**SOCIETY OF ACTUARIES**
**Introduction to Ratemaking & Reserving**

# Exam GIIRR

## AFTERNOON SESSION

**Date:** Wednesday, October 28, 2015
**Time:** 1:30 p.m. – 3:45 p.m.

### INSTRUCTIONS TO CANDIDATES

**General Instructions**

1. This afternoon session consists of 8 questions numbered 14 through 21 for a total of 40 points. The points for each question are indicated at the beginning of the question.

2. Failure to stop writing after time is called will result in the disqualification of your answers or further disciplinary action.

3. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.

**Written-Answer Instructions**

1. Write your candidate number at the top of each sheet. Your name must not appear.

2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.

3. The answer should be confined to the question as set.

4. When you are asked to calculate, show all your work including any applicable formulas.

5. When you finish, insert all your written-answer sheets into the Essay Answer Envelope. Be sure to hand in all your answer sheets since they cannot be accepted later. Seal the envelope and write your candidate number in the space provided on the outside of the envelope. Check the appropriate box to indicate morning or afternoon session for Exam GIIRR.

6. Be sure your written-answer envelope is signed because if it is not, your examination will not be graded.

Tournez le cahier d'examen pour la version française.

**14.** (*6 points*) You are given this summary of rate changes applied by ABC Auto Insurer:

| Calendar Year | Earned Premiums | Rate Change % in Year | Effective Date of Rate Change |
|---|---|---|---|
| 2011 | 22,000 | 6% | July 1, 2011 |
| 2012 | 24,000 | 10% | October 1, 2012 |
| 2013 | 27,000 | 8% | July 1, 2013 |
| 2014 | 25,000 | −12% | July 1, 2014 |
| 2015 | 23,000 | 8% | July 1, 2015 |

- Premiums are written evenly throughout the year.
- Premiums are earned evenly throughout the policy term.
- All policies are written for twelve-month policy terms.
- Each rate change applies to all policies written on or after the effective date of the rate change.

(a) (*2 points*) Calculate the weighted average rate level relative value for each of 2011 and 2012, using a rate level relative value of 1 at the beginning of 2011.

(b) (*1.5 points*) Calculate the premium on-level factor for 2012 for the purpose of:

    (i)     Projecting ultimate claims as of December 31, 2015

    (ii)    Ratemaking analysis

A mandated rate reduction of 15% has been applied on September 1, 2012 that is effective for all new and in-force policies.

(c) (*2.5 points*) Calculate the weighted average rate level for 2012.

**15.** (*4 points*)  You are given the following information for a group of claims in run-off:

| | Amounts as of | | | |
|---|---|---|---|---|
| | **June 30, 2013** | **Dec. 31, 2013** | **June 30, 2014** | **Dec. 31, 2014** |
| Cumulative Paid Claims | 0 | 10,000 | 25,000 | 40,000 |
| Case Reserves | 30,000 | 60,000 | 50,000 | 25,000 |

- Ultimate claims are reviewed annually on June 30.
- At June 30, 2013, the actuary estimated ultimate claims to be 100,000.
- At June 30, 2014, the actuary changed the estimate of ultimate claims to be 90,000.

(a) (*0.5 points*)  Determine the IBNR reserves recorded in the December 31, 2013 balance sheet.

(b) (*0.5 points*)  Determine the IBNR reserves recorded in the December 31, 2014 balance sheet.

(c) (*1 point*)  Determine the calendar year incurred claims recorded in the 2014 income statement.

You are also given the following information related to one claim file included in the data above.  The accident occurred on July 1, 2013 and the claim was closed on March 1, 2015.

| Trans. # | Transaction Date | Transaction Description | Change in Case Estimate | Indemnity Payment | ALAE Payment |
|---|---|---|---|---|---|
| 1 | Oct 1, 2013 | Open new claim file | +250 | | |
| 2 | Nov 1, 2013 | Payment on reported file | | | 50 |
| 3 | Apr 1, 2014 | Change in case estimate | +100 | | |
| 4 | Oct 1, 2014 | Payment and change in case estimate | −325 | 300 | 25 |
| 5 | Mar 1, 2015 | Close reported claim file | −25 | 100 | 25 |

(d) (*1.5 points*)  Calculate the incremental claims paid (including ALAE) and incremental reported claims at the end of calendar years 2013, 2014 and 2015 for this claim.

(e) (*0.5 points*)  Identify a situation where the reported claims may decrease over time.

**16.** (*6 points*)

    (a)      (*1 point*)  Describe two considerations in selecting development factors.

You are given the following information regarding automobile collision data:

| Accident | Reported Claims | | | |
|---|---|---|---|---|
| Year | 12 | 24 | 36 | 48 |
| 2011 | 1,000 | 2,350 | 2,820 | 3,102 |
| 2012 | 900 | 2,160 | 3,456 | |
| 2013 | 1,200 | 2,520 | | |
| 2014 | 1,300 | | | |

Assume a tail factor of 1.02 at 48 months development.

    (b)      (*2 points*)  Calculate ultimate claims for all accident years using the development method and a simple all-year average of the age-to-age development factors.

You are monitoring reported claim activity on a quarterly basis and are given the following additional information:

| Accident Year | Actual Reported Claims as of March 31, 2015 |
|---|---|
| 2012 | 3,659 |
| 2013 | 2,950 |
| 2014 | 1,983 |

    (c)      (*1 point*)  Calculate the expected reported claims as of March 31, 2015 for accident years 2012, 2013 and 2014, using a linear interpolation of the expected percentage reported derived from the cumulative development factors.

    (d)      (*1 point*)  Describe two possible explanations for the differences between the actual reported claims as of March 31, 2015 and the results from part (c).

    (e)      (*1 point*)  Recommend an action to either resolve or investigate each explanation identified in part (d).

**17.** (*4 points*)  You are estimating ultimate property claims for ratemaking purposes.

    (a)    (*0.5 points*)  Explain one advantage of applying a large claim loading to limited claims instead of using total limits claims.

You are given the following information:

| Accident Year | Selected Ultimate Claims at 500,000 Limit | Selected Ultimate Claims at Total Limits | Trend Period to Future Rating Period (Months) |
|---|---|---|---|
| 2012 | 6,200 | 7,400 | 45 |
| 2013 | 6,300 | 7,300 | 33 |
| 2014 | 6,400 | 8,800 | 21 |

The annual severity trend rates are 5% for 500,000 limit claims and 6% for total limits claims.

    (b)    (*1.5 points*)  Calculate the loading for large claims for each accident year, adjusted to the future rating period.

    (c)    (*0.5 points*)  Select a loading for large claims based on the calculations in part (b). Justify your selection.

    (d)    (*0.5 points*)  Calculate the relative severity trend rate for the 500,000 to total limits layer.

    (e)    (*1 point*)  Calculate the indicated ultimate claims for accident year 2013 by applying the loading for large claims selected in part (c).

**18.** (*5 points*) The expected loss size on Policy A with a policy limit of 200 can be expressed as

$$\int_0^{200} x\, dF(x) + 200[1 - F(200)] = \int_0^{200} [1 - F(x)]\, dx \,,$$

where $F$ is the cumulative distribution function of losses.

One side of the equation can be viewed as the sum of vertical strips and the other side of the equation can be viewed as the sum of horizontal strips.

(a)     (*2 points*) Illustrate this concept using a graph with labels to show how the graph relates to the equation above.

Policyholder losses follow an exponential distribution with mean 100. The expected loss size on Policy A is 86.47.

(b)     (*1.5 points*) Calculate the expected loss size on Policy A after one year and after two years, assuming an annual loss trend of 10%.

(c)     (*0.5 points*) Explain why the expected loss size on Policy A increases by less than 10% per year.

(d)     (*1 point*) Explain why the percentage increase in the expected loss size on Policy A during the second year is smaller than the percentage increase during the first year.

**19.** (*6 points*) You are reviewing several lines of business where conditions have been changing.

You are analyzing the reported development triangle for a line of business where the ultimate claim ratio is increasing unexpectedly due to inadequate price increases. All other aspects of the business are in a steady-state environment.

(a)     (*1 point*) Explain what effect the claim ratio deterioration will have on reported claim development factors.

(b)     (*1 point*) Explain which of the following two methods is likely to produce a more accurate estimate of ultimate claims under this scenario:

(i)      the reported development method, or

(ii)     the reported Bornhuetter Ferguson method.

You are analyzing the reported development triangle for a property-liability package line of business where the mix of business is changing unexpectedly to become more heavily weighted on liability. The liability development is longer-tailed than the property development, and has higher development factors. The liability claims ratio is also higher than the property claims ratio.

(c)     (*1 point*) Explain what effect the change in mix of business will have on the reported claim development factors.

(d)     (*1 point*) Explain which of the following two methods is likely to produce a more accurate estimate of ultimate claims under this scenario:

(i)      the reported development method, or

(ii)     the reported Cape Cod method.

You are analyzing the reported development triangle for a workers compensation line of business where a state-legislated change 18 months ago increased workers compensation benefit levels on all open claims. All other aspects of the business are in a steady-state environment.

(e)     (*1 point*) Explain what effect the legislative change will have on the reported claim development factors.

**19.** **Continued**

    (f)    (*1 point*)  Explain which of the following two methods is likely to produce a more accurate estimate of ultimate claims under this scenario:

        (i)    the reported Bornhuetter Ferguson method, or

        (ii)    the reported Cape Cod method.

**20.** (*4 points*) XYZ Insurer changed its marketing plans a few years ago to promote its 5% discount offered for automobile insurance when a policyholder's homeowners insurance is also with XYZ. The following information is provided:

| Calendar Year Experience Period | Proportion of Automobile Policyholders with 5% Discount |
|---|---|
| 2011 | 15.0% |
| 2012 | 21.0% |
| 2013 | 23.0% |
| 2014 | 25.0% |

(a)     (*1.5 points*) Calculate and select the annual premium trend to account for changes in the proportion of automobile policyholders with the 5% discount.

You are conducting a premium trend analysis for rates to be effective October 1, 2015. It is assumed that the proportion of policyholders receiving the 5% discount in 2014 has reached a steady-state position, and that no further change will occur in the distribution of policyholders with this discount.

(b)     (*1.5 points*) Calculate the trend factor to be used for 2012 using written premiums for the trending analysis and the annual trend selected in part (a).

(c)     (*1 point*) Explain an advantage of using written premiums instead of earned premiums for premium trend analyses.

**21.** (*5 points*)

    (a)    (*1 point*)  Describe two considerations appropriate for self-insured entities in choosing either the pure premium or the claim ratio approach for a ratemaking analysis.

You are given the following information:

| Accident Year | Earned Vehicles | Ultimate Counts | Trended Ultimate Pure Premium |
|---|---|---|---|
| 2010 | 87,600 | 1,433 | 181 |
| 2011 | 82,800 | 1,517 | 184 |
| 2012 | 78,300 | 1,174 | 172 |
| 2013 | 78,400 | 1,114 | 161 |
| 2014 | 81,100 | 1,135 | 178 |

- The full credibility standard is 4,331 ultimate counts.
- Fixed expenses per vehicle are 35.
- The ratio of non-premium related expenses to claims is 7%.
- The permissible claim ratio is 80%.

    (b)    (*1 point*)  Recommend the number of years to include in the weighted average pure premium for the ratemaking analysis.  Justify your recommendation.

    (c)    (*1 point*)  Calculate the weighted average pure premium.

    (d)    (*1 point*)  Calculate the indicated rate.

The current rate per unit of exposure adjusted for trend and premium changes is 250.

    (e)    (*1 point*)  Calculate the experience claim ratio.


**\*\*END OF EXAMINATION\*\***
**Afternoon Session**

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