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Exam 6

Reserving, Insurance Accounting
Principles, and Reinsurance

October 29, 2008

4 HOURS

INSTRUCTIONS TO CANDIDATES

1. This 80 point examination consists of 42 problem and essay questions.
2. The number of points for each full question or part of a question is indicated at the beginning of the question or part. Answer the 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, 6, 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 specific number of items is requested, do not offer more items than the number requested. For example, if three items are requested, 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.
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.

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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. 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 November 17, 2008.

END OF INSTRUCTIONS

EXAM 6 - FALL 2008

1. (1 point)

A company's reserving actuary observes that one segment for a particular line of business has much higher severity and a longer-tailed settlement pattern than the remaining segments. Exposures in the high-severity, longer-tailed segment are growing faster than in the other segments.

a. (0.5 point)

Explain how the guidance provided by the *Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves* applies to this situation.

b. (0.5 point)

Describe a potential bias that could result if the actuary analyzes these segments on a combined basis.

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EXAM 6 - FALL 2008

2. (1.5 points)

Given the following for policy year 2006 for a line of business:

Premium	\$1,600,000
Expected loss emerged at 24 months	68%
Expected loss emerged at 36 months	82%
Reported loss as of December 31, 2007	\$800,000
Bornhuetter-Ferguson estimate of ultimate loss	\$1,133,000

a. (0.5 point)

Calculate the expected loss ratio that was used in the Bornhuetter-Ferguson estimate of ultimate loss for policy year 2006.

b. (0.5 point)

Calculate the ultimate loss estimate for policy year 2006 using the chain-ladder method.

c. (0.5 point)

Calculate the expected calendar year 2008 development for policy year 2006 based on the Bornhuetter-Ferguson method.

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EXAM 6 - FALL 2008

3. (3 points)

Given the following:

Incremental Loss and ALAE Payments on Closed Claims (\$000)

Accident Year	Age of Development in Months			
	12	24	36	48
2004	400.0	300.0	180.0	75.0
2005	504.0	378.0	226.8	
2006	662.0	496.0		
2007	833.0			

Incremental Number of Claims Closed

Accident Year	Age of Development in Months				Ultimate Counts
	12	24	36	48	
2004	500	300	150	50	1,000
2005	600	360	180		1,200
2006	750	450			1,500
2007	900				1,800

- The annual severity trend is 5.0%.

a. (2.5 points)

Use Adler and Kline's claim closure projection method to calculate the projected reserve as of December 31, 2007.

b. (0.5 point)

Briefly describe two strengths of the Adler and Kline method.

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EXAM 6 - FALL 2008

4. (2.5 points)

Given the following as of December 31, 2007:

Cumulative Reported Loss (\$000)

Accident Year	Age of Development in Months			
	<u>12</u>	<u>24</u>	<u>36</u>	<u>48</u>
2004	82,132	149,968	164,530	177,132
2005	67,906	129,852	140,221	
2006	65,829	127,487		
2007	78,294			

Cumulative Paid Loss (\$000)

Accident Year	Age of Development in Months			
	<u>12</u>	<u>24</u>	<u>36</u>	<u>48</u>
2004	30,729	103,361	125,237	138,547
2005	24,573	85,337	105,979	
2006	22,567	88,009		
2007	27,761			

Average Case Reserve per Open Claim (\$000)

Accident Year	Age of Development in Months			
	<u>12</u>	<u>24</u>	<u>36</u>	<u>48</u>
2004	63.5	97.1	342.4	888.7
2005	62.1	115.0	394.2	
2006	66.2	109.2		
2007	79.8			

Number of Open Claims

Accident Year	Age of Development in Months			
	<u>12</u>	<u>24</u>	<u>36</u>	<u>48</u>
2004	810	480	115	43
2005	698	387	87	
2006	654	361		
2007	633			

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EXAM 6 - FALL 2008

4. (Continued)

a. (2 points)

Using the method described by Berquist and Sherman to adjust for changes in case reserve adequacy, calculate the adjusted cumulative reported loss triangle. Assume a severity trend of 5%.

b. (0.5 point)

Using all-year weighted average loss development factors, calculate the accident year 2007 ultimate loss based on the adjusted cumulative reported loss triangle. Assume a 48-to-ultimate loss development factor of 1.020.

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EXAM 6 - FALL 2008

5. (2 points)

When compiling data in preparation for a reserve analysis, the actuary must consider changes in the external environment as well as changes internal to the insurance company. For each of a., b., c. and d. below, give an example of a situation in which it would be preferable to use the suggested datasets and provide the rationale for each example.

a. (0.5 point)

Policy year data instead of accident year data.

b. (0.5 point)

Accident quarter data instead of accident year data.

c. (0.5 point)

Report year data instead of accident year data.

d. (0.5 point)

Earned exposures instead of claim counts.

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EXAM 6 - FALL 2008

6. (1.5 points)

While conducting the year-end 2007 reserving analysis, the actuary observes higher-than-expected reported and paid losses in accident year 2007.

All high-severity claims reported on or after January 1, 2007 have been handled by a newly established office that specializes in such claims. Compared to the prior claim office, this new office establishes higher initial case reserves and settles claims more promptly.

a. (0.5 point)

Explain the effect that the new claims-handling procedure will have on the liability estimate produced by the unadjusted reported loss development method.

b. (0.5 point)

Explain the effect that the new claims-handling procedure will have on the liability estimate produced by the unadjusted paid loss development method.

c. (0.5 point)

Suppose, instead, that there had been no changes in the claims handling, but the actuary still observes higher-than-expected reported and paid losses in accident year 2007.

Provide two questions that the actuary might ask the underwriting manager to help identify the source of the change in the loss data.

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EXAM 6 - FALL 2008

7. (3 points)

Given the following:

Accident Year	<u>Cumulative Paid Loss</u>		
	<u>Development Year</u>		
	<u>0</u>	<u>1</u>	<u>2</u>
2003	802,498	911,104	913,093
2004	1,111,320	1,261,721	1,264,476
2005	785,787	892,132	894,080
2006	1,576,432	1,789,779	
2007	1,096,211		

The following accident year development model is to be fit to the data in the triangle:

$$y(j) = \begin{cases} \alpha + \varepsilon_0, & j = 0 \\ \alpha + \sum_{k=1}^j \gamma_k + \varepsilon_j, & j = 1, 2 \end{cases}$$

where:

y = natural log of incremental paid loss

j = development year 0, 1, or 2

α, γ_j ($j = 1, 2$) are constants

ε_j ($j = 0, 1$ or 2) is an error term with a mean of zero.

a. (2.5 points)

Determine the values for α , γ_1 and γ_2 .

b. (0.5 point)

Use this model to estimate the median value of the incremental paid loss for accident year 2007 during development year two.

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EXAM 6 - FALL 2008

8. (2.5 points)

Given the following for a three-year extended warranty coverage policy:

- Premium (paid in full up front) \$1,200
- Expected loss ratio 60%
- Expected reporting pattern for incurred losses:
 - Year 1 10%
 - Year 2 25%
 - Year 3 65%

a. (1 point)

Assuming premium is earned based on expected losses, calculate the unearned premium reserve at the end of each of years 1, 2, and 3.

b. (0.5 point)

Identify one distortion that would be caused by earning premium using the *pro rata* method on this policy. Explain how this could cause management to make a misguided business decision.

c. (1 point)

Identify two types of policies other than warranty for which the *pro rata* method of earning premium is generally not appropriate, and briefly explain the reason for each.

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EXAM 6 - FALL 2008

9. (2 points)

Given the following:

Accident Year	<u>Cumulative Reported Losses (\$000)</u>			
	<u>Age of Development in Months</u>			
	<u>12</u>	<u>24</u>	<u>36</u>	<u>48</u>
2004	8,847	12,204	14,332	17,021
2005	10,280	14,650	16,807	
2006	11,747	14,826		
2007	12,077			

a. (0.5 point)

Estimate the cumulative reported loss as of 24 months for accident year 2007 using the link ratio method.

b. (0.5 point)

Estimate the cumulative reported loss as of 24 months for accident year 2007 using the budgeted loss method.

c. (1 point)

Estimate the cumulative reported loss as of 24 months for accident year 2007 using the least squares method.

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EXAM 6 - FALL 2008

10. (3.25 points)

Given the following for an accident year:

- Earned premium \$20,000,000
- Reported losses as of 12 months \$10,000,000
- Expected loss ratio 70%
- Coefficient of variation of the loss ratio .70
- Coefficient of variation of percent of loss reported .45
- The mean and coefficient of variation of the reporting pattern are independent of the ultimate losses.
- Expected reporting pattern:

<u>Age</u> <u>(in months)</u>	<u>Percent</u> <u>Reported</u>
12	40%
24	60%
36	80%
48	90%
60	100%

a. (1.5 points)

Calculate the linear approximation to the Bayesian credibility estimate as of 12 months of ultimate loss for this accident year.

b. (1 point)

At age 12 months, determine which of the following methods produces the estimate of ultimate loss closest to the Bayesian credibility estimate determined in part a. above.

- i. Chain ladder
- ii. Bornhuetter-Ferguson
- iii. Benktander

c. (0.75 points)

Explain how the Benktander formula can be described as a credibility weighted average.

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EXAM 6 - FALL 2008

11. (1.5 points)

The loss ratio for a book of business is improving. There have been no changes in either loss emergence patterns or the company's claim reserving practices. IBNR has been estimated based on three different methods:

a. (0.75 point)

Discuss the accuracy of each of the three methods in the situation described above.

b. (0.75 point)

After the period of improvement, the loss ratio stabilizes. Briefly describe the adjustments, if any, that should be made to each of the three reserving methods cited above to arrive at an accurate IBNR estimate.

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EXAM 6 - FALL 2008

12. (2 points)

Given the following for a workers compensation high deductible policy:

• Full coverage premium	\$2,100,000
• Full coverage expected loss ratio	0.455
• Excess ratio (per-occurrence charge)	0.140
• Aggregate ratio (per-aggregate charge)	0.020
• Reported excess losses	\$61,000
• Excess loss development factor	2.410

a. (1 point)

Estimate the ultimate loss for this policy using the loss ratio method.

b. (1 point)

Briefly describe two advantages and two disadvantages of using the loss ratio method to set reserves for workers compensation high deductible business.

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EXAM 6 - FALL 2008

13. (1.5 points)

Given the following:

Ratio of ultimate excess loss to ultimate ground-up loss

<u>Retention</u>	<u>Excess Ratio</u>
\$50,000	0.480
100,000	0.370
250,000	0.240
500,000	0.140

Excess loss development factor, 27 months to ultimate

<u>Retention</u>	<u>Factor</u>
\$50,000	3.150
100,000	3.670
250,000	4.490
500,000	5.220

a. (1 point)

Calculate the 27 months to ultimate loss development factor for the layer \$200,000 excess of \$50,000.

b. (0.5 point)

Explain why excess loss development generally lengthens as the retention increases.

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EXAM 6 - FALL 2008

14. (1.5 points)

Given the following as of December 31, 2007 for a book of retrospectively rated policies:

<u>Policy Year</u>	<u>Expected Future Loss Emergence</u>	<u>CPDLL Ratio</u>	<u>Premium Booked from Prior Adjustments</u>	<u>Premium Booked</u>
2004	\$9,000	0.410	\$200,000	\$202,000
2005	25,000	0.750	175,000	190,000
2006	101,000	1.120	95,000	175,000
2007	150,000	1.345	0	175,000

- No policies were written prior to January 1, 2004.

Calculate the premium asset as of December 31, 2007.

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EXAM 6 - FALL 2008

15. (3 points)

While performing a retrospective test for reserve accuracy, an actuary has computed the deviations between actual paid losses and estimates based on prior year data.

Accident Year	<u>Percentage Deviations</u>			
	<u>AY+1</u>	<u>AY+2</u>	<u>AY+3</u>	<u>AY+4</u>
2003	10%	14%	2%	-6%
2004	10%	-3%	4%	
2005	15%	-8%		
2006	5%			

Distribution of December 31, 2007 Loss Reserve to Year of Payment

Accident Year	<u>Year of Payment</u>			
	<u>AY+1</u>	<u>AY+2</u>	<u>AY+3</u>	<u>AY+4</u>
2004				540
2005			1,160	580
2006		3,125	1,250	625
2007	5,360	3,350	1,340	670

a. (2.5 points)

Calculate the weighted average bias in the December 31, 2007 reserve estimate, with the weights being the percent of the reserve as of December 31, 2007 contributed by each payment year.

b. (0.5 point)

State two advantages of using a weighted average instead of a straight arithmetic average when measuring bias.

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EXAM 6 - FALL 2008

16. (1 point)

a. (0.25 point)

Identify the fundamental assumption underlying a dollar-based approach to estimating ULAE liabilities.

b. (0.25 point)

Identify the fundamental assumption underlying a count-based approach to estimating ULAE liabilities.

c. (0.5 point)

Identify two considerations that could influence an actuary's decision to choose a dollar-based versus a count-based approach when estimating ULAE liabilities.

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EXAM 6 - FALL 2008

17. (1.5 points)

Identify and briefly describe the purpose of the three principal statements in GAAP or statutory financial reports.

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EXAM 6 - FALL 2008

18. (1.5 points)

a. (0.5 point)

Define the term *contingency* in the context of Financial Accounting Standards.

b. (0.5 point)

State the two conditions required to establish a loss contingency as a charge to income.

c. (0.5 point)

Give an example of a contingent event in the context of Financial Accounting Standards. Briefly describe the circumstances around the event.

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EXAM 6 - FALL 2008

19. (2 points)

a. (1 point)

Describe how each of the following two major accounting paradigms is used:

- i. Deferral/matching
- ii. Asset/liability

b. (0.5 point)

Contrast these two major accounting paradigms.

c. (0.5 point)

Explain which of these two paradigms would be appropriate for auto warranty insurance.

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EXAM 6 - FALL 2008

20. (1 point)

a. (0.5 point)

Briefly describe the difference between the purposes of GAAP and statutory accounting principles.

b. (0.5 point)

Briefly describe the difference between GAAP and statutory accounting principles with respect to the treatment of policy acquisition costs.

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EXAM 6 - FALL 2008

21. (2 points)

Given the following for an insurance company as of December 31, 2007:

	<u>(\$000)</u>
Bonds – market value	3,500
Bonds – amortized value	3,200
Agents’ balances – under 60 days	300
Agents’ balances – 60-90 days	100
Agents’ balances – over 90 days	200
Deferred acquisition costs	500
Bills receivable past due	50
Furniture	500
Loss and LAE reserve	1,000
Unearned premium reserve	400

- The company does not intend to hold the bonds to maturity.

Calculate each of the following quantities:

a. (0.5 point)

Total assets, according to GAAP.

b. (0.5 point)

Total liabilities, according to GAAP.

c. (0.5 point)

Total assets, according to statutory accounting principles.

d. (0.5 point)

Total liabilities, according to statutory accounting principles.

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EXAM 6 - FALL 2008

22. (1.5 points)

a. (0.5 point)

Describe the purpose of a premium deficiency reserve.

b. (1 point)

Given the following information for an insurance company:

- | | |
|---|-------------|
| • Unearned premium reserve as of December 31, 2007 | \$2,000,000 |
| • Expected loss ratio on the unearned premium reserve as of December 31, 2007 | 83.5% |
| • Loss from occurrence on December 26, 2007, reported on January 2, 2008 | \$250,000 |
| • Estimated marginal expenses related to the runoff of the unearned premium reserve | \$200,000 |
| • Fixed and general overhead expense ratio | 27.5% |

Calculate the premium deficiency reserve as of December 31, 2007.

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EXAM 6 - FALL 2008

23. (1.5 points)

a. (0.5 point)

State the “10-10” rule for testing risk transfer for reinsurance contracts.

b. (1 point)

Provide two examples of reinsurance contracts that may pose significant risk of loss to a reinsurer but fail the “10-10” rule. Briefly explain why this can happen for each of your examples.

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EXAM 6 - FALL 2008

24. (1 point)

a. (0.5 point)

Describe the purpose of the notes and disclosures sections of a financial report.

b. (0.5 point)

Provide two specific examples of items that may be included in the notes and disclosures sections.

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EXAM 6 - FALL 2008

25. (1.75 points)

a. (0.5 point)

Explain what the Expected Reinsurer's Deficit is intended to measure in risk transfer testing.

b. (0.5 point)

Provide the formula for the continuous case of Expected Reinsurer's Deficit.

c. (0.5 point)

Provide two advantages of using this metric to determine whether a reinsurance contract transfers risk.

d. (0.25 point)

Provide one disadvantage of using this metric to determine whether a reinsurance contract transfers risk.

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EXAM 6 - FALL 2008

26. (1.5 points)

Given the following regarding a quota share reinsurance treaty:

Ceded share	20%
Ceding commission	15%
Subject earned premium	\$1,000,000
Ultimate loss and ALAE on subject business	\$700,000

Assume no other sources of income or expense.

a. (0.25 point)

Calculate net earned premium for the ceding company.

b. (0.25 point)

Calculate the ultimate loss retained by the ceding company.

c. (0.5 point)

Calculate the gain or loss to the reinsurer from this treaty.

d. (0.5 point)

Provide two reasons for an insurance company to purchase a quota share treaty.

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EXAM 6 - FALL 2008

27. (2 points)

Given the following to be used in a reserve review:

<u>Accident Year</u>	<u>Reported loss as of December 31, 2006</u>	<u>Selected IBNR as of December 31, 2006</u>	<u>Reported loss as of December 31, 2007</u>
2004	\$4,500,000	\$1,100,000	\$4,750,000
2005	4,300,000	2,300,000	5,200,000
2006	3,700,000	4,800,000	5,000,000

<u>Age in months</u>	<u>Selected Reported Loss Development Factor to Ultimate</u>
12	2.222
24	1.538
36	1.250
48	1.176

a. (1.5 points)

Calculate the expected loss emergence during calendar year 2007 for accident years 2004 through 2006, based on the selected IBNR as of December 31, 2006.

b. (0.5 point)

Using numerical support, describe the conclusion that should be drawn regarding the accuracy of the IBNR reserving process at December 31, 2006, based on a comparison of actual versus expected loss emergence during calendar year 2007.

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EXAM 6 - FALL 2008

28. (1.5 points)

A primary insurance company has purchased an \$800,000 excess of \$200,000 per-occurrence excess-of-loss treaty with an annual aggregate deductible of \$1,000,000. The occurrences subject to the treaty are as follows:

<u>Occurrence</u>	<u>Loss Amount</u>
1	\$150,000
2	250,000
3	700,000
4	500,000
5	1,250,000
6	250,000

Calculate the primary company's net loss.

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EXAM 6 - FALL 2008

29. (2 points)

Given the following occurrences subject to a \$900,000 excess of \$100,000 per-occurrence excess-of-loss treaty:

<u>Occurrence</u>	<u>Incurred Loss</u>	<u>Incurred ALAE</u>
1	\$200,000	\$100,000
2	50,000	150,000
3	1,000,000	200,000
4	500,000	200,000
5	1,500,000	300,000

a. (1 point)

Calculate the total amount ceded to the treaty if allocated loss adjustment expense is to be included with loss.

b. (1 point)

Calculate the total amount ceded to the treaty if allocated loss adjustment expense is to be shared *pro rata* with loss.

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EXAM 6 - FALL 2008

30. (2 points)

Given the following for a primary insurer that is considering commuting a book of liabilities ceded to a reinsurer.

• Nominal Value of Liabilities	\$1,500,000
• Present Value of Liabilities	\$1,407,737
• Current Average IRS Discount Factor	0.850
• Present Value of the IRS Remainder Unwind	\$210,804
• Marginal Tax Rate	35%

a. (1.5 points)

Calculate the reinsurer's ambivalence point.

b. (0.5 point)

Determine whether the reinsurer would regard a \$1.35 million consideration offer from the primary insurer to be better or worse than break-even.

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EXAM 6 - FALL 2008

31. (3.25 points)

Given the following as of December 31, 2007 for pricing a proposed quota share agreement on a book of property business:

Accident Year	Historical Earned Premium (\$000,000)	Reported Losses (\$000,000)	On-Level Factor	Loss Development Factor	Loss Trend Factor	Property Value Inflation Factor
2003	1,000	555	1.250	1.010	1.338	1.159
2004	1,100	1,638	1.200	1.025	1.262	1.126
2005	1,210	614	1.120	1.065	1.191	1.093
2006	1,331	552	1.075	1.250	1.124	1.061
2007	1,464	481	1.015	1.750	1.060	1.030
Total	6,105	3,840				

- Accident year 2004 has a \$1,000,000,000 reported catastrophe loss included in the above data; no other years have experienced catastrophe losses.

<u>Reinsurer Expense Item</u>	<u>Loading as a Percentage of Reinsurance Premium</u>
Administrative Expenses	1.5%
Brokerage Fees	6.0%
Unallocated Expenses	1.5%

a. (2 points)

Calculate the five-year total ultimate non-catastrophe loss ratio projected to the treaty period.

b. (0.25 point)

Based on the output of a catastrophe model, the indicated catastrophe load is 15% as a percentage of non-catastrophe losses. Calculate the expected ultimate loss ratio for the treaty period.

c. (1 point)

The ceding company is requesting a 27.5% ceding commission for this treaty. The reinsurer's target combined ratio is 95%. Explain whether the reinsurer should accept or reject the 27.5% ceding commission.

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EXAM 6 - FALL 2008

32. (2.25 points)

A primary insurance company has two treaties with a single reinsurance company. The first is a 10% quota share subject to a \$100,000 maximum coverage amount for each policy. The second is a \$900,000 excess of \$100,000 per-occurrence excess-of-loss treaty where the primary company has a 5% co-participation. There have been four occurrences, each on a separate underlying policy, subject to the treaty:

<u>Occurrence</u>	<u>Ground-up loss</u>
1	\$500,000
2	50,000
3	850,000
4	1,150,000

a. (1 point)

Assuming that neither treaty inures to the benefit of the other, calculate the primary insurance company's total retained loss.

b. (1 point)

Assuming that the quota share treaty inures to the benefit of the excess-of-loss treaty, calculate the primary insurance company's total retained loss.

c. (0.25 point)

Briefly describe the purpose of a co-participation provision in a reinsurance treaty.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

33. (1.5 points)

Given the following primary company loss data for policies subject to a four-line surplus share reinsurance treaty with a net line of \$200,000:

<u>Policy Number</u>	<u>Policy Limit</u>	<u>Incurred Loss</u>
1	\$200,000	\$150,000
2	\$1,000,000	\$500,000
3	\$500,000	\$50,000
4	\$450,000	\$225,000

Calculate the primary company's net loss.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

34. (1 point)

According to Feldblum's discussion of curve-fitting methods in his review of Ludwig's "An Exposure Rating Approach to Pricing Property Excess-of-Loss Reinsurance," there are two problems with using curve-fitting methods to model the loss process. Describe these problems.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

35. (2.5 points)

Patrik states that a tendency of a primary insurance company's claims department to reserve claims initially to the mode of a probability distribution of claim outcomes is a contributing factor in longer claim report lags for excess contract reinsurers.

a. (0.5 point)

Explain why a claim department might reserve claims at modal values.

b. (0.5 point)

Explain why reserving at modal values could result in longer claim report lags for excess contract reinsurers.

c. (1.5 points)

Construct a specific, simple numerical example to illustrate how modal reserving by the primary insurer can cause a greater IBNR need for the reinsurer than for the primary insurer.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

36. (1.5 points)

Given the following as of December 31, 2007:

Calendar Accident <u>Year</u>	<u>Earned Premium</u>	<u>Adjusted Premium</u>	Aggregate Reported <u>Loss</u>	Aggregate Loss <u>Report Lag</u>
2003	\$10,000	\$9,000	\$8,000	0.95
2004	11,000	9,000	8,000	0.88
2005	13,000	11,000	7,000	0.75
2006	15,000	13,000	6,000	0.55
2007	17,000	15,000	4,000	0.30

Calculate the IBNR as of December 31, 2007 using the Stanard-Bühlmann method.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

37. (2 points)

A reinsurance company actuary is applying the Stanard-Bühlmann method to a set of premium and loss data for the most recent four accident years. The actuary has the reinsurer's estimated renewal rate level changes over time, as shown below.

The actuary also has available some industry loss ratios from the Schedule P line applicable to these exposures, also shown below.

<u>Accident Year</u>	<u>Reinsurer's Renewal Rate Change</u>	<u>Industry Booked Ultimate Loss & LAE Ratio</u>
2004	+5%	60.0%
2005	-26%	66.7%
2006	+10%	74.1%
2007	-12%	82.3%

a. (1 point)

Explain two reasons why, in this instance, the reinsurance company actuary might consider relying upon information derived from the industry data rather than using the reinsurer's own data when applying the Stanard-Bühlmann reserving procedure.

b. (1 point)

Explain two reasons why, in this instance, the reinsurance company actuary might disregard these industry loss ratios and instead use the reinsurer's own information when applying the Stanard-Bühlmann reserving procedure.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

38. (2 points)

Given the following for a reinsurance treaty:

- Provisional commission of 32.5%
- Minimum commission of 27.5% at a 62.5% loss ratio
- Sliding 1:1 to 40% at a 50% loss ratio
- Sliding 1:3 to a maximum of 50% at a 20% loss ratio

<u>Loss Ratio Range</u>	<u>Average in Range</u>	<u>Probability in Range</u>
$x \leq 20\%$	18.0%	0.15
$20\% < x \leq 50\%$	44.0%	0.20
$50\% < x \leq 62.5\%$	57.5%	0.25
$x > 62.5\%$	80.0%	0.40

Calculate the expected ceding commission for this book of business.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

39. (2.5 points)

Given the following to be used in pricing a property excess-of-loss treaty effective January 1, 2008 and expiring December 31, 2008:

- Treaty limit \$500,000
- Attachment point \$100,000
- Annual ground up loss trend 4%

Historical Losses

<u>Date of Loss</u>	<u>Ground-up Loss</u>
January 1, 2000	\$200,000
January 1, 2001	200,000
July 1, 2001	225,000
July 1, 2002	600,000
January 1, 2004	475,000
July 1, 2005	90,000

Loss Development Factors Applicable to Treaty Layer

<u>Accident Year</u>	<u>Factor to Ultimate</u>
2000	1.00
2001	1.00
2002	1.05
2003	1.10
2004	1.30
2005	1.50
2006	2.00

Calculate the trended ultimate losses in the treaty layer that would be used to experience rate this treaty.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

40. (2 points)

An Enterprise Risk Management team has identified the following risks facing a manufacturing company whose primary key business indicator is annual revenue:

<u>Risk</u>	<u>Probability</u>	<u>Income impact</u>
A new competitor enters the market.	30%	10%
Profit margins fall in industry.	30%	20%
Industry-wide demand decreases.	10%	25%
A recall tarnishes brand image.	5%	40%

a. (0.5 point)

Identify the greatest risk to this company from among those listed above. Justify your answer.

b. (1 point)

Identify two pairs of risks from the above list that seem likely to be correlated (either positively or negatively). For each pair, explain a possible cause for this correlation.

c. (0.5 point)

Explain how the correlation of risks might affect the selection of the second-greatest risk to this company.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

41. (2 points)

An investment bank has recently created a risk management team that meets monthly to discuss the risks to the company due to events such as interest rate movements, liquidity shortfalls, and credit downgrades. After each monthly meeting, the team reports to senior management on ways to treat or exploit these risks in order to improve the firm's quarterly results, with a focus on increasing the company's share price.

The CAS Committee on Enterprise Risk Management provides a definition of Enterprise Risk Management in an *Overview of ERM*.

a. (1 point)

Identify two ways in which the investment bank's approach is consistent with this definition.

b. (1 point)

Identify two ways in which the investment bank's approach deviates from this definition.

CONTINUED ON NEXT PAGE

EXAM 6 - FALL 2008

42. (2 points)

Slywotzky and Drzik describe the first step of the process of managing strategic risk as “Identify and assess your risks.” Provide and briefly describe the four characteristics that should be considered when assessing each risk.

END OF EXAMINATION

Exam 6

Reserving, Insurance Accounting Principles, and Reinsurance

10/29/2008

POINT VALUE OF QUESTIONS

QUESTION	VALUE OF QUESTION	SUB-PART OF QUESTION						
		(a)	(b)	(c)	(d)	(e)	(f)	(g)
1	1.00	0.5	0.5					
2	1.50	0.5	0.5	0.5				
3	3.00	2.5	0.5					
4	2.50	2	0.5					
5	2.00	0.5	0.5	0.5	0.5			
6	1.50	0.5	0.5	0.5				
7	3.00	2.5	0.5					
8	2.50	1	0.5	1				
9	2.00	0.5	0.5	1				
10	3.25	1.5	1	0.75				
11	1.50	0.75	0.75					
12	2.00	1	1					
13	1.50	1	0.5					
14	1.50	1.5						
15	3.00	2.5	0.5					
16	1.00	0.25	0.25	0.5				
17	1.50	1.5						
18	1.50	0.5	0.5	0.5				
19	2.00	1	0.5	0.5				
20	1.00	0.5	0.5					
21	2.00	0.5	0.5	0.5	0.5			
22	1.50	0.5	1					
23	1.50	0.5	1					
24	1.00	0.5	0.5					
25	1.75	0.5	0.5	0.5	0.25			
26	1.50	0.25	0.25	0.5	0.5			
27	2.00	1.5	0.5					
28	1.50	1.5						
29	2.00	1	1					
30	2.00	1.5	0.5					
31	3.25	2	0.25	1				
32	2.25	1	1	0.25				
33	1.50	1.5						
34	1.00	1						
35	2.50	0.5	0.5	1.5				
36	1.50	1.5						
37	2.00	1	1					
38	2.00	2						
39	2.50	2.5						
40	2.00	0.5	1	0.5				
41	2.00	1	1					
42	2.00	2						

TOTAL 80.00

Sample Solutions
Exam 06, 2008, Question 1

Solution 1

- a) The statement of principles says that both severity and development patterns can be used to identify homogeneous lines of business. Thus, this high-severity, long-tailed line can be analyzed separately from other lines.
- b) If the actuary analyzes these segments together, the analysis implicitly assumes growth is the same across all lines. This will lead to inadequate IBNR for the longer-tailed line. There is a bias to understate IBNR.

Solution 2

- a) The statement offers guidance on when to analyze business segments separately vs. when to combine them. In this case the higher severity, longer tailed line should be analyzed separately as long as there is enough data in the two groups (long & short tailed) to have credible analyses.
- b) Because the longer-tailed line is growing faster, it should have more weight in future loss payment patterns than it had in past ones. A bias could result in the analysis that assumes the past development patterns are predictive of future patterns. This would be a downward bias.

Sample Solutions
Exam 06, 2008, Question 2

Solution 1

a) $1,133,000 = 1,600,000 \times \text{ELR} \times \% \text{ Unpaid} + 800,000$
 $.208125 = \text{ELR} \times \% \text{ Unrptd}$
 $.208125 = \text{ELR} \times (1 - .68)$
 $\text{ELR} = 65\%$

b) $\text{Cum LDF} = 1 / \% \text{ emerged} = 1.47$
 $1.47 \times 800,000 = 1,176,000 \text{ CL ult. Loss}$

c) $1,600,000 \times .65 \times (1 - .68) = 332,800 \text{ [IBNR at 12/31/07]}$
 $1,600,000 \times .65 \times (1 - .82) = 187,700 \text{ [IBNR at 12/31/08]}$
 $332,800 - 187,700 = 145,600 \text{ CY 2008 development}$

Solution 2

a) $\text{B/F Ult. Loss est.} = [\text{EP} \times \text{ELR} \times \% \text{ Unreported}] + \text{Reported Loss}$
 $\text{B/F Ult. Loss est.} = [\text{EP} \times \text{ELR} \times (1 - \% \text{ Emerged})] + \text{Reported Loss}$
 $1,133,000 = [1,600,000 \times \text{ELR} \times (1 - 0.68)] + 800,000$
 $\text{ELR} = 0.65$

b) $\text{Chain ladder ult. Loss est.} = \text{Reported loss} / \% \text{ Emerged}$
 $= 800,000 / 0.68$
 $= 1,176,471$

c) $\text{Loss emergence in CY 2008} = \text{EP} \times \text{ELR} \times (\% \text{ Emerged}_{36} - \% \text{ Emerged}_{24})$
 $= 1,600,000 (0.65) (0.82 - 0.68)$
 $= 145,600$

Sample Solutions
Exam 06, 2008, Question 3

Solution 1

a)

Disposal Rates				
AY	12-24	24-36	36-48	48-60
2004	0.60	0.50	0.75	1.00
2005	0.60	0.50	0.75	1.00
2006	0.60	0.50	0.75	1.00
2007	0.60	0.50	0.75	1.00

Assuming all claims closed by 48 months

Average Closed Amount				
AY	12	24	36	48
2004	800.0	1000.0	1200.0	1500.0
2005	840.0	1050.0	1260.0	1575.0
2006	882.7	1102.2	1323.0	1653.8
2007	925.6	1157.3	1389.2	1736.5

Incremental Number of Claims Closed				
AY	12	24	36	48
2004				
2005				60
2006			225	75
2007		540	270	90

Projected Paid				
AY	12	24	36	48
2004				
2005				94,500
2006			297,675	124,035
2007		624,942	375,084	156,285

Projected Reserve = 1,672,521

b)

1. Its projections rely only on paid data and aren't subject to fluctuations in case reserve adequacy.
2. This method can explicitly incorporate assumptions about inflation and expected claim disposal rates.

Solution 2

a)

Incremental Closed Claims				
AY	12	24	36	48
2004				
2005				60
2006			225	75
2007		540	270	90

Sample Calculation: $450 / (1500 - 750) \times (1800 - 900) = 0.6 (900) = 540$

Paid on Closed				
AY	12	24	36	48
2004				1500
2005			1260	1575
2006		1102	1323	1654
2007		1157	1389	1736

Projected Reserve:

540 (1157) = 624,780

225 (1323) = 297,675

270 (1389) = 375,000

60 (1576) = 94,500

75 (1654) = 124,050

90 (1736) = 156,240

Total: 1,672,275 Reserve @ 12/31/2007

b)

1. Flexibility – the method can be adjusted to test different assumptions about claim closure rates.
2. Does not rely on incurred loss – the method is not sensitive to changes in case reserve adequacy.

Sample Solutions
Exam 06, 2008, Question 4

Solution 1

a)

Adjusted Case Reserve per Open Claim (using 5% trend)

AY	12	24	36	48
2004	68.93	99.05	$\frac{394.2}{1.05}$ = 375.43	888.7
2005	72.38	$\frac{109.2}{1.05}$ = 104.0	394.2	
2006	$\frac{79.8}{1.05}$ = 76.0	109.2		
2007	79.8			

Adjusted Case Reserves

AY	12	24	36	48
2004	810(68.93) = 55,833	480(99.05) = 47,544	115(375.43) = 43,174	
2005	50,521	40,248		
2006	49,704			
2007				

Adjusted Incurred Loss = (Adj
Case Resv + Cumulative Paid)

	12	24	36	48
2004	86,562	150,905	168,411	177,132
2005	75,094	125,585	140,221	
2006	72,271	127,487		
2007	78,294			

b)

All Yrs weighted LDF's

$$12 - 24: (150,905 + 125,585 + 127,487) / (86,562 + 75,094 + 72,271) = 1.727$$

$$24 - 36: 1.116$$

$$36 - 48: 1.052$$

$$48 - \text{ult}: 1.020$$

$$\text{AY 2007 Ult Loss} = 78,294 \times (1.727) \times (1.116) \times (1.052) \times (1.020) = 161,920$$

Solution 2

a)

All values in (000's)

Restated Case per Open

	12	24	36	48
04	$68.9 = \frac{79.8}{1.05^3}$	$99.0 = \frac{109.2}{1.05^2}$	$375.4 = \frac{394.2}{1.05}$	888.7
05	$72.4 = \frac{79.8}{1.05^2}$	$104.0 = \frac{109.2}{1.05}$	394.2	
06	$76.0 = \frac{79.8}{1.05}$	109.2		
07	79.8			

Restated Case

(above case per open × open claims)

	12	24	36	48
04	55,809	47,520	43,171	38,214
05	50,535	40,248	34,295	
06	49,704	39,421		
07	50,513			

Adjusted Reported

= (Restated Case + Paid)

	12	24	36	48
2004	86,538	150,881	168,408	177,761
2005	75,108	125,585	140,274	
2006	72,271	127,430		
2007	78,274			

b)

All Yrs weighted LDF's

<u>12 - 24</u>	<u>24 - 36</u>		<u>36 - 48</u>	<u>48 - ult</u>
1.7267	1.1165 = (168,408 + 140,274) / (150,881 + 125,585)		1.0496	1.02

to ult

2.0640	1.1953		1.0706	1.02
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07 ult = 78,274 × 2.0640 = 161,558

Sample Solutions
Exam 06, 2008, Question 5

Solution 1

- a) When the policy limits or deductible profile of a book of business has changed from the previous. Policy year should be used instead of AY.
- b) Accident quarter should be used instead of AY when the exposures of the book is growing rapidly resulting in a shift of the average accident date.
- c) Report year data should be used instead of AY data when a drastic change in the social or legal climate causes average severity to more closely correlate with the date of the report of the claim.
- d) Earned exposures should be used instead of claim counts when the definition of claim counts has changed and would cause a distortion if used.

Solution 2

- a) Use when there have been change in policy limits and deductibles. These changes track more with PY than AY.
- b) Use when there is significant growth in business where the average accident date is no longer in the middle of the AY.
- c) Use when data is affected by external triggers such as socio-economic changes or litigation. These are closely related to RY than AY.
- d) Use earned exposures when claim counts are unreliable. Changes in claims handling practices can distort claim count info. Where as earned exposures will remain more stable.

Sample Solutions
Exam 06, 2008, Question 6

Solution 1

- a) The effect of the unadjusted reported loss method will be ultimate loss overstatement. The method will calculate development factors based on historical emergence and developments and apply them to the latest reported values to determine ultimate estimates. Since case and paid will increase for the latest year (since case reserves are higher and payment rate will increase with settlement), the projected losses will be higher when the larger LDF is applied to larger emerged values.
- b) Similar to part a., paid loss development will be overstated. The change in case will not cause any changes but the increase in settlement will cause the distortion. More will be paid earlier as claims settle faster. Once again, the higher LDF application will cause overstatement.
- c) 1) Has the underwriting department lowered standards in regards to what constitutes an acceptable insured?
2) Has there been a change in geographic area regarding new underwriting strategies?

Solution 2

- a) Case reserves will be higher, increasing reported loss. However, we are settling more quickly so our LDFs will be off. If we use an average of incurred LDFs from the past, they will be too high because the reporting pattern is longer and case reserve increase to get to the higher indicated reserves needed. Applying these higher LDFs to an inflated reported loss will dramatically overstate the ultimate.
- b) Paid loss will be higher earlier because we are settling sooner. The historical average of paid LDFs will be too high to apply to the 2007 year because the LDF assumes that we have a longer development period than we actually do. The paid ultimate will be overstated because of this.
- c) 1) Have there been any change in underwriting guidelines (writing risks we don't know enough about)?
2) Have we been writing higher limits or lower deductibles?

Sample Solutions
Exam 06, 2008, Question 7

Solution 1

a)
 Incremental Paid Loss:

Accident Year	0	1	2
2003	802,498	108,606	1,989
2004	1,111,320	150,401	2,755
2005	785,787	106,345	1,948
2006	1,576,432	213,347	
2007	1,096,211		

$y = \ln(\text{Pd loss})$

Accident Year	0	1	2
2003	13.59548448	11.59548448	7.595484482
2004	13.92105878	11.921059	7.921058778
2005	13.5744408	11.574441	7.574440799
2006	14.2706747	12.270675	
2007	13.90737065		
Average	13.853806	11.840415	7.6970395

$a = \text{average of } y(0) = 13.8538$

$Y1 = \text{average } y(1) - a = 11.840415 - 13.853806 = -2.0134$

$Y2 = \text{average } y(2) - a - Y1 = 7.6970395 - 13.853806 - 11.840415 = -4.1434$

b)

$y(2) = 13.8538 + (-2.0134) + (-4.1434) = 7.6970$

median loss (paid) = $e^{y(2)} = e^{7.697} = 2,201.73$

Solution 2

a)

1st Calculate Incremental losses

Accident Year	0	1	2
2003	802,498	108,606	1,989
2004	1,111,320	150,401	2,755
2005	785,787	106,345	1,948
2006	1,576,432	213,347	
2007	1,096,211		

2nd Log Incremental Triangle

Accident Year	0	1	2
2003	13.60	11.60	7.60
2004	13.92	11.92	7.92
2005	13.57	11.57	7.57
2006	14.27	12.27	
2007	13.91		

a = average at 0 = 13.85

Calc. Y1 as Avg. of the incremental difference of log (Inc.) Triangle

Accident Year	0-1	1-2
2003	-2	-4
2004	-2	-4
2005	-2	-4
2006	-2	
Average	-2	-4

Y1 = -2

Y2 = -4

b)

The median incremental paid for AY 07 = $e^{(13.85 + (-2) + (-4))} = 2,566$

Sample Solutions
Exam 06, 2008, Question 8

Solution 1

- a) $UEPR_{EOY_1} = 1200 (.9) = 1080$
 $UEPR_{EOY_2} = 1200 (.65) = 780$
 $UEPR_{EOY_3} = 0$
- b) Using the prorated method of earning prems, premium will be earned evenly over the life of the policy. The experience will appear to be better than it actually is in the first two years, because the losses are concentrated in the third year. Therefore, the insurance company will think it is earning more profit than it really is, it will lower its rates, and lose money on subsequent policies written.
- c) 1. seasonal risks such as hurricanes, the losses concentrated in the months of July through November. The company will think the policy is profitable when it is not.
2. aggregate excess policies – this policy only responds to losses that exceed a certain \$ amount of losses. Therefore, since the losses do not aggregate to this large amount until the end of the policy period, the insurance company does not experience losses until the policy has been in effect for a long time. The company will think the policy is profitable when it is not.

Solution 2

- a) year 1: $UEPR = 1200 - .1(1200) = 1080$
year 2: $UEPR = 1200 - .35(1200) = 780$
year 3: $UEPR = 0$
- b) earning premium pro rata means earning it evenly over the coverage period. Since losses are not reported evenly the pro rata method will cause a distortion. In year one management could mistakenly overestimate the profit & reduce the rate to grow the business. This could cause devastating effects down the road.
- c) 1. aggregate excess policies – protects against an aggregation of losses over usually a one year period. Losses are more likely attachment later on in the period. Expect little to no losses at the beginning.
2. seasonal contracts – ex. Snowmobile liability insurance – expect more of losses in winter & relatively no losses in the summer months.

Sample Solutions
Exam 06, 2008, Question 9

Solution 1

- a) Link ratio method $L(x) = cx$
c – weighted average development 12-24 mo

$$c = (12,204 + 14,650 + 14,826)/(8,847 + 10,280 + 11,747) = 1.35$$

$$L(x) = 1.35 \times 12,077 = 16,304$$

- b) Budgeted loss method $L(x) = k$
k is $E(Y) = (12,204 + 14,650 + 14,826)/3 = 13,893$

- c) Least square method $L(x) = a + bx$

Where $a = y_{\text{avg}} - b \times x_{\text{avg}}$

and $b = [(xy)_{\text{avg}} - x_{\text{avg}} \times y_{\text{avg}}] / [(x^2)_{\text{avg}} - x_{\text{avg}}^2]$

$$x_{\text{avg}} = 10,291.3 \quad y_{\text{avg}} = 13,893.33$$

$$(xy)_{\text{avg}} = 144,243,936.7 \quad (x^2)_{\text{avg}} = 107,313,292.7$$

$$x_{\text{avg}} \times y_{\text{avg}} = 142,980,924.4 \quad x_{\text{avg}}^2 = 105,911,541.8$$

$$b = 0.901 \quad a = 4,620$$

$$L(x) = 4,620 + 0.901 \times 12,077 = 15,502$$

Solution 2

a)

12-24
2004 1.3795
2005 1.4251
2006 1.2621
3-yr avg = 1.3556

Link ratio estimate = $1.3556 \times 12,077 = 16,276$

b) Budgeted loss estimate = $y_{\text{avg}} = 13,893$

c) $x_{\text{avg}} = 10,291.3 = 1/3 \times (8,847 + 10,280 + 11,747)$
 $y_{\text{avg}} = 13,893.3$
 $(xy)_{\text{avg}} = 144,243,936.7 = 1/3 \times \Sigma(8,847 \times 12,204 + \dots)$
 $(x^2)_{\text{avg}} = 107,313,292.7 = 1/3 \times \Sigma(8,847^2 + \dots)$

$b = [(xy)_{\text{avg}} - x_{\text{avg}} \times y_{\text{avg}}] / [(x^2)_{\text{avg}} - x_{\text{avg}}^2] = 0.901$

$Z = b / (y_{\text{avg}} / x_{\text{avg}}) = 0.901 / 1.35 = 0.6674$

Least square estimate = $Z \times \text{Wtd Avg link ratio estimate} + (1-Z) \times \text{Budgeted method estimate} =$
 $0.6674 \times (1.35 \times 12,077) + (1-0.6674) \times 13,893 = 15,502.$

Sample Solutions
Exam 06, 2008, Question 10

Solution 1

a) $E(Y) = 14M$
 $Std(Y) = 9.8M$
 $E(x/y) = .4$
 $Std(x/y) = .18$

$$VHM = .4^2 \times 9.8^2 = 15.37$$
$$EVPV = .18^2 \times (9.8^2 + 14^2) = 9.46$$
$$Z = 6.19$$

$$Ult = .619 \times (10/.4) + (1 - .619) \times 14 = 20.81$$

b) $CL = 10/.4 = 25$
 $BF = 10 + .6 \times 14 = 18.4$
 $GB = 10 + .6 \times 18.4 = 21.04$

Benktander is the closest as it is usually close to the Bayesian estimate.

c) $U_{gb} = p_k \times U_{cl} + (1 - p_k) U_{bf}$ with $p_k =$ reported percentage

So, GB is average between the chainladder and BF with the reporting percentage as the credibility weight.

Solution 2

a) $E(LR) = .7$

$$E(d) = .4$$

$$S(LR) = (.7) \times (.7) = .49$$

$$S(d) = (.45) \times (.4) = .18$$

$$\begin{aligned} \text{EVPV} &= .182(.49^2 + .7^2) \\ &= .02365 \end{aligned}$$

$$\begin{aligned} \text{VHM} &= .4^2 \times .49^2 \\ &= .03891 \end{aligned}$$

$$\begin{aligned} Z &= (\text{VHM}) / (\text{VHM} + \text{EVPV}) \\ &= .6189 \end{aligned}$$

$$\begin{aligned} L(x) &= 10M / .4 \times .6189 + 20M \times .7 \times (1 - .6189) \\ &= \$20,807,946 \end{aligned}$$

b) $L(x) = 10M / .4 = 25M$

$$L(x) = 14M \times (1 - .4) + 10M = 18.4M$$

$$L(x) = 18.4M \times (1 - .4) + 10M = 21.04M$$

Benktander method provides closest estimate.

c) It is a credibility weighted average of the BF method and the chain ladder method.

$$21.04 = 25(z) + 18.4(1 - z)$$

Where $z = .4 = \% \text{ loss reported}$

Sample Solutions
Exam 06, 2008, Question 11

Solution 1

- a) Improving loss ratio, no change in loss development pattern.

Loss development method accurate – because no change in loss emergence or claim reserves

BF – overestimates IBNR

- Loss ratio is improving, IBNR based on ELR
- Since actual LR is better than ELR used by BF, IBNR is overestimated

PP – overestimates IBNR, not as bad as BF

- Since PP development factor is based on loss development divided by EP

- b) Loss development – no adjustment required; IBNR already accurate

BF – need to adjust ELR used in estimation of IBNR to reflect improved LR

PP – self-correcting

- as LR stabilizes, and if PP development factors are based on the new premium adequacy level, method has self-corrected

Solution 2

- a) LD method would produce the “true” reserve (the improvement in the loss ratio is reflected in emerged losses);

BF method would over-estimate reserve (it does not use actual emerged losses, and expected loss ratio is set to a level prior to improvement)

Percent of Premium method would over-estimate, although by a lesser amount than BF method (IBNR factors are related to loss ratios for prior periods, so better experience is not completely reflected)

- b) LD method – none

BF method – re-evaluate expected loss ratio to reflect better results for most recent periods

Percent of Premium method – will self-adjust as less experience from prior years (higher loss ratios) drops-off data used in analysis

Sample Solutions
Exam 06, 2008, Question 12

Solution 1

a) $PE(1-X) \times \Phi = (2.1M)(.455)(1-.14)(.02) = .0164346$
 $PEX = (2.1M)(.455)(.14) = .13377$

Ultimate Loss equals $.0164346M + .13377M = \mathbf{150,204.6}$

b) Advantages

- 1) at the outset can be tied to pricing program
- 2) relies on factors from a more credible pool of data (industry data)

Disadvantages

- 1) excludes emerged losses
- 2) industry data might be considerably different then the kind of business you are writing/using the data for.

Solution 2

a) $2,100,000 \times .455 \times .14 + 2,100,000 \times .455 \times (1-.14) \times .02 = 150,204.6$

b) Advantages

- 1) is useful when little or no data is available.
- 2) relies on industry data, the volume of data increases credibility.

Disadvantages

- 1) Does not take into consideration actual experience
- 2) Industry data may not be applicable to the book of business of the company.

Sample Solutions
Exam 06, 2008, Question 13

Solution 1

$$\begin{aligned}
 \text{a) } \text{XS LDF}_{27\text{-Ult}} &= \frac{f(50) - f(250)}{\frac{f(50)}{\text{XS LDF}_{50, 27\text{-Ult}}} - \frac{f(250)}{\text{XS LDF}_{250, 27\text{-Ult}}}} \\
 &= \frac{0.48 - 0.24}{\frac{0.48}{3.15} - \frac{0.24}{4.49}} \\
 &= \frac{0.24}{0.152 - 0.053} \\
 &= 2.426
 \end{aligned}$$

- b) Change in the distribution of size of claims at the different development age. Generally, large claims tend to be reported later.

Solution 2

$$\begin{aligned}
 \text{a) } \text{LDF} &= \frac{0.48 - 0.24}{\frac{0.48}{3.15} - \frac{0.24}{4.49}} \\
 &= 2.426
 \end{aligned}$$

- b) 1) Due to change in reporting pattern distribution at different maturities – small claims reported early
 2) Due to change in size of loss distribution at different maturities – excess losses will appear later as loss develops.

Sample Solutions
Exam 06, 2008, Question 14

Solution 1

	(1)	(2)	(3) = 1 × 2	(4)	(5) = 3 + 4
PY	Ex Fut Loss	CPDLD	Ex Future Prem	Prior Booked	Ultimate
04	9000	.410	3690	200,000	203,690
05	75000	.750	18,150	175,000	193,750
06	101,000	1.120	113,120	95,000	208,120
07	150,000	1.345	201,750	0	201,750
	(6)	(7) = 5 - 6			
PY	Prem Booked	Prem Asset			
04	202,000	1,690			
05	190,000	3,750			
06	175,000	33,120			
07	175,000	26,750			
Total		65,310			

Solution 2

	(1)	(2)	(3) = 1 × 2	(4)	(5) = 3 + 4
PY	Ex Fut Loss	CPDLD	Ex Future Prem	Prior Booked	Total
	Emergence	Ratio		Prior Adj	Premium
04	9000	.410	3690	200,000	203,690
05	75000	.750	18,150	175,000	193,750
06	101,000	1.120	113,120	95,000	208,120
07	150,000	1.345	201,750	0	201,750
	(6)	(7) = 5 - 6			
PY	Prem Booked	Prem Asset			
04	202,000	1,690			
05	190,000	3,750			
06	175,000	33,120			
07	175,000	26,750			
Total		65,310			

Sample Solutions
Exam 06, 2008, Question 15

Solution 1

a)

Weights	5360	6475	3750	2415
Pick Deviations	+10%	+1%	+3%	-6%
=avg for CY (10+10+15+5)=+10%				

$$\text{Weighted avg bias} = (5360 \times 10\% + 6475 \times 1\% + \dots) / (5360 + 6475 + \dots)$$

$$= 568.35 / 18000 = +3.1575\%$$

b)

Thorne's improvement

--more accurate in terms of distribution of biases in future payment years

--simple arithmetic average can cause a huge swing in bias as all biases receive equal weights in determining total bias.

Solution 2

a)

Weights

Total reserve = 18000

AY+1: $5360 / 18000 = 29.78\%$

AY+2: $(3125 + 3350) / 18000 = 35.97\%$

AY+3: $3750 / 18K = 20.83\%$

AY+4: $2415 / 18K = 13.42\%$

Avg dev	AY+1	AY+2	AY+3	AY+4
Row 1	$(10+10+15+5)/4=10$	$(14-3-8)/3=1$	$(2+4)/2=3$	-6
Row 2 %Wt	29.78%	35.97%	20.83%	13.42%

$$\text{Sumproduct}(\text{Row1}, \text{Row2}) = \boxed{3.16\%}$$

b)

1. Bias at later development periods does not get leveraged when using a weighted avg.
2. More reflective of the relative amount of reserves at each development period.

Sample Solutions
Exam 06, 2008, Question 16

Solution 1

- a) Dollar-based – ULAE payments follow the paid losses & ALAE.
- b) Count-based – ULAE payment for some type of transaction will be same irrespective of claim size and nature.
- c)
 - 1) If there is enough data (claims paid, transactions done) to identify the cost associate with each transaction type to make the count-based method reliable. That is, if the ULAE paid is large enough to warrant a detailed analysis of transactions/cost-based operation.
 - 2) If the ULAE to paid loss ratio is stable then better to use a dollar-based system.

Solution 2

- a) ULAE dollars track with claim dollars i.e., a \$1000 claim has 10 times as much ULAE as a \$100 claim.
- b) ULAE dollars track with the type of transaction regardless of dollars, so similar types of transactions have same ULAE expenditures.
- c)
 - 1) Whether the volume of losses is growing considerably.
 - 2) The application of the company's resources to various stages of the life of a claim.

Sample Solutions
Exam 06, 2008, Question 17

Solution 1

- Balance Sheet
 - reports the firm's assets & liabilities as of the statement's report date w/ the difference being net assets or policyholder surplus
 - gives a snapshot of the firm's value as of the report date

- Income Statement
 - reports on the firm's revenue & expenses over the reporting prd w/ the difference being net income
 - $\text{income} = \text{revenue} - \text{expenses}$
 - gives the firm's income for the reporting period

- Cash Flow Statement
 - reports on the firm's sources and uses of cash over the reporting prd
 - should reconcile the firm's beginning & ending cash position
 - should show reader where the firm has obtained cash & what it has been spend on over the reporting period

Solution 2

1. Balance Sheet – shows the assets & liabilities of the company as of a given point in time. Snapshot of the financial position.
2. Income Statement – reports on the revenues and expenses of the company with the difference being the income for the company during a specific period of time.
3. Cash Flow Statement – reports on the sources and uses of cash flow and reconciles the beginning and ending position of the company.

Sample Solutions

Exam 06, 2008, Question 18

Solution 1

- a) A contingency is a condition involving uncertainty as to the possible gain or loss to a party that will ultimately be resolved when one or more events occur or fail to occur.
- b)
 1. It must be probable that the liability has been incurred or the asset has been impaired as of the financial statement date.
 2. It is possible to reasonably estimate the amount of the loss.
- c) Threatened/pending litigation. The loss event giving rise to the claim has occurred and based on what the claimant is seeking, the amount of possible liability can most likely be estimated. This serves as a contingency because it is uncertain what the settlement will be.

Solution 2

- a) An existing condition involving uncertainty as to possible gain or loss to a firm that is ultimately resolved when one or more future events either occur or fail to occur.
- b)
 1. Information available prior to the issuance of the financial statements indicates that it is probable that an asset has been impaired or a liability incurred.
 2. The amount of the contingency can be reasonably estimated.
- c) Collection of receivables – If the insurer is due some recoveries from their reinsurer and there is some question as to whether the reinsurer has enough capital. The contingent event would be the reinsurer becoming insolvent.

Sample Solutions

Exam 06, 2008, Question 19

Solution 1

- a) i. Deferral/Matching: focus on the timing of revenue and expense recognition so that they occur at the same time.
ii. Asset/Liability: focus on correctly measuring the value of assets and liability as of the financial statement date.
- b) i. Deferral Matching:
- Revenues recognized as earned
 - Expenses are realized in proportion to the protection provided over the policy period.
 - Focus on the timing of profit emergence
- a) Asset Liability
- Revenue and expenses are recognized when incurred.
 - Focus on the reliable measure of values as of the balance sheet date.
- c) Deferral Matching approach will be appropriate. Since the losses and protection will be provided over policy term, the revenue should be recognized in proportion to the protection provided. The expenses should be recognized as revenue is earned.

Solution 2

- a. i. Deferral matching is used to defer recognition of policy acquisition expense so that it is recognized in proportion to earned premium, set up a deferred policy acquisition expense asset.
ii. Asset/Liability is used to reflect actual assets/liabilities in hand. Does not allow DPAC asset, must recognize as expense once incurred.
- b. i. Deferral Matching
- defer or accelerate recognition of an asset or expense to match revenue with expenses.
 - Focus is on the income statement more than the balance sheet
 - Focus is on the timing of profit emergence.
- ii. Asset Liability
- Recognize revenue and expenses once they are incurred.
 - Focus is on the balance sheet more than the income statement.
 - Focus is on a reliable measure of value as of balance sheet date.
- c. Would be appropriate to use the deferral matching approach because then you could earn premiums and recognize acquisition expense in proportion to the period of risk.

Sample Solutions

Exam 06, 2008, Question 20

Solution 1

- a) GAAP – Intended for users of GAAP statements (e.g., creditors, investors) – focuses on the value of a firm as an ongoing concern.
Statutory – Intended for regulators & solvency concerns – focuses on liquidation market values right now.
- b) GAAP – expenses them in proportion to the policy’s term over its lifetime.
Statutory – expenses them immediately as they’re incurred.

Solution 2

- a) GAAP focuses on company values on a “going concern” basis and is used by investors and creditors (among others). SAP is focused on the ability of a company to pay its liabilities (its “liquidation” value), and is used by regulators to ensure insurers can pay its policyholders.
- b) Under GAAP, policy acquisition costs are amortized over the policy period (creating an asset for the deferred cost), while under SAP such costs are expensed immediately (with no asset created).

Sample Solutions

Exam 06, 2008, Question 21

Solution 1

a) bonds not held to maturity → use mkt value

GAAP Assets: mkt value bonds + all receivables from agents and bills receivable + deferred acquisition costs + furniture

$$\begin{aligned} &= 3500 + 300 + 100 + 200 + 500 + 50 + 500 \\ &= 5150 \end{aligned}$$

b) GAAP liabilities: L & ALAE reserve + UEPR = 1000 + 400 = 1400

c) SAP assets: amortized bonds, balances < 90 days (no bills past due, > 90 days, no furniture, no DPAC)

$$\begin{aligned} &= 3200 + 300 + 100 \\ &= 3600 \end{aligned}$$

d) SAP liabilities = L & LAE reserve + UEPR = 1400

Solution 2

a) Asset under GAAP

$$\begin{aligned} &= \text{Bonds (market values)} + \text{Agents balance} + \text{Deferred acquisition cost} + \text{Furniture} + \text{Bills} \\ &\text{receivable past due} \\ &= 3500 + 300 + 100 + 200 + 500 + 50 + 500 \\ &= 5150 \end{aligned}$$

b) Liability under GAAP

$$\begin{aligned} &= \text{Loss \& LAE reserve} + \text{UEPR} \\ &= 1000 + 400 \\ &= 1400 \end{aligned}$$

c) Asset under SAP

$$\begin{aligned} &= \text{Bonds (amortized value)} + \text{Agents' balance (0 – 90 days)} \\ &= 3200 + 300 + 100 \\ &= 3600 \end{aligned}$$

Liability under SAP

$$\begin{aligned} &= \text{Loss \& LAE reserve} + \text{UEPR} \\ &= 1000 + 400 \\ &= 1400 \end{aligned}$$

Sample Solutions

Exam 06, 2008, Question 22

Solution 1

- a) To provide for deficiency in unearned premium reserve when UPR will not be able to cover expected loss & LAE, marginal expenses, DAC & policyholder dividends from the run-off of the remaining policy period.
- b) UPR = 2M

Loss occurring on December 26 is cover by loss reserve, not UPR

$$\begin{aligned} \text{Expected loss} &= 1.67\text{M} \\ \text{Marginal Expense} &= \frac{0.20\text{M}}{1.87\text{M}} \end{aligned}$$

So $2.00 - 1.87 = 0.13$; there is no deficiency.

Solution 2

- a) The purpose of a premium deficiency reserve is to set up a reserve for the amount by which future loss and expenses attributed to unearned premiums exceed those unearned premiums.
- b) Loss associated with UPR = $(2,000,000) (0.835) = 1,670,000$

$$\text{So premium deficiency reserve} = 2,000,000 - 1,670,000 - 200,000 = 130,000$$

Therefore, premium deficiency reserve is \$0. Note that fixed and general overhead expenses are not included, as well as losses from premium that has already been earned.

Sample Solutions

Exam 06, 2008, Question 23

Solution 1

- a) In order for a reinsurance risk to be treated as risk transfer it must incur a 10% loss 10% of the time (ie at 90th percentile there is 10% loss)
- b)
 - (1) An Excess of Loss contract - at 90th percentile there may not be a 10% loss but at 95th percentile there may be a 100% loss)
 - (2) A Quota Share that cedes nearly all of the losses to the reinsurer. This puts the reinsurer in the same position as the reinsured.

Solution 2

- a) The reinsurer must have a value at risk of 10% at the 90th percentile of the net present value of the distribution of underwriting losses
- b)
 - (1) A high layer catastrophe excess of loss treaty may not pass the "10-10" rule but still transfer significant risk. The risk of loss may not be until the 95th or higher percentile, where the loss to the reinsurer is very high.
 - (2) A Quota Share on a profitable book of business may not pass the "10-10" rule. If the Quota Share is a large percentage of the book, the reinsurer is in essentially the same position as the insurer, so they have assumed a lot of the risk.

Sample Solutions

Exam 06, 2008, Question 24

Solution 1

- a) Provide additional information not in the Balance Sheet, Cash Flow Statement, or Income Statement. Includes how estimates of liabilities when calculated or accounting policies used.
- b) 1) Whether investment income was used in calculation of premium deficiency reserve
2) Forward-looking information = Events insurer expects to happen after publication and after statement date. (e.g. We're buying a \$12M corporate jet next year)

Solution 2

- a) Provide information not included in other financial statements, e.g. in the Income Statement, Balance Sheet, or Cash Flow Statement
- b) Forward Looking Info – Events that will take place subsequent to publication date
Subsequent Events – Events that occur after statement date but prior to publication date

Sample Solutions

Exam 06, 2008, Question 25

Question material was not on current syllabus. Extra credit was given to candidates successfully answering Question 25.

Solution 1

a) EPD measures the reinsurer's expected deficit, when a deficit exists.

$$b) \quad ERD = \int_{NPV(\text{loss}) > NPV(\text{Premium})}^{\infty} [\text{NPV}(\text{premium}) - \text{NPV}(\text{loss})] f(x) dx$$

c) 1) Does not rely on a single point estimate (10-10 rule).

2) Is well grounded in actuarial theory.

d) There is no established critical value, so ambiguity remains as to whether risk is transferred.

Sample Solutions

Exam 06, 2008, Question 26

Solution 1

- a) $1,000,000 \times (1-20\%) = 800,000$
- b) $700,000 \times (1-20\%) = 560,000$
- c) Reinsurer Premium = $20\% \times 1,000,000 = 200,000$
 - Ceding Commission = $200,000 \times 0.15 = 30,000$
 - Assumed losses = $700,000 \times 0.2 = 140,000$
 - = 30,000 gain
- d) Provide surplus relief
To take advantage of reinsure's underwriting expertise

Solution 2

- a) $\text{Subj Prem} \times (1 - \text{ceded \%}) = 1\text{M} \times 0.8 = 800,000$
- b) $(1 - \text{ceded \%}) \times \text{ult loss} = 0.8 \times 700,000 = 560,000$
- c) Reinsurer gets 200,000 prem
Gives ceding commission of $200,000 \times 0.15 = 140,000$
Gain/loss for reinsurer = $200,000 - 30,000 - 140,000 = 30,000$ gain
- d) Surplus relief through the ceding commission
Increase line capacity for higher valued risks

Sample Solutions

Exam 06, 2008, Question 27

Solution 1

a) Emerged loss = $(LDF_{t \text{ to } t+1} - 1)/(LDF_{t \text{ to } Ult} - 1) \times IBNR$

2004: Loss = $[(1.25/1.176 - 1)/(1.25 - 1)] \times 1,100,000 = 276,871$

2005: Loss = $[(1.538/1.25 - 1)/(1.538 - 1)] \times 2,300,000 = 984,981$

2006: Loss = $[(2.222/1.538 - 1)/(2.222 - 1)] \times 4,800,000 = 1,746,907$

b) Reported emerged loss = $R_{07} - R_{06}$

2004: 250,000

2005: 900,000

2006: 1,300,000

Total 2,450,000

Expected emerged loss total = $3,008,759 > 2,450,000$

Much more loss was expected compared to what actually emerged. The IBNR method used is overstating losses and the development factors should be tested for accuracy.

Solution 2

a)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			% Unrep	% Unrep	Incremental	Ratio to	Expected
AY	Month _B	Month _{END}	@BOP	@EOP	Report	Unreported	Reported
2004	36	48	20%	15%	5%	25%	275,000
2005	24	36	35%	20%	15%	42.8%	984,400
2006	12	24	55%	35%	20%	36.4%	1,747,000
							3,006,600

- (1) Maturity @ 12/31/2006
- (2) Maturity @ 12/31,2007
- (3) $1 - 1 / CLFD_1$
- (4) $1 - 1 / CLDF_2$
- (5) (3) - (4)
- (6) (5) / (3)
- (7) (6) × IBNR

b) Actual Reported = Reported @ 12/31/2007 – Reported @ 12/31/2006
= 2,450,000

Expected Reported = 3,006,600
Actual Minus Expected = 556,600

* This would say that the IBNR estimate @ 12/31/2006 was overstated.

Sample Solutions

Exam 06, 2008, Question 28

Solution 1

Claim	Retained Loss	Ceded Loss	Reinsurance Cover
1	150,000	-	-
2	200,000	50,000	-
3	200,000	500,000	-
4	200,000	300,000	-
5	450,000	800,000	650,000
6	200,000	50,000	50,000
			700,000

Primary Net Loss
= 3100 - 700
= 2.4M

Solution 2

Occ	Loss Amount	Ceded Loss	Agg Ceded Loss	Ded
1	150,000	-	-	-
2	250,000	50,000	50,000	-
3	700,000	500,000	550,000	-
4	500,000	300,000	850,000	-
5	1,250,000	800,000	1,650,000	650,000
6	250,000	50,000	1,700,000	700,000

Primary Company's Net Loss = 3,100,000 - 1,700,000 - 1,000,000
= 2,400,000

Sample Solutions

Exam 06, 2008, Question 29

Solution 1

- a) ALAE included with loss -> combine loss and ALAE and treat as one loss applicable to reinsurance

Treaty is \$900,000 xs \$100,000

<u>Occurrence</u>	<u>Loss & ALAE</u>	<u>Ceded to treaty</u>
1	300,000	200,000
2	200,000	100,000
3	1,200,000	900,000
4	700,000	600,000
5	1,800,000	<u>900,000</u>
		2,700,000 – Total ceded to treaty

- b) ALAE is showed pro rata -> proportion of loss ceded is same percentage applied to ALAE to be ceded.

XOL => \$900,000 xs \$100,000

<u>Occurrence</u>	<u>Loss Ceded</u>	<u>% Ceded Loss</u>	<u>ALAE Ceded</u>	<u>Inc Loss</u>	<u>Inc ALAE</u>
1	100,000	50%	50,000	200,000	100,000
2	0	0%	0	50,000	150,000
3	900,000	90%	180,000	1,000,000	200,000
4	400,000	80%	160,000	500,000	200,000
5	900,000	60%	180,000	1,500,000	300,000
Total	2,300,000		570,000		

2,870,000 – total ceded to treaty

Solution 2

a)	Occurrence	Loss+ALAE	900xs100 Ceded
	1	300k	200k
	2	200k	100k
	3	1200k	900k
	4	700k	600k
	5	1800k	900k

Total = \$2,700,000

b)	Occurrence	Loss	900xs100 Ceded Loss	% Ceded	ALAE	Ceded ALAE
	1	200k	100k	50%	100k	50k
	2	50k	0k	0%	150k	0k
	3	1000k	900k	90%	200k	180k
	4	500k	400k	80%	200k	160k
	5	1500k	<u>900k</u>	60%	300k	<u>180k</u>
			2300k			570k

Total = \$2,870,000

Sample Solutions

Exam 06, 2008, Question 30

Solution 1

a) Nominal value x IRS discount factor = $\$1.5\text{M} \times 0.85 = \1.275M

$$AP = (AP - 1.275\text{M})(\text{tax rate}) + (\text{PV Liab} - \text{Tax on PV Unwind})$$

$$AP = (AP - 1.275\text{M})(0.35) + (1,407,737 - (0.35)(210,804))$$

$$0.65AP = 1,333,956 - 446,250$$

$$AP = \text{Ambivalence Point} = \$1,365,701$$

- b) Reinsurer is "seller" of liability, so they will be the payer in this commutation. Therefore, since $\$1.35\text{M} < AP$ in this case, reinsurer would consider $\$1.35\text{M}$ better than break-even.

Solution 2

a) PV of Liabilities = 1,407,737

$$\text{IRS discounted liabilities} = (0.85)(1,500,000) = 1,275,000$$

$$\text{PV of IRS Unwind} = 210,804$$

$$\text{Taxes of PV of Unwind} = (0.35)(210,804) = 73,781$$

$$\text{Basis for Ambivalence Point} = 1,407,737 - 73,781 = 1,333,956$$

$$\text{Ambivalence Point} = AP = (1,333,956 - (1,275,000)(0.35)) / (1 - 0.35)$$

$$AP = 1,365,701$$

- b) The reinsurer, though the seller, is paying the buyer. $\$1.35\text{M}$ is less than the Ambivalence Point, so it is better for the reinsurer.

Sample Solutions

Exam 06, 2008, Question 31

Solution 1

a)

Accident Year (1)	Dec. 31, 2007 Case-Incurred Losses (ex-CAT) (\$000) (2)	Loss Development Factor (3)	Loss Trend Factor (4)	Ex-CAT Trended Ultimate Losses (5) = (2)×(3)×(4)
2002	555	1.010	1.338	750
2003	638 = (1638 – 1000 cat)	1.025	1.262	825
2004	614	1.065	1.191	779
2005	552	1.250	1.124	776
2006	481	1.750	1.060	892
Total	\$2,840			\$4,022

Accident Year (1)	Unadjusted Historical Earned Premium (\$000) (6)	On-Level Factor (7)	Property Value Inflation Factor (8)	Projected Earned Premium (\$000) (9) = (6)×(7)×(8)
2002	1,000	1.250	1.159	1,449
2003	1,100	1.200	1.126	1,486
2004	1,210	1.120	1.093	1,481
2005	1,331	1.075	1.061	1,518
2006	1,464	1.015	1.030	1,531
Total	\$6,105			\$7,465

Non-Cat Loss Ratio = 53.9% = 4,022 / 7,465

b) **Ultimate Loss Ratio, Including Cat** = 53.9% × (1.15) = 62.0%

c) Example 1:

Combined Ratio, before Commission = 0.62 + 0.015 + 0.06 + 0.015 = 71%

Max Possible Ceding Commission Reinsurer will accept = 0.95 – 0.71 = 24%

As 27.5% > 24%, the reinsurer should reject it.

Example 2:

Combined Ratio if 27.5% ceding commission in place

0.62 + 0.275 + 0.015 + 0.06 + 0.015 = .985, the reinsurer should reject

Sample Solutions

Exam 06, 2008, Question 32

Solution 1

Treaty 1: 10% QS w/ 100K max/pol

Treaty 2: 900K x 100K per occurrence XOL w/ 5% co-part

(a)

Occurrence	G-U Loss	Treaty 1	Treaty 2
1	500K	50K	$380 = (.95) (500-100)$
2	50K	5	0
3	850K	85	712.5
4	1,150K	100	855
	\$2,550	240	1947.5

Primary Retains $2,550 - 240 - 1947.5 = 362,500$

(b) Table:

Occurrence	G-U Loss	Treaty 1	Sub to XOL	Treaty 2
1	500K	50K	450	$332.5 = (.95) (450-100)$
2	50K	5	45	0
3	850K	85	765	631.75
4	1,150K	100	1050	855
	\$2,550	240		1819.25

Primary Retains $2,550 - 240 - 1819.25 = 490.75$ \$490,750

(c) Co-participation provision used to provide an incentive for the primary to efficiency manage losses that exceed the attachment point. It requires the primary to retain a % above the attachment point.

Solution 2

- a) QS Ceded = 10% (100,000 + 50,000 + 100,000 + 100,000) = \$35,000
Per Risk Ceded = 95% (400,000 + 750,000 + 900,000) = \$1,947,500
Total Retained = 2,550,000 – 35,000 – 1,947,500 = \$567,500

b)

Occurrence	Net of QS	Per Risk	QS
1	490,000	390,000	10,000
2	45,000	0	5,000
3	840,000	740,000	10,000
4	1,140,000	900,000	10,000

total retained = 2,550,000 – 35,000 – 2030000 (.95) = \$586,500

- c) Provide primary financial incentive to settle all claims above the attach-point (in the excess layer).

Sample Solutions

Exam 06, 2008, Question 33

Solution 1

Pol	Ceded %	Primary Pays
1	$(200\,000 - 200\,000) / 200\,000 = 0\%$	150 000
2	$(1\,000\,000 - 200\,000) \text{ Cap at } 800\,000 / 1\,000\,000 = 80\%$	$500\,000 \times 20\% = 100\,000$
3	$(500\,000 - 200\,000) / 500\,000 = 60\%$	$50\,000 \times 40\% = 20\,000$
4	$(450\,000 - 200\,000) / 450\,000 = 55.55\%$	$225\,000 \times (1 - 55.55\%) = 100\,000$

Primary Net Loss = 370 000

Solution 2

4 Line Surplus => max reinsurance = $4 \times 200,000 = 800,000$

(1)	(2)	(3)	(4) = 1 - (3) / (2)	(5)	(6) = (5) / (4)
Policy #	Policy Limit	Amount xs 200k capped at 1M	Primary %	Incurred Loss	Primary Net Loss
1	200,000	0	100%	150,000	150,000
2	1,000,000	800,000	20%	500,000	100,000
3	500,000	300,000	40%	50,000	20,000
4	450,000	250,000	44%	225,000	100,000
Total					370,000

Sample Solutions

Exam 06, 2008, Question 34

Solution 1

- 1) Subjectivity: Many curves may be fit that model actual losses well for small losses but that each produce very different results in the tail. The actuary must subjectively choose the “best” fit.
- 2) Complexity: May not be easy to explain to underwriting and claims people, or senior management, who may not have a strong mathematical background.

Solution 2

- 1) Subjectivity in choosing a family of curves – Many curves will fit data below the tail, but projections for the tail can vary widely.
- 2) Complexity – Curve fitting process is difficult to explain to non-actuaries to justify results.

Sample Solutions

Exam 06, 2008, Question 35

Solution 1

- a) Not initially clear which of a group of similar claims will become large, so choose the same most likely value for all
- b) Mode may be under attachment point of treaty, so reinsurer does not learn about claim until it is known to be large, which may be several years after reported to primary insurer.
- c) There are 10 claims initially reserved at 50K per claim. 9 eventually develop to 60K, while one becomes 1M. There is a 900K XS 100K reinsurance treaty.

Primary case reserve	$10 \times 50K = 500K$
Primary IBNR	$9 \times 10K + 1 \times 50K = 140K$
Reinsurer's case reserve	0
Reinsurer's IBNR	900K

Solution 2

- a) They are reserving the claim to the most likely ultimate payment amount for that type of claim
- b) The most likely claim amount is probably not above the retention amount for the excess reinsurance contract, so the reinsurer will not even hear about the claim until it is shown to actually pierce the retention threshold
- c) Assume excess of loss reinsurance contract with a \$100,000 retention. A claim comes in for a fire to property that does not cause a total loss. The modal value for a partial loss fire is \$50,000, so the claims department reserves \$50,000 for this claim. In actuality though, the property is a large property and the amount of the loss is \$250,000. The primary insurer's IBNR need was only \$50,000 to get to their retention, but the reinsurer's IBNR need was \$150,000

Sample Solutions

Exam 06, 2008, Question 36

Solution 1

$$\begin{aligned} \text{SBELR} &= \frac{\sum \text{rpt losses}}{\sum (\text{AdjEP} \times \% \text{reported})} \\ &= \frac{8\text{K} + 8\text{K} + 7\text{K} + 6\text{K} + 4\text{K}}{[9\text{K}(0.95) + 9\text{K}(0.88) + 11\text{K}(0.75) + 13\text{K}(0.55) + 15\text{K}(0.3)]} \\ &= 33/36.37 = 0.907 \end{aligned}$$

$$\begin{aligned} \text{SBIBNR} &= \text{SBELR} \times \sum [\text{AdjEP} \times (1 - \% \text{rpt})] \\ &= 0.907 [9\text{K}(1-0.95) + 9\text{K}(1-0.88) + 11\text{K}(1-0.75) + \\ &\quad 13\text{K}(1-0.55) + 15\text{K}(1-0.3)] \\ &= 0.907 \times 20.63\text{K} \\ &= 18,711 \end{aligned}$$

Solution 2

$$\begin{aligned} \text{SBELR} &= \frac{\sum \text{Rptd losses}}{\sum (\text{Adj. Prem} * \text{Rlag})} = \frac{33,000}{36,370} = .907 \end{aligned}$$

$$\text{SBIBNR} = \text{SBELR} \times \sum [\text{AdjPrem} \times (1 - \text{Rlag})] = .907 \times 20,630 = \boxed{18,718}$$

Sample Solutions

Exam 06, 2008, Question 37

Solution 1

- a) 1) The reinsurer may want to rely on industry data if their own line of business is relatively new and the data is thin.
2) Similarly, the reinsurer's own data may be volatile because of all the rate changes and decreases. Since the industry's data is more stable, they may want to use the industry data.
- b) 1) The reinsurer may want to rely on their own data because the rate changes do not seem to be reflected in the industry Loss & LAE ratios. Since the reinsurer's experience seems to be unique, they will want to rely on their own data.
2) Similarly, the reinsurer may want to rely on their own data because the industry data may include long developing lines which may be significantly different from the lines of business they write.

Solution 2

- a) 1) Reinsurer's rate change history may not be credible.
2) There may have been a shift in the underlying policies, making the historical rate changes irrelevant.
- b) 1) The underlying policies may not be well represented by the Schedule P data. E.g. Schedule P combines all business into not many lines. A specialty product may not be represented well by its Schedule P line.
2) The actuary may believe that the reinsurer's data is credible and more representative of the specific business involved.

Sample Solutions

Exam 06, 2008, Question 38

Solution 1

Loss Ratio Range	Average in Range	Ceding Commission for Average	Probability in Range
$X \leq 20\%$	18.00%	50.00%	0.15
$20\% < x \leq 50\%$	44.00%	A	0.2
$50\% < x \leq 62.5\%$	57.50%	B	0.25
$x > 62.5\%$	80.00%	27.50%	0.4

$$A = 40\% + (1/3) \times (50\% - 44\%) = 42\%$$

$$B = 27.5\% + 1 \times (62.5\% - 57.5\%) = 32.5\%$$

$$\begin{aligned} \text{Expected ceding commission} &= 50\% \times 0.15 + 42\% \times 0.20 + 32.5\% \times 0.25 + 27.5\% \times 0.40 \\ &= 35.025\% \end{aligned}$$

Solution 2

LR Range	Expected ceding commission	Prob
≤ 20	50%	0.15
20-50	$50 - (44 - 20)/3 = 42\%$	0.2
50-62.5	$40 - (52.5 - 50) = 32.5\%$	0.25
62.5+	27.5%	0.4
Sumproduct =		35.03%

Sample Solutions

Exam 06, 2008, Question 39

Solution 1

Average Accident Date → 7/1/08

Date of Loss	Amount (000s)	Trend (Yrs)	Trended Amount	In Layer (500 xs 100)	LDFs	Trended Loss In Layer (limit 500k)
1/1/2000	200	8.5	279.134	179.134	1	179.134
1/1/2001	200	7.5	268.398	168.398	1	168.398
7/1/2001	225	7	296.085	196.085	1	196.085
7/1/2002	600	6	759.000	500.000	1.05	500.000
1/1/2004	475	4.5	566.680	466.680	1.3	500.000
7/1/2005	90	3	101.237	1.237	1.5	1.855
						1,545.473

Solution 2

Trend to 7/1/08

Loss Year	Ground Up × Trend	Trended Loss In Layer = (1)
2000	$200k \times (1.04)^{8.5} = 279,134$	179,134
2001	$200k \times (1.04)^{7.5} = 268,398$	168,398
2001	$225k \times (1.04)^7 = 296,085$	196,085
2002	$600k \times (1.04)^6 = 759,191$	500,000
2004	$475k \times (1.04)^{4.5} = 566,688$	466,688
2005	$90k \times (1.04)^3 = 101,238$	1,238

Loss Year	Developed Trended Loss in Layer = (1) × LDF
00	179,134
01	168,398
01	196,085
02	500,000 *max
04	500,000 *max
05	1,857
1,545,474	

Sample Solutions

Exam 06, 2008, Question 40

Solution 1

- a) $30\% \times 10\% = 3\%$
 $30\% \times 20\% = 6\%$
 $10\% \times 25\% = 2.5\%$
 $5\% \times 40\% = 2\%$

The weighted impact shows “Profit margin fall in industry” is the highest risk.

- b) “A new competitor enters the market” and “Profit margins fall in industry” are negatively correlated. When there is less profit margin, competitor is less likely to enter the industry.

“Industry-wide demand decreases” and “Profit margins fall in industry” are positively correlated. When demand decreases, the price will drop, then the profit margin will decrease.

- c) Since “A new competitor enters the market” is negatively correlated with “Profit margin fall”, and “Decrease in demand” is positively correlated with “Profit margin fall”, “Industry-wide demand decreases” can be the second largest risk.

Solution 2

- a) $.3(.1) = .03$
 $.3(.2) = .06$
 $.1(.25) = .025$
 $.05(.4) = .02$

The greatest risk is that profit margins will fall in the industry because it has the greatest expected value of income impact.

- b) Industry-wide demand decreases + Profit margins fall in industry (positively correlated) - if demand falls, companies will have to lower their rates to attract business, which will depress profit margins

Industry-wide demand decreases + A new competitor enters the market (negatively correlated) – if demand decreases, the market will be less attractive to companies that were considering entering.

- c) The second greatest risk should be chosen giving more weight to risks that are positively correlated to the greatest risk & less weight to those that are negatively correlated.

Sample Solutions

Exam 06, 2008, Question 41

Solution 1

- a)
 - 1. The monthly meetings and reports to management are consistent with ERM definition in that they are following a systematic process that involves senior management.
 - 2. They are trying to exploit risk, not just manage it.

- b)
 - 1. The risks discussed are only financial risks. All risks (hazard, operational, strategic and financial) should be considered.
 - 2. The focus on improving quarterly results and increasing share price diverges from the ERM definition in that the goal should be increasing both short- and long-term value to all stakeholders (share and debtholders, employees, managers & officers, customers, community).

Solution 2

- a) ERM is a discipline – it requires a disciplined approach such as having regular meetings to assess risk position.

It involves management – they report to senior management and get feedback from them to improve their risk handling process.

- b) They do not address all types of risks – they address only financial risk.

They only focus on share price – they should focus on increasing value to all stakeholders, not just shareholders (example: how do they increase customers' value?)

Sample Solutions

Exam 06, 2008, Question 42

Solution 1

Severity – the amount of earnings or market value at risk

Probability – the chance that the business will suffer a risk and at which severity

Timing – when will the business suffer the risk

Change in Probability over Time – the probability of the risk taking place may change over time.

Solution 2

1. Assess the severity each risk possesses – what % of company value can be impacted from the risk? Relative to other risk?
2. Probability – what is the chance the risk will materialize and impact the enterprise
3. Timing – when is the risk expected to occur? In accordance with new regulation?
4. Changing Probability over Time – is there a time when the probability of the risk materializing peaks or increases or decreases?