# Exam GIIRR

## MORNING SESSION

**Date:** Wednesday, May 4th, 2016
**Time:** 8:30 a.m. – 11:45 a.m.

### INSTRUCTIONS TO CANDIDATES

**General Instructions**

1. This examination has a total of 100 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 40 points).

   a) The morning session consists of 11 questions <u>numbered 1 through 11</u>.

   b) The afternoon session consists of 8 questions <u>numbered 12 through 19</u>.

   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.

**1.** (*6 points*) XYZ insurer writes one six-month policy at the beginning of each month in 2015. Each policy has a premium of 2,000.

    (a)    (*0.5 points*) Calculate the policy year 2015 earned premium evaluated as of December 31, 2016.

    (b)    (*0.5 points*) Calculate the calendar year 2015 earned premium.

You are given the following summary of rate changes applied by XYZ insurer:

| Calendar Year | Rate Change % in Year | Effective Date of Rate Change |
|---|---|---|
| 2011 | 8% | October 1, 2011 |
| 2012 | 4% | July 1, 2012 |
| 2013 | –7% | October 1, 2013 |
| 2014 | 12% | October 1, 2014 |
| 2015 | 6% | October 1, 2015 |

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

    (c)    (*3 points*) Calculate the premium on-level factors for 2011 and 2012 used to project expected claim ratios for reserving purposes as of December 31, 2015.

On July 1, 2012, a 10% discount was introduced that was applicable to 40% of all new and in-force policies.

    (d)    (*2 points*) Calculate the weighted average rate level for 2012.

**2.** (*8 points*) You are given the following information as of December 31, 2015:

| Accident Year | Earned Premium | Actual Paid Claims | Paid Cumulative Development Factors | Actual Reported Claims |
|---|---|---|---|---|
| 2013 | 90,000 | 49,000 | 1.20 | 54,000 |
| 2014 | 100,000 | 40,500 | 1.60 | 50,000 |
| 2015 | 110,000 | 40,000 | 2.00 | 45,000 |

The a priori claims ratio is 65% for all accident years.

(a)  (*0.5 points*)  Calculate the difference between actual paid claims and expected paid claims for each accident year.

(b)  (*0.5 points*)  Calculate the accident year 2014 expected paid development from December 31, 2015 to March 31, 2016 using linear interpolation and the a priori expected claims ratio.

(c)  (*0.5 points*)  Explain why linear interpolation might not be appropriate for estimating expected development for accident year 2014.

(d)  (*0.5 points*)  Provide one alternative to linear interpolation for estimating expected development between annual evaluations.

(e)  (*3 points*)  Calculate estimated IBNR reserves for each accident year using the following methods applied to paid claim data:

   (i)    Development method

   (ii)   Bornhuetter Ferguson method

   (iii)  Benktander method, one iteration

You recognize that no single method of estimating IBNR is appropriate for all circumstances.

(f)  (*0.5 points*)  Describe one situation for which the development method might provide a better estimate for the accident year 2015 IBNR reserves.

(g)  (*0.5 points*)  Describe one situation for which the Bornhuetter Ferguson method might provide a better estimate for the accident year 2015 IBNR reserves.

**2.** **Continued**

You are also given the following information related to ULAE:

| Calendar Year | Actual Paid ULAE | Actual Paid Claims | Expected Paid Claims |
|---|---|---|---|
| 2013 | 5,580 | 50,700 | 55,800 |
| 2014 | 5,890 | 53,500 | 60,100 |
| 2015 | 7,100 | 64,500 | 69,600 |

(h) (*1 point*) Estimate accident year 2015 unpaid ULAE as of December 31, 2015 using the classical paid-to-paid method, a multiplier of 50%, estimated IBNR from the Bornhuetter Ferguson method (part (e) above), and the Mango-Allen smoothing adjustment.

(i) (*1 point*) Identify four situations in which the Mango and Allen smoothing adjustment should be considered in the selection of a ULAE ratio.

**3.** (*5 points*) You are analyzing claim trend for a long-tail liability line of business. Your company's own experience lacks sufficient volume to determine the claim trend. You decide to explore other sources of data.

    (a) (*1.5 points*) Identify one distinct consideration, for each of the following options:

        (i) Use industry general insurance data for the applicable line of business and jurisdiction.

        (ii) Combine your company's experience in one jurisdiction with your company's regional experience.

        (iii) Combine your company's experience with that of other affiliated insurers in your group.

The experience data that you are using includes a reform-driven policy change two years ago that was expected to decrease all industry claims by 20%.

    (b) (*1 point*) Explain the effect this change will have on a claim trend analysis if there is no adjustment in the historical data for the reform-driven policy change.

You are given the following claim experience distribution prior to the reform-driven policy change and net of a deductible of 500:

| Claim Distribution Net of Deductible | |
|---|---|
| **Claim Size** | **Counts** |
| 50 | 5 |
| 500 | 10 |

    (c) (*1 point*) Calculate the post-reform losses net of deductible using the claim distribution above.

You are given the following information:

- New rates are to be in effect for all policies written from July 1, 2016 to June 30, 2017.
- All policies written from July 1, 2016 are two-year policies.
- The annual frequency trend is –1.5%.
- The annual severity trend is 3.0%.

    (d) (*1.5 points*) Calculate the accident year 2015 pure premium trend factor.

**4.** (*5 points*)

(a) (*1 point*) Explain how the Bornhuetter Ferguson method of estimating ultimate claims combines the development method and the expected method.

You are given the following information for an automobile collision line of business:

| Accident Year | Reported Salvage | Age-to-Age Development Factors for Salvage | Ultimate Claims |
|---|---|---|---|
| 2012 | 62,000 | 1.00 | 230,100 |
| 2013 | 66,000 | 0.99 | 229,400 |
| 2014 | 65,000 | 0.98 | 232,700 |
| 2015 | 67,000 | 0.95 | 239,200 |

Expected salvage is determined using a ratio approach and a selected ratio of 27% of ultimate claims.

(b) (*1.5 points*) Calculate the ultimate salvage for each accident year using the Bornhuetter Ferguson method.

(c) (*2 points*) Compare the actual reported salvage to the expected reported salvage for each accident year.

(d) (*0.5 points*) Explain whether or not any accident years from part (c) merit further investigation.

**5.** (*7 points*)  You are estimating ultimate claims for PVA Insurance.  Your reserving software produces the following preliminary estimates based on age-to-age development factors.

| Accident | Reported Claims | | | |
|---|---|---|---|---|
| Year | 12 | 24 | 36 | Ultimate |
| 2013 | 12,800 | 16,900 | 21,000 | 21,000 |
| 2014 | 13,700 | 20,200 | - | 25,100 |
| 2015 | 16,600 | - | - | 28,900 |

| Accident | Paid Claims | | | |
|---|---|---|---|---|
| Year | 12 | 24 | 36 | Ultimate |
| 2013 | 8,700 | 10,800 | 19,000 | 21,000 |
| 2014 | 9,300 | 11,600 | - | 22,500 |
| 2015 | 9,800 | - | - | 23,600 |

| Accident | Reported Counts | | | |
|---|---|---|---|---|
| Year | 12 | 24 | 36 | Ultimate |
| 2013 | 200 | 250 | 300 | 300 |
| 2014 | 206 | 258 | - | 310 |
| 2015 | 212 | - | - | 318 |

| Accident | Closed Counts | | | |
|---|---|---|---|---|
| Year | 12 | 24 | 36 | Ultimate |
| 2013 | 156 | 209 | 280 | 300 |
| 2014 | 161 | 235 | - | 337 |
| 2015 | 195 | - | - | 392 |

- The expected annual severity trend for PVA Insurance is 3%.
- Ultimate estimates shown above are based on simple development methods.

The claims department manager advises you that the department has introduced new processes to:

- provide a more accurate estimate of the liability on large claims, and
- accelerate settlement of small claims.

(a) (*1.5 points*)  Calculate the average case estimate triangle.

(b) (*0.5 points*)  Explain whether the average case estimate triangle indicates decreasing, increasing or stable case reserve adequacy.

**5.** **Continued**

(c) (*0.5 points*) Select ultimate counts for each accident year and justify your selection.

(d) (*0.5 points*) Calculate the disposal ratio triangle using the selections from part (c).

(e) (*0.5 points*) Explain whether the disposal ratio triangle indicates decreasing, increasing or stable claim settlement rates.

You have decided to use Berquist-Sherman adjustments to allow for both changing case estimate adequacy and changing settlement rates.

Your analysis indicates that a simple relationship between closed counts and paid claims will be sufficiently accurate for your estimates.

| Accident Year | Ratio of Cumulative Paid Claims to Cumulative Closed Counts | | |
|---|---|---|---|
| | **12** | **24** | **36** |
| 2013-2015 | 55 | 50 | 68 |

(f) (*1.5 points*) Calculate the adjusted paid claims triangle.

(g) (*2 points*) Calculate the adjusted reported claims triangle.

**6.** (*5 points*) You are assessing a general insurer's historical data for pricing a homeowners catastrophe load. You need to consider the relevance and applicability of the data for future projections.

(a) (*2 points*) Describe four considerations for your assessment.

You are given the following complete hail experience of ABC insurer:

| Accident Year | Earned House Years | Trended Hail Ultimate Claims (000) |
|---|---|---|
| 2010 | 13,929 | 0 |
| 2011 | 14,070 | 0 |
| 2012 | 14,212 | 234 |
| 2013 | 14,356 | 0 |
| 2014 | 14,169 | 358 |

- Utimate claims are trended to the average accident date of the period starting on April 1, 2016.
- 2014 earned premiums at current rate levels and trended to the average earned date of the period starting on April 1, 2016 are 11,291,000.

(b) (*1.5 points*) Calculate the hail catastrophe loading as a claim ratio for annual policies starting on April 1, 2016.

(c) (*1 point*) Describe two concerns you would have in relying on the calculation from part (b) in your rating analysis.

(d) (*0.5 points*) Recommend one improvement to address each concern identified in part (c).

**7.** (*4 points*) Individual Risk Insurance Exchange (IRIE) has received applications for individual risk rating from three companies, each of which had 5 million in premium for the experience period and 100% credibility based on IRIE credibility tables. You are given the following claims experience:

| Accident Year | Claims Experience by Company (in millions) | | |
|---|---|---|---|
| | **ABC** | **DEF** | **GHI** |
| 2011 | 0.7 | 0.7 | 0.0 |
| 2012 | 0.9 | 0.5 | 0.0 |
| 2013 | 0.7 | 0.7 | 3.5 |
| 2014 | 0.6 | 0.8 | 0.0 |
| 2015 | 0.6 | 0.8 | 0.0 |

(a) (*0.5 points*) Identify two items of information to request in order to get a broader perspective on the three companies and their historical experience.

(b) (*1.5 points*) Evaluate each company for retrospective rating, from the perspective of IRIE.

Assume that there is no inflation and that the historical claims experience is representative of future experience. IRIE accepts each risk for a 0.15 million minimum annual premium plus an additional premium based on claims experience of 120% of claims, with a maximum total premium of 1.95 million.

(c) (*2 points*) Recommend whether each insured should accept the retrospective premium option or a fixed 1.0 million annual premium. Justify your recommendation.

**8.** (*5 points*)  You are given the following claims and counts for aggregated claim data that is not censored from XYZ Insurance Company:

| Claim Range | Counts in Interval | Claims (000) |
|---|---|---|
| 0-100,000 | 15,000 | 375,000 |
| 100,001-250,000 | 2,000 | 300,000 |
| 250,001-500,000 | 500 | 175,000 |
| 500,001-unlimited | 0 | 0 |

The basic limit is 100,000.

(a)   (*1.5 points*)  Calculate the observed increased limit factors (ILF) for:

   (i)   250,000 limit

   (ii)   500,000 limit

   (iii)   1,000,000 limit

(b)   (*0.5 points*)  Explain whether or not your selected ILF at 1,000,000 should equal your selected ILF at 500,000.

(c)   (*1 point*)  Describe two challenges insurers face when determining ILFs for high limits using empirical data.

XYZ Insurance Company policies have a disappearing deductible with a stated value of 1,000, where losses at least two times the stated value will be covered in full.

(d)   (*1 point*)  Calculate the amount of a covered loss retained by the insured and paid by the insurer for the following covered losses:

| Covered Loss | Retained by the Insured | Paid by the Insurer |
|---|---|---|
| 900 | | |
| 1,400 | | |
| 2,000 | | |

(e)   (*1 point*)  Explain why increasing deductible amounts will reduce claim frequency, but will not necessarily reduce the insurer's claim severity.

**9.** (*5 points*) You are calculating premium liabilities as of December 31, 2015 for ABC Insurance. You are given the following information:

| | |
|---|---|
| Gross Unearned Premium | 5,000,000 |
| Net Unearned Premium | 3,750,000 |
| Number of Policies Written in 2015 | 50,000 |

Claims (including ALAE) are expected to have the following distribution in 2016:

| Gross Claim Per Policy | Probability |
|---|---|
| - | 56% |
| 100 | 30% |
| 500 | 10% |
| 2,000 | 4% |

- Policies are annual and are written uniformly throughout the year.
- The reinsurance in force during 2015 was a 25% quota share policy covering policies written in 2015.
- A new additional excess reinsurance policy will be added effective January 1, 2016. This will cover claims incurred in 2016 in excess of 500 per policy, after quota share.

(a) (*1.5 points*) Calculate the 2016 pure premium per policy, gross and net of reinsurance.

You are given the following additional information:

- The excess reinsurance premium is estimated to be 50 per policy.
- Reinsurance does not cover ULAE or general expenses.
- ULAE is estimated to be 10% of gross claims.
- The general expense ratio is 20% of net premium. The proportion of general expense applicable to net unearned premium is 25%.

(b) (*2.5 points*) Calculate the premium liabilities as of December 31, 2015, gross and net of reinsurance.

(c) (*0.5 points*) Determine either the premium deficiency reserve or the equity in the unearned premium.

(d) (*0.5 points*) State the maximum deferred policy acquisition expense (DPAE) ABC Insurance could record as an asset.

**10.** (*5 points*) You are considering combining indemnity and allocated loss adjustment expenses (ALAE) when using the development method.

    (a)    (*0.5 points*) Identify one practical consideration in your decision.

    (b)    (*0.5 points*) Identify one situation where you should project indemnity and ALAE separately.

You are given the following information:

| Report Year | Reported at Dec. 31, 2015 | | Projected Ultimate Based on Reported Development Method | | Selected Ultimate Claims |
| --- | --- | --- | --- | --- | --- |
| | ALAE | Claims | ALAE | Claims | |
| 2012 | 655 | 14,000 | 720 | 15,000 | 15,000 |
| 2013 | 630 | 14,330 | 740 | 16,100 | 16,100 |
| 2014 | 735 | 13,350 | 930 | 16,000 | 16,000 |
| 2015 | 570 | 12,200 | 820 | 16,400 | 16,400 |
| **Total** | **2,590** | **53,880** | **3,210** | **63,500** | **63,500** |

Because of uncertainty in estimating ultimate ALAE using the development method, you are using an expected ratio approach.

    (c)    (*1 point*) Calculate the ratio of ALAE to claims for each report year.

    (d)    (*1 point*) Select an expected ratio of ALAE to claims. Justify your selection.

    (e)    (*0.5 points*) Calculate the projected ultimate ALAE by report year using the expected ratio from part (d).

    (f)    (*0.5 points*) Calculate the indicated ALAE IBNR by report year using the projected ultimate ALAE from part (e).

    (g)    (*1 point*) Select the ALAE IBNR by comparing the indicated ALAE IBNR calculated in part (f) with the indicated ALAE IBNR from the reported development method. Justify your selection.

**11.** (*5 points*)

    (a)    (*0.5 points*)  Describe how a more refined risk classification system might lead to a competitive advantage for a company.

You are given the following information:

| Exposures (000) | | |
|---|---|---|
| | **Gender** | |
| **Age** | Male | Female |
| Young | 90 | 80 |
| Old | 100 | 110 |

| Observed Pure Premiums | | |
|---|---|---|
| | **Gender** | |
| **Age** | Male | Female |
| Young | 200 | 150 |
| Old | 125 | 120 |

    (b)    (*1.5 points*)  Calculate age one-way relativities and gender one-way relativities.

    (c)    (*1 point*)  Calculate indicated pure premiums for each age and gender combination without rebalancing.

    (d)    (*0.5 points*)  Explain why one-way analysis fails to replicate the observed pure premiums in this scenario.

Regulators in your state of operation have announced a ban on using gender as a rating variable.

    (e)    (*1 point*)  Calculate the revised pure premiums.

    (f)    (*0.5 points*)  Describe the potential rating effects on male and female policyholders.

**\*\*END OF EXAMINATION\*\***
**Morning Session**

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