Institute of Actuaries of India

Subject SA3 – General Insurance

November 2012 Examinations

INDICATIVE SOLUTIONS

Introduction

The indicative solution has been written by the Examiners with the aim of helping candidates. The solutions given are only indicative. It is realized that there could be other points as valid answers and examiner have given credit for any alternative approach or interpretation which they consider to be reasonable.

Q1 **a**. Analysing historic loss ratios would be misleading as they are impacted by changes in premium rates and changes in relativities. Unless the loss ratios are adjusted to be on "as if" basis i.e. to match the current rating schedule, incorrect conclusions can be drawn from analyzing historic loss ratios. Analysing claims frequency and claims severity separately allows one to identify if the driver of an increased relativity is frequency or severity. In some cases cost relativities can be quite similar despite underlying frequency and severity relativities being quite different.

There is no benefit in using average claim sizes over individual claim sizes as basically you would be reducing the number of data points available for analysis.
The gain in computational speed is only marginal, besides which for most rating models the reduction in dataset size is only marginal (less than 5%).
By taking averages, one reduces the within cell variation. This modification means that the modeled dispersion will differ from a model with individual claim sizes.

b. Lowest premium would be INR 4000*exp(-4.65+0-0.6) = INR 21 for policies sold by bank J in area A. Existing premium for this policy would be INR 50 for renewals and INR 45 for new business

Highest premium would be INR 4000*exp(-4.65+2.15-0.1+0.6) = INR 542 for policies sold by bank K in area F. Existing premium for this policy would be INR 200.

c. Further analysis needed:
- Data validation
- Validation/improvement of claims frequency analysis
- GLM of claim size
- Time series – any trends in claim frequency or severity
- Interest rates for discounting
- Expense analysis – by type and channel and whether fixed per policy or varying with premium/sum insured
- Analysis of profit margin required to achieve a target return on capital
- Analysis of catastrophe exposure and of suitable allowance of catastrophe reinsurance premiums by area
- Analysis of capital required to support the business
- Analysis of price elasticity of policyholders in different segments (channels) – likely to be a change in the mix of business away from segments with increasing premiums towards those with decreasing premiums. Retention rates might also reduce on policies getting a big

price decrease on renewal – as the policyholder realizes he/she was paying too much in the previous year

- Compare current volumes with expected volumes under sound basis using the price elasticity information
- Vary proposed premiums to compare volumes and profit under different pricing structures
- Comparison of competitor prices
- Assess the potential brand damage/legality of charging significantly different premiums for the same product through different channels
- Underwriting controls – examine whether the current rating structure may be left unchanged but control for anti-selection through tighter underwriting controls
- Customer value – retention rates, cross selling opportunities

d. Information needed:
- Commission terms for other channels (brokers and bank J) for this business
- Commission terms of competitors
- Strategic importance of a relationship between bank K and India Inc: Does India Inc get discounted banking services?
- Does Bank K distribute other profitable products for India Inc?
- Investigate whether it is possible to net rate i.e. allow the bank to charge higher premiums and recoup the increase in commission
- Bank K's mix of business by area
- Bank K's catastrophe exposure i.e. mix by cyclone zone, construction type
- India Inc's budget expenses for the year split by expense type
- India Inc's target loss ratio and profit target

Analysis needed:
- Analysis of channel by area to determine whether bank K's frequency is lower because it targets low frequency areas
- Analysis around bank K's claims experience which is only partly described in Wald's statistic
- Internal expense allocation to Bank K's home insurance business
- Analysis of profitability of the home insurance business written through bank K (are premiums sufficient to cover expected claims cost and internal expenses and provide an adequate profit as well as cover the extra 5% commission)
- Analysis of profitability of home insurance business written through other channels (if bank K is the most profitable channel then growing the business through bank K may provide scale benefits sufficient to make the whole portfolio profitable)

Change in response based on output from GLM analysis

When allowing for both area and channel, bank K appears to have a higher claims frequency rather than lower as has been observed historically. This does not favor bank K's proposal for increased commission payouts. Bank K's claim frequency in area F poses a problem in particular and requires further investigation.

If the proposed rates are implemented then it is likely to reduce the business written by bank K in area F which should improve the profitability of bank K's portfolio allowing consideration of the commission rate increase

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Q2. a. Memorandum

To: CEO, Company XYZ
From: Chief Actuary, Company XYZ
Ref: Business plan projections for Fire insurance portfolio

You have requested for my comments regarding the business plans prepared for our Fire insurance portfolio by the underwriting manager. While the projections appear to be consistent with historical experience, I have several concerns over the figures presented. A summary of my comments on each projected item is given below:

Gross written premiums
Growth of 20% per annum in GWP has been budgeted for – how exactly will this be achieved? Will premiums need to be reduced to increase market share by 20% and if so, what impact will this have on the overall GWP. It would be unrealistic to achieve a 20% growth in market share without reducing prices.

Gross earned premium
Given the GWP estimates, the estimate for the Gross Earned premium appears to be calculated assuming that business is written evenly over the year. With the portfolio growing at 20% per annum, this may no longer be appropriate

Reinsurance premiums earned
The reinsurance premiums over the projected period are equal to the historical cost of reinsurance premiums. One might expect that as the portfolio increases in size, the cost of reinsurance cover would also increase

Net earned premium
Given the estimates of GEP and reinsurance premiums earned, the calculation of the net earned premium appears to be fine

Gross incurred claims

The projections assume a constant loss ratio of 80% for the next three years. While this may appear consistent with the historic performance of the portfolio, one would expect the loss ratio to increase with increased growth in business volumes

It is inappropriate to assume that new business being written will be as profitable as existing business. The large growth in market share may either be the result of price cutting or lead to bad risks, both of which would imply a deteriorating loss ratio

Reinsurance recoveries
The projections allow for a slight increase in projected reinsurance recoveries, consistent with the growth in the portfolio. While this may be reasonable, it is inconsistent with the assumption that reinsurance premiums will not increase. If the increase in premium comes from writing larger/higher risk business then, as a percentage of gross claims incurred, reinsurance recoveries may increase

Net claims incurred
Given the projections for gross claims incurred and reinsurance recoveries, the net claims incurred figures have been calculated consistently.

Underwriting expenses
The projections allow for no dollar increase in the cost of underwriting expenses. This implies an improvement in the expense ratio from historic levels of 19-20% to 16% in 2000, 14% in 2001 and 12% in 2002. While the portfolio may achieve some economies of scale, it is highly unlikely that expenses will not increase as the portfolio expands. Underwriting expenses appear to be under-stated

Underwriting result
The calculation of the underwriting result is consistent with the calculation of the underlying items. The significant improvement in underwriting result should highlight that the projections are too optimistic.

Overall, in my opinion, projections prepared by the underwriting manager are too optimistic. They allow for significant growth in the portfolio without assuming any reduction in average premiums, increase in reinsurance costs, deterioration in loss experience and increase in underwriting expenses.

I would be happy to discuss this memo with you, should you have any questions.

Yours sincerely, XXX

b. The change in business strategy would affect the following:
Business overview: This section covers general operations, plans and projections. It would require amendment to reflect the increased operations in Gujarat, as well as the change in distribution channels. Some projections around each of these items

would be required. The FCR needs to comment on any material risks arising out of these plans

Pricing and premium adequacy: Given the change in strategy, the actuary will need to investigate pricing of the new business, including any impact on pricing and profitability from the use of brokers. The FCR will need to comment on the pricing process and underwriting

Asset and liability management: Risks arising from having exposure to an aggregation of liability exposure through a natural catastrophe (i.e. cyclone) as well as assets whose value might deteriorate as well as become difficult to liquidate in these circumstances

Capital management and capital adequacy: This section is intended to include comments on the insurer's capacity to meet capital targets in the next three years. The impact of the move into Gujarat and therefore potential growth in business will need to be considered, as this will influence the level of capital held or the need for capital in future

Reinsurance arrangements: The actuary should investigate the reinsurance arrangements in place for the new business and also understand the impact on retention limits. Any increase in concentration risk or change in exposure due to differing regions (and potentially different exposure to catastrophes) will need to be considered. This may affect the capital required above.

Risk management: The actuary will need to comment on the extent to which the risk management strategy covers the new circumstances and strategy.

c. Factors to consider:
- Stability of portfolio and profits: The insurer will look to ensure that its profits are protected from the impact of large individual claims in that portfolio and for the business as a whole
- Risk attitude of the insurer: A risk averse insurer is more likely to choose a lower excess hence retaining less of the risk compared to another insurer with a more aggressive risk appetite
- Distribution of claim costs for each property type: This will determine the claim cost that will impact the layer and the expected claims cost retained by the company.
- Sum insured levels for each property type. Higher sums insured mean higher limits need to be taken
- Cost of reinsurance: If reinsurance cover is expensive (for example in a hard market), the company may consider choosing a lower limit and/or a higher excess to reduce reinsurance premium costs.

The level of excess and limits for the various properties types would have been chosen with these factors in mind:

- In terms of limits, residential properties have the lowest limits and large commercial properties have the highest limits. This is likely to follow the sum insured levels or probable maximum losses. For properties with sums insured higher than the limits, other reinsurance covers may come into effect such as higher excess of loss covers or Facultative covers.

- In terms of excess levels, these will vary by the frequency of losses, the distribution of losses, how these contribute to the volatility of the results for the entire company and the risk appetite of the insurer. In the present case, the claims frequency is likely to be lower for the larger properties and the insurer may be comfortable retaining a larger amount of the risk and only covering itself against large losses.

d. Possible methods for allocating the reinsurance premium are:
- Pro rata according to premium (net preferable to gross) by class of business
- Pro rata according to total sums insured in each class
- Pro rata according to total PML in each class
- Pro rata according to total claims cost in each class
- Pro rata according to number of claims in each class
- Pro rata according to the total catastrophe claims cost in each class over the last 5 years say. This limit would need to be adjusted to allow for changing amount of business in each class e.g. by weighting catastrophe losses according to total sums insured for each class for each year

I would recommend either of the following:
Allocating the premium in proportion to the total catastrophe claims cost in each class over the last 5 years say. However care needs to be taken to ensure that changing mix of business is taken into account when using data over a large number of years

Advantages: Gives most accurate measure of cost
Disadvantages: May not have data or long enough history; more difficult to calculate

Alternate recommendation would be pro rata according to the total sums insured in each class. Sums insured is a good indication of the exposure in each class
Advantages: Simple to calculate, likely to be able to get data easily
Disadvantages: Not as accurate as a method involving catastrophe losses

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Q3.

Part A:
Existing Accounting System:

Exposure Year	Paid Loss	Paid Development	Earned Premium	Unpaid as per Chain Ladder	Unpaid as per BF	Selected Unpaid Estimate
2007	575	95%	900	30	32	30
2008	550	85%	1000	97	106	97
2009	450	65%	950	242	235	242
2010	350	40%	1100	525	467	525
2011	200	20%	1200	800	679[1]	679

> *BF Loss Ratio is based on Paid Losses divided by used-up premiums. Used-up premium for a given Exposure Year is Percentage Development multiplied by earned premium. Other admissible options are a simple average of the loss ratios of the prior years, the paid/ incurred chain ladder loss ratio of 2010*
> [1]*The answer would change as per the assumption made in calculating the IELR for BF.*

New Accounting System:
Apply Margins by selecting 75th percentile on the gross undiscounted loss distribution

Exposure Year	Mean Gross Unpaid Estimate	CV	Std Dev	75th Percentile
2007	30	50%	15	40
2008	97	40%	39	123
2009	242	30%	73	291
2010	525	20%	105	596
2011	679	10%	68	725

Project the incremental paid amounts by exposure year in each calendar year.

Exposure Year	Gross Unpaid Estimate (75th percentile)	Paid Development	CY 2012	CY 2013	CY 2014	CY 2015	CY 2016
2007	40	95%	40				
2008	123	85%	82	41			
2009	291	65%	166	83	42		
2010	596	40%	248	199	99	50	
2011	725	20%	181	227	181	91	45

Apply the discount factors to the projected paid amounts

Tenure	1 year	2 year	3 year	4 year	5 year	6 year
Yield	7%	7.25%	7.50%	7.75%	8%	8%

Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Discount Factor	93%	87%	80%	74%	68%	63%

Apply the discount factors on the projected incremental paid triangle

Paid Development (Discounted, with margins incorporated)

Exposure Year	CY 2012	CY 2013	CY 2014	CY 2015	CY 2016	Total
2007	38					38
2008	77	36				113
2009	156	72	34			261
2010	232	173	80	37		521
2011	169	197	146	67	31	611

Total = 1,544

Part B:
Existing Accounting System:

Under the existing system, UPR would be the difference of written premiums till date and earned premiums till date $= 1250$

New Accounting System:

First project the undiscounted loss payments from the unexpired premium. Use the BF loss ratio from part A as the expected undiscounted loss ratio on the unexpired premium. A loss ratio of 71% projects 887.5 in undiscounted losses.

Projected claim payments

Calendar Year	2012	2013	2014	2015	2016	2017
% of Ultimate	20%	20%	25%	20%	10%	5%
Amount	178	178	222	178	89	44

Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Discount Factor	93%	87%	80%	74%	68%	63%
Discounted Payments	166	154	179	132	60	28

The total discounted losses amount to 719.

Part C:
Existing Accounting System:
The ceded unpaid loss is estimated by reinsurer. The probabilities of default are applied to these losses. Loss given default is assumed at 100% for both the reinsurers.

Exposure Year	Selected Gross Unpaid	Selected Ceded Unpaid
2007	30	15
2008	97	49
2009	242	121
2010	525	263
2011	679	340
Total		**787**

Reinsurer	Probabilities of Default				
	2012	2013	2014	2015	2016
ABC Re	1.00%	1.10%	0.95%	0.90%	0.88%
EFG Re	3.00%	3.20%	3.07%	2.87%	2.48%

Provisions towards RI bad debt = 50%*787*1% + 50%*787*3% =   15.74

New Accounting System
From Part A, the projected gross discounted cash flows by calendar period are as follows:

Paid Development (Discounted, with margins incorporated)

Exposure Year	CY 2012	CY 2013	CY 2014	CY 2015	CY 2016	Total
2007	38					38
2008	77	36				113
2009	156	72	34			261
2010	232	173	80	37		521
2011	169	197	146	67	31	611
					Total =	**1,544**

Under the quota share arrangement of 50%, the projected ceded discounted cash flows by calendar period would be:

Ceded Paid Development (Discounted, with margins incorporated)

Exposure Year	CY 2012	CY 2013	CY 2014	CY 2015	CY 2016	Total
2007	19	-	-	-	-	19
2008	38	18	-	-	-	56
2009	78	36	17	-	-	131
2010	116	86	40	18	-	261
2011	85	99	73	34	15	305
					Total =	**772**

The two reinsurers have an equal share in the cessions.

Cash flows

	2012	2013	2014	2015	2016	**Total**
ABC Re	168	119	65	26	8	**386**
EFG Re	168	119	65	26	8	**386**

Apply the probabilities of default from the given table to each reinsurer's share of the cash-flows above.

Rating	Probabilities of Default				
	2012	2013	2014	2015	2016
AA	1.00%	1.10%	0.95%	0.90%	0.88%
BBB	3.00%	3.20%	3.07%	2.87%	2.48%

And then, 60% of loss given default is also applied to arrive at the RI Bad Debt provision.

	2012	2013	2014	2015	2016	**Total**
ABC Re	1.01	0.79	0.37	0.14	0.04	**2.35**
EFG Re	3.02	2.29	1.19	0.45	0.11	**7.07**
						9.42

Alternative Approach to calculation of RI bad debt provision

Assumption:
Future development of discounted losses is the same as that of undiscounted losses.
Project the payments from ceded unpaid losses using this pattern. Under the quota share arrangement, the development pattern would be the same for gross and ceded.

Projected Ceded Payments

Exposure Year	Selected Gross Discounted Unpaid	Selected Ceded Discounted Unpaid	Paid Development	CY 2012	CY 2013	CY 2014	CY 2015	CY 2016
2007	38	19	95%	19				
2008	113	56	85%	38	19			
2009	261	131	65%	75	37	19		
2010	521	261	40%	109	87	43	22	
2011	611	305	20%	76	95	76	38	19
			Total	**316**	**238**	**138**	**60**	**19**

To the projected ceded paid amounts by calendar year, the probabilities of default by Reinsurer are applied.

Rating	Probabilities of Default				
	2012	2013	2014	2015	2016
AA	1.00%	1.10%	0.95%	0.90%	0.88%
BBB	3.00%	3.20%	3.07%	2.87%	2.48%

Rating	RI Bad Debt				
	2012	2013	2014	2015	2016
AA	1.58	1.31	0.66	0.27	0.08
BBB	4.74	3.81	2.13	0.86	0.24
Total	**6.32**	**5.13**	**2.78**	**1.13**	**0.32**

Total for all calendar years = 15.68. The loss given default of 60% is then applied on the total of 15.68 to give a provision of 9.41.

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Q4
Part A:

Risk features e.g. CC of vehicle, geographical location, gender of the driver, marital status, vehicle type, use of vehicle, parking location, age of driver etc are typically considered in the calculation of premium.

Customers may not be willing to share ample information as the average premium size is very low. It is more cost intensive to capture and store all the risk characteristics.

Since it is possible that heterogeneous risk groups could belong to the same risk group, potential for adverse selection exists.

NCB Past claims experience of a policy is a useful variable to forecast future claims. No-claim bonus system utilizes the past claims experience in the determination of next policy *years premium. Every claim free year places the insured in a better merit class while even one claim could bring back In the process of reflecting past claim experiences, the premium converges to the policy's true premium level.*

Under the proposed 5 year product, it is not possible to apply no-claim bonus system as the premium is paid in one go at the outset.

Part B:

Adverse selection could be reduced through
1. imposing deductibles or
2. co-payments or a combination of the two.

The deductibles or co-payments could vary based on the NCB class. For example, the copayment could be zero in the highest NCB class.
Advantages:
- Easy for the customers to understand,
- Easy to implement using the IT system

Disadvantages:
- Under this mechanism, customers can not be provided with a choice to vary the extent of co-payment or deductible. Any choice would provide scope for adverse selection
- Deductibles or Copayments that increase with each claim made could induce 'Bonus Hunger'

PartC:
Considerations in using the historical claims data of the single-year product:

Copayments: Without any adjustment, the pure premium would be understated
  o Past claims data will not include claims that were unreported due to bonus hunger
  o If the copayment percentage is not fixed, each past claim has to be classified under one of the copayment levels
- Deductibles:
  o The deductible to be applied on the 5 year product under this mechanism is likely to be greater than the deductibles applied on single year products

    o   If the deductible is not fixed, each past claim has to be classified under one of the deductible levels

Part D:

Related to Exposure: The Insured Declared Value (IDR) decreases over time, vehicle parts also   depreciate

Risk Factors: Age of vehicle is not constant over the 5 year period, Changing risk environment and other risk factors could change

Inflation: Inflation of repair costs, replacement cost of vehicle parts in the case of OD. Judiciary inflation in the case of TP

Discounting of Losses and investment income from the premium

Premium refund rules under policy cancellation should be devised

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