Exam 8

CASUALTY ACTUARIAL SOCIETY
AND THE
CANADIAN INSTITUTE OF ACTUARIES

Exam 8

Advanced Ratemaking

October 29, 2014

4 HOURS

INSTRUCTIONS TO CANDIDATES

1. This 60.25 point examination consists of 25 problem and essay questions.

2. For the problem and essay questions, the number of points for each full question and part of a question is indicated at the beginning of the question or part. Answer these questions on the lined sheets provided in your Examination Envelope. Use dark pencil or ink. Do not use multiple colors or correction fluid/tape.

   - Write your Candidate ID number and the examination number, 5, at the top of each answer sheet. 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.

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.

CONTINUE TO NEXT PAGE OF INSTRUCTIONS

- Verify that you have received the reference materials:

  a. National Council on Compensation Insurance, Experience Rating Plan Manual for Workers Compensation and Employers Liability Insurance (*Excerpt from 2014 Study Kit*).
  b. Insurance Services Office, Inc., Commercial General Liability Experience and Schedule Rating Plan.
  c. National Council on Compensation Insurance, Retrospective Rating Plan Manual for Workers Compensation and Employers Liability Insurance (*Excerpt from 2014 Study Kit*).

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 November 17, 2014.

END OF INSTRUCTIONS

1. (1.25 points)

An actuary has devised a new method to assign credibility to observations of severity relativities by state. In order to test the validity of the method, the following quintile test has been prepared. The actuary has split the data into two distinct partitions: Test and Holdout. Test data was used to predict the credibility-adjusted relativities of the holdout data.

Quintile	Holdout Relativity	Prediction Based on Countrywide Average	Prediction Based on Raw Test Data	Prediction Based on New Credibility Procedure
1	0.55	1.00	0.25	0.90
2	0.75	1.00	0.40	0.95
3	0.90	1.00	0.85	0.99
4	1.30	1.00	1.40	1.05
5	1.50	1.00	2.10	1.10
Mean	1.00	1.00	1.00	1.00
Sum of Squared Errors		0.6150	0.5850	0.3931

a. (0.75 point)

Describe whether this new method overstates or understates the credibility of the state relativities.

b. (0.5 point)

Discuss whether the new method or the countrywide average should be used to determine state relativities.

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2. (1 point)

In their 2007 review of hazard group mappings, the National Council of Compensation Insurance (NCCI) chose to continue to use the following formula to calculate the credibility by class:

$$z = \min\left(\frac{n}{n+k} \times 1.5,\ 1\right)$$

where
n = number of claims in the class
k = average number of claims per class

The following table shows the distribution of classes by credibility range using the credibility formula above:

Credibility Range	Claims per Year	Number of Classes	Percent of Premium
$0\% \le z < 10\%$	0 - 237	355	1.2%
$10\% \le z < 20\%$	238 - 511	89	1.3%
$20\% \le z < 30\%$	512 - 831	61	1.6%
$30\% \le z < 40\%$	832 - 1209	56	2.7%
$40\% \le z < 50\%$	1210 - 1662	46	2.5%
$50\% \le z < 60\%$	1663 - 2216	34	2.5%
$60\% \le z < 70\%$	2217 - 2909	46	4.8%
$70\% \le z < 80\%$	2910 - 3799	35	4.3%
$80\% \le z < 90\%$	3800 - 4987	29	4.0%
$90\% \le z < 100\%$	4988 - 6649	18	3.2%
$z = 100\%$	≥ 6650	101	71.8%
Total		870	100.0%

a. (0.5 point)

Based on the table above, discuss one consideration when deciding whether to use this credibility formula.

b. (0.5 point)

Briefly describe two alternative methods that could be used to calculate credibility by class.

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3. (2 points)

The random component of a generalized linear model must come from the exponential family of distributions.

The variance of a distribution from the exponential family can be expressed using the following formula:

$$Var(Y_i) = \frac{\phi V(\mu_i)}{\omega_i}$$

a. (0.5 point)

Define the parameters ϕ and ω_i in the formula above.

b. (1 point)

For each of the data sets below, identify the error distribution that should be used to model the data. Briefly explain why that error distribution is appropriate.

i. Severity

ii. Policy Renewal Retention

c. (0.5 point)

For each of the error distributions in part b. above, provide an example of how ω_i should be assigned for the type of data being modeled.

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4. (1.5 points)

One approach for estimating excess ratios by individual class in workers compensation insurance is to use a multi-dimensional credibility technique.

According to each of the three statistical considerations listed below, explain whether this technique is an improvement over estimating excess ratios by hazard group:

i. Homogeneity

ii. Credibility

iii. Predictive Stability

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5. (2.5 points)

The following data shows the experience of a merit rating plan for a specific state.

Number of Accident-Free Years	Earned Car Years	Earned Premium ($000)	Number of Incurred Claims
3 or More	250,000	250,000	1,200
2	300,000	100,000	625
1	25,000	100,000	750
0	12,000	150,000	1,500
Total	587,000	600,000	4,075

The base rate is $1,000 per exposure. No other rating variables are applicable.

a. (0.5 point)

The typical exposure base used to develop the merit rating plan is earned premium. Briefly discuss two assumptions in selecting this exposure base.

b. (1.5 points)

Calculate the ratio of credibility for an exposure with two or more years accident-free experience to one or more years accident-free experience.

c. (0.5 point)

Calculate the premium for an exposure that is accident free for two or more years.

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6. (3.5 points)

Losses on a policy have the following distribution:

- 60% probability of a loss between $0 and $250,000
- 30% probability of a loss between $250,000 and $500,000
- 10% probability of a loss between $500,000 and $1 million

Losses are uniformly distributed within each range. Assume a 20% trend is applied uniformly to all losses.

a. (1.5 points)

Draw a diagram depicting the cumulative loss distribution described above before and after the 20% trend. Label all relevant features of the diagram.

b. (2 points)

Calculate the implied trend for the layer $500,000 excess of $500,000.

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7. (1.75 points)

An insurer currently offers the following coverage limits at actuarially sound premiums.

Limit	Premium
$100,000	$350
250,000	700

Next year, underwriting would like to offer additional coverage options. The following premiums are under actuarial review.

Limit	Premium
$500,000	$1,000
1,000,000	1,800

Argue for and against the actuarial soundness of these new premiums as they relate to the lower-limit options.

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8. (2.5 points)

An actuary is pricing a one-year commercial general liability occurrence policy. The following information is available:

- Renewal effective date is January 1, 2014
- Losses are evaluated as of September 1, 2013

Effective Date of Policy	Company Subject Loss Costs
January 1, 2013	$35,700
January 1, 2012	50,300
January 1, 2011	40,300
January 1, 2010	32,600
January 1, 2009	22,500

Date of Loss	Paid & Outstanding Loss Amounts	ALAE
July 21, 2013	$2,000	$0
September 7, 2012	10,000	0
April 1, 2011	100,000	20,000
November 13, 2010	40,000	0
February 14, 2010	70,000	0
May 5, 2009	12,000	0

Given that the experience modification is equal to 0.443, calculate the adjustment to reflect the ultimate level of loss.

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9. (2 points)

An actuary is pricing an account that qualifies under a single-split experience rating plan. The account's actual losses during the experience rating period are:

Claim	Loss and ALAE
1	$8,000
2	21,000
3	3,000
4	11,500

The following information is also available:

Split point:	$10,000
Primary credibility:	0.80
Excess credibility:	0.20
Expected loss:	30,000
Loss-free modification:	0.60

Calculate the experience modification.

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10. (2.25 points)

The National Council of Compensation Insurance (NCCI) has proposed making the following three changes to its Experience Rating Plan:

1. Increasing the effect of medical-only losses.
2. Giving zero credibility to excess losses.
3. Keeping the primary-excess split of actual losses at a constant value of $10,000 for the next 10 years.

a. (1.5 points)

Evaluate each of these changes with respect to the following goals of experience rating:

- Safety incentive
- Predictive accuracy

b. (0.75 points)

Briefly discuss each of the proposed changes' effect on the experience modification of an insured that has historically experienced worse than class average claim frequency, but has never had a loss greater than $10,000.

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11. (2.5 points)

The following formula is used by the National Council of Compensation Insurance (NCCI) to calculate workers compensation experience modifications under its Experience Rating Plan:

$$M = \frac{A_p + WA_e + (1-W)E_e + B}{E + B}$$

where $W = \frac{E-B}{E+K}$ and B and K vary by size of risk.

a. (0.5 point)

Explain the assumptions behind the theory that B and K should be constant for all risk sizes.

b. (0.5 point)

Critique the theory that B and K should be constant for all risk sizes.

Suppose a new experience rating plan is proposed such that B and K are constant for all risk sizes.

c. (1 point)

Fully explain a valid method that can be used to assess the performance of the proposed plan as compared to the current NCCI plan.

(0.5 point)

Assess the impact of implementing the newly proposed experience rating plan in a competitive market.

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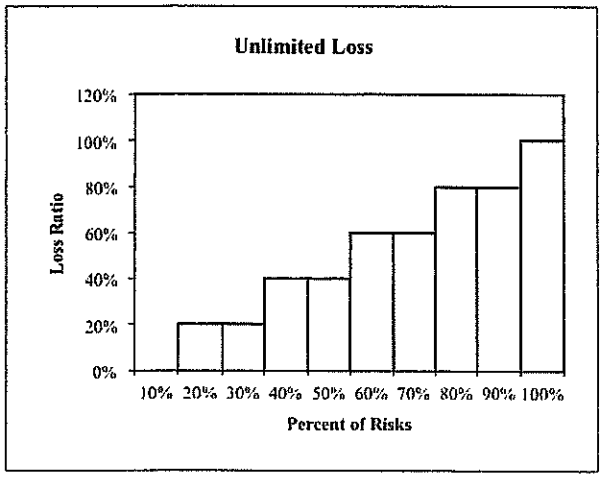
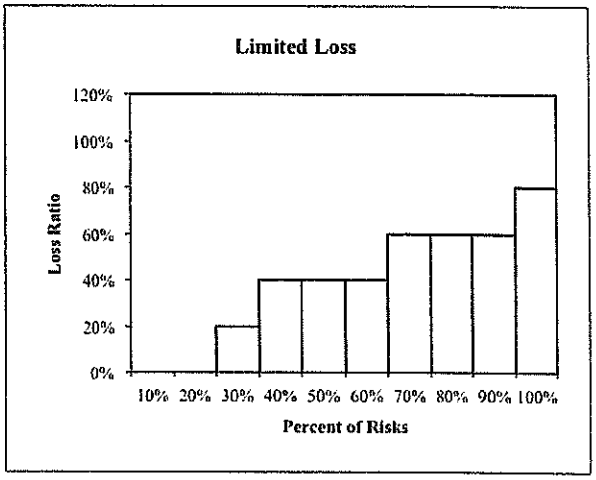
12. (3 points)

The following Lee diagrams depict the loss experience of a group of 10 similar risks; one for unlimited losses and the other for limited losses.





a. (2.25 points)

Calculate the Table L charges at loss ratios of 0% to 100% in 20% increments.

b. (0.75 point)

Describe what the Table L savings at an entry ratio of 0.4 reflects, assuming an expected unlimited loss of $500,000 and a per accident limit of $100,000.

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13. (2 points)

A Table M is constructed based on the experience of the following 10 similarly sized risks:

Risk	Aggregate Loss Ratio
1	10%
2	30%
3	35%
4	40%
5	60%
6	75%
7	X%
8	90%
9	110%
10	120%

X is the aggregate loss ratio for Risk 7.

Assume:

- $75\% \leq X \leq 90\%$
- The Table M charge at entry ratio 1.5 is 0.05.

Calculate X.

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14. (3.75 points)

An actuary is pricing an excess workers compensation policy with the following characteristics:

- Excess loss pure premium factors are based on empirical data for losses and ALAE up to $250,000 and a fitted curve for losses greater than $250,000
- $1,000,000 attachment point
- No aggregate limit

Historical adjusted data for similarly sized risks:

Loss Amount	Probability
$20,000	70%
100,000	14%
250,000	8%
500,000	5%
750,000	2%
1,000,000	1%

Standard Premium:	$500,000
ULAE as Ratio of Loss+ALAE:	6.0%
General Expense:	2.0%
Acquisition Expense:	5.0%
Tax:	3.0%
Profit and Contingency Margin:	-10.0%

- Empirical data has been truncated and shifted at $250,000 and normalized to a unity mean.
- A mixed Exponential-Pareto curve has been fit to the resulting mean residual lives as described by the following parameters:

<<QUESTION 14 CONTINUED ON NEXT PAGE>>

Distribution	Pareto	Exponential
Cumulative Function	$1-\left(1+\frac{x}{b}\right)^{-s}$	$1-e^{-x/c}$
Mean	$\frac{b}{s-1}$	C
Variance	$\frac{b^2 s}{(s-1)^2(s-2)}$	c^2
Excess Ratio	$\left(1+\frac{x}{b}\right)^{1-s}$	$e^{-x/c}$
Mean Residual Life	$\frac{b+x}{s-1}$	C
Shape	4.0	n/a
Scale	12.0	0.8
Weight	0.050	0.950

Calculate the premium for this policy.

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15. (2.75 points)

The balanced plan provisions for a 2014 workers compensation risk are:

Standard Premium:	$6,000,000
Expected Loss (Ratio to Standard Premium):	0.5
Minimum Entry Ratio, r_H:	0.15
Maximum Entry Ration, r_G:	2.52
Basic Premium (Ratio to Standard Premium):	0.2766
Loss Conversion Factor:	1.25
Tax Multiplier:	1.08
State Hazard Group Differential:	0.95

Assume that in the following year the endpoints of the expected loss size ranges in the NCCI Retrospective Rating Manual are increased by 10% to reflect assumed inflation.

Calculate the expected shortfall, as a percentage of 2015 expected retrospective premium, from failing to update the expected loss size ranges.

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16. (4 points)

A company experiences an annual level of low-severity losses totaling $500,000 and periodic loss events as shown in the table below:

Period of Occurrence	Descriptor	Loss Amount
Once every Five years	Additional Low Severity Losses	$2,000,000
Once every Three years	Single Large Loss	$1,000,000

All loss events are independent of each other.

a. (1.25 points)

The company and their insurer agree on a Large Dollar Deductible (LDD) policy with the following characteristics:

- minimizes effect of a single large loss
- guarantees reimbursable loss will not exceed $2,000,000
- results in expected annual reimbursable loss of $1,000,000

Design an LDD plan that meets the goals of the company. Note that the expected losses can be expressed as a function of the aggregate maximum and the per occurrence limit.

b. (1.75 points)

Construct a Lee diagram showing the effect of the designed LDD plan structure on the loss profile of the company.

c. (1 point)

The company is also considering a retrospective policy with the following characteristics:

- no per-occurrence limit
- same maximum entry ratio as in the LDD plan above

Assume the single large loss had an expected value of $500,000 instead of $1,000,000. Describe the change to the Table M charge for the retrospective plan compared to the charge described in the LDD plan in a. above.

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17. (3.5 points)

A large insured is considering a retrospectively rated policy for its workers compensation coverage with the following characteristics:

Standard premium:	$1,000,000
Unlimited expected loss ratio:	65%
Expense ratio:	20%
Loss conversion factor:	1.10
Premium tax rate:	4.0%
Maximum premium:	$1,200,000
Minimum premium:	$750,000

The actuary will use the following tables for rating:

Entry Ratio	Expected Loss Group (ELG)					
	31	30	29	28	27	26
0.70	0.4026	0.4000	0.3975	0.3949	0.3924	0.3898
0.80	0.3912	0.3826	0.3740	0.3656	0.3581	0.3489
0.90	0.3519	0.3426	0.3334	0.3242	0.3189	0.3060
1.00	0.3135	0.3037	0.2938	0.2839	0.2809	0.2642
1.10	0.2777	0.2673	0.2570	0.2464	0.2416	0.2254
1.20	0.2519	0.2413	0.2307	0.2200	0.2093	0.1986
1.30	0.2300	0.2194	0.2088	0.1981	0.1874	0.1766
1.40	0.2081	0.1975	0.1868	0.1761	0.1654	0.1547
1.50	0.1863	0.1756	0.1649	0.1542	0.1435	0.1327
1.60	0.1644	0.1537	0.1429	0.1322	0.1215	0.1107

ELG	Expected Loss Range
31	630,000 - 720,000
30	720,001 - 830,000
29	830,001 - 990,000
28	990,001 - 1,180,000
27	1,180,001 - 1,415,000
26	1,415,001 - 1,744,000

Per Occurrence Limit	Excess Loss Factor
$50,000	0.214

a. (0.5 point)

Determine the guaranteed cost premium.

<<QUESTION 17 CONTINUED ON NEXT PAGE>>

b. (2.25 points)

Determine the basic premium for a $50,000 per occurrence limit.

c. (0.75 point)

The insured's risk manager believes the retrospective premium can be reduced by selecting a higher per occurrence limit because the insured will assume a greater portion of the losses.

Evaluate the risk manager's assertion.

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18. (2.5 points)

An actuary prices a retrospectively rated policy with the following provisions resulting in a balanced plan:

Minimum premium:	17,500
Maximum premium:	80,000
Expense provision:	8,125
Loss conversion factor:	1.25

- Aggregate losses follow a uniform distribution between $0 and $100,000
- No taxes

After pricing the policy, the actuary discovers an error in the original loss distribution and determines that losses should instead follow a uniform distribution between $0 and $90,000. The actuary decides to re-balance the plan based on the corrected distribution while still maintaining the same minimum and maximum premium.

Calculate the loss at minimum premium and loss at maximum premium that re-balance the plan.

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19. (2.75 points)

A company is considering options for a workers compensation policy with the following parameters:

Item	Value	Applicable to:
Standard Premium	$1,000,000	
Expected Loss and ALAE	900,000	
Per Occurrence Deductible	250,000	Loss and ALAE
Aggregate Limit	1,000,000	Loss and ALAE
ULAE	7.0%	Loss and ALAE
Loss Based Assessment	5.0%	Loss and ALAE
General Overhead	5.0%	Standard Premium
Credit Risk	4.0%	Standard Premium
Acquisition Expense	5.0%	Net Premium
Profit and Contingency	2.5%	Net Premium
Tax and Assessment	8.0%	Net Premium

Limit	ELPPF	Entry Ratio	Insurance Charge
$250,000	0.20	1.11	0.18
500,000	0.09	1.25	0.13
750,000	0.06	1.39	0.09
1,000,000	0.03	1.50	0.06

a. (1 point)

Calculate the premium for a large dollar deductible (LDD) policy.

b. (0.75 point)

Identify three reasons why an employer might choose an LDD Plan.

<<QUESTION 19 CONTINUED ON NEXT PAGE>>

c. (0.5 point)

Assume the following revised assumptions for an excess workers compensation (WC) policy:

- Profit and Contingency = -1.5%
- Tax and Assessment = 3%

Calculate the revised premium.

d. (0.5 point)

Describe the difference in profit and tax assumptions for LDD and excess WC policies.

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20. (1.5 points)

An insurer is evaluating the experience of an annual umbrella policy that is renewing on April 1, 2015.

Attachment Point:	$3,000,000
Policy Limit:	10,000,000

- The insurer paid a $4,000,000 claim for a loss that occurred on July 1, 2014.
- Trend is applied to the midpoint of a prospective policy year

a. (0.75 point)

The insurer has trended the July 1, 2014 claim to $4,395,940. Determine the insurer's annual trend factor.

b. (0.75 point)

Explain how the upward drift of policy limits and attachment points on the underlying and umbrella policies can distort the trending of historical losses and if the trended claim would likely be overstated or understated had the loss occurred in 2004.

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21. (3.5 points)

Company A is pricing an umbrella policy with an effective date of July 1, 2014 for a large commercial risk that is written above Company B's underlying layer. Company A is considering various options for the treatment of allocated loss adjustment expenses (ALAE).

a. (2 points)

Fully explain how the following options rank with respect to the relative cost of the umbrella policy:

1. ALAE is included within both the underlying and umbrella limits.
2. ALAE is in addition to both the underlying and umbrella limits.
3. ALAE is included within the underlying layer's limit, but is in addition to the umbrella's limit.

b. (1 point)

The following loss history of the risk is provided by Company B below:

Date of Loss	Paid Loss	Paid ALAE	Reserved Loss	Reserved ALAE
September 16, 2009	$240,030	$324,235	$0	$0
December 14, 2009	43,658	8,750	0	0
March 1, 2010	2,000,000	140,000	0	0
March 14, 2010	50,000	891,320	0	0
August 11, 2010	0	75,500	25,000	174,500
January 2, 2011	1,257,902	124,870	0	0
March 14, 2012	200,000	45,040	1,800,000	55,960
July 1, 2012	32,320	175,340	0	0
November 30, 2012	1,000,000	22,430	1,000,000	250,000

Explain two reasons why the pricing actuary for Company A should be wary of using the historical data to determine the ALAE load.

c. (0.5 point)

The pricing actuary has been asked to opine on the treatment of ALAE for a clash cover excess treaty. The actuary states that because penetration of high excess layers is infrequent, the calculation of ALAE is difficult and the loading is insignificant. Evaluate this statement.

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22. (2.5 points)

The following information is given for a one-year reinsurance treaty effective January 1, 2012.

Risk	Effective Date	Insured Value	Loss	Loss Date
1	June 1, 2011	$200,000	$100,000	March 1, 2012
2	January 1, 2012	500,000	400,000	June 1, 2012
3	June 1, 2012	1,500,000	1,500,000	September 1, 2012

a. (0.5 point)

Calculate the reinsurer's loss liability for a 30% quota share agreement written on a risks attaching basis.

b. (1 point)

Calculate the reinsurer's loss liability for a 5-line surplus share agreement written on a losses occurring basis with a retained line of $100,000.

c. (1 point)

The primary insurance company purchased a treaty on a risks attaching basis for the time period from January 1, 2013 to December 31, 2013 time. They then decided to purchase the same treaty but on a losses occurring basis for the time period from January 1, 2014 to December 31, 2014.

Describe a coverage issue that could arise with these two treaties. Explain how the ceding company and reinsurer can structure the treaties to avoid this issue.

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23. (2 points)

While negotiating the terms of a quota share treaty, a reinsurer is considering an agreement with a sliding scale commission and an agreement with a loss corridor.

The terms of the sliding scale commission are as follows:

Provisional Commission:	20% at a 65% loss ratio
Sliding 1:1 to a minimum:	10% at a 75% loss ratio
Sliding 0.5:1 to a maximum:	30% at a 45% loss ratio

The terms of the loss corridor are as follows:

Commission:	15%
Loss Corridor:	60% of 75% to 85% loss ratio

The expected loss ratio is 73%

a. (0.5 point)

Assume that the ceding company is interested in optimizing the amount and the timing of cash flows. Identify and briefly describe one advantage of the sliding scale commission option when compared to the loss corridor option.

b. (1 point)

The insurer and reinsurer agree that the performance of the underlying business is highly volatile. Describe two ways the insurer can stabilize its results for its sliding scale commission structure over time.

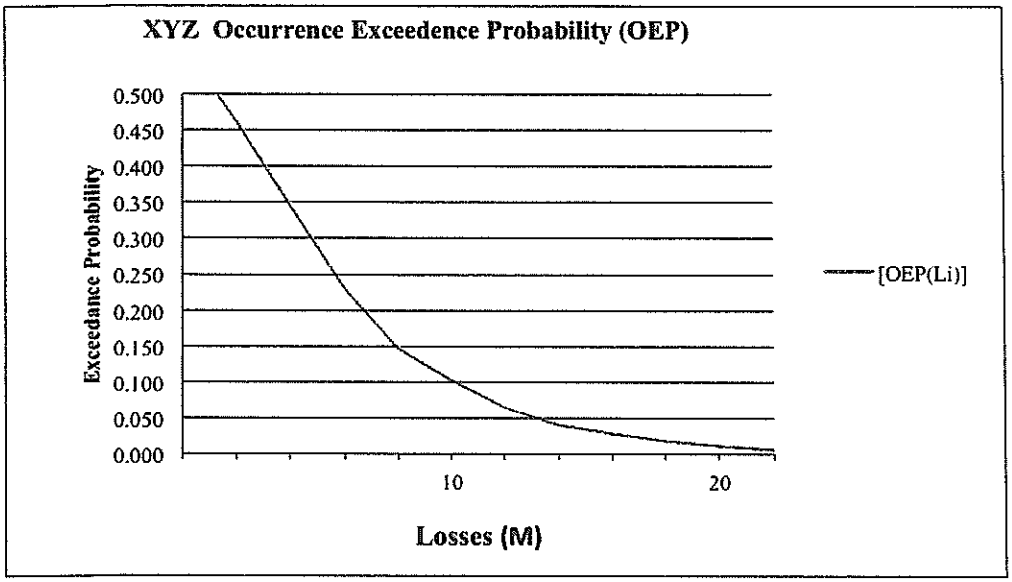
c. (0.5 point)

Explain whether the smoothing mechanisms in part b. above should be used in the determination of an aggregate loss distribution model.

CONTINUED ON NEXT PAGE

24. (2.25 points)

A reinsurer is offering a property catastrophe cover of $10,000,000 in excess of $10,000,000 per occurrence with one reinstatement to an insurer. The reinsurance broker produces a catastrophe model with the following output for losses in excess of $10,000,000.



a. (0.5 point)

Calculate the pure premium using the payback approach.

b. (0.5 point)

The treaty incepts on July 1, 2014 with a premium of $1,200,000. The insurer experiences a catastrophe loss on December 1, 2014 resulting in total loss amount of $15,000,000. Calculate the reinstatement premium given the reinstatement provision is 115% pro-rata as to amount.

a. (1.25 points)

The insurer also purchases a 30% quota share treaty which inures to the benefit of the catastrophe treaty. Calculate the amount paid under each treaty and the insurer's net loss.

CONTINUED ON NEXT PAGE

25. (1.5 points)

An actuary is using exposure rating to calculate increased limit factors for an auto liability treaty. The actuary has selected a severity distribution for the exposures being considered. The expected value function of losses capped at L is:

$$E[x; L] = 30 + 900(1 - ln(1000/L))$$

Additionally, the actuary has the following information:

- All of the ceding company's underlying policy limits are $1,000,000
- The reinsurance treaty attachment point is $250,000
- The reinsurance treaty limit is $750,000

a. (1 point)

Calculate the exposure factor.

b. (0.5 point)

Calculate the ground up expected loss if the estimated loss cost of the treaty layer is $243,500.

END OF EXAMINATION

Exam 8
Advanced Ratemaking

October 29, 2014

POINT VALUE OF QUESTIONS

QUESTION	VALUE OF QUESTON	SUB-PART OF QUESTION (a)	(b)	(c)	(d)	(e)	(f)	(g)
1	1.25	0.75	0.50					
2	1.00	0.50	0.50					
3	2.00	0.50	1.00	0.50				
4	1.50							
5	2.50	0.50	1.50	0.50				
6	3.50	1.50	2.00					
7	1.75							
8	2.50							
9	2.00							
10	2.25	1.50	0.75					
11	2.50	0.50	0.50	1.00	0.50			
12	3.00	2.25	0.75					
13	2.00							
14	3.75							
15	2.75							
16	4.00	1.25	1.75	1.00				
17	3.50	0.50	2.25	0.75				
18	2.50							
19	2.75	1.00	0.75	0.50	0.50			
20	1.50	0.75	0.75					
21	3.50	2.00	1.00	0.50				
22	2.50	0.50	1.00	1.00				
23	2.00	0.50	1.00	0.50				
24	2.25	0.50	0.50	1.25				
25	1.50	1.00	0.50					
TOTAL	60.25							

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

GENERAL COMMENTS

- This exam was considered to be longer and more difficult than previous exams. There were several errors in the exam that are pointed out in the commentary of each affected question. These errors may have contributed to the perceived difficulty and length of the exam as they may have unintentionally confused candidates. As a result, the pass score was selected to reflect the impact both the length of the exam and the errors may have had on the candidates' performance.
- Candidates should note that the instructions to the exam explicitly say to show all work; graders expect to see enough support on the candidate's answer sheet to follow the calculations performed. While the graders made every attempt to follow calculations that were not well- documented, lack of documentation may result in the deduction of points where the calculations cannot be followed or are not sufficiently supported.
- Incorrect responses in one part of a question did not preclude candidates from receiving credit for correct work on subsequent parts of the question that depended upon that response.
- Candidates should try to be cognizant of the way an exam question is worded. They must look for key words such as "briefly" or "fully" within the problem. We refer candidates to the Future Fellows article from December 2009 entitled "The Importance of Adverbs" for additional information on this topic.
- Some candidates provided lengthy responses to a "briefly describe" question, which does not provide extra credit and only takes up additional time during the exam.
- Candidates should be cautious of relying solely on study manuals, as some candidates lost credit for failing to provide basic insights that were contained in the syllabus readings.

EXAM STATISTICS

- Number of Candidates: 729
- Available Points: 60.25
- Passing Score: 37.50
- Number of Passing Candidates: 350
- Raw Pass Ratio: 48.01%
- Effective Pass Ratio: 50.22%

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 1

TOTAL POINT VALUE: 1.25 **LEARNING OBJECTIVE: A2**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1

New method understates the credibilities. New method has lower relativities than holdout at higher risks and larger relativities at lower risks. Thus, it gives too little credibility to actual experience.

Sample 2

Quintile	Pred/Holdout
1	1.636
2	1.267
3	1.100
4	0.808
5	0.733

Above should show no pattern, but it is decreasing

⇨ credibility is understated since predictions are not reacting enough to raw data

Part b: 0.5 point

The new method should be used since it has the lowest SSE from the quintile test

EXAMINER'S REPORT

General Commentary

- The candidate was expected to have a basic understanding of the credibility approach described in Courier & Venter
- Candidates largely received partial credit, most received full credit on part b

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part a

- Overall, some candidates received full credit but most candidates received partial credit.
- Candidates were expected to have a basic understanding of the Couret & Venter credibility procedure
- In order to receive full credit a candidate needed to:
  - Correctly identify that credibility was understated
  - Describe the relationship between the raw, holdout, and new credibility predictions
- Common errors made by candidates:
  - Incorrectly assuming that increasing relativities by quintile meant credibility was understated. The proper assumption would have been that the ratio of holdout to prediction increasing would imply that credibility was understated.
  - Some candidates incorrectly assumed the new credibility procedure should be similar in magnitude to the raw data rather than the holdout data
  - Trying to relate a lower SSE to understated credibility

Part b

- Most candidates received full credit.
- Candidates were expected to identify the model with the lowest SSE (given) and state that as reasoning
- In order to receive full credit a candidate needed to:
  - Correctly select the new credibility procedure
  - Identify that the new method has the lowest SSE
- Common errors made by candidates:
  - Not selecting the new method due to incorrectly assuming that increasing relativities by quintile meant credibility was understated. (see part a)

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 2

TOTAL POINT VALUE: 1 **LEARNING OBJECTIVE: A1**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

Need to consider the amount of premium in each range. The above table shows most premium is in the Z=100%

Sample 2

K is based on the average # of claims per class, there are a large number of classes that represent a small portion of the premium and have very few claims, and opposite more premium and higher frequency for a fewer number of classes in high range, so the range may be skewed and the average may not be the best to use

Sample 3

What size of class is required to achieve full credibility – in this case a class must have at least 6650 claims.

Part b: 0.5 point

Any of the following responses received 0.25 point. Two correct responses received full credit.

- Could replace k with the median claims per class
- Could include serious claims only rather than all claims
- Square root rule
- Eliminate med-only claims
- Multi-dimensional credibility
- Classical/Limited Fluctuation credibility
- Bayesian credibility
- K = EPV/VHM
- Exposures
- Expected Loss
- Volatility of loss
- Varying full credibility standard by injury type
- Variation on square root giving more importance to serious claims
- Only include classes with a minimum number of claims in the calculation of k

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

EXAMINER'S REPORT

Part a

- The candidate was expected to provide a relevant credibility consideration and a connection to the table.
- Many candidates did not receive full credit because
  - A credibility consideration was provided, but with no connection to the table
  - A relevant observation of the table was made, but no consideration was provided
  - A basic credibility consideration was provided, but one that was already known to be true given Buhlman credibility was used (e.g. credibility must be between 0 and 1)

Part b

- The candidate was expected to provide 2 possible alternative credibility methods
- Many candidates did not receive full credit because
  - The method described was not different than the current method. For example, the provided formula is a Buhlman formula and changing the scalar is not a different method.
  - The method described was not valid or not well described. Examples include using the mode, premium, expected claims, splitting primary and excess, changing k to a different constant.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 3

TOTAL POINT VALUE: 2 **LEARNING OBJECTIVE: A3**

SAMPLE ANSWERS

Part a: 0.5 point

Sample responses for defining φ

- Scale
- Shape
- Dispersion

Sample responses for defining ω_i

- Prior weights
- Credibility

Part b: 1 point

Sample responses for Severity

- Gamma error distribution as it has a longer tail and produces only positive outcomes. Good fit for severity modeling.
- Gamma error distribution because it is invariant to measures of currency.
- Gamma error distribution because variance proportional to x^2. This will naturally assign higher variance to higher expected values which is appropriate for severity.

Sample responses for Renewal Retention

- Binomial error distribution as the retention is either a yes/no outcome and the binomial is a good fit when modeling a 0 vs. 1 outcome.
- Binomial error distribution because it is invariant to probabilities of success or failure.

Part c: 0.5 point

Sample responses for Severity: ω_i =

- claim count
- 1 for each claim

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Sample responses for Retention: $\omega_i =$

- 1
- # policies available for renewal
- # years with company

EXAMINER'S REPORT

General Commentary

Candidates were expected to know the components of a GLM formula for typical model forms. Candidates overall scored very well on this question.

Part a

- Candidates were expected to identify the scale and prior weights parameters of the GLM variance formula.
- Candidates overall scored very well on this part. The majority of candidates earned full credit.
- There were no common errors on this part.

Part b

- Candidates were expected to know the appropriate error distribution for common model forms and be able to list a reason supporting the selected distribution.
- Candidates scored well on this part. The majority of candidates earned full credit.
- Common errors were listing a link function instead of the error distribution or listing the error distribution without a supporting reason.

Part c

- Candidates were expected to know the appropriate prior weights for common model forms.
- This was the most difficult part of the problem for candidates. The majority of candidates earned half credit or more.
- Common errors were listing prior weights for a different model form.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 4

TOTAL POINT VALUE: 1.5 **LEARNING OBJECTIVE: A1, A2**

SAMPLE ANSWERS

Sample responses for Homogeneity

Sample 1

Yes, multi-dimensional credibility technique for individual classes could be viewed as an improvement over estimating excess ratios by hazard group from a homogeneity standpoint, because at a hazard group level there could be greater variance within the hazard group, whereas we would expect lower within variance at the class level and thus greater homogeneity.

Sample 2

The class excess ratios are an improvement in homogeneity over the hazard group excess ratio because each of the individual risks in each class should have similar expected costs. There is a greater chance that a subset of risks within a hazard group does have significantly different loss potential since a hazard group contains a wider array of classes, so it is more diverse.

Sample 3

Hazard groups are made up of classes, so the classes themselves will be more homogenous than combined classes.

Sample responses for Credibility

Sample 1

Each hazard group or class needs to be large enough to allow credible statistical predictions. Since hazard groups contain multiple classes, they are larger than the individual classes and their excess ratios will be more credible. Therefore, the class excess ratio technique is not an improvement over the hazard group excess ratios for credibility.

Sample 2

MDCT both improves & worsens credibility of excess ratio estimates, in different ways. Credibility is improved because each injury type is calculated using data from other, correlated injury types, so more information & credibility goes into the final MDCT

estimate. Credibility is worsened because the same data is subdivided much more finely by class by state vs by HG by state, so the sample size that each excess ratio is based off of is much smaller.

Note:
A candidate who said that the multi-dimensional credibility technique improves credibility could have also gotten full credit using a justification similar to sample 2.

Sample responses for Predictive Stability

Sample 1

The class excess ratios will be more responsive to changes in expected costs for the class than the hazard group excess ratios will be. However, since each class is volatile, the excess ratios will probably respond to unwarranted changes in expected costs. Since the hazard groups are larger, their excess ratios will be more stable. Therefore, the class excess ratios are not an improvement for predictive stability.

Sample 2

Balances the responsiveness of individual class injury type weights while maintaining stability by using the current hazard group excess ratio as the complement of credibility.

Sample 3

By incorporating information from more common minor injury types with the less frequent major injuries, the predictive stability will be improved because excess ratios will not be solely dependent on the less frequent major claims that can vary year-to-year. It is an improvement for predictive stability.

EXAMINER'S REPORT

We expected the candidates to demonstrate:

- an understanding of the concepts of homogeneity, credibility & predictive stability as described in the AAA Risk Classification Statement of Principles,
- an understanding of the difference between the hazard group technique and the class-level multi-dimensional credibility technique, and
- the ability to apply the concept of homogeneity, credibility & predictive stability in the context of these two classification methods.

All 3 of these pieces were required in order to obtain full credit for each of the subparts of the question.

The three statistical considerations are fundamental concepts from the AAA Risk Classification Statement of Principles. However, the application of these concepts to the

multi-dimensional credibility technique from the Couret & Venter paper adds a non-trivial complexity to the question. If the candidate did not have a good knowledge of the Couret & Venter paper but understood that their credibility technique is on a class level (which is mentioned in the question), and that hazard groups are made up of groups of classes, they may still have gotten full credit if they could apply the statistical considerations appropriately.

Most candidates showed an understanding of the statistical considerations and received credit accordingly, but candidates struggled with displaying the application of the statistical considerations to the methodologies. Many candidates did not have a good understanding of the multi-dimensional credibility technique and/or the hazard group method.

Common mistakes include:

- Commenting only on one of the two classification methods but failing to compare it with the other method.
- Misunderstanding the multi-dimensional credibility technique, for example saying that the multi-dimensional technique is a method of grouping classes.
- Failing to recognize that the multi-dimensional technique is looking at class level data, which is a subset of hazard group data and therefore has more similar risks but less volume.
- Confusing injury types, classes and/or hazard groups
- Arguing that combining injury type data increases homogeneity
- Discussing the credibility technique or methodology being used, as opposed to the credibility statistical consideration as described in the AAA Statement of Principles.
- Discussing the predictive accuracy of the methods alone instead of the predictive stability.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 5

TOTAL POINT VALUE: 2.5 **LEARNING OBJECTIVE: A2**

SAMPLE ANSWERS

Part a: 0.5 point

The 2 assumptions made are:

1. High frequency territories are also high premium territories
2. Territorial differentials are proper / adequate

Part b: 1.5 points

Frequencies:

- Freq 2 or more = (1,200+625)/(250,000+100,000) = 0.0052
- Freq 1 or more = (1,200+625+750)/(250,000+100,000+100,000) = 0.0057
- Freq total = 4,075/600,000 = 0.0068

Mod factor:

- Mod 2 or more = 0.0052/0.0068 = 0.7677
- Mod 1 or more = 0.0057/0.0068 = 0.8425

Credibility factors:

- Cred 2 or more = 1 – Mod 2 or more = 1 – 0.7677 = 0.2323
- Cred 1 or more = 1 – Mod 1 or more = 1 – 0.8425 = 0.1575

Ratio = 0.2323/0.1575 = 1.4750

Part c: 0.5 point

Premium = Base rate x Mod

Premium = 1000 x 0.7677 = $ 767.7

EXAMINER'S REPORT

Part a

Most candidates were awarded full credit. No common errors were identified.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part b

Most candidates were awarded full credit. The most common error was using earned-car years in the calculation of the frequency instead of earned premium.

Part c

Most candidates did well on this question. The two most common errors were:

- Using something other than the base rate
- Calculating premium for the sum of all earned-car years

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

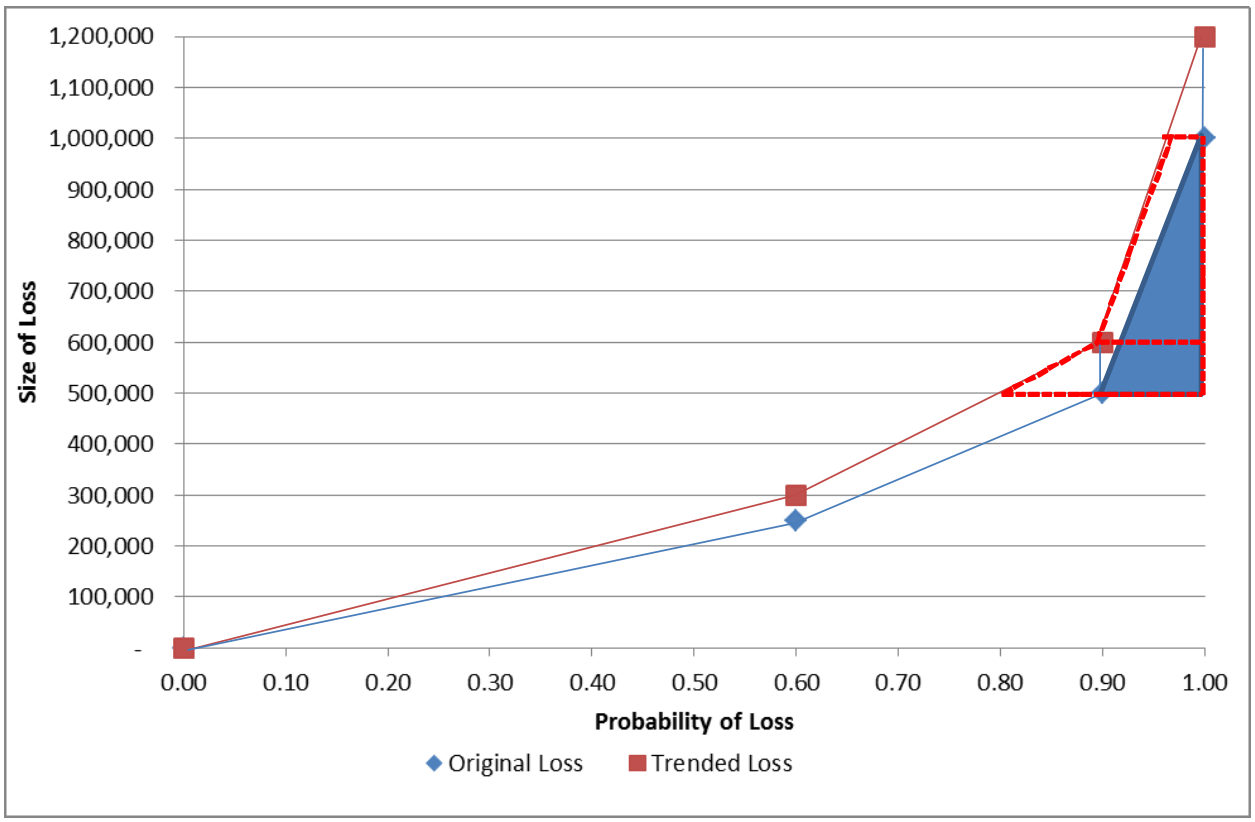
QUESTION 6

TOTAL POINT VALUE: 3.5

LEARNING OBJECTIVE: B1

SAMPLE ANSWERS

Part a: 1.5 points



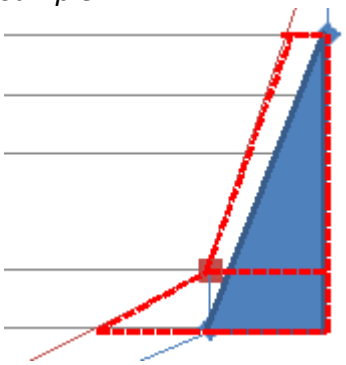
cum. prob	Original Loss	Trended Loss
0.00	-	-
0.60	250,000	300,000
0.90	500,000	600,000
1.00	1,000,000	1,200,000

Trended loss = original loss * 1.2

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part b: 2 points

Sample 1



From Part a), we can see that the implied trend is defined by the area of the two trapezoid divided by the area of the triangle

Triangle:	(500)/2*0.1 = 25
Probability:	0.1 * (200/600) = 0.0333. This is the length of the top trapezoid 0.3 * (200/300) = 0.2. This is the length of the bottom trapezoid
Top Trapezoid	(0.1+0.0333)/2*400 = 26.66666
Bottom Trapezoid	(0.1+0.2)/2*100 = 15
Implied Trend:	(15+26.6666)/25 -1= 0.667

Sample 2

Before Trend

E[x; 1M]				
[1]	[2]	[3]	[4]	[5]=[4]*[1]
Prob	Layer	Formula	Average Loss in Layer	Expected Loss in Layer
0.6	0-250k	(0+250)/2	125	75.00
0.3	250k-500k	(250+500)/2	375	112.50
0.1	500k-1M	(500+1000)/2	750	75.00
Total				**262.50**

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

E[x; 500K]

[1] Prob	[2] Layer	[3] Formula	[4] Average Loss in Layer	[5]=[4]*[1] Expected Loss in Layer
0.6	0-250k	(0+250)/2	125	75.00
0.3	250k-500k	(250+500)/2	375	112.50
0.1	500k-1m	(500+500)/2	500	50.00
Total				**237.50**

E[x ; 500k xs 500k] = E[x; 1M] - E[x; 500K]
= 25.00

After Trend

E[x'; 1M]

[1] Revised Prob	[2] Layer	[3] Formula	[4] Average Loss in Layer	[5]=[4]*[1] Expected Loss in Layer
0.6	0-300k	(0+300)/2	150	90.00
0.3	300k-600k	(300+600)/2	450	135.00
0.1 * (400/600) = 0.06666	600k-1.2M	(600+1000)/2	800	53.33
0.1 * (200/600) = 0.03333	600k-1.2M	(1000+1000)/2	1000	33.33
Total				**311.66**

E[x'; 500k]

[1] Revised Prob	[2] Layer	[3] Formula	[4] Average Loss in Layer	[5]=[4]*[1] Expected Loss in Layer
0.6	0-300k	(0+300)/2	150	90.00
0.3 * (200/300) =	300k-	(300+500	400	

0.2		600k	)/2		80.00
0.3 * (100/300) =		300k-	(500+500		
0.1		600k	)/2	500	50.00
		600k-	(500+500		
	0.1	1.2M	)/2	500	50.00

Total	**270.00**

E[x' ; 500k xs 500k] = E[x'; 1M] - E[x'; 500K] =	**41.66**

Implied Trend =	**{E[x' ; 500k xs 500k] / E[x; 500k xs 500k]} -1**	**0.666**

EXAMINER'S REPORT

Part a

The vast majority of candidates received full credit on this part. To receive full credit, the candidates were expected to graph the original losses and trended losses as well as label the x and y axis and the lines through the points.

The most common errors were:

- Only graphing 1 line instead of 2
- Using the wrong trend
- Not labeling the points or making it clearly on the axis

Part b

The candidates were expected to calculate the trend in the 500K xs 500K layer. While most candidates drew the graph in Part A correctly, a vast majority only got partial credit for part B. Almost all candidates understood and applied the implied trend formula correctly. However, errors were made in calculating the correct pieces that made up the trend.

To receive full credit the candidates were expected to:

- Calculate the expected loss in the 500k xs 500k in the original and trended distributions
- Calculate the implied trend in layer as the trended expected loss divided by untrended expected loss

The most common errors were:

- Calculated expected loss in 700k xs 500k in the trended distribution

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

- Calculated expected loss in 600k xs 600k in the trended distribution
- Errors were made in calculating the correct probabilities for 500k and 1M on the trended line
- Errors were made in applying the area formula for trapezoid on non trapezoid shapes

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION *7*

TOTAL POINT VALUE: 1.75 **LEARNING OBJECTIVE: B1**

SAMPLE ANSWERS

Sample 1

Limit (000)	Premium	Chg in prem/Chg in limit
100	350	-
250	700	.0023
500	1000	.0012
1000	1800	.0016 = (1800-1000)/(1000K – 500K) – this fails the ILF test

Fails because the incremental change in premium is higher than a lower layer which implies negative probability. Therefore, reject.

This can be acceptable if adverse selection is considered. This will occur when risks that have large loss potential purchase higher limits. (Knowing there will be large losses) or since court cases and settlements tend to look at policy limits when settling cases.

Sample 2

Limit	Premium	ILF
100,000	350	1.0
250,000	700	2.0 = 700/350
500,000	1000	2.8571 = 1000/350
1,000,000	1800	5.1429 = 1800/350

ILF	Marginal Rate
1.0	-
2.0	.0067 = (2-1)/150 = Change in ILF/Change in Limit
2.8571	.0034
5.1429	.0046

Against: The marginal rate is not mathematically decreasing as the marginal rate increases from the 500K limit to the 1M limit. This fails the consistency test. The marginal rate should monotonically decrease as the limit increases since losses have to penetrate lower layers in order to breach the higher layers.

For: There may be antiselection occurring at these higher layers in that

a) Insureds purchasing higher limits may be doing so because they have worse loss experience

b) Legal settlements may settle based on policy limits so higher limits mean higher settlements.

Therefore higher limits are justified in charging a higher marginal rate.

Sample 3
Alternative credit for the "For"

Favorable selection is also possible, where less risky insureds are opting for higher limits to protect their assets, or the insurer is seeking out these higher limits for better risks. In this case the premiums for 500K are not justified.

Sample 4
Alternative credit for the "For"

If we add risk load to ILF – the loss at 1M may have a very high volatility (this is likely since we are talking about high severity low frequency losses). In this case, the premium could be actuarial sound.

Sample 5
Alternative credit for "For"

Market conditions

EXAMINER'S REPORT

Candidates were expected to know the properties of actuarially sound ILFs and should be able to explain why the ILFs do not adhere to the properties, yet could make sense given other factors, like risk load, adverse selection or favorable selection.

To obtain full credit for the "against" argument, candidates should have calculated marginal rates, determined that the marginal rates were inconsistent and explain why the inconsistency is not appropriate. Full credit for the "for" argument would include two examples and a brief explanation of how the ILFs might be appropriate.

Candidates generally were able to calculate marginal rates and determine that the ILFs failed the consistency test. Many candidates missed the part of the question that required the candidate to explain arguments for both "for" and "against" the ILFs. A complete answer for either argument gave the candidate a little more than half credit for the question.

The biggest trip-up in this question was if a candidate did not recognize that they were supposed to argue for and against the new ILFs. Candidates that were able to calculate the marginal rates and note that they failed the consistency test but did not explain the

underlying reason for the consistency did not receive full credit.

Candidates that only gave one argument for the ILFs or just said adverse selection without describing adverse selection did not receive full credit.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 8

TOTAL POINT VALUE: 2.5 **LEARNING OBJECTIVE: B3**

SAMPLE ANSWERS

Sample 1

CSLC = 50,300 + 40,300 + 32,600 = 123,200 (PYs 2010 – 2012)

Using the ISO Manual Provided:
Z = 0.30
EER = 0.853
MSL = 102,850

0.443 = 0.3 * [(AER – 0.853) / 0.853]
AER = 2.1126

Actual Includable Loss + ALAE Capped @ BL & MSL = 10k + 102.85k + 40k + 70k = 222.85k
(only from losses between 1/1/2010 – 12/31/2012; the 4/1/2011 loss must be limited by the MSL)

2.1126 = (222,850 + ARULL) / 123,200
ARULL = $37,422

Sample 2

CSLC = 50,300 + 40,300 + 32,600 = 123,200

Using the ISO Manual Provided:
Z = 0.30
EER = 0.853
MSL = 102,850

Loss + ALAE Capped @ BL & MSL = 10k + 102.85k + 40k + 70k = 222.85k

AER = [(BL Loss + ALAE limited by MSL + ARULL) / CSLC]

Mod = [(AER – EER) / EER] * z
= {[(222,850*LDF / 123,200) – 0.853] / 0.853} * 0.3 = 0.443
LDF = 1.168

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

EXAMINER'S REPORT

To receive full credit on this question, candidates were expected to be familiar with the ISO GL Experience Rating Plan (which was also provided during the examination). The question specifically asked for the ARULL, a component of the AER, and expected candidates would be able to taken the given information and correctly calculate this value.

Full credit was given if the candidate expressed the ARULL as a dollar amount or a factor which would be applied to the actual loss limited by the basic limit and MSL. Also, if the candidate calculated the correct adjustment and then attempted to express this as a factor of the (CSLC * EER), no points were deducted.

Candidates generally performed well on this question, with a large majority receiving full credit. Common errors which prevented a candidate from receiving full credit included:

- Using the incorrect experience period (PYs 2010 – 2012) in the CSLC and Loss + ALAE calculations
- Incorrectly using the ISO manual to determine the appropriate Z, EER, and MSL values
- Failure to limit the 4/1/2011 Loss + ALAE by the MSL of $102,850
- Use of incorrect formulas for the modification and AER, or other calculation errors

Note that if candidates calculated one value incorrectly, but applied it correctly in determining the ARULL (e.g., looking up the Z, EER, and MSL correctly using an incorrect CSLC amount), only one deduction was taken.

Candidates appeared to have difficulty applying a couple concepts. It appeared some candidates were unfamiliar with what the question was asking for and attempted to incorrectly calculate an adjustment that would be applied to the given experience modification. Also, detrending is used in the calculation of the Company Subject Loss Costs (given in the problem), so candidates who attempted to apply detrend factors were not awarded full credit.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 9

TOTAL POINT VALUE: 2

LEARNING OBJECTIVE: B1, B3

SAMPLE ANSWERS

Sample 1

$$Mod = \frac{ZpAp + ZeAe + (1 - Zp)Ep + (1 - Ze)Ee}{E}$$

Clm	Ap	Ae
1	8000	0
2	10000	11000
3	3000	0
4	10000	1500
Total	31000 = Ap	12500 = Ae

$$M_0 = \frac{(1 - Zp)Ep + (1 - Ze)Ee}{E} = 0.60$$

Substitute X for Ep and (30000-X) for Ee

0.60=[X(1-.80)+(30000-X)(1-.20)] /30000 ➔

18,000=0.2X + 24,000 – 0.8X ➔

-6,000 = -.6X ➔

X = 10,000 = Ep

Ee = 20,000

Now, we plug the figures into the M formula above:

$$M = \frac{0.8x31K + 0.2x12.5K + 0.2x10K + 0.8x20K}{30K} = 1.51$$

Sample 2

$$M = \frac{Ap + WAe + (1 - W)Ee + B}{E + B}$$

$$W = \frac{Ze}{Zp} = \frac{0.2}{0.8} = 0.25$$

$$Zp = \frac{E}{E+B}, so\ 0.8 = \frac{30000}{30000+B}, so\ B = 7500$$

$$0.6 = \frac{0+0+(1-0.25)Ee+7500}{30000+7500}$$

Ee=20,000

$$M = \frac{31000+0.25*12500+0.75*20000+7500}{30000+7500}$$

.

Sample 3

E(L)=30,000, so W=0.09 and B=17,500 from the Alabama tables.

$$0.6 = \frac{0+0+(1-0.09)Ee+17500}{30000+17500}$$

Ee=12,088

$$M = \frac{31000+0.09*12500+0.91*12088+17500}{30000+17500} = 1.276$$

EXAMINER'S REPORT

On the exam, the losses in the table are incorrectly labeled as "Loss and ALAE". This was unintentional, and it did not seem to impact many candidates' responses. A handful noted that this should be Loss only, and several tried to "remove" the ALAE.

No deductions were taken off for those candidates who attempted to remove the ALAE by a valid method. Some candidates attempted to remove the ALAE using the Loss Free Mod, which demonstrated a misunderstanding of a core concept of Gillam & Snader's study note. These candidates did not receive any direct deductions for this, however, they most likely did not receive full credit as they made other mistakes showing they did not have full command of the material.

The first sample solution was based on Gilliam and Snader I. Note, there is a shortcut, if you notice that the M formula can be rewritten like this:

$$M = \frac{ZpAp+ZeAe}{E} + \frac{[1-ZpEp-ZeEe]}{E} = \frac{ZpAp+ZeAe}{E} + \overline{M}$$

Candidates who recognized this, and therefore skipped the splitting of Ep and Ee, got full credit.

The second sample solution uses Perryman's equation, which is found in the NCCI manual. As with first sample solution, the M formula can be rewritten as:

$$M = \frac{Ap + WAe + (1-W)Ee + B}{E + B} = \frac{Ap + WAe}{E + B} + \frac{(1-W)Ee + B}{E + B} = \frac{Ap + WAe}{E + B} + \overline{M}$$

and a similar shortcut applied to receive full credit.

The third sample uses the NCCI manual to look up the W and B values for Alabama for 2011 (Pages E4 and E5, respectively), and proceed as in method 2 to derive Ee, and then M. This solution wasn't expected, as the problem does not indicate that it is an Alabama risk or that the actuary is using the NCCI plan. A few candidates selected the 2010 table; these candidates got credit despite selecting the outdated tables.

There were some candidates who did a combination of the 2nd and 3rd methods, calculating W from the 2nd method, and looking up B from the 3rd. Mixing the methods resulted in a loss of credit, as this produces an inconsistency among the inputs for the Mod formula.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 10

TOTAL POINT VALUE: 2.25 **LEARNING OBJECTIVE: B3**

SAMPLE ANSWERS

Part a: 1.5 points

Sample 1

Increase Med-only effect
Safety Incentive – Decreases
Predictive Accuracy – No Change
Zero Credibility to Excess
Safety Incentive – Decreases
Predictive Accuracy – Decreases
Constant Primary/Excess Split
Safety Incentive – No change
Predictive Accuracy – Decreases

Sample 2

Increase Med-only effect
Safety Incentive – Will drop as company will be discouraged from reporting med losses and may not try to prevent them
Predictive Accuracy – Not affected as med losses represent very small portion of total losses
Zero Credibility to Excess
Safety Incentive – will reduce as insurer has less incentive to control losses
Predictive Accuracy – Will reduce as excess losses are predictive of severity
Constant Primary/Excess Split
Safety Incentive – Not affected
Predictive Accuracy – Will reduce because the plan will be thrown out of balance as primary losses remove into excess layer due to inflation if split is not indexed

Sample 3

Increase Med-only effect
Safety Incentive – Decreases
Predictive Accuracy – Will hurt predictive accuracy if many companies decide to cut back on their med claims reporting significantly
Zero Credibility to Excess
Safety Incentive – Decreases
Predictive Accuracy – Decreases

Constant Primary/Excess Split

Safety Incentive – As primary losses pierce into excess layer due to inflation, since excess losses get no credibility per change #2, companies will have less incentive to control large losses

Predictive Accuracy – Decreases

Sample 4

Increasing the effect of medical only losses

- Safety incentive – increasing effect of medical only losses could encourage insureds to control their medical only losses; however, more likely insureds would stop reporting them instead as they are small
- Predictive accuracy – as insureds are likely to stop reporting the small medical losses and pay for them themselves, that would decrease the predictive accuracy – not satisfied

Giving zero credibility to excess losses

- Safety incentive – giving 0 credibility to excess losses would discourage insureds from controlling excess losses – not satisfied
- Predictive accuracy – predicted future losses would be based on primary only losses which would account for the frequency part but not the severity; this would decrease predictive accuracy as severity is measured by excess losses

Keeping the primary excess split of actual losses at a constant value of $10,000 for the next 10 years

- Safety incentive – with the inflation more actual losses would move from primary to excess layer with the fixed split point; with (2) in effect, excess losses are given no credibility and safety incentive would not increase; on its own there is not significant impact
- Predictive accuracy = as more losses would move to the excess layer from primary due to strictly by inflation, predictive accuracy decreases, additionally without ELR and D ratios, updates there would be a mismatch between actual and expected losses.

  Overall the plan does not satisfy the goals

Part b: 0.75 point

Sample 1

Increase Med-only effect – Increases mod

Zero Credibility to Excess – Increases mod

Constant Primary/Excess Split- No change

Sample 2

Increase Med-only effect – This will increase mod as this company has worse than average claim frequency and med-only losses are mainly small losses used for predicting frequency.
Zero Credibility to Excess – This change will also increase mod since this company has better than average excess loss experience but this change is removing that benefit and further increasing the effect of the primary losses.
Constant Primary/Excess Split- This can potentially lower company's mod as primary losses move into excess layer due to inflation which in turn receives no credibility.

Sample 3

Increase Med-only effect – If the company stops reporting med only claims all together, mod may go down
Zero Credibility to Excess – Increase
Constant Primary/Excess Split- No Change

Sample 4

- Medical Only losses are usually small so would be in the primary layer mostly; this would increase the mod for the insured with higher frequency of small losses
- As the insured never had excess claims the mod would increase as the primary claims are now given more weight
- This has no immediate impact on the mod; but if the claims after inflation would start piercing the 10,000 split point, mod would decrease since:
    - Expected excess losses will increase relative to primary losses
    - More claims would hit the 10,000 limit for primary (high frequency)
    - ELRs and D ratios assumed to not be updated, so it would cause mis-alignment (they would be too low)

EXAMINER'S REPORT

Part a

This question has six subparts asking the candidate to evaluate how three different changes would affect two areas of the NCCI plan. Candidates generally received credit if they were able to indicate the correct directionality of the effect, even without providing a full explanation.

However, many candidates wrote way too much on this part. Please note from the examples above, candidates wrote extremely verbose responses (compare responses 1 and 4 above). While both received full credit, a candidate could have save time with the

concise answer in version 1 above.

The most commonly made mistake on this part is the evaluation of the change regarding increasing the effect of med-only losses with respect to safety incentive. The key concept here is that this change will discourage companies from reporting med only losses and as a result will hurt safety incentive because the carrier is more qualified to ensure quick and proper treatment for injured workers and effective management of the claim. Many candidates predicted that companies will be less likely to report under this change, but not all were able to make the connection that this would hurt safety incentive.

Part b

This question has three subparts asking the candidate to evaluate the impact on the experience mod per the three changes identified in part a. Credit was generally granted if the candidate was able to provide the general directionality of the impact for each change, however, as in part a, many candidates wrote too much.

Please note from the examples above, candidates wrote extremely verbose responses (compare responses 1 and 4 above). While both received full credit, a candidate could have save time with the concise answer in version 1 above. Several candidates had such a long response to part a, that it appears they forgot there was a part b.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 11

TOTAL POINT VALUE: 2.5 points **LEARNING OBJECTIVE: B4**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

According to the law of large numbers, large risks should be more stable than small risks. Keeping these numbers constant gives much more credibility to large risks than small risks.

Sample 2

If B&K are constant, their variances of losses should decrease proportional to the inverse in risk size, leading to self-rating for large risks.

Part b: 0.5 point

Sample 1

Empirical data shows that the variance of loss ratios did not decrease that quickly as size of risk increases.

Sample 2

It has actually been shown that the variance of large insureds does not decrease as fast as one would expect, so B&K should not be constant because this gives large risks too much credibility. There are certain circumstances that affect small and large insureds the same regardless of size.

Sample 3

WC loss experience does not follow the law of large numbers due to the long tailed nature of the business. Also, large insureds have more loss ratio variance due to diverse operations and exposures.

Part c: 1 point

Sample 1

Quintile test. For each plan, group by risk size. For each risk size, sort risks by mod.

Group into 5 groups. Calculate the standard loss rations and manual loss ratios for each quintile group. Calculate the test statistic for each plan: variance (standard loss ratio)/variance (manual loss ratio). The plan with the lower test statistic performs better.

Sample 2

I would apply an efficiency test. I would sort by determining the current mod and the proposed mod for each risk. Then I would sort the modes into quintile groups (in increasing order of mods) for both current and proposed. I would then calculate the sample variance of the manual loss ratios and standard loss ratios for both plans. Then find the test statistic equal to variance (SP LR)/variance (MP LR) for current and proposed. I would confirm that the proposed plan performs better if the test statistic is smaller than the test stat in the current plan.

Part d (not labeled correctly on exam): 0.5 point

Sample 1

It will assign smaller credibility to small risks and assign too much credibility to large risks. Small risk with credit mod will become preferred business because their premium is higher because of low credibility. Because of that, in a competitive market, rates will go down for those preferred risks (demand stays the same while offer increases will push down prices). The same will happen to large risk with debit mod (they will pay too much, offer increases while demand stays equal, and rates decrease).

Sample 2

If B&K are constant, not enough credit will be given to small risks and too much will be given to large risks. Small accounts with a credit mod and large accounts with a debit mod will become preferred business, and companies will adjust their pricing accordingly.

EXAMINER'S REPORT

General Commentary

On the exam, there was an error in the formula for W in the stem of the question. This was unintended, and the equation should have been:

$$W = \frac{E + B}{E + K}$$

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Candidates responded in two different ways. Some responded as the question was written and some responded as the question was intended. Both responses were acceptable and could receive full credit.

Part a

To receive full credit, candidates should demonstrate two key points:

1. How variance of loss relates to size of risk
   - The theory is based on the law of large numbers
   - The Variance of the loss ratio is inversely proportional to the size of the insured.
2. How variance ties to credibility/stability by risk size
   - Large Risks approach full credibility / Self-Rating
   - Large Risks are more stable
   - The largest risks are more credible/predictable

Common errors made by candidates included:

- Confusing constant B & K with constant credibility
- Asserting the general constraints behind any credibility standard (such as $0<Z<1$)
- Focusing on the effect of B&K constant (cred grows) without describing why

Part b

Candidates were expected to make at least two of three key points:

1. How should B & K behave?
   - B & K should increase with size of risk
   - No risk should be fully self-rated
2. What support is there for the B & K not being constant?
   - NCCI studies showed variance for larger risks did not decline as fast as predicted.
   - Historical experience does not support the theory.
3. Why might B & K not be constant?
   - Some sources of variation do not decrease with size (changing conditions, parameter risk)
   - As risks get larger, they are more likely to have diverse operations (heterogeneity)

Common errors made by candidates included:

- Explaining B&K "should vary" (which the question states is currently done) without also why and/or what that would imply
- B&K stabilize loss experience, so larger risks need a proportionally bigger B&K

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part c

Candidates were expected to discuss a quintiles test in order to receive full credit. However, alternative solutions were accepted as well and could receive full credit.

For example, the Gillam paper compares the quintile test with the efficiency test which does not require grouping by mods. So where the candidate explained they were using the efficiency approach, we accepted this in place of the mod. Other methods were also accepted and could receive full credit if the candidate could explain how the method was appropriate.

Common errors made by candidates included:

- Looking at new plan statistics without comparing to current NCCI plan
- Improperly setting up metric, inverting the ratios, or miscalculating the variances

Part d

Almost half the candidates did not follow Venter's assumption that the NCCI plan would apply to all companies equally. Instead many tried to estimate the impact of just one company filing the plan while its competitor did not. Both approaches were deemed acceptable.

Candidates were expected to comment on the specific risks impacted by the change and how the market will react. The following items could be provided to receive credit:

1. Which specific risks would be impacted by the change?
    - Large risks with debit mods will become preferred
    - Small risks with debit mods will be avoided
    - Insurers will target large risks with poor experience

2. How will the competitive market ultimately react – depended on candidate assumption
    - [If the NCCI implements the bad plan] supply & demand will adjust rates back into balance
    - [if a particular company implements a bad plan] creates adverse selection
    - [if company's new plan performs better] – we may be able to gain competitive advantage by improved risk selection

Common errors made by candidates included:

- Asserting new plan would overcharge all large risks
- Asserting new plan would overcharge all risk with bad experience
- Saying market will target certain risks, but not noting this will rebalance the plan
- Asserting the market will rebalance only the overall adequacy/off balance

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 12

TOTAL POINT VALUE: 3 points **LEARNING OBJECTIVE: B2**

SAMPLE ANSWERS

Part a: 2.25 points

Sample 1

Exp LR for unlimited = 0.2 x 0.2 + 0.2 x 0.4 +0.2 x 0.6 +0.2 x 0.8 +0.1 x 1 = 0.5
Exp LR for limited = 0.1 x 0.2 + 0.3 x 0.4 +0.3 x 0.6 +0.1 x 0.8 = 0.4

LER = 1- (0.4 / 0.5) = 0.2

Loss Ratio	r (limited LR /unlimited LR)	# risks (limited)	% risks above	Table L Charge
0%	0	2	0.8	0.68+0.8 x (0.4)=1
20%	0.2/0.5 = 0.4	1	0.7	0.4+0.7 x (0.4)=0.68
40%	0.4/0.5 = 0.8	3	0.4	0.24+0.4 x (0.4)=0.4
60%	1.2	3	0.1	0.2+0.1 x (1.6-1.2)=0.24
80%	1.6	1	0	0.2+0 x (2-1.6)=0.2
100%	2	0	0	LER = 0.2

Sample 2

E[x] = .5
E[x`] = .4
k = 1 – (E[x`] / E[x]) = 1 – (.4/.5) = .2

Loss Ratio	# at LR	# Over	Double Sum	Partial Charge (n)	$\phi^* = (n)(1-k) + k$
0	2	8	20	1 = 20/20	1
20	1	7	12	.6 = 12/20	.68
40	3	4	5	.25 = 5/20	.4
60	3	1	1	.05 = 1/20	.24
80	1	0	0	0 = 0/20	.2
100	0	0	0	0	.2

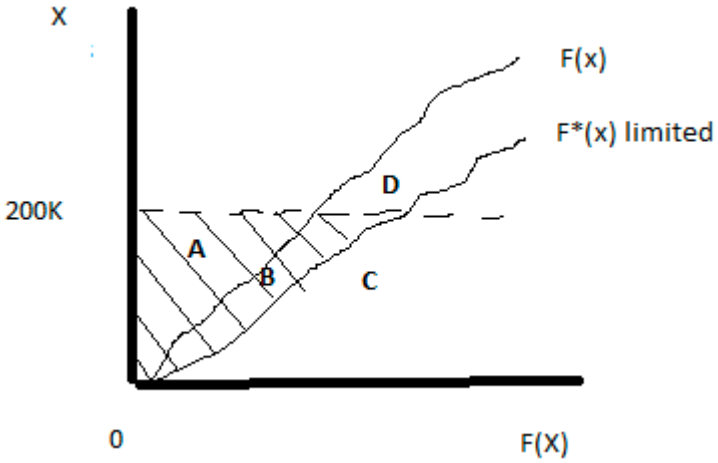
EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part b: 0.75 point

Sample 1

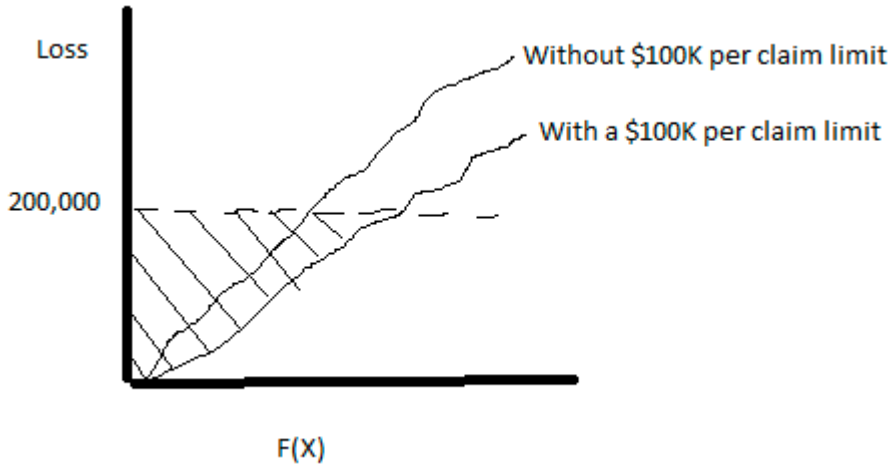
R = .4 E=500,000 per acc = 100K

Entry ratio at .4 corresponds to a hypothetical aggregate limit of 200k (E of 500k x .4). This aggregate limit is on limited losses, limited by the 100k per accident limit. The savings at the entry ratio of .4 is describing the amount by which 200,000 on average exceeds the occurrence limited losses (or A+B below)



Sample 2

R x E = 0.4 x 500000 = 200000
Table L savings at r=0.4 and E=500,000, per-acc limit = 100000 is the average amount below 200,000 but above the limited loss curve.



It is represented as the shaded area in the diagram.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

EXAMINER'S REPORT

General Commentary

Candidates generally did very well on part a, but for part b their explanations of the savings was much poorer than expected. They struggled to describe in words what the Table L savings represents.

Part a

- Candidates were expected to know how to calculate Table L charges when given limited and unlimited loss ratios.
- Candidates were expected to calculate Table L charges for loss ratios requested.
- When using the % of risks above method, candidates often divided by 8 instead of 10 to get the percentage of risks above the given loss ratio. When calculation errors occurred and their charge at 0 was not equal to 1, the candidate was expected to know to normalize the Table L charges. Some candidates calculated the LER as the difference between the unlimited and limited loss ratios.
- Generally candidates either received full credit on this question or they received very few points. Most candidates performed well on this question.

Part b

- Candidates were expected to know what the Table L savings means and express it in words.
- Candidates needed to express that the savings is the average difference between the loss amount corresponding to the entry ratio of 0.4 (200,000) and the actual losses limited to the per occurrence limit of 100,000.
- Candidates often didn't accurately describe what the savings actually are and tried to use Table L buzz words to get partial credit.
- Many candidates calculated the savings based on their part a results, while the question never indicated that the scenario in b applied to the data in a.
- Very few candidates received full credit on this part.
- We gave partial credit when candidates calculated the correct savings amount based on their work from part a. We also gave partial credit when they drew a correctly labeled graph that displayed the Table L savings area.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 13

TOTAL POINT VALUE: 2 **LEARNING OBJECTIVE: B2**

SAMPLE ANSWERS

Sample 1 (Vertical slices approach)

Average Loss ratio = $\frac{.1+.3+.35+.4+.6+.75+X+.9+1.1+1.2}{10}$ = 0.57+.1X
Loss ratio is between 64.5% and 66%
LR * Entry ratio (1.5) is between 96.75% and 99%
so only losses 9 & 10 contribute to the charge. Therefore:

0.05 = $\frac{[1.2-1.5*(0.57+.1X)]+[1.1-1.5*(0.57+.1X)]}{10*(0.57+.1X)}$
.5*(0.57+.1X) = 2.3 – 3*(0.57+.1X)
3.5*(0.57+.1X) = 2.3
0.57+.1X = 0.657
X=87.14%

Sample 2 (Horizontal slices approach)

Φ(1.5) = 0.05
Unlimited LR mean = $^{1}/_{10}\,[0.1+0.3+0.35+0.4+0.6+0.75+0.9+1.1+1.2+X]=M$
0.57+$^{X}/_{10}$ = M
r = $\frac{\text{risk LR}}{0.57+^{X}/_{10}}=1.5$
risk LR = 0.855+0.15X

since 0.75 ≤ X ≤ 0.9 0.645 ≤ mean ≤ 0.66
0.9675 ≤ risk LR ≤ 0.99

Only 9 & 10 are above 0.9675 and 0.99.

r	LR	# risks	risks above	% risk above	$\Phi(r_i)=\Phi(r_{i-1})+(r_i-r_{i-1})*(\%above)$
1.5			2	0.2	$0.05=Y_1+\left(^{11.1}/_{M}-1.5\right)*(0.2)$
1.667 ≤ r ≤ 1.7057	1.1	1	1	0.1	$\left(\frac{1.2}{M}-\frac{1.1}{M}\right)*(0.1)=Y_1$
1.818 ≤ r ≤ 1.86	1.2	1	0	0	0

M = mean

$0.05 = \left(\frac{1.2}{M} - \frac{1.1}{M}\right) * 0.1 + \left(\frac{1.1}{M} - 1.5\right) * (0.2)$

$0.05 = \frac{0.01}{M} + \frac{0.22}{M} - 0.3$

$0.35 = \frac{0.23}{M}$

$M = 0.657 = 0.57 + \frac{X}{10}$

X = 87.14%

Sample 3

Average Loss ratio = $\frac{.1+.3+.35+.4+.6+.75+X+.9+1.1+1.2}{10}$ = 0.57+.1X

At x = 75%: E(A) = 0.645

r=1.5→ LR_r = 0.9675

$$\frac{{}^{1}/_{10}\left[(1.1 - 0.9675) + (1.2 - 0.9675)\right]}{0.645} = 0.057$$

At x = 82%: E(A) = 0.652

r=1.5 → LR_r =0.978

$$\frac{{}^{1}/_{10}\left[(1.1 - 0.978) + (1.2 - 0.978)\right]}{0.652} = 0.0527$$

At x = 85%: E(A) = 0.655

r=1.5 → LR_r =0.9825

$$\frac{{}^{1}/_{10}\left[(1.1 - 0.9825) + (1.2 - 0.9825)\right]}{0.655} = 0.0511$$

At x = 86%: E(A) = 0.656

r=1.5 → LR_r =0.984

$$\frac{{}^{1}/_{10}\left[(1.1 - 0.984) + (1.2 - 0.984)\right]}{0.656} = 0.0506$$

At x = 87%: E(A) = 0.657

r=1.5 → LR_r =0.9855

$$\frac{{}^{1}/_{10}\left[(1.1 - 0.9855) + (1.2 - 0.9855)\right]}{0.657} = 0.05$$

X = 87%

EXAMINER'S REPORT

This question was more challenging than a standard table M construction question. It required candidates to understand the interplay between the loss ratio, the entry ratio, the charge, and the calculation of the charge. Many candidates scored very well. While some candidates were able to get to the final answer by testing various values of x and calculating the resulting charge, the optimal approach to complete was to set up

the charge calculation in terms of x and set equal to 0.05, which many candidates were not able to do. Both the horizontal and vertical slicing methods of calculating the charge were used successfully.

In any approach, the use of the range was helpful in determining that only risks 9 & 10 would be included in the calculation, but a common mistake was not using that information and including more risks.

Another common mistake was an error in the setup of the equality, such as not dividing the calculation by the average loss ratio. Others set everything up correctly but had an algebra error in solving for x.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 14

TOTAL POINT VALUE: 3.75 **LEARNING OBJECTIVE: B2, B7**

SAMPLE ANSWER:

$$R(1M) = \hat{R}(1M - 250K) \cdot R(250K)$$
$$R(250K) = E[\text{loss xs } 250\text{K}] / E[L]$$
$$E[L] = \Sigma\{p(L) * L\}$$
$$E[L] = 0.7 * 20{,}000 + 0.14 * 100{,}000 + 0.08 * 250{,}000 + 0.05 * 500{,}000 + 0.02 * 750{,}000 + 0.01 * 1{,}000{,}000$$
$$E[L] = 98{,}000$$
$$E[\text{L xs } 250\text{K}] = \Sigma\{p(L) * \max[(L - 250{,}000), 0]\}$$
$$E[\text{L xs } 250\text{K}] = (500{,}000 - 250{,}000) * 0.05 + (750{,}000 - 250{,}000) * 0.02 + (1{,}000{,}000 - 250{,}000) * 0.01$$
$$E[\text{L xs } 250\text{K}] = 30{,}000$$
$$R(250K) = \frac{30{,}000}{98{,}000} = .3061$$
$$\hat{R}(1M - 250K) = \hat{R}(750K) \Rightarrow$$
$$E[\text{trunc loss}] = E[\text{L xs } 250\text{K}]/\text{Prob}[\text{L xs } 250\text{K}] = 30{,}000/(0.05 + 0.02 + 0.01)$$
$$E[\text{trunc loss}] = 375{,}000$$
$$r(750{,}000) = 750{,}000 / 375{,}000 = 2$$
$\Rightarrow$ *use mixed distribution* (weights = the product of the mean of each distribution times the weight in the mixture of each distribution.)

$$\hat{R}(750K) = \frac{(p)(\frac{b}{s-1})(1 + \frac{x}{b})^{1-s} + (1-p)(c)(e^{-x/c})}{(p)(\frac{b}{s-1}) + (1-p)(c)}$$
$$\hat{R}(750K) = \frac{(.05)(\frac{12}{4-1})(1 + \frac{2}{12})^{1-4} + (.95)(.8)(e^{-2/8})}{(.05)(\frac{12}{4-1}) + (.95)(.8)} = .1962$$
$$R(1M) = \hat{R}(750K) * R(250K) = .0601 = XL$$
$$P = [\text{ EL} * \text{XL} * (1 + \text{ULAE}) + \text{SP} * \text{GO }] / [\text{ 1 - A - T - P }]$$
$$P = \frac{(98{,}000)(0.0601)(1 + 0.06) + (500{,}000)(0.02)}{1 - 0.05 - 0.03 + 0.10} = 15{,}920$$

Note: Because of rounding the most common answer that received full credit was $15,914.5
i.e., R(1M) = 0.3061 * .1962 = 0.06 and
P = [(98K)(0.06)(1.06)+(500K)(0.02)]/(1-0.05-0.03+0.10)=$15,914.5

EXAMINER'S REPORT

The candidate was expected to know you need to know the empirical part R(250K) and the R ^{hat} (1M-250K) to calculate R(1M). In addition the candidate was expected to know the excess premium formula.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

A good portion of the candidates received full credit for their responses. Common mistakes were made including:

- Switching the pareto parameters
- Incorrect premium formula
    - Incorrectly applying the ULAE load to total expected loss
    - Incorrectly applying the excess ratio to standard premium
- Incorrect calculation of the entry ratio

The most complex part of the piece was R^{hat} (1M-250K) and most candidates understood the formula and the components of this calculation.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 15

TOTAL POINT VALUE: 2.75 **LEARNING OBJECTIVE: B5, B6**

SAMPLE ANSWER

AEL = 6,000,000*(0.5)*(0.95)= 2,850,000 Initial ELG 28

ELG	Original Range	Inflated Range	
29	2,248,334-2,672,625	2,473,167-2,939,882	New ELG =29
28	2,672,626-3,195,877		

	ELG 28	ELG 29
Φ (2.52)	0.0621	0.07
Ψ (0.15)	0.0016	0.002
Φ (2.52) - Ψ (0.15) =	0.0605	0.068

E (L) =E(A) – I
= 6,000,000 * 0.5 *[1- (Φ (2.52) - Ψ (0.15))]
E_{28} (L) = 2,818,500
E_{29} (L) = 2,796,000

E(R)= [b + c E(L)] T
E28(R) = [6,000,000*(.2766) + 1.25 * (2,818,500)] * 1.08 = 5,597,343
E29(R) = 5,566,968

$$\text{Shortfall} = \frac{E_{29}(R) - E_{28}(R)}{E_{29}(R)} = -.55\%$$

EXAMINER'S REPORT

- Candidates were expected to calculate a Retrospective Premium and the impact that would result on that premium if there was assumed 10% inflation impact on expected loss ranges
- Over 1/3 of the candidates received over 70% of the points (2 or better out of 2.75). The number of candidates that received full credit was low.
- The majority of the candidates could do the lookups correctly but did not demonstrate knowledge of the application of the retro premium formulas.
- Common errors included:
  - Incorrectly updating the endpoints of the expected loss ranges
  - Inaccurate lookups
  - Improper use of retrospective formula
  - Not calculating the shortfall as a percent and/ or as a percent of 2015 retro premium.

QUESTION 16

TOTAL POINT VALUE: 4 **LEARNING OBJECTIVE: B5, B6**

SAMPLE ANSWERS

Part a: 1.25 points

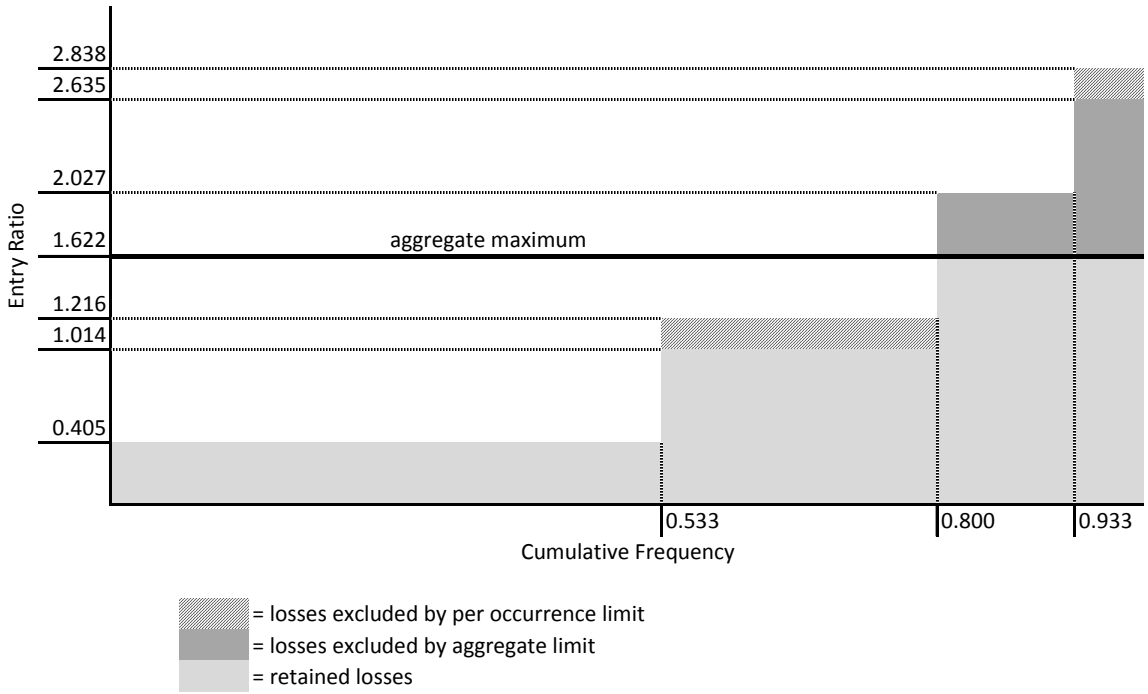
Agg Limit = $2M
Occurrence Limit = X

prob	unlimited	limited
0.533	500,000	500,000
0.267	1,500,000	X + 500,000
0.133	2,500,000	2,000,000
0.067	3,500,000	2,000,000

$$(0.533)(500{,}000) + (0.267)(X + 500{,}000) + (0.2)(2{,}000{,}000) = 1{,}000{,}000$$

Occurrence Limit = $750K

Part b: 1.75 points



EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part c: 1 point

For the retro policy, the decrease in the large loss will decrease the volatility of the entry ratio distribution resulting in a smaller charge. For the LDD policy, the distribution is less volatile due to the occurrence limit, so a decrease in the large loss will be less impactful.

EXAMINER'S REPORT

General Commentary

This was a very challenging question for many reasons (synthesis across multiple papers, question has not been asked before, long question with many details) with no candidate receiving full credit and many not attempting any answer.

Part a

- Candidates were expected to understand how aggregate limits and occurrence limits impact unlimited losses.
- In order to receive full credit, candidates needed to determine the aggregate limit and occurrence limit that combine to yield the three LDD characteristics given in the question.
- While most candidates who attempted to answer this part gave the correct aggregate limit, very few were able to determine the correct occurrence limit.

Part b

- Candidates were expected to draw an accurate Lee diagram consistent with part a.
- In order to receive full credit, candidates needed to draw a Lee diagram that was either correct or consistent with their answer in part a, including labeled axes and clear identification of the impact of the aggregate and occurrence limits.
- Less than one-quarter of the candidates were able to produce a Lee diagram that was consistent with part a.

Part c

- Candidates were expected to understand how a change in the tail/volatility of the unlimited distribution would impact the charge for a retro policy compared to an LDD policy.
- In order to receive full credit, candidates needed to note that both charges would decrease, but the retro charge would decrease more than the LDD charge.

- Nearly half the candidates left this part blank.
- Of those that answered, more than half received no credit, with very few full credit responses.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 17

TOTAL POINT VALUE: 3.5 **LEARNING OBJECTIVE: B5, B6**

SAMPLE ANSWERS

Part a: 0.5 point

$$GCP = (e + E)T \cdot SP$$

$$T = \frac{1}{1-\tau} = \frac{1}{1-.04}$$

$$GCP = \frac{(.2 + .65)}{.96} \cdot 1{,}000{,}000 = 885{,}417$$

Part b: 2.25 points

$$Adj\ E = \frac{1 + .8LER}{1 - LER} \cdot E \cdot SP = \frac{1 + .8(.214/.65)}{1 - (.214/.65)} \cdot 650{,}000 = 1{,}224{,}266 \Rightarrow ELG\ 27$$

Set up balance equations:

$$r_G - r_H = \frac{G - H}{c\hat{E}T} = \frac{1.2 - .75}{\frac{(1.1)(.65 - .214)}{.96}} = .9008$$

$$\hat{X}_H - \hat{X}_G = \frac{e + E - {}^{H}/_{T}}{c\hat{E}} = \frac{.2 + .65 - (.75)(.96)}{(1.1)(.65 - .214)} = .2711$$

In ELG 27, $r_G = 1.6$ and $r_H = .7$, and $\hat{X}_G = .1215$ and $\hat{X}_H = .3924$, satisfy both equations.

Calculate the savings at r_H as

$$\hat{S}_H = \hat{X}_H - 1 + r_H = .3924 - 1 + .7 = .0924$$

Now calculate the basic premium factor:

$$\hat{b} = e - (c-1)E + c\hat{I} = e - (c-1)E + c\left(\hat{X}_G - \hat{S}_H\right)\hat{E}$$
$$= .2 - (1.1 - 1)(.65) + (1.1)(.1215 - .0924)(.65 - .214) = .148956$$

$$\Rightarrow basic\ premium = \$148{,}956$$

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part c: 0.75 point

Sample 1
(*Assuming "retrospective premium" means "expected"*)

If per occ. Limit is higher, the charge for it is lower, but the losses that enter the calculation are higher. If the plan is balanced, expected retro premium = guaranteed cost. Changing the per occ limit does not change GCP and so expected retro premium stays the same.

Sample 2
(Assuming "retrospective premium" means "expected")

$E(R^*) = (b + c*E(L^*) + cPF)*T$

If the plan is balanced than $E(R^*) = GCP$ so the exp. Retro prem. Should stay the same, i.e., when per occ limit increases the charge for this limit goes down (cPF above), but portion of insureds converted expected loss $c*E(L^*)$ will go up accordingly. If these two offset as in a balanced plan, then the insured is paying the same prem regardless of the per-occ limit.

Sample 3
(Assuming "retrospective premium" means "actual")

A higher per occurrence limit would actually result in more of the losses being included in the retro premium calculation from a single accident, so the impact on premium would depend on the insureds expected losses. A higher per occurrence would mean a lower excess loss factor in the Retro Prem = (b +cF+cL)T equation so if they had smaller losses than the current per occurrence limit anyways, then it may be more beneficial to increase the per occurrence since those losses are not going to hit the higher limit.

EXAMINER'S REPORT

General Commentary

Overall, this question tested a candidate's ability to calculate components of retro premium, and to describe impacts of parameter shifts on this premium.

Part c was challenging and required a solid understanding of the mechanics of retro plans and premium. Many candidates who received full or almost full credit on parts a and b still struggled on part c, citing irrelevant facts or incorrectly interpreting how retrospective premium is actually calculated (e.g believing retro premium is based on actual excess losses, or that the insurance charge changes with experience).

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part a

This question required the candidate to recall two formulas. To get full credit, the candidate needed to know the formula for guaranteed cost premium and the tax multiplier, and to perform the calculation correctly.

Most candidates received partial or full credit. By far the most common error was to miscalculate the tax multiplier T. Many candidates assumed T = 1.04, which is incorrect.

Part b

This question tested the candidate's ability to perform the ICRLL procedure, to use the balance equations with a per occurrence limit, and to calculate a basic premium. To get full credit, the candidate needed to recall and execute this entire process, as well as perform all calculations.

Candidates' scores varied widely as would be expected given the wide scope of the question and the number of calculations involved. There were several common errors candidates made, including:

- Failing to calculate an adjusted *E* (and using $650,000), resulting in an incorrect ELG;
- Using *E* instead of $\hat{E}$ in the denominators of the balance equations;
- Neglecting the balance equations altogether, and assuming entry ratios of 1.2 and .75;
- Incorrectly using *E* and $\hat{E}$ in the calculation of the basic premium.

Partial credit was awarded to candidates who correctly wrote the formula for *b* (but failed to calculate it), but only if they correctly identified each component (including the change and savings, and limited and unlimited expected losses).

Candidates who did not actually perform the Table M lookup due to either time constraints or incorrect balance equations could still receive credit if they adequately described the lookup, including the iterative aspect of it.

If the candidate used 1.04 for the tax multiplier in part a, no further credit was deducted in part b for carrying that error through.

No credit was deducted for candidates who didn't convert the basic premium to dollars, or for candidates who included the converted ELF in their basic premium; even though neither is done in the source material, both are standard industry practices.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part c

This question tested the candidates' understanding of how retro premium is impacted via changes in retro parameters. Furthermore, it tested the candidate's understanding of how retro premium "works" beyond the basic calculations in part b.

Very few candidates received full credit on this subpart. The most common reason was the candidate assuming "retrospective premium" meant "basic premium", which is incorrect. Two meanings of "retrospective premium" were accepted: expected retrospective premium, and actual retrospective premium.

If the candidate assumed that "retrospective premium" meant "expected", then a full credit response was one that recognized that in a balanced plan, the expected retro premium *always* equals the guaranteed cost premium, and thus will not change due to a shift in parameters. An increase in per occurrence limit would lead to a decrease in the ELF, and an increase in both the limited expected loss and insurance charge. These movements would fully offset one another and leave the expected retro premium unchanged.

Many candidates cited the overlap between the ELF and insurance charge as an argument for or against the assertion, but this was not accepted. The ICRLL procedure is designed to correct for the overlap, and thus the overlap issue does not apply.

A candidate who recognized one or more values that would shift, correctly identified the direction(s) of the shift, and provided a clear explanation for why they would shift, received partial credit.

A candidate who recognized two or more values that would shift, *and* identified that the shifts would offset one another, *but* didn't recognize that the offset would be dollar for dollar, also received partial credit.

If the candidate assumed that "retrospective premium" meant "actual", then a full credit response needed to clearly articulate the relationship between the insured's actual losses and their expected losses. Specifically, the candidate needed to demonstrate that the insured would save premium only if their actual losses were lower that what the E and ELF would anticipate.

In this case, partial credit answers recognized the connection between retro premium and losses, but failed to solidly connect these to expected losses.

There was a surprising number of candidates who scored well in Parts a and b but received no credit for Part c. It might be that those candidates were overly focused on memorization and not sufficiently focused on understanding the material in depth.

QUESTION 18

TOTAL POINT VALUE: 2.5 **LEARNING OBJECTIVE: B5**

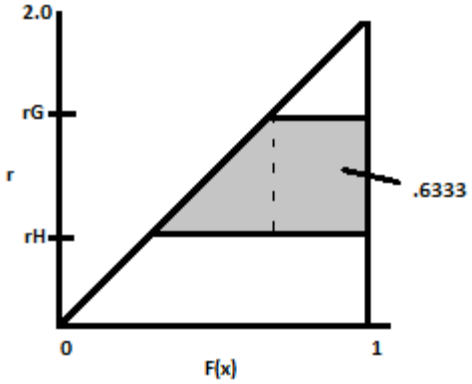
SAMPLE ANSWERS

Sample 1

$$E = 45k$$

$$r_G - r_H = \frac{G-H}{cE} = 1.111$$

$$X_H - X_G = \frac{e+E-H}{cE} = .6333$$



$$(r_G - r_H)(1 - {}^{r_G}\!/_{2}) + \frac{(r_G - r_H)\frac{(r_G - r_H)}{2}}{2} = .6333$$

$$r_g = 1.111 + r_H$$

$$1.111\left(1 - \frac{1.111 + r_H}{2}\right) + \frac{1.111(1.111/2)}{2} = .6333$$

$$r_H = .3044$$

$$r_G = 1.4155$$

$$L_H = r_H * E = .3044 * 45k = 13.7k$$

$$L_G = r_G * E = 1.4155 * 45k = 63.7k$$

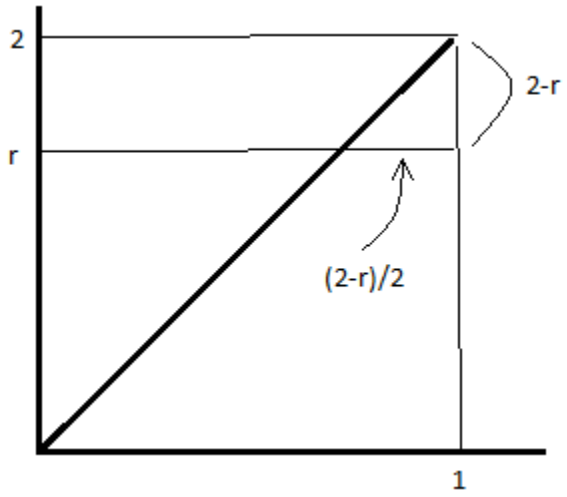
Sample 2

$$E = \frac{0 + 90,000}{2} = 45,000$$

$$\phi(r_H) - \phi(r_G) = \frac{e + E - H}{cE} = \frac{8,125 + 45,000 - 17,500}{1.25 \times 45,000} = 0.6333$$

$$r_G - r_H = \frac{G - H}{cE} = \frac{80,000 - 17,500}{1.25 \times 45,000} = 1.1111$$

$$r_G = 1.1111 + r_H$$



$$\phi(r) = \frac{1}{2}(2 - r)\frac{(2 - r)}{2} = \frac{(2 - r)^2}{4}$$

$$\phi(r_H) - \phi(r_G) = \frac{(2 - r_H)^2}{4} - \frac{(2 - r_G)^2}{4} = 0.6333$$

$$(2 - r_H)^2 - (2 - (1.1111 + r_H))^2 = 0.6333 \times 4$$

$$2^2 - 4r_H + r_H^2 - 0.8889^2 + 2 \times 0.8889 r_H - r_H^2 = 0.6333 \times 4$$

$$\frac{4 - 0.8889^2 - 0.6333 \times 4}{4 - 2 \times 0.8889} = r_H = 0.3045$$

$$L_H = r_H \times E = 0.3045 \times 45,000 = 13,702.5$$

$$r_G = 0.3045 + 1.1111 = 1.4156$$

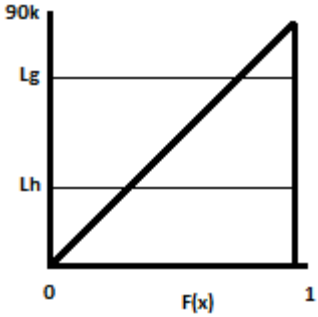
$$L_G = 63,702$$

Sample 3

$$E = 45k$$

$$L_G - L_H = \frac{G-H}{cT} = \frac{80-17.5}{1.25*1} = 50k$$

$$(X_H - X_G)E = \frac{(e+E)-H/T}{cE} * E = \frac{(8.125+45)-17.5}{1.25*45} * E = .6333 * E = 28.5$$



$$X_G E = \frac{1}{2}(90-L_G)\frac{90-L_G}{90} = \frac{1}{180}(90-L_G)^2$$

$$X_H E = \frac{1}{180}(90-L_H)^2$$

$$\frac{1}{180}(90-L_H)^2 - \frac{1}{180}(90-L_G)^2 = 28.5$$

$$L_G - L_H = 50 \ (from\ above)$$

$$(90-L_H)^2 - (90-50-L_H)^2 = 5130$$

$$L_H = 13.7k$$

$$L_G = 63.7k$$

EXAMINER'S REPORT

This was a challenging question, and candidates generally performed poorly. The most difficult aspect was relating the "left-hand side" of the 2nd balance equation to the aggregate loss distribution, that is, expressing $\phi(r_H) - \phi(r_G)$ in terms of r_G and r_H (or L_G and L_H). Very few candidates made this connection; in fact, the majority of candidates failed to realize that the balance equations were necessary in order to re-balance the plan.

Many candidates calculated the guaranteed cost premium, which was not needed to solve the problem. Many candidates also attempted to find the basic premium, which was not needed to solve the problem.

Other common mistakes included:

- Confusing G and H (80k and 17.5k) with L_G and L_H
- Confusing the expense provision (8.125k) with the basic premium
- Using the original loss distribution of U[0, 100k] rather than the revised distribution of U[0, 90k]
- Coming up with the system of equations (that is, two equations with two unknowns) but failing to correctly solve the system (candidates were only marginally penalized for not completing this step)

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 19

TOTAL POINT VALUE: 2.75

LEARNING OBJECTIVE:

SAMPLE ANSWERS

Part a: 1 point

Sample 1

Entry Ratio = $1M / 900K (1 - .20) = 1.39 which the table corresponds to an insurance charge of 0.09.

LDD Premium = $\dfrac{900{,}000\left[0.20 + 0.09 + 0.07 + 0.05\right] + 1{,}000{,}000(.05+.04)}{1-.05-.08-.025}$

= 543,195

Sample 2

LDD Premium = $\dfrac{900{,}000\left[0.20 + 0.8\left(0.09\right) + 0.07 + 0.05\right] + 1{,}000{,}000(.05+.04)}{1-.05-.08-.025}$

= 524, 024

Part b: 0.75 point

Sample 1

A medium-sized employer may be allowed to purchase an LDD plan even if it doesn't qualify for self-insurance.

Sample 2

If the company already has a full coverage policy, it is already familiar with the insurer's service if it decides to purchase an LDD policy.

Sample 3

LDD still services all losses (even those below the deductible) and insured can be comfortable with an experienced insurer handling the claims.

Sample 4

Employer gets to keep savings from tax and assessments for premium from losses under the deductible

Sample 5

Cash flow benefits as employer will get to hold onto cash longer since insurer will pay losses first and then seek reimbursement from the employer.

Sample 6

There is a tax incentive since the insured can deduct a tax liability for an unpaid deductible but not on a liability for a loss reserve.

Sample 7

Give employer more control of losses under the large deductible.

Part c: 0.5 Point

Sample 1

Excess Premium = $\frac{900,000\ (0.20+0.09)(1.07) + \ 1,000,000(.05)}{1-.05-0.03+.015}$ = 352,160

Sample 2

Excess Premium = $\frac{900,000\ [0.20+(0.80)\ 0.09](1.07) + \ 1,000,000(.05)}{1-.05-.03+.015}$ = 333,621

Part d: 0.5 Point

Sample 1

	LDD Plan	**Excess WC**
Profit	Profit is higher since company competes on excess price as well as quality of service	Profit is lower since company competes only on price
Tax	Tax rate on premium is WC tax rate	Tax rate charged on premium is GL tax rate

Sample 2

Profit – More ability for investment income due to longer payout period on XS vs. LDD → profit can be lower
Tax – XS uses GL taxes whereas LDD uses WC – WC taxes and assessments are higher

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Sample 3

LDD policies compete mostly on service while XS compete on profit. Therefore CS policies have lower profits than LDD.
Taxes are less on XS policies since they are not subject to certain tax based assessments while LDD is.

EXAMINER'S REPORT

Part a

The most common error candidates made was forgetting to use limited losses in the denominator of the entry ratio calculation. Since it was not specified whether the insurance charge would apply to limited or unlimited losses, both answers were accepted.

Part b

A variety of answers were accepted if they were explained correctly.

Part c

The most common errors were ULAE not being applied to the total excess loss and only to either the insurance charge or the losses above the per occurrence deductible. Some candidates also forgot to exclude credit risk or loss based assessments. Errors made on part A were not penalized further on part C.

Part d

The majority of candidates were able to identify the differences between these two assumptions but we include a few varieties of acceptable answers above.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 20

TOTAL POINT VALUE: 1.5 **LEARNING OBJECTIVE: C3**

SAMPLE ANSWERS

Part a: 0.75 point

Midpoint of prospective policy year is 10/1/2015.
Trend from 7/1/2014 to 10/1/2015 = 1.25 years.
$4,000,000 claim = $7,000,000 loss with the attachment point at $3,000,000.

$$7{,}000{,}000 * (1 + x)^{1.25} = 7{,}395{,}940$$
$$(1 + x)^{1.25} = 1.05656$$
$$1 + x = 1.045$$

Annual trend factor = 4.5%

Part b: 0.75 point

Sample 1

Suppose ten years ago the attachment point was $2,000,000. Then a $4,000,000 payment in 2004 is from a $6,000,000 loss, but if we had assumed the same limits with no growth, we would assume it was a $7,000,000 loss. Therefore the trended claim would be overstated.

Sample 2

The upward drift of policy limits and attachment points can distort trending of historical losses if historical losses are being subject to the current limits and attachment points before being trended to the prospective year.

Had the loss occurred in 2004, the trended claim would be overstated because the actual attachment point/limit in 2004 would have been lower, so the ground-up loss being trended would have been lower.

EXAMINER'S REPORT

Part a

Candidates were asked to calculate the factor used by an insurer to trend a claim. A large number of candidates made the mistake of trending only the $4,000,000 umbrella portion of the loss rather than trending the entire $7,000,000 ground-up loss and then

subtracting the $3,000,000 underlying layer. A second common mistake was to err in determining the length of the trending period.

Part b

Part b was clearly more difficult than Part a for candidates, with most candidates missing the important point that the attachment point in 2004 likely would have been less than $3,000,000. This means that a $4,000,000 umbrella claim in 2004 would have been produced by a ground-up loss of less than $7,000,000.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 21

TOTAL POINT VALUE: 3.5 **LEARNING OBJECTIVE: C3**

SAMPLE ANSWERS

Part a: 2 points

Sample 1

The greatest cost would be option 3, because including ALAE in underlying limit will mean more losses will reach the umbrella layer, but having ALAE in addition to umbrella means the potential umbrella payments will be greater than the loss limit alone.

It is difficult to say which is greater between the other two options. For option 1, including ALAE in underlying will mean that more losses are reaching umbrella layer, but by also including ALAE in umbrella the total loss & ALAE is capped at the layer amount. For option 2, not as many losses will reach the umbrella layer, but the umbrella may pay more than its limit.

Sample 2

1)middle cost
2)lowest cost
3)highest cost

3 is clearly the highest cost option. ALAE being included in the primary limit acts to lower the umbrella attachment point, which increases expected costs. ALAE in addition to the umbrella policy limit makes the overall max loss higher than when it is included in the limit.

The increased cost for essentially lowering the attachment point in #1 should outweigh the potential for large ALAE claims above the umbrella limit in #2. Even though there is uncapped ALAE for option #2, the majority of the expected loss is in the lower portion of umbrella layers.

Part b: 1 point

Common responses that received 0.5 point each:

- ALAE to loss paid is very volatile
- The underlying layer appears to have a limit of 2M. It looks like losses may be capped, which distorts the ALAE ratio.
- There are only 9 claims. The credibility of such a small data set is an issue
- There are multiple losses where paid ALAE exceeds paid loss. This could be evidence of extensive litigation and aggressive defense of claims that could inflate the ALAE ratio.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part c: 0.5 point

Sample 1

I do not agree. ALAE itself can be the cause of clash covers to be penetrated due to extra contractual obligations. It would be understating ultimate expense to exclude an ALAE load.

Sample 2

No, if ALAE is included with loss for the limit, penetration to excess layers is more likely. The ALAE pick is important in this scenario.

EXAMINER'S REPORT

General Commentary

- Candidates were expected to have an understanding of how ALAE can impact policy limits at various layers of an insurance tower.
- Overall, candidates did not score well on this question, though partial credit was regularly given on each section.
- Generally, candidates were able to provide definitions of the key concepts, but they did not do well in applying the concepts to the given problem.
- Though points were not deducted for this, many candidates used terms such as treaty, reinsurance, free cover, exposure vs experience rating, and ILF relationships where such concepts were irrelevant. In the instances of this misapplication, candidates appeared to be referring to previously tested concepts as opposed to mastery of the material. (e.g. many responses referred to the umbrella policy in part a. as a treaty)

Part a

- Roughly 10% of candidates received full credit, while half received some amount of partial credit.
- Candidates were expected to understand how ALAE treatment (included with loss or in addition to) would impact the relative price of a primary and umbrella layer. Candidates commonly confused the ranking of the three, though partial credit was awarded for knowing that outside/outside is least expensive or inside/outside is most expensive.

Common errors:

- The most common answer that received no credit was the ranking of ALAE

outside/outside as most expensive. While, it creates a scenario where the umbrella carrier could pay more than the stated limit, it also takes more loss activity on the underlying to reach the layer.

- Often, they were able to identify that ALAE inside will breach the umbrella faster, but did not note that it also exhausts the umbrella more quickly nor could they apply this knowledge to the ranking.
- Many candidates ranked inside/inside as more expensive to the umbrella than inside/outside.

Part b

- Expectation for this part was that candidates would illustrate an understanding of key concerns surrounding volatility and credibility by incorporating the given data set into their responses.
- Roughly 10% received full credit, but many candidates received a half point for simply stating that the data is volatile.

Common errors

- Reference to general insurance topics that provided far too broad of a response, given the scope of the question. Examples include: loss trending, development, loss size correlations, claims handling practices.
- Some candidates again referred to reinsurance terminology. (e.g. If this is the first time company B is buying a treaty….) This is incorrect because the insured buys umbrella policies, not the underlying carrier.
- Some responses focused in on individual claims in order to determine a relationship to be considered, essentially stating that an ALAE load may be calculated from that one claim.

Part c

- 10% of candidates received full credit, but 79% received at least partial credit
- The original intent of this part was for the candidate to respond to how ALAE is treated in underlying layers (inside vs outside) and whether it matters for a clash cover. Very few candidates addressed this, so the ambiguity of the question was taken into account and full credit given as follows below:
- Candidates were expected to know that the treatment of ALAE can be significant for clash covers and to explain one of the two points: 1)ALAE inside underlying limits can lead to clash cover breach, or 2)specific instances of runaway ALAE (ECO, XPL)
- The vast majority of candidates disagreed with the actuary in the question regarding the insignificance of ALAE treatment.

Common errors

- Full credit was not given for explanations that used high indemnity scenarios (hurricane, earthquake) nor for a general description of how clash is breached (e.g. high ALAE claims).
- Full credit was not given for stating that ALAE can exceed loss for large claims.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 22

TOTAL POINT VALUE: 2.5 **LEARNING OBJECTIVE: C3**

SAMPLE ANSWERS

Part a: 0.5 point

Only risks written in 2012 are included (risks 2 and 3). Reinsurer's loss = 400,000 * 0.3 + 1,500,000*0.3 = 570,000

Part b: 1 point

Based on loss date, so all claims considered. Reinsurer's share = # of reinsurer's lines / Insured Value. Share 1 = 100k/200k = 50%. Share 2 = 400k/500k = 80%. Share 3 = 500k/1.5m = 33.33%. Reinsurer's loss liability = reinsurer's share * loss amount = 50% * 100k + 80% * 400k + 33.33% * 1.5m = 870k.

Part c: 1 point

Coverage issue results when a policy written in 2013 (and still inforce in 2014) has a loss in 2014. Both treaties would cover the loss by definition. An interlocking clause can be introduced to assign the loss to a specific treaty.

EXAMINER'S REPORT

Candidates generally performed well on the entire question, which required knowledge of quota-share and surplus-share reinsurance and application of the differences between risks attaching and losses occurring concepts.

Part a

Most candidates received full credit on this subpart. The common error was including risk 1 in the calculation.

Part b

Like part a, most candidates received full credit on this subpart. Common errors were excluding risk 1 and calculating the ceded loss as excess of the insurer's one line with a $500K maximum.

Part c

This was the most difficult subpart for candidates as about half of the candidates received full credit. Most candidates were able to identify the problem; however the most common oversight was neglecting to provide a solution to how the ceding company and reinsurer can structure the existing treaties to avoid a coverage overlap. Simply changing the type of treaty written (e.g. just use two loss occurring treaties) was not a valid response.

Other correct solutions to the overlap included:

- The reinsurer may add a clause in the 2014 treaty to exclude claims that would be covered by 2013 treaty.
- Commute the risks attaching policy at 1/1/14 and replace it with the loss occurring treaty.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 23

TOTAL POINT VALUE: 2 **LEARNING OBJECTIVE: C3, C4a**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

The sliding scale commission has a higher provisional commission than the commission for the loss corridor. This means that at the beginning of the treaty, the ceding company will receive more commission to reimburse them for underwriting expenses. The commission may be adjusted down later, but they will have the positive cash flow above initially.

Sample 2

The provisional commission for the sliding scale plan is higher than for the loss corridor option so the insured will receive more cash up front which they can invest.

Part b: 1 point

Sample 1

Introduce a carryforward in which the portion of the loss ratio in excess of the loss ratio corresponding to the minimum commission is added to the subsequent years LR for the purpose of determining the sliding scale commission. This can be done in 1 of 2 ways:

1. Assume all past carryforwards only apply to the current year
2. Calculate the LR for a block of years together

Sample 2

- They can establish a carryover provision which takes the LR used to calculate the commission…the excess of it if it is already past the min commission rate (10% at 75% LR) and add it to the following year's LR to then calculate its commission.
- A profit sharing provision would also incentivize the insurer to manage losses before the potential return in premiums.

Sample 3

1) It could reduce the range for the max and min – less volatility in commission rate from losses
2) It could incorporate a carryforward provision such that the amount of the

loss ratio in excess of the maximum (leading to minimum commission) will be added to the following year's loss ratio.

Part c: 0.5 point

Sample 1

No, because in determining an aggregate loss distribution model the most important part is to truthfully reflect the expected potential loss cost. Hence, it should not be carried over to later years because the insurance contract or treaty may not be in existence in later years.

Sample 2

I would include in the aggregate loss distribution as this will be a way to estimate aggregate commissions at an ultimate level.
=> The challenge is that it is difficult to reflect the potential that policies can non-renew or be cancelled and then there is no longer the carryforward component.

EXAMINER'S REPORT

General Commentary

- Candidates were expected to understand different commission structures between the primary insurer and reinsurer. Candidates were expected to understand advantages and disadvantages between the different commission structures described in Clark.
- Candidates generally performed well on part b, however they struggled on parts a and c.
- For part a, candidates often described aspects of the sliding scale correctly but not in relation to the loss corridor as the question asked.
- For part c, candidates often stated whether or not smoothing should be included but lack of explanation was the main reason candidates did not receive credit for this part.

Part a

- Candidates were expected to understand the purpose and timing of the provisional commission paid in the sliding scale as well as the ceding commission paid in the loss corridor.
- Candidates were expected to mention that the provisional commission in the sliding scale is higher than the ceding commission paid in the loss corridor. Candidates were expected to comment on how these commissions are paid at the onset of the policy

giving the sliding commission a cash flow advantage over the loss corridor.

- Common errors made by candidates:
    - Candidates not mentioning that the provisional commission in the sliding scale is greater than the loss corridor commission.
    - Candidates not mentioning the commissions are paid at the onset of the policy thus giving the sliding scale a timing advantage over the loss corridor.
    - Candidates comparing the sliding scale provisional commission to the expected sliding scale commission.
    - Candidates discussing the sliding scale plan on its own; not in comparison to the loss corridor.

Part b

- Candidates were expected to understand potential mechanisms to smooth cash flows between the primary insurer and reinsurer.
- Candidates were expected to provide and describe two ways to stabilize results from the insurer's perspective.
- Common errors made by candidates:
    - Candidates mentioned an approach to stabilize results but didn't describe the approach.
    - Candidates described stabilizing the commission structure from the reinsurer's perspective rather than the insurer's perspective or it was unclear from the description.
    - Candidates described an approach that would increase the volatility of the cash flows between the reinsurer and primary insurer.
- The most common ways candidates received full credit were to describe the carryforward provision and its extension in considering a block of years to model the carryforward. Additional explanations receiving full credit as one of the ways to stabilize results included:
    - Describe a provision to cap the losses being used in the determination of commission.
    - Describe other reinsurance policies that could be used to decrease the amount of volatility in the losses being used in the commission calculation for the contracts described in the question.
    - Describe revisions to the sliding scale structure provided in the question to reduce the volatility such as decreasing the range of loss ratios, decreasing the range of commissions possible, decreasing the sliding scale sensitivity to losses.

Other solutions were accepted.

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Part c

- Candidates were expected to explain whether the aggregate loss distribution should be adjusted for the smoothing mechanisms in b. Candidates could say yes or no as long as they supported their position.
- Candidate responses were accepted that didn't directly link their answers in c to their answers in b as long as the explanation in c was clear.
- Candidates receiving full credit tended to comment on the impact to the volatility of the aggregate loss distribution of incorporating the smoothing provisions. For example, mentioning the need to preserve the volatility of the underlying loss distribution.
- Common errors made by candidates:
    - Candidates not providing an explanation that supported their position
- Partial credit was given for mentioning potential difficulties in incorporating the variance reduction attributed to smoothing:
    - With a carryforward, need to make an assumption on whether policies will renew.

Other solutions were accepted.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 24

TOTAL POINT VALUE: 2.25 **LEARNING OBJECTIVE: C1, C3**

SAMPLE ANSWERS

Part a: 0.5 point

Sample 1

OEP for 10M xs 10M = 0.10,
therefore, it should take 1 / 0.10 years to pay back and thus the PP for the treaty should be 10,000,000 / 10 = $1,000,000

Sample 2

Losses of 10M xs 10M have OEP = 0.10. Pure Premium = 10M * 0.10 = 1M

Part b: 0.5 point

Total loss of 15M, 5M in layer. Reinstatement premium = (5M/10M) * 1.15 * 1.2M = 690,000

Part c (incorrectly labeled as Part a on exam): 1.25 points

QS treaty applied first.
QS treaty covers 0.3 * 15M = 4,500,000
left = 15,000,000 – 4,500,000 = 10,500,000
CAT treaty covers 10M x 10M = 500,000
insurer net loss = 15M – 4.5M – 500k = 10M

EXAMINER'S REPORT

General Commentary

Candidates were expected to know how:

- To interpret an occurrence exceedance probability curve
- To use the "payback approach" to calculate a loss cost for a reinsurance treaty
- To compute a simple reinstatement premium
- To apply both a quota share treaty and a catastrophe treaty to a single loss.

Most candidates scored very well; by far the most frequent errors involved candidates having some difficulty interpreting the exceedance probability curve in part a.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

Part a

Successful candidates understood that the given exceedance probability curve was stated from the perspective of the catastrophe reinsurer; the question specifically refers to the curve as for "losses in excess of $10,000,000." With that understanding, successful candidates correctly understood that the reinsurer would be concerned with the probability of a total loss in the reinsurance layer.

To get full credit, candidates were expected to either explicitly state the 10-year payback period and to divide the full layer loss by the payback period to get a pure premium, or to multiply the full layer loss by the relevant value from the exceedance probability curve.

The most common error among the responses was to use the OEP curve to compute a probability other than 0.1. For example, several candidates attempted to use the OEP curve to calculate a probability that would correspond to the 10x20 layer, rather than the 10x10 layer.

If the candidate used the incorrect probability correctly to calculate a premium, the candidate received partial credit.

Part b

Candidates were expected to know how to compute a reinstatement premium given an original premium, a reinstatement provision, a reinsurance structure, and a ground-up loss.

For full credit, candidates had to compute the correct reinstatement premium. Most candidates scored very well on this part, with common mistakes involving calculation errors.

Part c

Candidates were expected to know how to apply both a quota share treaty and a catastrophe excess of loss treaty to a ground-up loss, recognizing the effect of one treaty inuring to the benefit of the other. To get full credit, candidates needed to calculate the portion of the ground-up loss paid by each reinsurer, and retained by the primary insurer.

While most candidates scored well on this part, and while most mistakes were calculation errors, one somewhat common incorrect response was to show the CAT treaty as inuring to the benefit of the quota share treaty. Some candidates included a calculation of the CAT treaty reinstatement, along the lines described in part b; as long as this calculation was reasonable, it had no impact on the candidate's score.

EXAM 8 FALL 2014 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION 25

TOTAL POINT VALUE: 1.5 **LEARNING OBJECTIVE: C5**

SAMPLE ANSWERS

Part a: 1 point

Sample 1

(E[x;250K+750K] – E[x;250K])/E[x;1,000K] = (7146.98 – 5899.31)/7146.98 = 0.1746

Sample 2

Layer is 750K xs 250K
G(1) – G(0.25) = 1 – 5899.31/7146.98 = 0.1746

Part b: 0.5 point

Sample 1

(0.1746) * x = 243,500, therefore x=1.395M

Sample 2

Loss in layer = freq.* (E[X^1000] – E[X^250]) = 243,500
Ground up loss = freq. * (E[X^1000])
Freq. = 195.269
Ground up loss = 195.269*7146.98 = 1395.58K

EXAMINER'S REPORT

Part a

The candidates needed to know the exposure curve and finding the exposure factor based on the layers asked in the question.

Candidates generally scored well but there are some common mistakes:

- Selecting the wrong layers (ex. use the concept of ILFs instead of exposure curves)
- Plugging in values in thousands rather than in dollars into given formula, which causes exposure factors to be greater than 1
- Calculating the individual expected limited losses incorrectly

The vast majority of candidates conceptually knew what to do, but several had minor errors in execution

Part b

The candidates needed to know how to use the exposure factor calculated from part) a to set up the relationship between the ground up losses and losses in the layer.

There are some common mistakes, including:

- Not knowing the right formula to use
- Not knowing the relationship between the ground up losses and losses in the layer