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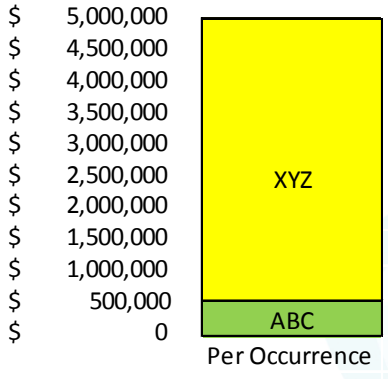
Reinsurance Structure Analysis
Part 1: Per Occurrence Coverage

To be in the business of risk transfer, we must understand the very nature of Risk. Although we feebly attempt to simulate, mitigate and regulate Risk, we will never be able to eliminate it. It is for this very reason that understanding it, and knowing how others are measuring it, is important for those buying financial protection against catastrophic risk. Reinsurance contracts can cost a considerable portion of the primary risk transfer premiums; and, when properly analyzed and purchased, they can be an effective component in protecting the financial soundness of a risk bearing organization.

With this intention, this is the first in a series of papers aimed at explaining, analyzing and determining the appropriateness of different reinsurance structures. This paper focuses on reviewing the most basic of reinsurance structures, "Per Occurrence" coverage. Understanding this coverage will help set the stage for the explanation of other, more complicated structures in later papers.

Background

Reinsurance purchased on a 'Per Occurrence' basis aims to protect the reinsured against a single catastrophic loss, or the severity of loss. To start, let's set up a simple example policy. ABC Insurance Co. (ABC) is insuring a fleet of tractor trailers. They would like to pay a maximum of $500,000 per accident, but would also like to provide each truck with $10,000,000 of liability coverage. ABC purchases a reinsurance policy from XYZ Reinsurance Co. (XYZ) for $9,500,000 in coverage in excess of the $500,000 retained, or $9.5m xs $500k in industry shorthand. This means, for each occurrence, ABC retains the green box below, and XYZ retains the yellow box. XYZ does not have to reimburse on any claim until the cost exceeds $500,000. For this reason, during the life of the primary policy, there is usually a good chance ABC's reinsurance policy may never be triggered to collect reinsurance recoverables from XYZ.

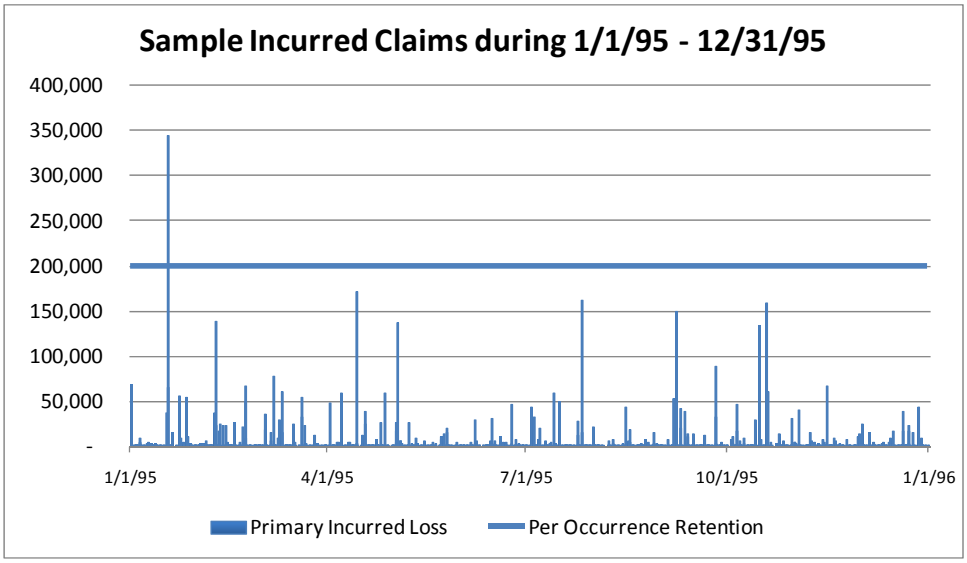


Per Occurrence: Selecting the Self-Insured Retention

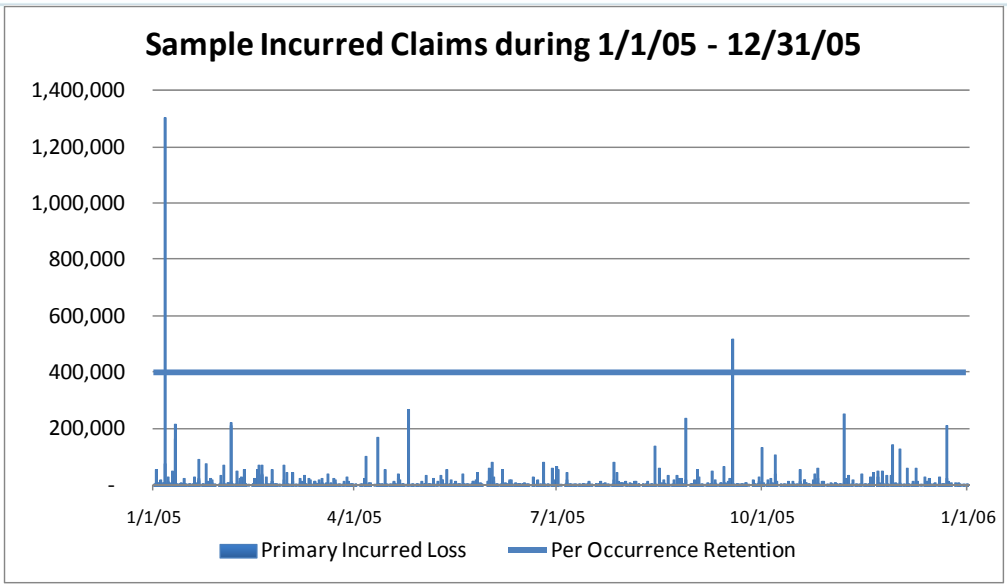
In the above example, the company decided to retain $500,000 per occurrence. But, if they retained $750,000 per occurrence, their reinsurance premium would be less. So, the intuitive problem is determining the "correct" Self-Insured Retention (SIR) level.

Unfortunately, there is no "correct" answer when purchasing reinsurance. And, it would take an enormous length of time to ultimately know if the purchase was prudent, since reinsurance policies often take decades for all claims to materialize and be paid. The right purchase for each reinsured varies depending on their own and their organization's comfort level with Risk.

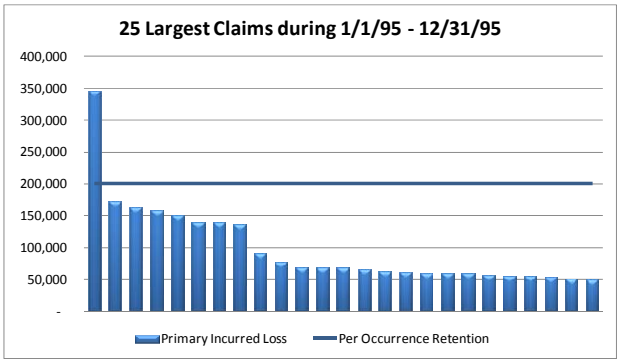
One approach to selecting an SIR is to analyze historical losses. The profession of actuarial science was born out of the need to understand historical trends to make informed decisions about the future. Below is a graph of all losses for a group in the policy year 1995, ordered chronologically. From these losses there are only a handful of claims above $150,000 and only one above $200,000. With hindsight perspective, management might have purchased reinsurance in the late 1990's with a $200,000 SIR. Again, the purpose of per occurrence reinsurance is to protect one's organization from catastrophically severe losses, and not common loss amounts (say, $150,000).

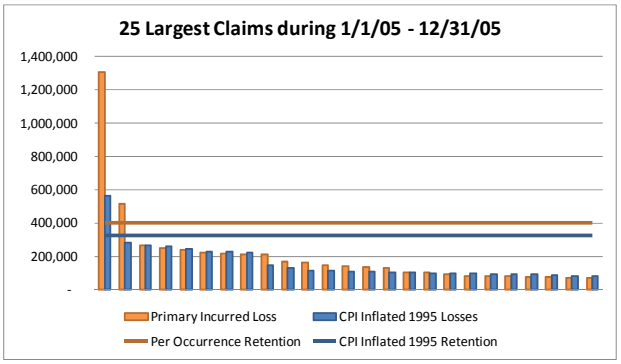


A more detailed and analytical approach incorporates a number of years (usually 10 or more) to determine the appropriate SIR. But, one needs to re-assess each year. Here is a similar graph of all losses in the policy year 2005. Notice there is a much larger claim, but now it appears that $400,000 is an appropriate selection.



So, how do we compare results from 1995 and 2005? First, let's simplify the graphs and only look at the 25 highest losses. As seen below, on the left graph shows the 25 largest losses in 1995, with the $200,000 SIR selected. On the right graph, the 25 highest losses from 2005 are shown (orange), with the CPI-inflation adjusted 1995 losses (blue) superimposed. By adjusting 1995 losses with a 10-year CPI index factor, we can more accurately compare losses separated by 10 years of changing dollar values. In this example, the 10-year CPI increases the 1995 losses about 163%. Notice, except for one rather large aberration, the orange and blue losses are highly correlated. And, even though the blue and orange SIR selections are disjoint, either one appears to be a suitable choice.





It is noteworthy to point out that the process of comparing years is much more complex, and actuaries are trained to understand and compare the nature of losses from two books of business (or two different years). But, the process employed is the same: gather historical information, analyze and compare it, and then select an SIR based on the presumption that the future should behave like the past. More about the "should" below.

The second element to consider when purchasing a reinsurance contract is the price. Reinsurers price each contract based on a propriety processes, based partially on expected

losses, company expenses, profit margin, market competition, capital charges and (shockingly) guesswork. Even more frustrating to the layperson is that even though reinsurance pricing typically follows a rigorous discipline, in the end, it produces a wide range of possible answers.

For purposes of this paper, let's assume there is a definite price for each structure offered. Below is a table of possible SIRs for ABC's upcoming renewal. For each SIR in the left most column, there is a corresponding Quoted Reinsurance Premium, and a percentage indicating the ratio of that premium to the primary premium. Intuitively, as ABC assumes more losses with a higher SIR, the reinsurance premium becomes a smaller percentage of the overall premium. But, based on the loss history explained above, the Expected Reinsurance Losses as a percentage of Expected Primary Losses decrease as well.

SIR Selection for 2006 Policy Year

SIR	Primary Premium	Quoted Reinsurance Premium	Percentage	Expected Primary Losses	Expected Reinsurance Losses	Percentage
100,000	16,275,018	4,728,914	29.1%	11,880,763	2,823,131	23.8%
200,000	16,275,018	3,194,628	19.6%	11,880,763	1,635,703	13.8%
300,000	16,275,018	2,677,381	16.5%	11,880,763	1,221,905	10.3%
400,000	16,275,018	2,527,381	15.5%	11,880,763	1,021,905	8.6%
500,000	16,275,018	2,477,381	15.2%	11,880,763	821,905	6.9%

An important detail to note is that the decreasing amounts of Quoted Reinsurance Premiums are progressively smaller as the SIR increases. The SIR option to focus on is where the difference in Quoted Reinsurance Premium is equivalent to the difference in Expected Reinsurance Losses. Below is another chart outlining these calculations. Notice the change from a negative amount to the positive amount occurs somewhere between an SIR of $300,000 and $400,000.

SIR Selection for 2006 Policy Year

SIR	Quoted Reinsurance Premium	Expected Reinsurance Losses	Difference	Next SIR Margin*
100,000	4,728,914	2,823,131	1,905,783	
200,000	3,194,628	1,635,703	1,558,926	(346,857)
300,000	2,677,381	1,221,905	1,455,476	(103,449)
400,000	2,527,381	1,021,905	1,505,476	50,000
500,000	2,477,381	821,905	1,655,476	150,000

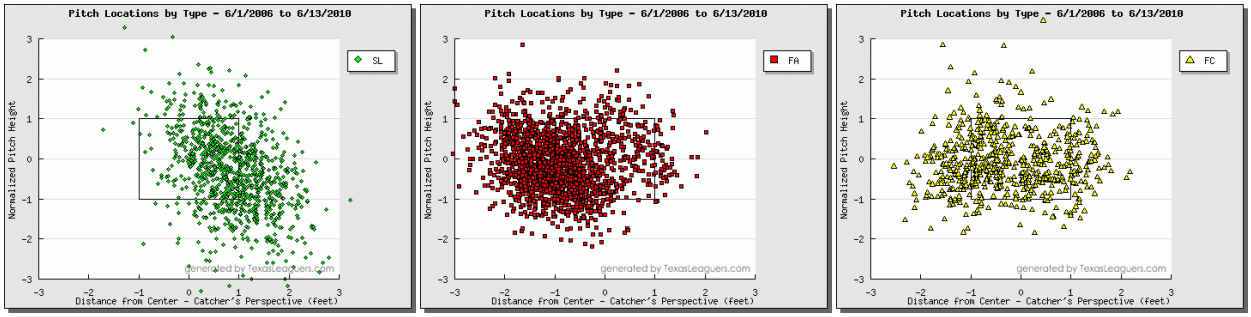
*Next SIR Margin calculation: (346,857) = 1,558,926 - 1,905,783

Unfortunately, this is where most reinsurance contract purchasers stop their analysis. Equally unfortunate, is that up until now the largest element of risk transfer has not been discussed. That is, of course, the Risk itself.

As mentioned earlier, the process of making a reinsurance purchasing decision is typically the same: gather historical information, analyze and compare it, and select an SIR based on the presumption that the future should behave like the past. Risk is the undeniable fact that the future will NOT behave like the past.

Trying to be a little less obtuse, we should examine risk as reinsurers do. Above we looked at two years of claims (1995 and 2005). This is a simplification, but even if we were to look at 10 years, it would still be a simple exercise. With the advent of computers and microprocessors, we are able to analyze historical data in a very complex manner.

As an example, let's take a baseball pitcher throwing baseballs over home plate during a baseball game. The object of the pitcher is to throw the ball in the strike zone, which is an imaginary box the width of home plate from the batter's shoulders to his knees. During a game a pitcher throws about 140 pitches, and roughly two-thirds of them are strikes. But, let's look at the actual results of those 140 pitches by three different pitchers.



The first pitcher drifted around the right side of the strike zone, the second was drifting left and the third pitcher was about even in his strike placement. So, based on this finite data we can say that over the course of a game, a pitcher has approximately a 2/3rd's chance of getting a strike. These are pretty good odds. But, now look closer at the outlier balls in the extremes of the graphs. There is a 7/140 or 5% chance of a not just a "ball", but a pitch so wild that it threatens the safety of all those around home plate.

Through computer modeling, reinsurers are able to simulate not just what a couple of pitchers will pitch in a single game, but what happens if we compile every pitch (140) by every pitcher (2 pitchers) in every game (say, 162 games) since the invention of professional baseball (say, 100 years). That's a large data set (4,536,000) to work with, and reinsurers assume that over the course of the next baseball game's140 pitches, the statistical chances of a strike or wild pitch will be the same as indicated by the historical data.

Although this is a reasonable assumption, those who purchase reinsurance need to be aware that there is a chance, say 5%, of getting that wild pitch (that which varies greatly from the

'expected'). And, an even smaller chance of the pitch landing way off the graphs, where no pitch has ever been pitched before. This is the "Black Swan" event conjured up by author Nassim Taleb.

Conclusion

The focus in this article, and others that follow it in the series, is to help those making the decision to purchase reinsurance more educated about the process. All too often, especially in this weakened economy, the central driver behind a decision is price. This is an important component, but with price savings comes more risk. And, more risk means the potential that a group could face a much larger funding crisis in the near future. Often, groups purchasing reinsurance have policies which define the amount of risk the group is willing to bear in relation to goals of targeted surplus. These policies offer guidelines, but should never be followed blindly without reason and judgment.

The three elements that should be understood by each reinsurance purchaser are the following:

- What is the correct reinsurance structure, regardless of price?
- What are the price differences between structures, regardless of risk?
- What is the risk associated with each structure and corresponding price?

It is easy to get caught in the trap of continuing to renew the same reinsurance structure, year after year. There may be a price and risk tradeoff that is not immediately evident without proper analysis. Likewise, changing SIR's to accommodate budgets imposed by external economic factors could prove to be a grave error in judgment. The decision to change SIR levels should be analyzed based on actuarially sound methodologies and an organization's appetite for Risk.

References

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Taleb, N. (2007). *The Black Swan: The Impact of the Highly Improbable.*