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Report Reinsurance business case

Group 12

ISFA

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The purpose of this project is to propose pricing for risk coverage via the reinsurance mechanism. We have used the database provided to propose optimal pricing for different reinsurance structures. In order to be able to implement our results, we use R software and Excel for estimating laws, determining the threshold separating attritional claims from extremes, and processing data. Upon obtaining the results, we went through placement sessions as a reinsurer to negotiate the terms with the insurer. This report will present the explanation of the decision during that section, what could have been done differently, and the answers to questions.

Question 1: Placement experience: explanation of your decisions during the placement sessions, what could have been done differently? What did you learn? Explain your final results.

Placement Session Decision

Because of our error during the stimulation step, the loss ratio of Quota Share agreement will be 50% during the placement session. We came to an agreement to use the commission of 32% and the share of 10% for the first Quota Share. For the Excess Loss, we came to an agreement to use the rate of 3% and the share of 40% for the first layer and the rate of 1% and the share of 40% for the second layer. For the second Quota Share agreement, the commission is 40% and the share is 8%. For the Excess Loss risk + Event, we use a rate of 3.5% and the share of 10% for the first layer, and a rate of 2.4% and a share of 20% for the second. We use only the technical ratio rule as the criteria for our negotiation. We believe that profit is the most important factor. Therefore, we try to negotiate a deal that has the technical ratio smaller than 100% to ensure making profit. The result of our negotiation as mentioned above satisfied the condition technical ratio be smaller than 100%.

Improvement

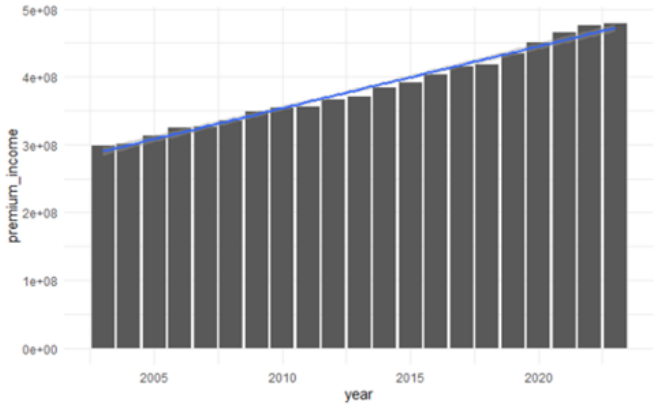
First, for the data we prepared, we should have selected a different set of Pareto parameters (Threshold A and alpha). The previous set of parameters did not sufficiently demonstrate the actual difference between the Large losses following Pareto and those who don't. While this set of parameters is better, it is still not the best due to only using the graphical approach (looking for linearity on the ME and Alpha graph). A more meticulous method would be to use tuning and the calculation of MSE between the simulated data and the actual data to find the best fit. However, due to technical limitations and time constraints, we decided not to do this. Next, we have a slight issue created due to the misunderstanding of the 2 terms "Limit" and "Cover". The previous version used (Deductible + Limit) as the Limit because we've mistakenly thought the given Limit was only the Cover and Fixed a mistake made when the Burning Cost was calculated using the Expected Premium of 2023 instead of the actual given Historical Premiums. This mistake has been fixed in the new quotation report. Next, our first quotation report contains a mistake in the calculation of the Average LR of the QS product. We've mistakenly calculated the loss ratio using the Average Ceded Claims rather than the Average Claims. This resulted in an unexpectedly lower Average LR. Next, in our first report, we've been using the wrong method by dividing each Aggregated Sum Reinsured by its Frequency to find the Average Sum Reinsured, then the Technical Premium was the Average of those calculated Averages. This has since been fixed to be the Average of the Aggregated Sum Reinsured, as it makes no sense to take a double Average here. Our version might still be faulty because we struggled to understand whether the Reconstitutions and Limits are deemed as a clause or not, so as it stands, we are only counting AAD as a possible clause. Consequently, except for the products with AAD, the Technical Premium (No Clause) is equal to the Burning Cost of the simulated claims for each product. (Which is possibly wrong)**.** For the negotiation during the placement session, we should have not relied solely on the technical ratio to negotiate. It is true that it is crucial to make profit, but ignorance of other factors could lead us into potential trouble. We should have included other factors: ROE, Combined Ratio, as criteria during our negotiation. This will lead us to a better result. For the two Quota-Share, we didn’t include expenses in our calculation,

therefore, the calculation of TR has problems. We also accidentally let the other party know our number during the first meeting. As a result, we lost our advantages during the negotiation. The following part will use the new version of our quota report, in which we have fixed the mentioned errors.

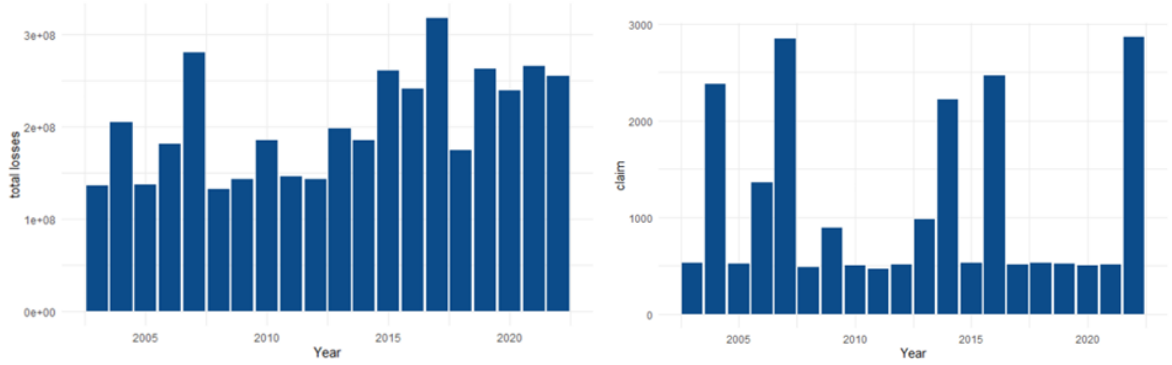
Question 2: Analysis of your portfolio: premium trend, profiles, claims, total losses

The premium income has steadily increased from 2003 to 2023, with a few minor fluctuations along the way. The rate of increase in premium income appears to have slowed down in recent years, with a smaller increase from 2021 to 2022 compared to the increase from 2020 to 2021. It will be interesting to see if this trend continues in the future.

Overall, the steady increase in premium income over the years (about 3% per year) suggests that the entity is experiencing growth and gaining more policyholders. However, it's important to note that premium income alone does not indicate the profitability or financial health of the entity, as expenses and other factors can also affect its financial performance.



The total losses for the insurance company have increased over the years, with some fluctuations. The largest increase in losses occurred between 2006 and 2007, where the losses almost doubled. The largest losses occurred in 2017, with over $3 billion in losses. However, the losses decreased in 2018 and then increased again in 2019 and 2020. It's important to note that these trends may be impacted by various factors, such as changes in the insurance market, natural disasters, and global events.



The highest number of claims was on April 7, 2016, with a total of 1536 claims. This suggests that there may have been a significant event or incident that resulted in a large number of claims being filed on that date.

Other dates with relatively high numbers of claims filed include March 6, 2007, June 18, 2022, and March 5, 2014. It's interesting to note that some of these dates are separated by

several years, indicating that there may be fluctuations in the frequency of claims filed over time.

On the other hand, there are also several dates with a relatively low number of claims filed, including December 18, 2009, December 24, 2016, February 3, 2007, and December 23, 2008, where the number of claims filed was only 7 or 6. These dates may represent quieter periods with fewer incidents or events that resulted in claims being filed.

From the reinsurance profile, we can draw some conclusions:

- As we go from the lower layers to the higher layers, the total sum insured typically rises.
- Although the rise is not constant across the layers, the trend is also seen at premium levels.

Question 3: The reinsurance market is harder than expected and commercial prices for identical structures increase between +15% and +40% by structure (depending on the volatility of the structure). More volatility implies more expensive.
- Insurers: How does it impact your optimal reinsurance study?
- Reinsurers: How do you impact this increase by layer? Where are the biggest changes, why? How would you restructure the programs in order to have better results?

The increase by layer:
We have:

$$commercial\,price \;=\; commercial\,rate \;*\; technical\,price$$

that:

$$commercial\,rate \;=\; \frac{1 + fee + tax}{1 - brokage\,NP}$$

In this case, because of the difficulty in changing any of the elements of commercial rate (fee, tax, and brokerage NP), the increases in commercial price is caused by the increases in the technical prices. Hence, commercial prices for identical structures increase between +15% and +40% by structure when the technical prices change with the same proportion. Observing the technical price, we could see that the technical price of layer SL is the average of all values that equal to:

$$MIN(MAX(loss\,ratio \;-\; deductible, 0), deductible \;-\; limit)$$

Besides, the technical price of each layer XL is equal to the quotient of the expected sum covered by this layer and the EPI. Those values depend mainly on simulation results and the EPI. On the other hand, the commercial price could be negotiated between the reinsured and the reinsurer.Therefore, if the values shown in the table below depend only on the commercial prices, they would face the biggest changes.

XL Risk Option			Technical price	Commercial Price (Premium Rate)	Commercial Price		Expected Reinsurance's	Expected Reinsurer's Claim	Expected Profit	Combined Ratio	RORAC	
	Deductible	Limit										
XL1-a	7 500 000	20 000 000	0,073451	0,108137	51 678 327,43	XL1-a	51 678 327,43	35 102 260,14	185 736 877,05	19,845%	5,2693%	
XL2-a	20 000 000	35 000 000	0,042552	0,062646	29 938 464,97	XL2-a	29 938 464,97	20 335 561,11	192 710 040,48	16,755%	5,4671%	
XL3-a	35 000 000	60 000 000	0,035005	0,051535	24 628 255,61	XL3-a	24 628 255,61	16 728 626,45	194 413 315,18	16,000%	5,5154%	
										Option to Maximize RORAC	**5,5154%**	**XL3-a**
XL Event Option			Technical price	Commercial Price (Premium Rate)	Commercial Price							
	Deductible	Limit										
XL1-b	20 000 000	60 000 000	0,014231	0,020951	10 012 464,84	XL1-b	10 012 464,84	6 800 919,52	199 101 399,01	13,923%	5,6484%	
XL2-b	60 000 000	200 000 000	0,015711	0,023130	11 053 613,65	XL2-b	11 053 613,65	7 508 114,94	198 767 445,62	14,071%	5,6389%	
XL3-b	200 000 000	350 000 000	0,005287	0,007784	3 719 888,63	XL3-b	3 719 888,63	2 526 716,80	201 119 772,51	13,029%	5,7057%	
										Option to Maximize RORAC	**5,7057%**	**XL3-b**
XL Risk + event Option			Technical price	Commercial Price (Premium Rate)	Commercial Price							
	Deductible	Limit										
XL1-c	20 000 000	35 000 000	0,052704	0,077591	37 080 819,05	XL1-c	37 080 819,05	25 186 971,43	190 419 096,72	17,770%	5,4021%	
XL2-c	35 000 000	60 000 000	0,046000	0,067722	32 364 029,81	XL2-c	32 364 029,81	21 983 114,58	191 932 029,12	17,100%	5,4450%	
XL3-c	60 000 000	350 000 000	0,062729	0,092351	44 134 526,73	XL3-c	44 134 526,73	29 978 169,10	188 156 586,71	18,773%	5,3379%	
										Option to Maximize RORAC	**5,4450%**	**XL2-c**
SL Option			Technical price	Commercial Price (Premium Rate)	Commercial Price							
	Deductible	Limit										
SL1	75%	130%	0,038133	0,056140	26 829 215,98	SL1	26 829 215,98	18 223 618,40	193 707 346,76	16,313%	5,4954%	
SL2	80%	135%	0,032550	0,047921	22 901 162,28	SL2	22 901 162,28	15 555 506,45	194 967 288,51	15,755%	5,5311%	
SL3	85%	140%	0,027604	0,040639	19 421 304,21	SL3	19 421 304,21	13 191 829,27	196 083 469,40	15,260%	5,5628%	
										Option to Maximize RORAC	**5,5628%**	**SL3**
QS Option			Technical price (Cession)	Commercial Price (Premium Rate)	Commercial Price							
			0,35	0,515278	246 250 239,89	QS	246 250 239,89	167 264 313,89	123 327 018,33	47,500%	3,4987%	

As we can see from the table, the rise in commercial and technical prices lead to changes in all expected values presented on the right side of our report.
The expected reinsurance premium increases proportionally with the commercial price(

$$expected\ reinsurance's\ premium\ =\ commercial\ price\ *\ \ expected\ premium$$

). The less dependent on commercial price are the expected reinsurer's profit and the RORAC, in which:

$$expected\ reinsurer's\ profit\ =\ expected\ premium\ -\ expected\ claim$$
$$-\ (expected\ reinsurance's\ premium\ -\ expected\ reinsurer's\ claims)$$

and the RORAC changes proportionally with it. The least dependent on commercial price is the expected reinsurer's claims, which are proportionally changed with the technical price. To have better results, we should try to optimize the expected profit. To increase this term, we have to decrease the subtraction between the expected reinsurance premium and the expected reinsurer's claims by bridging the gap between commercial price and technical price.

Question 4: The inflation forecast for 2023 was wrong and is finally unknown but between +2% and +8% compared to what you first estimated. Impacts on your portfolio, decisions, and results? Justify also which inflation shock you choose!
- Reinsurers: impacts on the pricing and on your underwriting strategy. What alternative structures would you propose to the insurers in case their reinsurance budget does not increase?
- Insurers: impacts on your results, reinsurance budget, optimal reinsurance structures, and decisions. Alternative structures you would like to have in case your reinsurance budget does not increase?

Impacts on the pricing and underwriting strategy

Layer SL:
In this layer, we use the method of collective risk model to estimate the burning cost

$$burning\ cost\ \ =\ \ average(min(max(loss\ ratio\ -\ \ deductible, 0), limit\ -\ \ deductible)$$

The increase in inflation leads to an increase in the loss ratio. If we do not change the limit and the deductible, this situation leads to an increase in the burning cost.

Layers XL:
The method to estimate the burning cost has been changed:

$$burning\ cost = \frac{Observed\ XL\ Losses}{Premium\ Income}$$

As real inflation rises between 2% and 8% higher than the estimated, all the Observed XL Losses and Premium Income rise. However, the end result is that even though premiums are raised across the industry, they are not raised in the same proportion as the rise in claims. Therefore, the burning cost will rise higher than the inflation.

We have seen that the real burning cost is higher than expected because of the underestimated inflation, so the first decision for the reinsurer is that they have to raise their own costs to ensure the stable profit. It's impossible in the situation of inflation when the insurance business also faces an increase in claims. The second decision is that we could decline the losses covered (the difference between limit and deductible), in which case an increase in deductible is preferable with the growth of risk.

Another big problem that reinsurance businesses inevitably face is the growth of the interest rate. This could make us raise the commercial price. Besides, the probability of risk in their portfolio rises. The companies have to offer a higher return to attract investors. If the return offered is only marginally higher than the debt instruments, then most investors will avoid taking any risks and stick to debt. As a result, almost all companies take higher risks to offer a better return on their equity shares. Now, this means that no matter which company the reinsurance company chooses to park its additional funds, it will end up taking a higher risk. Therefore, they have to look carefully at their situation to determine whether they should trade off this risk for an enormous profit.

In case their reinsurance budget does not increase:

Suppose that we expect the results for that year up - to - date to the inflation rate, consider the impact to this value can be partly calculated by the sum of the budget and the profit.
Consider the estimated budget for 2023 this 100 Budget, so we expect the result to be:

$$(100 + a)(Budget + Profit)$$

However, the budget for the reinsurance could not be changed. In order to maintain these results, we have to raise a proportion of the profit:

$$\begin{aligned}(100 + a)(Budget + Profit) &= 100\,Budget + [(100 + a)Profit + a\,Budget] \\ &= [100\,Budget + 100\,Profit] + a[E(premium) - E(claims) + Budget]\end{aligned}$$

According to the formula, we have to raise the part premium at least by a Budget to reach our expectations. Overall, the problem is still the burning cost and the risk created by inflation.
On the other hand, the burning cost can be calculated by:

$$burning\ cost = average(min(max(loss\ ratio - deductible, 0), limit - deductible)$$

Therefore, as we mentioned above, we could keep the stable expected profit by lowering the burning cost, and in this situation, we could lower the difference between the limit and deductible, and also decrease their own cost to an acceptable level through negotiation with customers.