A Statistical Simulation Approach for Estimating the Reserve for Uncollectible Reinsurance

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It is important to note that the ideas presented in this paper are purely the author's own. Depending on the actual circumstances, it is possible that other approaches for estimating the uncollectible reinsurance reserve may be more appropriate than that presented herein.

Abstract

Recent insolvencies and catastrophic events have heightened concern in the insurance industry over the risk of uncollectible reinsurance. The current approach for estimating reserves for this line in the Annual Statement is relatively unscientific and, as a result, may not reflect the company's true reinsurance recoverability risk.

The objective of this paper is to introduce a statistical approach for estimating this reserve that considers more specifically the risks of the company's reinsurers and the potential for correlations between reinsurer failures within a given period as well as over time.

The paper will describe the basic framework for this model, including:

1. Defining the data required
2. Setting up the basic structure of the model
3. Consideration of the timing of future payments and potential offsets
4. Consideration of correlations
5. Potential applications

Introduction

The potential for uncollectible reinsurance has always been a major concern for both insurers and reinsurers[1]. For some companies, reinsurance recoveries represent one of the largest assets on their balance sheet (or contra-liability under statutory accounting principles). Some carriers have gone insolvent over the years as a result of an inability to collect reinsurance recoveries (usually because the reinsurer has gone insolvent as well). In times of financial difficulty for the industry, whether due to the market cycle, the general economy, or catastrophic events, the ripple effect of reinsurer insolvencies is often felt throughout the industry for years. As a result of these concerns, security considerations are often (and should be) the largest factor for a ceding company when purchasing reinsurance, both in selecting a reinsurer and in negotiating the terms of the reinsurance contract.

Given all of the above factors, it is surprising that the process for estimating uncollectible reinsurance recoveries in a company's financial statements utilized by regulators in the U.S. is fairly unscientific and often does not receive thorough scrutiny. This may be in part due to the fact that standard actuarial opinion wording requires mention of such amounts, but does not require sign off by the opining actuary. Recently, many countries throughout the world have

[1] As of December 31, 2002, reported reinsurance recoverables amounted to nearly 80% of reported surplus.

been reviewing their accounting and actuarial requirements, and some of these countries have now required that the reserve for uncollectible reinsurance be a part of the actuarial sign off requirements.

Without delving into the question as to whether such signoff is appropriate or should be required, this paper will discuss an alternative methodology for estimating this reserve. The paper will first discuss in broad terms some potential factors that may influence reinsurer default as well as describe the current approach for estimating the reserve and some of its weaknesses. An alternative methodology will then be described. The alternative method described uses a statistical simulation approach that more specifically considers the potential failure of the company's reinsurers and the potential for correlations between reinsurer failures within a given period as well as over time. The key parameters of the model and the data required will be introduced and the general structure of the model will be described. Key issues such as offset and correlations will also be discussed in more detail. Finally, a simple example will be presented, followed by a discussion of potential applications and areas where more research could be undertaken.

Potential Factors Influencing Reinsurer Default

Failure to recover amounts due from reinsurers can result from a number of factors. The most common factors causing defaults have been:

1) Disputes between the cedant and the reinsurer, and
2) An inability to pay due to financial difficulties for the reinsurer.

The financial difficulties of the reinsurer may have been caused by poor economic conditions, poor insurance market conditions, exposure to cumulative causation claims, or catastrophic events. Unfortunately, factors which contribute to a particular reinsurer's financial difficulty will most likely also negatively influence many of the insurance company's other reinsurers, as well as the insurance company itself. Further, these factors are likely to have lingering effects for a number of years, which may influence reinsurance collections in future years.

This paper is primarily intended to address uncollectible reinsurance arising from the inability to pay due to reinsurer financial difficulty. Disputes between insurer and reinsurer are typically distinct events and need to be evaluated based on the unique conditions of the particular dispute. While the incidence of disputes often increases during times of financial stress, it is frequently the case that the potential for uncollectibility will depend primarily on the specific issues of the dispute.

Current Regulatory Approach for Estimating the Reserve

For Statutory Annual Statements, the currently required methodology used in the U.S. for estimating uncollectible reinsurance is outlined in the NAIC Instructions to the Annual Statement. The uncollectible reinsurance reserves (referred to as the Provision for Reinsurance) are calculated in Schedule F of the Statement and can be broadly separated into two components: overdue authorized reinsurance and unauthorized reinsurance. Authorized reinsurers include most U.S. reinsurers meeting certain conditions (e.g. non-affiliates and/or not in liquidation), certain pools and associations, and Lloyd's of London. Unauthorized reinsurers include other foreign reinsurers, affiliates, certain pools and associations, and reinsurers in liquidation.

The provision for overdue authorized reinsurance is calculated as 20% of amounts due and unpaid over 90 days plus 20% of disputed amounts. An additional penalty can be applied for reinsurers where at least 20% of all recoveries are overdue. In this case, the total provision is the maximum of the amount calculated using the formulas above, or 20% of the net unsecured recoverables[2]. The provision for unauthorized reinsurance is calculated as the sum of the net unsecured recoverables, 20% of amounts due over 90 days, and 20% of amounts in dispute. However, this sum is limited to the total reinsurance recoverable from the particular reinsurer. The provision for unauthorized reinsurance can be quite significant. Its existence often results in a significant competitive disadvantage for foreign reinsurers operating in the U.S., as reinsurance contract provisions often require any unauthorized reinsurer to post collateral for the full amount of outstanding losses, IBNR, and unearned premiums in order for the cedant to avoid this penalty. Some of the largest international reinsurers have developed or acquired U.S. operations in part to avoid the penalty.

The current regulatory approach does consider many factors that likely have a significant influence on reinsurance recoveries, such as security, disputes, and late payments. In addition, it also encourages desirable behaviors among insurers and reinsurers, such as collateral requirements and increased pressure to recover and pay amounts due. However, this approach also has a number of weaknesses and limitations. Some of the key limitations are:

- Timing of recoveries – The current approach does not consider the potentially significant differences in the reinsurance recoverability risk between reinsurers based on the expected timing of the recoveries. Expected timing in recoveries between reinsurers may differ significantly based on the lines of business written, the limits and attachment points, and the terms of the contracts. All things being equal, recoveries that are due sooner (e.g. for a Property reinsurer) are less risky than recoveries due a number of years in the future (e.g. for an excess Workers' Compensation reinsurer). This is because any number of negative events could influence the reinsurer's financial condition in the future, before the long-term recovery is due. Also, in situations where a reinsurer may already be facing financial difficulties, short-term recoveries may be available from current assets, but there will be no guarantee that assets will be available to make payments in future years. Such considerations can also make a cedant pursue a commutation of recoverables, providing certainty of cash flow, at the expense of reinsurance coverage in the future.

- No reflection of relative financial strength – The blanket 20% provision for overdue or disputed amounts and the flat penalty for certain unsecured recoveries does not make any distinction between the financial stability of a cedant's specific reinsurers, other than the general theory that foreign reinsurers are generally not as strong as U.S reinsurers and that weaker reinsurers are more likely to have amounts overdue or in dispute. While these premises are generally accepted in the industry, more specific measures of financial

[2] "Net unsecured recoverables" is the total recoverables for paid and unpaid loss and LAE, unearned premiums, and contingent commissions less offsets (which include funds held under reinsurance treaties, letters of credit, ceded balances payable, and other balances).

strength are available and could be used to more precisely estimate the uncollectibility risk.

- Overdue balances and disputed amounts may not reflect the ability to pay – Further to the points above, if overdue balances and amounts in disputes are due from an otherwise financially strong reinsurer, the expected recovery may still be 100%; however, the timing of such recovery may just be delayed. While the timing issue can have a critical impact on the recoverability risk, some disputes and delays may just be caused by a reinsurer being contentious in their settlement practices.

- Correlation between reinsurers and over time – As discussed, many of the factors that influence the recoverability risk for a specific reinsurer will also influence many of the other reinsurers in the industry. As a result, the provision for uncollectible reinsurance at any point in time will be a function of the relative strength of the insurance industry as well as other factors, such as the prevailing economic and interest rate environment. Further, the relative risk will likely change over time and will also be a function of the specific reinsurers, type of business reinsured, and the timing of future recoveries. The correlation between reinsurers at a point in time and over a longer period of time could have a significant effect on the expected non-collections for an individual company.

- Foreign bias – The current provision for uncollectible reinsurance has been accused of having a bias against foreign reinsurers, as collateral requirements on unauthorized reinsurance can be costly and potentially restrictive, along with creating additional frictional costs. While various reasons can be put forth supporting this practice, the effects can limit foreign reinsurers ability to compete in the U.S. market, which may further weaken their relative financial standing against U.S. reinsurers

Proposed Approach

The proposed approach involves estimating the timing and amount of expected cash flows from each individual reinsurer and simulating expected failure rates (i.e. the percent of the reinsurance recovery *not* received) against each cash flow. The sum of the failure rates times the cash flows equals the uncollectible reinsurance reserve.

The failure rates at each point in time are based on the likelihood of default for each given reinsurer, i.e. financially unstable reinsurers would likely have higher expected failure rates. Further, the simulation model would include an "industry effect" to reflect the potential correlation of failure rates between reinsurers. The application of this industry factor would increase the expected failure rates for each reinsurer in a poor environment and reduce the failure rates in a favorable environment. In addition, the correlation of failure rates over time would be reflected in both the industry effect and at the individual reinsurer level (i.e. a poor industry in one time period is unlikely to immediately become a favorable industry in the next period, and a reinsurer who defaulted in one period is likely to also default in future periods).

Note that a best estimate of the reserve could be estimated without using simulation by simply multiplying the expected failure rates by the expected recoveries. However, use of the approach detailed here will help give the company a better understanding of the underlying risk and can also be used in a number of different applications.

Data Required

The following information would be required to build the model:

- Details of reinsurance program participants and their shares of each contract
- Current outstanding balances and amounts payable by reinsurer
- Expected recoveries and future premium payments for each reinsurance contract
- Expected payment patterns and timing of future premium payments by contract
- Potential funds available to offset uncollectible recoveries by reinsurer (premiums payable, funds held, letters of credit, etc.)
- Expected failure rates by reinsurer
- Correlation coefficients for the failure rates between reinsurers and across time periods

The expected failure rates and correlation coefficients would clearly be the most difficult and judgmental data items to determine and such a discussion is beyond the scope of this paper. The author is not aware of any studies performed or methodologies developed to estimate failure rates specifically for reinsurers. However, a number of methods and techniques have been used to analyze factors such as bond default rates in a variety of industries. One potential approach is to use the results of one of these techniques to measure default rates by bond rating (such as Moody's or S&P) and utilize these as the expected failure rating for each reinsurer. Further analysis could be performed to try and relate these bond ratings to more commonly accepted insurer ratings, such as A.M. Best ratings. Of course, this leaves the difficult issue of foreign reinsurers, where no published rating may exist. An approach in such a case could be to assign a rating based on surplus level or some other financial measure.

The estimate of the correlation between reinsurers and between time periods would also be difficult to determine. One potential approach for estimating the reinsurer correlation could be to gather historic information on reinsurer failure rates and to simulate industry failure rates (assuming various correlations) against actual failures. Estimating the correlations between time periods could be done by gathering data on insurance underwriting cycles and measuring the correlation in underwriting results over different periods of time.

Estimating the Timing of Recoveries

The first step in building the model is to estimate the amount and timing of expected recoveries by reinsurer. Depending upon the complexity of the company's reinsurance program this can be a very time-consuming and data-intensive step. That being said, cedants already need to perform a significant part of this step to complete Schedule F. The only additional effort that is required beyond what is needed to produce Schedule F is to determine the timing of the expected recoveries.

To estimate the timing, loss payment patterns can be applied to the expected recoveries by reinsurer. The payment patterns should be applied at a detailed enough level to produce accurate overall recovery estimates for each reinsurer. If the data is not too unwieldy, this can be done at the contract level for each reinsurer. Or, if the reinsurance program is extremely complicated, this can be done at a more summarized level (e.g. line of business, type of contract, etc.).

An example of the output from this step for a single reinsurer is shown in the following table:

Table 1
Reinsurer A – Timing of Expected Recoveries by Calendar Period
(All figures in 000's)

Contract Type	Period =>	Curr O/S Balance	Cal Yr 2003	Cal Yr 2004	Cal Yr 2005	Cal Yr 2006	Cal Yr 2007	Cal Yr 2008+
Q/S – Work Comp		$1,000	$2,000	$1,000	$750	$500	$250	$250
Q/S – Genl. Liab		0	400	0	0	0	0	0
Q/S – Property		0	2,000	600	50	0	0	0
XS – CAT Property		0	0	0	0	0	0	0
XS – All Casualty		2,000	3,000	2,000	1,500	1,000	750	500
Finite – Whole Account		1,000	4,000	2,000	1,500	750	400	250
Total		$4,000	$11,400	$5,600	$3,800	$2,250	$1,400	$1,000

For simplicity, the recoveries in the chart above have been summarized by contract type. In addition, all recoveries expected to be made after five years have been grouped. This is another potential simplification that can be made to the model. If the expected recoveries beyond a certain point in time are small, the impact may be minimal. In such a case, in the actual application of the model it could reasonably be assumed that a reinsurer who had defaulted on obligations prior to this point would also default on all subsequent obligations.

In the above table, the timing of recoveries would be determined based on the date the payments would be due from the reinsurer (i.e. the date of recovery assuming no defaults or slow-paying reinsurers). Further adjustments can be made to the above figures to reflect slow-paying reinsurers or, alternatively, this could be handled as part of the actual modeling. This is discussed in more detail below.

Offsets

The second step in setting up the model is to determine the potential offsets that could be applied to uncollectible balances at each point in time. The three most commonly used offsets to uncollectible balances are: 1) funds withheld under reinsurance treaties, 2) ceded balances payable, and 3) letters of credit or other allowable forms of collateral. In addition, if the cedant also assumes business from the same reinsurer, then amounts payable under such a treaty could also be used as an offset.

Once again, the majority of this information is already collected at the reinsurer level in order to complete Schedule F. However, an additional factor that could be considered within the model is the possibility for premiums due on reinsurance contracts written in the future being used to offset current uncollected balances. Of course, in such a case the future reinsurance contracts will also likely produce losses that would also have similar collection problems. For now, we will focus solely on balances due and offsets on contracts written previously.

The following table shows an example of the output from this step.

Table 2
Potential Offsets by Reinsurer at 12/31/02
(All figures in 000's)

Reinsurer	**Offset Item =>**	**Funds Held**	**Letters of Credit**	**Ceded Bal. Payable**	**Assumed Balances**		**Total**
Reinsurer A		$7,000	$5,000	$2,500	$0		$14,500
Reinsurer B		2,000	0	300	650		2,950
Reinsurer C		0	3,500	0	3,300		6,800
Reinsurer D		3,650	3,650	0	0		7,300
Total		$12,650	$12,150	$2,800	$3,950		$31,550

An additional consideration that can be incorporated into the model is the timing and availability of the various offsets, and the priority in which they may be applied. While the full amount of the potential offsets could be available to offset uncollectible balances in the coming year, some of these amounts may be paid to the reinsurer before the reinsurer defaults, hence reducing the available offsets at the time of default. Further, the priority in which the offsets are applied may also impact the available amount of offsets at any point in time.

For example, a reinsurance contract may specify that letters of credit are to be drawn down for any overdue balance before any other offset can be applied, and balances due the reinsurer can not be delayed as long as capacity exists on the LOC. In such a case, the ceding company may have to continue to pay balances due to a reinsurer in default as long as they are able to draw down on the LOC. Subsequently, these balances may be greatly reduced or eliminated at the point that the LOC is finally depleted and future uncollectibles may not be able to be offset by such funds. In this example, the timing and priority of offsets would have had a significant impact on the net uncollectible balance.

The following table shows the available offsets for a single reinsurer over time, assuming that recoveries are paid as due (i.e. as recoveries are made, collateral requirements are reduced). The structure of this chart is designed to be consistent with recovery timing chart above.

Table 3
Availability of Offsets for Reinsurer A
(All figures in 000's)

Offset Item	Period =>	Current Offsets	Yr End 2003	Yr End 2004	Cal Yr 2005	Yr End 2006	Yr End 2007
Funds Withheld		$7,000	$2,700	$1,400	$800	$400	$200
Letters of Credit		5,000	0	0	0	0	0
Ceded Balance Payable		2,500	0	0	0	0	0
Assumed Balances		0	0	0	0	0	0
Total Available Offsets		$14,500	$2,700	$1,400	$800	$400	$200

Simulating Failure Rates

The failure rates can reflect various different scenarios of reinsurer default, both full and partial. A full default would reflect an insolvency situation while partial defaults could reflect negotiated settlements (e.g. with a financially troubled reinsurer or a reinsurer in receivership). Slow-paying reinsurers could also be considered (i.e. payments defaulted in one year could potentially be recovered in a subsequent year).

The simulation of failure rates can be done in a fairly straightforward fashion. A simple approach is to create a uniform distribution for each reinsurer, with various points on the distribution corresponding to specific failure rates. For example, assume a specific reinsurer is expected to have a 5% probability of defaulting on 25% of their obligations, a 5% probability of defaulting on 50% of their obligations, and a 5% probability of total default. In this case, a random number could be simulated from a uniform distribution where a value between 0 and 0.05 would correspond to a 100% default, a value between 0.05 and 0.10 would correspond to a 50% default, and a value between 0.10 and 0.15 would correspond to a 25% default. An alternative could also be to create a continuous distribution of failure rates, though it would probably be necessary for this distribution to have a certain amount of probability mass at a level that corresponded to a full recovery.

The correlation between reinsurers can be modeled by first simulating an industry effect to reflect whether the environment was favorable or adverse for reinsurer solvency in that year. The simplest approach would be to simulate a random number from a uniform distribution. This random number could then be used to adjust the expected failure rates for each reinsurer. If we assumed that the adjustment varied between +/- 100%, then you could simply multiply the initial failure rates by 2 times the random number (i.e. if the randomly generated number was 0.57, the failure rates would be multiplied by 2 x 0.57, or 1.14). If the correlation between reinsurers was assumed to be lower, then the factor could be adjusted (e.g. this factor could be weighted with another random number).

The correlation across time periods is modeled in both the industry effect and at the individual reinsurer level. For the industry effect, the random number for a given period can be weighted with industry effect from the prior period. For example, if the Year 1 industry effect was 0.57 and the random number generator for Year 2 produced a factor of 0.49, these two numbers could be weighted together (using the year-over-year correlation coefficient as the weight) to produce the industry factor for Year 2.

One potential approach is to require that the default percentage in one year be at least as high as the default rate in the prior year (e.g. if the default rate in Year 1 was 25%, then the default rate in the following year would be 25% or higher). This would be consistent with insolvency and negotiated settlement scenarios. The downside of this approach is that it would not allow for a scenario where the reinsurer could recover from financial difficulties.

Another approach could be to weight the random number generated for a given year with the number generated for the previous year. At the individual reinsurer level, it is likely that the weight assigned to the prior year should be relatively high, since a reinsurer who fails to pay in one year is likely to fail to pay in the subsequent year as well. This approach could implicitly reflect slow-paying reinsurers as well as default. For example, if the default rate was 50% in Year 1 but reduced to 25% or 0% in a subsequent year, applying the reduced rate to the cumulative outstanding balance in Year 2 would allow partial or full recovery of the uncollected amounts from Year 1.

Simple Example

For this example, we will work off of the data shown above. In this case, we have assumed that the insurer has four reinsurers.

For our first step, assume we have determined the expected recoveries by calendar year period and reinsurer. This is shown in the chart below:

Table 4
Expected Recoveries by Reinsurer
(All figures in 000's)

Reinsurer	Period =>	Curr O/S Balance	Cal Yr 2003	Cal Yr 2004	Cal Yr 2005	Cal Yr 2006	Cal Yr 2007	Cal Yr 2008+
Reinsurer A		$4,000	$11,400	$5,600	$3,800	$2,250	$1,400	$1,000
Reinsurer B		550	1,000	700	700	0	0	0
Reinsurer C		10,000	4,000	1,000	0	0	0	0
Reinsurer D		800	5,000	3,000	1,000	500	500	0
Total Exp. Recoveries		$15,350	$21,400	$10,300	$5,500	$2,750	$1,900	$1,000

Note that the actual payments in the model will be specified by both reinsurer and reinsurance contract in order to allow any offsets to be applied appropriately to the specific recoveries that they support.

The potential (current) offsets by reinsurer are shown in the following chart:

Table 5
Potential Offsets by Reinsurer at 12/31/02
(All figures in 000's)

Reinsurer	**Offset Item =>**	**Funds Held**	**Letters of Credit**	**Ceded Bal. Payable**	**Assumed Balances**		**Total**
Reinsurer A		$7,000	$5,000	$2,500	$0		$14,500
Reinsurer B		2,000	0	300	650		2,950
Reinsurer C		0	3,500	0	3,300		6,800
Reinsurer D		3,650	3,650	0	0		7,300
Total		$12,650	$12,150	$2,800	$3,950		$31,550

For this example, we will use A.M. Best rating as an evaluator of each reinsurer's financial condition, and assume that each rating level relates to a specified failure distribution. The distribution will include three possible outcomes, 1) full recovery, 2) 50% failure, and 3) 100% failure.

The following chart shows each reinsurer's A.M. Best rating, the total outstanding recoveries (summarized from the chart above), the total current offsets, and the assumed probabilities of failure in a given year.

Table 6
Recoverables and Failure Rates by Reinsurer at 12/31/02
(All figures in 000's)

Reinsurer	A.M. Best Rating	Total O/S Recoveries	Total Curr. Offsets	Prob. Of 50% Failure	Prob. of 100% Failure
Reinsurer A	A-	$29,450	$14,500	1.5%	0.6%
Reinsurer B	B+	2,950	2,950	6.0%	1.5%
Reinsurer C	A-	15,000	6,800	1.5%	0.6%
Reinsurer D	A	10,800	7,300	0.6%	0.2%
Total		$58,200	$31,550		

We have assumed that Reinsurer B is fully collateralized, but the other three reinsurers only have collateral available to support certain contracts. In each case, the collateral is reduced in proportion to the remaining outstanding recoveries for the specific contract at the end of each calendar year.

Our correlation assumptions will be that each reinsurer's failure rate is 50% correlated with the industry factor, the industry factor is 50% correlated with the prior year's industry factor, and each reinsurer's failure probability in a given year is 80% correlated with their failure probability in the prior year.

Our failure rate simulations can then be performed. The first factors to be simulated are the industry effect factors. This process is shown below:

Table 7
Industry Effect Factors

Simulation Element	Period =>	Cal Yr 2003	Cal Yr 2004	Cal Yr 2005	Cal Yr 2006	Cal Yr 2007	Cal Yr 2008+
(1) Uniform Random Number		0.19	0.41	0.23	0.34	0.80	0.43
(2) Base Effect 2 x (1)		0.38	0.82	0.46	0.68	1.60	0.86
(3) Correlated Effect = [Avg (2), Prior Year Effect]		0.38	0.60	0.53	0.60	1.10	0.93

The reinsurer failure rates are then adjusted in the first year for the industry effects, as shown below.

Reinsurer	(1) Init. Prob. 50% Failure	(2) Init. Prob. of 100% Failure	(3) CY 2003 Industry Effect	(4) Uniform Random Number	(5)* Adj. Prob. Of 50% Failure	(6)* Adj. Prob. Of 100% Failure
Reinsurer A	1.5%	0.6%	0.38	0.67	1.29%	0.52%
Reinsurer B	6.0%	1.5%	0.38	0.82	6.06%	1.52%
Reinsurer C	1.5%	0.6%	0.38	0.43	0.93%	0.37%
Reinsurer D	0.6%	0.2%	0.38	0.56	0.45%	0.15%

* Failure rates are adjusted by the following factor: Average [(3), 2 * (4)]

Random numbers can then be generated to simulate whether any failures occur in the first year. The failure percentage (50% or 100%) is then applied to the balance due and reduced by any offsets.

For subsequent calendar years, the failure rates for each reinsurer can be adjusted in a similar fashion. Then, for each reinsurer, the random number generated to determine whether failure occurs is correlated with the prior year's number. This is done in a similar fashion to the manner that the industry effect was adjusted. For Reinsurer A, the first chart below shows the adjusted failure rates over each calendar year period. The second chart shows the calculation of the correlated random number for each period.

Table 8
Reinsurer A – Adjusted Failure Rates

Adjusted Failure Rates	Period =>	Cal Yr 2003	Cal Yr 2004	Cal Yr 2005	Cal Yr 2006	Cal Yr 2007	Cal Yr 2008+
(1) Init. Prob. of 50% Failure		1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
(2) Init. Prob. of 100% Failure		0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
(3) Industry Effect		0.38	0.60	0.53	0.60	1.10	0.93
(4) Uniform Random Number		0.67	0.49	0.51	0.42	0.38	0.68
(5) Adj. Prob. of 50% Failure		1.29%	1.19%	1.16%	1.08%	1.39%	1.72%
(6) Adj. Prob. of 100% Failure		0.52%	0.47%	0.46%	0.43%	0.56%	0.69%

Table 9
Reinsurer A – Correlated Random Numbers

Simulation Element	Period =>	Cal Yr 2003	Cal Yr 2004	Cal Yr 2005	Cal Yr 2006	Cal Yr 2007	Cal Yr 2008+
(1) Uniform Random Number		0.019	0.005	0.241	0.482	0.170	0.496
(2) Correlated Number = .20*(1) + .80*Prior Year		0.019	0.016	0.061	0.145	0.150	0.219

In this example, Reinsurer A would default on 50% of their obligations in calendar year 2004, since the correlated number of 0.016 is greater than the 100% failure rate of 0.0047, but still less than the sum of the 100% and 50% failure rates (0.0119+0.0047=0.0166). However, these amounts would subsequently be recovered in calendar year 2005.

Hence, for Reinsurer A, the simulated bad debt amounts for iteration 1 would be as follows:

Table 10
Reinsurer A – Bad Debt (in 000's)

	Period =>	Cal Yr 2003	Cal Yr 2004	Cal Yr 2005	Cal Yr 2006	Cal Yr 2007	Cal Yr 2008+
(1) Correlated Number		0.019	0.016	0.061	0.145	0.150	0.219
(2) Failure %		0%	50%	0%	0%	0%	0%
(3) O/S Balance = Prior Year (9)		4,000	0	100	0	0	0
(4) Cal Year Recoverables		11,400	5,600	3,800	2,250	1,400	1,000
(5) Total Due = (3)+(4)		15,400	5,600	3,900	2,250	1,400	1,000
(6) Amount Defaulted = (2)*(5)		0	2,800	0	0	0	0
(7) Available Offset		14,500	2,700	1,400	800	400	200
(8) Remaining Offsets*		14,500	2,700	0	800	400	200
(9) Net Default = Max[(6)–(8),0]		0	100	0	0	0	0
(10) Amount Recovered = (5) – (9)		15,400	5,500	3,900	2,250	1,400	1,000
(11) Ending Balance = (5) – (10)		0	100	0	0	0	0
(12) Bad Debt =11–Prior Year (11)		0	100	(100)	0	0	0
(13) Cumulative Bad Debt		0	100	0	0	0	0

* Remaining offsets are reduced by offsets applied in the prior year

The result for this iteration is that no bad debt reserve would be needed for Reinsurer A, though there would be an interruption in their expected cash flow pattern. Similar calculations would be performed for each reinsurer.

The following chart shows sample output from a complete simulation.

Table 10
Estimated Bad Debt Amounts by Reinsurer
(in 000's)

Reinsurer	Total Recoveries	Current Offset	Current Unsecured Recoveries		Estimated Bad Debt
Reinsurer A	$29,450	$14,500	$14,950		$280
Reinsurer B	2,950	2,950	0		10
Reinsurer C	15,000	6,800	8,200		155
Reinsurer D	10,800	7,300	3,500		30
Total	$58,200	$31,550	$26,650		$475

Table 11
Distribution of Overall Bad Debt Amounts
(All figures in 000's)

Simulation Element	Mean	50%	60%	70%	80%	90%
Cumulative Bad Debt Amount	475	35	96	175	860	2,500

The confidence levels in the above chart are based on the results of all simulations for all reinsurers.

Potential Applications

There are a variety of potential applications for this model. Areas of use could include loss reserving and analysis of relative risk between reinsurers. Both of these areas could also impact pricing and reinsurer selection, as well as affect commutation decisions and negotiations. The results of such a model could also be incorporated into a company's corporate risk or DFA analyses.

- Reserving – Currently the statutory provisions for uncollectible reinsurance are driven by formula (though a company can have some impact on the provision if they choose to write off certain recoverables sooner than the statutory provisions would require). GAAP rules are not as strict, as they only require a company to book their best estimate of provision. The model presented here could be used as a means to determine a best estimate as well as test the reasonability of the statutory provision, in addition to giving a company greater insight as to the potential (ultimate) impact on the company's balance sheet. Also, some countries now require insurers to estimate the confidence level in their booked reserves, including the potential for bad debt. In some cases companies are required to book additional reserves or carry capital to bring their overall funding level to a certain confidence level. A model such as this would be needed as part of this process.

- Reinsurer risk analysis – Creditworthiness is often the most critical factor considered by an insurer when purchasing reinsurance. Pricing and terms can be significantly different for reinsurers based on the perceived collectibility risk for each assuming company. As discussed previously, collateral requirements are often driven by the perceived collection risk for certain reinsurers implicit in Schedule F. Analysis of this risk could be crucial to the pricing process and a derivation of this model could be relatively easily incorporated into a company model for pricing outward reinsurance.

- Commutations - A company with an active commutation program could use the results of this model to help target reinsurers for commutation. Reinsurers could be classified by collection-risk level. "High-risk" reinsurers and reinsurance contracts could potentially be commuted before collection problems arise. The negotiation process for commutations could also be significantly affected, with a company's target price being adjusted for the future uncollectibility risk.

- Corporate risk and DFA analysis - This model could be incorporated as part of an analysis of a company's overall underwriting and credit risk. As discussed at the beginning of the paper, the reinsurance asset is often one of the largest and potentially most uncertain items on a company's balance sheet. Further, the risk for this asset is likely to be significantly correlated with many of the other major risks for an insurance company (i.e. catastrophe risk, underwriting or market cycle risk, and other timing risks). Consideration of the uncollectibility risk in conjunction with these other risks can be a critical component of a company's corporate risk model.

Areas for Future Research

This paper provides a basic framework for a model to estimate uncollectible reinsurance. A number of areas could be considered to help further refine the results and enhance its applicability within a company. Some of these areas include:

- Reinsurer Failure rates – Further research could be done to investigate actual historical reinsurer failure rates and the leading indicators or metrics that could be used to help predict such failures. One potential study could involve collecting historical financial ratings and other financial data for reinsurers and attempt to measure whether reinsurer failures could have been predicted from such data. Such a study could also be used to help refine a company's approach for selecting reinsurers, and even give regulators an additional tool for identifying potentially troubled companies so they can take corrective action.

- Correlations – Further analysis can be undertaken to estimate the correlation effects in the model, both between reinsurers and over time. Historical reinsurer failures could be analyzed against various underlying insurance industry measures, such as industry combined ratios, operating ratios, and premium growth or decline. The correlation of the failures to such measures could then be determined. In addition, another area of consideration with regard to correlations is the extent to which recoveries in specific lines of business may be subject to greater uncollectibility risk (for example, catastrophes versus excess casualty). In the two lines mentioned, one argument is that catastrophe events may be more likely to cause reinsurer failure, and should be subject to greater risk. However, the alternative argument is that catastrophes are short-tail, so even in such a scenario it is the long-tail recoveries that will ultimately not be recovered (since the funds needed to pay such recoveries will be depleted by the catastrophe recoveries).

- Time series effects – The time series aspect of the model presented here relates to the potential correlation of failures over time. The model shown here treats the "industry effect" and the correlation in a particular reinsurer's failure rate over time essentially as a random walk, i.e. a poor year in the industry is likely followed by another relatively poor year. The same is true for an individual reinsurer, where default in one year is more likely to be followed by default in the following. The reinsurer-specific correlation over time is likely indisputable. A company who defaulted on reinsurance recoveries and/or suffered financial stress is likely not expected to re-emerge from these difficulties, and previous defaulted amounts are typically not fully recovered. However, the industry as a whole is subject to market cycles. Various DFA models have attempted to measure such an effect in their financial projections. A similar approach could be used to capture this effect in this model.

- Recovery size effect/disputes –In the basic framework of the current model, the expected recoveries by reinsurer are considered only as a point estimate. A technical enhancement to the model could also allow the recoveries themselves to be introduced as a random variable, one that would be heavily correlated with the "industry effect" factor. Further research could be undertaken to estimate the extent that adverse treaty experience also impacts failure rates. From a general standpoint, this relationship is obvious, as poor industry results would likely cause both poor company results and higher reinsurer failures. However, analysis could also be performed to measure whether poor performance on specific treaties may influence uncollectbility by resulting in increased disputes with reinsurers.

Summary

Reinsurance recoverables can be a very significant factor in influencing the financial health of an insurance organization. The Annual Statement method for estimating recoveries does not consider a number of factors that often have significant effects on the risk of non-collection. The simulation methodology presented herein attempts to more specifically consider the risks of the company's reinsurers and the potential for correlations between reinsurer failures.

The results of this model can be used as a means for testing the reasonability of current provisions, as well as helping to identify areas of risk in a company's portfolio. Results can also be utilized during the reinsurance purchasing and selection process, the cedant management and commutation process, and other risk analysis and DFA-type initiatives.