its Class1 customers, who are over-priced in that company. Company A will continue to send Class 2 customers to Company B, who ruin B's profit margin. Company A can "skim the cream" while B is adversely selected against.

Question 12, Answer A

- To ensure the insurance system's financial soundness by protecting it against adverse selection, which happens in a competitive environment when others are using risk classification.
- To be fair. Risk classification allows the insurer to better match expected costs and premiums for the policy holders based on how they classify with respect to exposure to risk.

[These purposes come from AAA Risk Classification Principles]

Question 12, Answer B

- 1) Protect financial soundness of the insurance system. If buyers are free to purchase insurance in a competitive market, adverse selection could result if appropriate risk classification is not used. This could put the solvency of insurers at risk.
- 2) Encourage availability of coverage through economic incentives. Equitable pricing ensures that prices reflect expected differences in cost. In the long run, this allows insurers to better serve both low and high cost insureds.

Question 13

This is not a good variable. "None," "Smoke Detector," and "Fire Alarm" all receive the same rate relatively. "Sprinkler system" receives a different relativity than the others, but it is a class with low volume. The error bars are also very wide. Probably reject this rating variable.

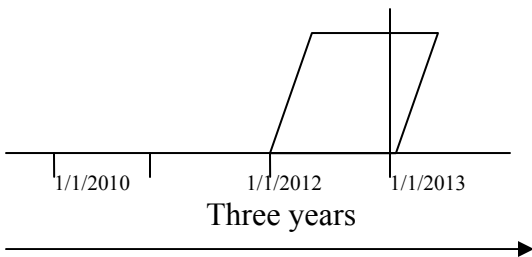
Question 14

- a) $LER = [(772 - 605) + (4024 - 3505) + (8244 - 7345) + (3230 - 2926)] / (772 + 4024 + 8244 + 3230)$
 $= [16270 - 14381] / 16270 = 0.1161$ Credit
- b) Low risk drivers more likely to purchase higher deductibles

Question 15

a)

Terr	Pure Prem	Pure Prem Trend	Trended Pure Prem	Ind Rel
A	25	0.95 ³	21.43	0.9672
B	25	1	25	1.1281
C	16.67	1.1 ³	22.18	1.0010
			22.161	



Terr	Credibility	Curr Rel	Adj. Curr Rel	Cred weight Rel.
A	1.00	1.00	0.9195	0.9672
B	0.673	0.95	0.8739	1.0448
C	1.00	1.25	1.1494	1.001
		1.0875	1.00	

Terr	2 nd Rel (@ Base
A	1.00
B	1.08
C	1.03

b) Territories are generally heavily correlated with other variables. Multivariate techniques take into account the effects of other variables, whereas univariate techniques do not.

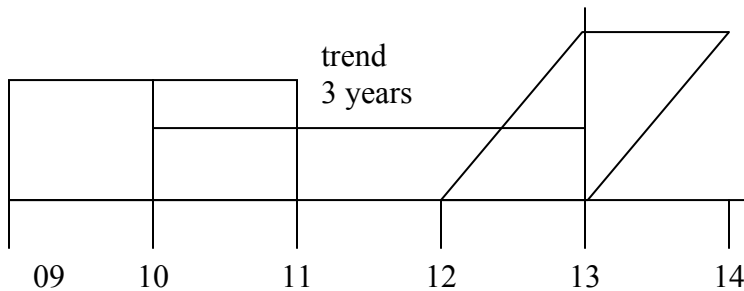
Question 15

a)

	(1)	(2)	(3) = (1) x (3)	(4) = (3)/(3) tot
Terr	PP = L&ALAE/EE	Annual trend	Trended PP	Ind. Chg.
A	25	0.95 ³	21.434375	0.979857
B	25	1 ³	25	1.142857
C	16.667	1.1 ³	22.183	1.014095
	21.875		21.875	

(5)	(6)	(7) = (5) / (5)totl		(8) = (4)xz + (1-z)x(z)	(9)=(8)/(8a)
Curr rel	EE	Curr rebased	Cred(z) = $\sqrt{EE/11050}$	Cred weighted ind. chg	Cred weighted ind Chg to base
1.00	20k	0.919540	1	0.979857	1
0.95	5k	0.873563	0.672671794	1.0547097	1.076391
1.25	15k	1.103448	1	1.014095	1.03494
1.0875					

Exposure weighted



b) Because territorial relativities are generally highly dependent of other variables in the model. Thus, it is better to use a multivariate classification technique because it consider the exposure correlations between variables.

Question 16

	(1)	(2)	(3)	(4) = (3) / (1-.08)	(5) = (4) * (1)
Prem Range	Prem in Range	Prod + Gen	Diff. From 1 st Range	Discount	\$Discount
0-75W	7500	.24	0	0	0
7500-75000	67500	.18	.06	.06522	4402.17
75000-200000	105000	.13	.11	.1196	12554.35
200000+	0	.09	.15	.163	0
					16956.52

Question 17

Claim #	Loss	XS Loss	Trended Loss = loss x (1+10%)	XS Trended Loss
1	10,000	0	11,000	0
2	15,000	0	16,500	0
3	30,000	5,000	33,000	8,000
4	35,000	10,000	38,500	13,500
Total		15,000		21,500

Excess Loss trend = $21,500/15,000 - 1 = 43.33\%$

Question 18, Answer A

a)

		Total Prem w/o minimum
26	35	910
34	80	2720
45	150	6750
150	300	45000
		55380
		Total prem with minimum
26	100	2600
34	100	3400
45	150	6750
150	300	45000
		57750

Effect = $57750/55380 = 1.0428 = 4.28\%$

Base Rate = $1001/1.0428 = \$95.90$

b) The purpose of a minimum premium is to cover expected fixed expenses and some expected losses

Question 18, Answer B

a) total Prem required = $26 * 35 + 34 * 80 + 45 * 150 + 150 * 300 = 55380$

	Avg. w/ min prem
0-50	100
51-100	100
101-200	150x
201-500	300x

Total w/ Min = $26 * 100 + 34 * 100 + x[45 * 150 + 150 * 300] = 6000 + 51750x$

Set = $55380 \rightarrow x = .9542$

New base rate = $100 * .9542 = \boxed{95.42}$

b) Minimum premium ensures that the company collects an amount of premium that is enough to cover fixed expenses and a minimum risk provision for small-premium policies.

Question 19, Answer A

a) $M = [ZpAp + (1 - Zp)Ep + ZeAe + (1 - Ze)Ee] / (Ep + Ee)$
 $[0.5(47000) + 0.5(75000) + 0.1(10000) + 0.9(15000)] / (75000 + 15000)$
 $= 0.8388 \rightarrow$ Mod factor

b) manual premium = $2500000 / 100 * 4.1 + 500000 / 100 * 0.5 + 100000 / 100 * 0.3$
 $= 108000$

Standard prem = $108000 * 0.8388 = 90590$

c) Final prem = $90590 * (1 - 0.15) + 250 = 77252$, where 0.15 = discount and 250 = exp. Const

Question 19, Answer B

a) $M = [Ap + w * Ae + (1 - w)Ee + B] / (E + B) = [47 + .2(10) + .8(15) + 90] / (90 + 90) = \boxed{.8389}$

$Zp = E / (E + B) \rightarrow .5 = 90,000 / (90,000 + B) \rightarrow B = 90,000$

$W = Ze / Zp, E = 90,000$

$W = .1/.5 = .2$

Question 20

a) Profit for class A = $800 - 550 - (800 * .2) - 42 = 48$

Profit loading = .06

Premium for class B =

$.06P_B = P_B - 650 - .24P_B - 50$

$.7P_B = 700$

$P_B = 1,000$

b)

Year	Prem	PV Loss	VarExp	Fixed exp	Persis	Discount Factor	PV Prem	PV Losses
1	800	550	160	42	1.0	1.0	800	48
2	800	550	96	20	.85	1.08	630	105.463
							1,430	153.463

Return on sales = $153.463/1430 = .1073$

c)

Year	Prem	PV Loss	VarExp	Fixed exp	Persis	Discount Factor	PV Prem	PV Losses
1	P	650	.24P	50	1.0	1.0	P	.76P - 700
2	P	650	.20P	30	.60	1.08	.5556P	.444P - 377.78
							1.5556P	1.204P - 1,077.78

$(1.204P - 1,077.78) / 1.5556P = .1073$

$.167P = 1.204P - 1,077.78$

$1.037P = 1,077.78$

$P = 1,039.32$

Question 21

1. Credibility of Data:

Should consider if each line has large enough volume of data to be credible. If not, combining the data may be the alternative.

2. Severity (average claim size)

Average claim size for each line should be considered since this will distorted the results from the various estimation techniques and thus the estimated unpaid claim would be inaccurate. Usually, long-tailed-low-frequency has higher severity (e.g. medmal) than short-tailed high frequency (e.g. AutoPD)

3. Case reserve adequacy

Review the case reserve philosophy on each line of business. Different reserving practice may affect the results of estimated unpaid claims.

4. Claim settling rate

Consider the differences between the claim settlement rate. This is crucial that because the long-tailed low frequency may have longer reporting pattern and thus the resulting development factors may be distorted by this and affecting the unpaid claim estimate.

Question 22, Answer A

a) Reported losses

AY	12	24	36
2008	1065	1305	1330
2009	1100	1120	
2010	1100		

b) When you want to estimate IBNR – this is impossible (or at least very difficult) with report year data, since unpaid claims for a report year are IBNER, not pure IBNR.

c) When you are modeling claims made policies, it makes sense to use report year, since CM policies operate on report years and have no IBNR at year end.

Question 22, Answer B

a) Incremental Paid Loss (as of months)

AY	12	24	36
08	375	355	305
09	520	400	
10	545		

Case reserve (as of mths)

AY	12	24	36
08	690	575	295
09	580	200	
10	555		

Cumulative Rpt Loss (as of mths) = cum. Paid loss + Case reserve

AY	12	24	36
08	1065	1305	1330 = 375+355+305+295
09	1100	1120	
10	1100		

- b) AY data is widely used to estimate unpaid claims so there are many industry benchmarks and data based on AY aggregation. When the actuary wants to use such benchmarks or industry data, then it is preferable to use internal AY data as well.
- c) When there is a severe change in legal or social climate that the average severity tracks more with the report date rather than the occurrence/accident date of the policy.

Question 23

Can look at disposal rate or ratio of paid to reported.

Cum paid/cum rpt

AY	12	24	36	48
07	0.170	0.361	0.853	0.963
08	0.181	0.479	0.922	
09	0.189	0.506		
10	0.2			

Looking down each column indicates that there may be a speed up in claims closure rate, however the increasing ratio may also be due to a decrease in case reserving adequacy.

Question 24, Answer A

Age-age LDFs

	12-24	24-36	36-48	48-60	60-ult
2006	2.524	1.283	1.103	1.013	1.0
2007	2.750	1.309	1.083		
2008	2.457	1.316			
2009	2.541				

All Year Straight Average

12-24	24-36	36-48	48-60	60-ult
-------	-------	-------	-------	--------

2.568	1.303	1.093	1.013	1.0
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Cumulative

3.705 1.443 1.107 1.013 1

(Where 1.107 = 1.013 x 1.093)

a) $\frac{\text{Rpt.} \times \text{LDF} - \text{Paid}}{[310 \times 1.443 - 250]} \times 1000 =$

$$[310 \times 1.443 - 250] \times 1000 = \boxed{197,330}$$

b) $[2010 \text{ pd @ } 12 \text{ mo}] \times [12\text{-}24 \text{ factor} - 1]$

$$\frac{128,000}{x} \times (2.568 - 1) = \boxed{200,704}$$

- c) 1. Future development will be similar to prior dev.
 2. Implied assumption that losses to immature accident year tell you something about losses not reported yet.
 3. Stable claims practices (i.e, no change in case reserve adequacy)
- d) When you don't have enough loss history in the triangles such that development ceases.
- e) 1. Extrapolate based on selected development pattern
 2. Use industry benchmarks that are appropriate for line of business being reviewed.

Question 24, Answer B

a) age-to age factors as of

AY	12-24	24-36	36-48	48-60
2006	2.5238	1.2830	1.1029	1.0133
2007	2.75	1.3091	1.0833	
2008	2.4569	1.3158		
2009	2.5410			

	12-24	24-36	36-48	48-60	60-ult
Selected link ratio	2.5679	1.3026	1.0931	1.0133	1.00
CDF to ultimate	3.7050	1.4428	1.1076	1.0133	1.00

$$\text{AY 2009 unpaid claims} = 310000 \times 1.4428 - 250000 = 197268$$

b) AY 2010 Expected Reported Claims in the next 12 months = $[(128 * 3.7050 - 128)/(1 - (1/3.7050))] \times (1/1.4428 - 1/3.7050) \times 1000 = 200694$

- c) 1. Reported claims will continue to development in a similar manner in the future.
 2. Consistent claims process. no change in case reserve adequacy.
 3. Consistent policy limits, retention limits, mix of claim types.
- d) When the age-to age factor is still greater than 1.00 in the last development period.
- e) 1. Use insurance industry benchmark data.
 2. Fit a curve using average or selected LDF exponential decay model.

Question 25

a)

	On-Level EP	Trend Period	Trended Ult. Loss	Loss Ratio
2007	22953000	3	16108952	.702
2008	23395050	2	16283704	.696
2009	23847075	1	16841261	.706
2010	23525000	0	15069888	.641

Avg. Loss ratio 2007-2009 = 70.13%

AY 2010 expected Ult. Loss = 23,525,000 x 70.13% = $\boxed{\$16,498,082.50}$

b) The expected claims technique is relatively unresponsive to recent changes in claims experience.

Question 26

a) Trend paid to 2010 @ 10%

$$\frac{[(20,000)(1.10)^7 + (28,000)(1.10)^7 + (25,000)(1.10)^7 + (33,000)(1.10)^6 + (36,000)(1.10)^6 + (36,000)(1.10)^5]}{[2,000 + 2,000 + 1,000 + 3,000 + 2,000 + 3,000]} \times 1,000 = \boxed{24,806}$$

- b) 1. Consider the age at which the data becomes erratic.
2. Consider the % of claims expected to closed beyond the selected age.

Question 27

a) $1,000,000 \times 0.6 \times (1 - 1.30^{-1}) = \boxed{138,462}$ IBNR

b) $ELR = (510 + 520 + 450) / (950/1.05 + 915/1.12 + 1000/1.3) = 0.5816$

$$0.5816 \times 1,000,000 \times (1 - 1.30^{-1}) = \boxed{134,215}$$
 IBNR

c) The BF method uses an a priori estimate of the claims ratio. The Cape Cod method uses a claims ratio calculated from the actual experience.

Question 28, Answer A

Closed claim with pmt tri

AY	12	24	36	48
2007	520	620	695	720 = 840-120
2008	645	750	795	
2009	590	740		
2010	675-40 = 635			

Use volume weighted avg for LDF selections

$$12-24 = (620 + 750 + 740) / (520 + 645 + 590) = 1.2023$$

$$24-36 = (695 + 795) / (620 + 750) = 1.08759$$

$$36-48 = 720 / 695 = 1.0359$$

$$LDF \text{ to ULT (12-ULT)} = 1.2023(1.08759)(1.0359) = 1.35465$$

$$\text{Ult claim count w/ payment 2010} = 1.35465(635) = 860.2$$

$$\text{Ult claim amount 2010} = 860.2(3450) = \boxed{2,967,690}$$

Question 28, Answer B

Cum. Claim count closed with payment = total closed-total closed with no payment

AY	12	24	36	48
07	520	620	695	720
08	645	750	795	
09	590	740		
10	635			

LDF

12-24	24-36	36-48
-------	-------	-------

$(620 + 750 + 740) / (520 + 645 + 590) = 1.202$	1.088	1.036
CLDF 1.355	1.127	1.036

AY	Ult Severity	Count	Age-Ult LDF	Ult Count	Ult Claims = Ult Sev x Ult Count
07	3,350	720	1	720	2,412,000
08	3,400	795	1.036	824	2,801,600
09	3,275	740	1.127	834	2,731,350
10	3,450	635	1.355	860	2,967,000

AY10 Ult claim = 2,967,000

Question 29, Answer A

PD at 36m = 1350 x .6 = 810

OUTSTANDING at 36m = 1350 x .4 = 540

PD at 48m = 540 x 1.05 = 567

a) ULT claims = 1700 + 1200 + 810 + 567 = 4277

b) Usually used with claims made analysis since there is no pure IBNR

Question 29, Answer B

b) When all you have available is case o/s data, for example due to the acquisition of another company.

Question 29, Answer C

b) When the IBNR is consistently related to reported claims

Question 29, Answer D

b) Appropriate when most of the claims are reported in the first AY period.

Question 30, Answer A

Avg Case Trend	Avg paid/closed	A2A for Pd	A2A for Pd
12 mon	12mon	12-24	24-26
06 3%	06 3%	1.2	1.25
07 3%	07 3%	1.2	1.25
08 3%	08 3%	1.2	1.25
09 14205 / 10929 = 1.3 30%	09 3%	1.2	
10	10		

- a) Reported claims are not appropriate without a case reserve adjustment. A case trended as it did from 09 to 10 is a clue that case reserves have been strengthened. If not accounted for, this would overstate losses.
- b) Paid claim development is appropriate. The reserve changes will not show up in the paid estimates. Also, the development factors are very stable.
- c) Since there appears to be a good volume of paid data and the develop factors are consistent, I would not use the expected claims technique which is best when actual losses are not reliable.

Question 30, Answer B

a) Check trend in o/s average reserves.

10,000

> +3%

10,300

> +3%

10,609

> +3%
 10,927
 > +30% ← increase in trend, unadjusted development technique is not appropriate.
 14,205

b) Check trend in avg. paid claims

5000 +3% 6000 +3%
 5150 +3% 6180 +3%
 5305 +3% 6365 +3%
 5464 +2.9% 6556 +3%
 5625

Trend is consistent, no change in settlement patterns in evident. It is appropriate to use the paid claim development technique.

c) Expected claims technique is appropriate to use since the technique is not affected by changes in reserve adequacy.

Question 31, Answer A

a) Avg Case o/s (Case o/s / open claim count)

AY	12	24	36
08	12000	16800	18018
09	17100	17905	
10	18700		

Adj. Avg Case o/s (10% Trend)

AY	12	24	36
08	15455	16277	18018
09	17000	17905	
10	18700		

Detrend current diagonal by 10%

Adj Reported [(adj Avg Case) x (open count) + (paid)]

AY	12	24	36
08	32,067,740	40,697,300	45,942,000
09	29,780,000	39,940,000	
10	37,310,000		

Selected ATAF (USING weighted avg) – $\Sigma(x+12) / \Sigma x$

AY	12-24	24-36	36-Ult
Selected	1.304	1.129	1.05 (given)
Cum.	1.5458	1.18545 (1.05 x 1.129)	1.05

AY	Reported @ 12/31/10	LDF	ULT= Loss x LDF
08	845942000	1.05	48239100
09	39940000	1.18545	47346873
10	37310000	1.5458	57673798
			153,259,771

b) If there has been an increase in reserves, the unadjusted LDF's will overestimate development. The B-S technique adjusts the Avg O/S to avoid this.

c) Adj. Avg Case o/s (5% trend)

AY	12	24	36
08	16961	17052	18018
09	17800	17905	
10	18700		

Adj RPTD (000)

AY	12	24	36
08	34821	42170	45942
09	31027	39940	
10	37310		

Selected ATAF Cum. Using 10% trend

12-24	24-36	36-48
1.247	1.089	1.05
1.4256	1.144	1.05
1.5458	1.18545	1.05

For ages 12 & 24, the ultimates would be lower using a 5% trend opposed to a 10% trend.

Question 31, Answer B

a) Avg case o/s

	12	24	36
2008	12000	16800	18018.40
2009	17100	17905	
2010	18700		

Trend back 10%

2008	15454.54	16277.27	18018.40
2009	17000	17905	
2010	18700		

Adjusted reported claims = adjusted case o/s x open claim + paid

	12	24	36
2008	32066909.10	20697818.18	45942000
2009	29780000	39940000	
2010	37310000		

CDF 12-24 = 1.30383 24-36 = 45942000 / 40697818.18 = 1.12886 36 – ult = 1.05

2008	45942000	1.05	48239100
2009	39940000	1.1853	47340858.55
2010	37310000	1.545428	57659928.84

Ultimate Claim

- b) 1. Trend back from the latest diagonal so like that our case adequacy will all be at the same level.
 2. Using the new adjusted avg case o/s calculate the adj reported claims
 → avg case o/s x open claim counts + unadj. Paid claims

c) If we trend at a lower rate, then the avg case o/s will be higher and thus our adjusted rptd claims will be higher for the years we bring to the same adequacy level. Thus our CDF ult will be lower and our ultimate claims will be lower.

Question 32

Salv/Subro Paid Claims

						ATU – Ratio	Ult Ratio
07	.252	.352	.355	.357		1.0	.357
08	.254	.343	.345			1.006	.347
09	.247	.337				1.014	.342
10	.239					1.389	.332

	12-24	24-36	36-48
	1.397	1.009	1.006
	1.35	1.006	
	1.364		
Sel	1.37	1.008	1.006
ATU	1.389	1.014	

Paid LDF

	12-24	24-36	36-48
	1.087	1.002	1.0
	1.092	1.002	
	1.09		
Sel	1.09	1.002	1.0
ATU	1.092	1.002	1.0

Ult Loss

	CDF	ULF
07	1.0	13280
08	1.0	13320
09	1.002	14068
10	1.092	13082

Salv Subro Ult = (Ult Ratio)(ult loss)

07	.357	13280	4741
08	.347	13320	4622
09	.342	14008	4811
10	.332	13082	4343
			18517

Ult salv-subro all yrs

Question 33

a) Ratio of net-to-gross

	12	24	36	48
2006	0.9	0.81	0.77	0.77
2007	0.65	0.65	0.65	0.65

For AY 2006, it's a excess of loss reinsurance since the ratio from one maturity to another are not consistent. The ratio depends of the amount of excess loss that have been ceded.

For AY 2007, it's a quota share. They cede 35% of their business to reinsurance. It's a quota share since the ratios are consistent.

b) The tail factor for the gross reported claims would be chosen as normal. However, for the net reported claims, it would vary from years to years. The net tail factor is less than the gross tail factor.

Question 34, Answer A

a) Pd ALAE to Paid claims

AY	12	24	36	48
07	.0536	.0626	.0682	.0722
08	.0573	.0658	.0719	
09	.0570	.0657		
10	.0574			

Age – to- Age (additive)

AY	12-24	24-36	36-ult
07	.0090	.0056	.004
08	.0085	.0061	
09	.0087		

Avg	.00873	.00585	.004
	↓ = +	↓ = +	+
CDF	.01858	.00985	.004

$$2010 \text{ Ult ALAE} = 101,535 \times [.0574 + .01858] = 7,714.63$$

b) Using a ratio instead of a straight dollar development method reduces the chance of highly leverages CDFs at early maturities.

Question 34, Answer B

b) Less leveraged LDFs

Question 34, Answer C

b) An advantage is that the development factors are more stable when compared to the factors that result from the ALAE only data.

Question 34, Answer D

b) Advantage : recognizes the inherent relationship between claims only and ALAE.

Question 34, Answer E

b) Allows actuary to interject opinion & selections directly into the reserving process

Question 35, Answer A

ULAE – unpaid

CY	B	M	W
07	13440	2000	0.1488
08	17960	2750	0.1531
09	30060	4500	0.1497
10	36040	5500	0.1526

	97500	14750	0.1513
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Selected $W^* = 0.15$

$$\text{ULAE Ratio} = W = M / B = M / [(u_1 \times r) + (u_2 \times p)]$$

$$u_1 = 0.60$$

$$u_2 = 0.40$$

$$\text{Ult ULAE} = 0.15(117,500) = 17625$$

$$\text{Unpaid ULAE} = 17625 - 14750 = \boxed{2875}$$

Question 35, Answer B

$$B = 117.5 \times 60\% + 67.5 \times 40\% = 97500$$

$$M = 14750$$

$$W = M / B = 15.13\%$$

$$\begin{aligned} \text{Unpaid ULAE} &= W \times L - M \\ &= 15.13\% \times 117500 - 14750 \\ &= \boxed{3025.64} \end{aligned}$$

Question 36, Answer A

- a) Will cause speed-up in claim settlement
Paid method – will overstate ult. Because dev. Factors are selected based on old pattern.
Reported method- accurate assuming reserves were set correctly and unaffected by this change
- b) Will cause lower severity
Both methods will produce inaccurate estimates (overstated) if unadjusted for tort reform impact.
- c) Increase in losses due to writing higher limits
Both methods will produce inaccurate estimates (Understated) – old data will have smaller dev factors because pol. limits were reached quicker.
- d) a) look @ ratios of paid-to-reported claims. They will show increase if there is speedup.
b) Look at avg. paid and avg reported – they will show decrease
c) Look at avg. paid, avg. reported, ult loss ratios – they all should show increase.

Question 36, Answer B

- a) There will be a speed up of claims being settled so if the two developments are not adjusted for this change, they will overstate the unpaid claim liabilities.
- b) The average losses should decrease with this tort reform, so the unadjusted methods (both paid and reported) will overstate the unpaid claim liabilities.
- c) The losses should increase as the policy limits increase, so both methods will understate the unpaid claims if they are not adjusted.
- d) a) Look at paid claims to reported and see if there is an increasing ratio or look at closed counts to reported counts ratios and see if it is increasing.
b) Analyze the average reported and average paid values and look for downward trend between accident years.
c) Analyze average reported and average paid amount and look for a positive trend between subsequent accident years.

Question 37, Answer A

- a) A deteriorating LR will cause the Rpt Dev, Paid Dev, methods to estimate correct IBNR and Exp claims, BF methods to understate b/c ECR will be too low for most recent years.
- b) Case Reserve Strengthening. Paid methods are not affected by changing case reserve adequacy and Exp. Claims does not depend on experience. Reported methods will overstate IBNR.

- c) Change in Claim Closure Rate. If rate is increasing, paid methods will overstate IBNR.
- d) Meet with Claims Dept, UW, and management to discuss any internal changes that may be causing the difference b/w methods.

Question 37, Answer B

- a) A change in claim ratio ie. Increased claim ratios will cause expected claims method to underestimate IBNR. Development (reported and paid) are accurate. The Bornhuetter-Ferguson methods underestimate but not as much as the expected claims technique as it weights expected claims method with development technique.
- b) A change in case reserving methods ie. Case strengthening. The reported Development and B-F Methods over-state as the CDFs calculated are too high and these high CDFs are applied to high reported claims. So only the paid development, BF paid and expected claims are accurate. BF reported is less over-stated than Rpt Development as it weighs in the expected claims method which is accurate.
- c) A change in claim settlement rates, ie. Increased claim closure rates. The paid development and B-F paid techniques over-state as the CDFs selected are high and these CDFs are applied to high paid claims. BF-paid is less over-stated because it weighs in the expected claims technique.
- d) Should calculate loss ratios, pure premiums, average paid and average case outstanding, etc. bearing in mind the year-to-year changes and pick the most appropriate reserve, knowledge from the management and knowledge of the industry.