Estimating the Parameter Risk of a Loss Ratio Distribution

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Abstract
Actuaries commonly build statistical models to predict future experience. To do this a model must be chosen, and parameters for that model must be calculated and selected. This paper assumes that the correct model has been chosen, but looks at the risk taken by assuming that the selected parameters accurately represent the true underlying distribution. A bootstrapping methodology is used to estimate the parameter risk associated with a loss ratio distribution. The results provide an estimate of the parameter risk of the ground-up loss ratio and for excess loss ratio layers commonly known as aggregate stop loss contracts. The paper shows that the impact of parameter risk on expected losses can be significant especially for aggregate stop loss contracts.

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Estimating the Parameter Risk of a Loss Ratio Distribution

Introduction

This paper presents a methodology for estimating the parameter risk of a loss ratio distribution. Estimates of parameter risk will be calculated for the ground-up loss ratios and for excess loss ratio layers. The parameter risk estimate is calculated when determining the expected loss of the business being priced.

The basic idea of estimating parameter risk is similar to Hayne [1], and to Meyers and Shenker [2], but instead of a theoretical approach a bootstrapping technique is used. Also different is that the work mentioned above concentrates on the collective risk model with frequency and severity distributions, but this paper uses loss ratios directly. Loss ratios were used because this is frequently all that is available for pricing aggregate stop loss covers, and often used when pricing primary business.

The key idea of the paper is that many different sets of parameters could have produced the actual data, and it is impossible to know which set of parameters produces a model that accurately represents the actual underlying distribution. The methodology presented determines sets of lognormal model parameters that could have produced the given loss ratios, and the relative probability of each of these sets of parameters. These parameters sets and their relative probabilities are then used to determine a ground-up expected loss ratio and to price possible aggregate stop loss reinsurance layers.

The paper will show that an actuary that does not take parameter risk into account runs the risk of underestimating the expected loss. The impact of parameter risk on expected losses can be significant especially for aggregate stop loss contracts.

Assumptions Underlying the Analysis

It was assumed that a simple loss ratio distribution would adequately represent the true underlying exposure of the ceding insurance company. A one in a hundred year catastrophe is likely not included in the data available, but the exposure for this type of loss is still present. The loss experience for these types of exposures should be removed from the total loss experience, and the expected loss for these exposures should be calculated separately.

It was also assumed that the loss ratios given produce the correct prospective estimate of the ultimate loss, and that there was no risk from reserving or pricing assumptions. This simplification allows the paper to concentrate on the parameter risk of the loss ratio distribution.

The lognormal distribution was used because it is a flexible distribution, and much of the math has been programmed directly into most spreadsheet software. This methodology can be completed using most probability distributions.

It should also be noted that the selected distribution should be a good approximation of the actual prospective loss ratio probability distribution. If there is not a reasonably good fit then this methodology will not provide appropriate results. All models should be checked against the actual data to ensure they are a reasonable representation of that data.

The Prospective Loss Ratio Distribution

Exhibit 1 provides a ten-year prospective loss ratio distribution and the mean, standard deviation and skewness of that distribution. It also provides the logs of the loss ratios, and the mean and standard deviation of the logs of the loss ratios. The mean and standard deviation of the logs were assumed to be the best-fit parameters Mu and Sigma.

It is a good idea to calculate a reasonable pair of best-fit parameters. This can be done using several well-documented methods [3]. The best-fit parameters will act as the starting point for determining viable parameter sets.

Also presented in Exhibit 1 is the actual experience of an aggregate stop loss layer, and the expected loss for the aggregate stop loss layer using the fitted parameters. The Expected Loss on Line is also given. This is the expected loss of the layer divided by the maximum loss of the layer.

Determining Viable Parameter Sets

The intent of the methodology is to find sets of parameters for the lognormal distribution that could have produced the prospective loss ratio distribution, and to determine the relative probability for each set of parameters. These parameter sets and their relative probabilities are then used to directly price the cover.

The methodology first needs to determine what sets of lognormal parameters could have possibly produced the given data. This is done using an excel macro stepping through parameter ranges. The macro methodically steps through ranges around the best-fit Mu and Sigma parameters creating possible parameter sets.

The following procedure was used to determine viable parameter sets.

1.) A Possible Mu and Sigma parameter set is determined from the excel macro.
2.) Ten years of data were used for this analysis; so 10,000 ten-year blocks of loss ratios are simulated using the lognormal distribution with the possible parameter set.
3.) For each ten-year block the simulated mean, standard deviation and skewness is compared to the actual ten-year prospective loss ratio mean, standard deviation and skewness. If it is close then that ten-year block is marked, and the parameter set is considered to be viable.
4.) The number of simulated ten-year blocks that were marked as having a mean, standard deviation and skewness close to the actual prospective loss ratio experience are tallied and recorded along with the parameter set Mu and Sigma values.
5.) The Excel macro moves to the next possible Mu and Sigma parameter set in step 1 until it has stepped through the entire range of possible Mu and Sigma parameters.

The size of the parameter ranges, the step sizes through the ranges and the definition of close are discussed in the Comments on Determining Viable Parameter Sets section of the paper.

A sample of steps 2 through 4 above can be seen in Exhibit 2. The parameter set used for the simulations in Exhibit 2 was the best-fit parameters with a Mu parameter of -0.45 and a Sigma parameter of 0.11. In the bottom section of Exhibit 2 each row is a simulated 10-year block with the mean, standard deviation and skewness of the simulated 10-year block given. These are compared to the ranges determined and labeled above as "Min Target Range" and "Max Target Range". If the simulated mean, standard deviation and skewness are all within the target ranges determined it shows up as a 1 in the "Frequency" column at the far right. Just one row of simulated loss ratios in Exhibit 2 meets all three criteria.

A sample of the outcome from the entire process can be seen in Exhibit 3. The parameter set test number of 1600 means that -0.45 and 0.11 were the 1600th set of parameters tested. The frequency of 1600 is 117. This is how many times out of the 10,000 simulations that the simulated ten-year loss ratio mean, standard deviation and skewness were close to the actual prospective loss ratio mean, standard deviation and skewness. Finally the relative frequency is given. For parameter set 1600 the relative probability is 2.985%. This is calculated by taking the frequency of parameter set 1600 (117) divided by the total frequency of all parameter sets (not given but is 3,920). The parameter sets with frequencies greater than zero are sorted out and used for pricing.

In Exhibit 3 it can be seen that the Mu parameter was -0.45 and Sigma varies from 0.0055 to 0.4345. Some insignificant entries were removed so that the exhibit is easier to read. There are 78 total steps through the Sigma range. The Mu parameter also steps through a range, but this is not shown in Exhibit 3 where it is just –0.45. The range that the Mu parameter steps through is bounded by –1.549 to 0.226, and there are 50 steps through the Mu parameter range.

In the bottom section of Exhibit 4 the parameter sets have been sorted by relative probabilities, and the sets with the largest relative probabilities are presented. The best-fit parameters of -0.45 under Mu and 0.11 under Sigma were the third most likely set of parameters to simulate close 10-year blocks. Using 10,000 simulations did not ensure that the best-fit pair was the most likely, but it does produce a relative probability that is close to what it should be. More simulations could be used to increase accuracy, but there are trade-offs between the processing time and the accuracy.

The important thing to note is not which parameter set is most likely, but how many possible parameter sets had large relative probabilities. In total there are 364 parameter sets out of 3950 parameter sets tested that simulated at least one ten-year block close to the actual data provided.

Graphs of the parameter sets and their relative probabilities are given in Figures 1and 2. Each of the graphs shows the relative probabilities of the parameter sets from different perspectives. Figure 1 shows the distribution from the side, and Figure 2 is a top view. These graphs must be read carefully because the scale for the Mu and Sigma are determined by the step sizes selected. Note that the scales were selected so that all of the parameter sets greater than zero could be seen.

In Figures 1 and 2 it can be seen that the Sigma parameter has a significant amount of skew. It should also be pointed out that Mu and Sigma are related. Given a certain Mu only Sigma parameters within a certain range will provide simulated 10-year blocks that are close to the given mean, standard deviation and skewness, and within that Sigma range some Sigma parameters are much more likely than others.

Calculating the Estimate of Parameter Risk

Calculating the expected loss using the viable parameter sets is a reasonably straightforward task. The lognormal expected value formula is used for each viable parameter set to come up with the expected loss for the parameter set. Each parameter set expected loss is then weighted together using the relative probabilities determined earlier in the process.

Exhibit 4 shows the expected loss for the best-fit pricing methodology and the parameter set methodology. The top block labeled "Fitted Original Distribution" gives the expected loss for the best-fit pricing, and the second block labeled "Parameter Set Distributions" gives the summary of the expected loss for the parameter set pricing. The difference between the expected losses of the two methods is labeled as "Difference Parameter Set to Fitted". This is calculated as (Parameter Set Expected Loss/Fitted Expected Loss) – 1. The weighted expected loss for the most likely parameter sets is shown in the lower section of the exhibit. The first column of calculated expected losses gives the ground-up expected loss for the distribution, and the second column gives the expected loss of the aggregate stop loss layer given in Exhibit 1. Each column after that gives the expected loss for the given loss ratio range.

In Exhibit 4 it can be seen that for a primary insurer the ground up best-fit expected loss ratio is 64.1% (Exp Loss Ratio = Exp(Mu+(Sigma^2)/2)), but the parameter set expected loss is 64.5%. If the company's permissible loss ratio is 63.0% than the best-fit indicated rate change is 1.75%, but the parameter set indicated rate change is 2.38%. If the margin for the risk and profit of this business is 5.0%, than the difference between the two indications is 12.38% of the margin including the lower rate increase ((2.38%-1.75%)/(5% of 101.75%)).

The aggregate stop loss layer given in Exhibit 1 is the second column in Exhibit 4. It has an attachment point of 72.5% and a layer of 2.5%. It can be seen in Exhibit 4 that there is a 45.85% difference or load in expected loss for a 2.5% excess 72.5% aggregate stop loss layer. The additional columns show how the difference in expected losses changes by layer, and how it increases significantly as the expected loss on line goes down.

Note that the difference in expected losses is negative for the low layers up to 65%. It appears that the parameter set methodology is shifting the probability distribution from the lower loss ratios to the higher loss ratios where aggregate stop loss contracts are usually purchased.

The difference in expected losses is the key finding of the paper. It is the estimated parameter risk for the prospective loss ratio distribution given. If the actuary does not calculate and include an estimate of parameter risk in the price then the company may not be charging enough for the business.

Sensitivity Analysis

Several alternative situations were looked at using the parameter set methodology. A higher mean, a larger standard deviation, a larger skewness and decreasing the number of years of data were investigated. Loads for primary expected losses and expected loss by layer are both considered.

The other alternatives are presented in Exhibits 5 through 8. Exhibit 5 increases the expected mean of the actual data (-0.36 0.11 0.5). Exhibit 6 increases the standard deviation of the actual data (-0.45, 0.2 0.5). Exhibit 7 increases the skewness of the actual data (-0.45, 0.11 1.5). Exhibit 8 assumes that only five years worth of data were available for pricing but that the mean, standard deviation and skewness remained the same (-0.45, 0.11 0.5 5Yr).

If the loads by layer are looked at by expected loss on line (expected loss for the layer/maximum loss of the layer) they can be compared to distributions with different means and standard deviations. In Exhibits 4 through 8 the expected loss on line is given for both the best-fit pricing and the parameter set pricing. A graph comparing the loads by expected loss on line for the parameter set pricing is given in Figure 3.

Parameter set relative probability graphs for the four additional distributions are given in Figures 4 through 11. The same views are presented for each distribution. Please note that these must be looked at carefully because the scales are not consistent. Looking at the relative probabilities should help compare between the four distributions given. Using only five years of data required that the Sigma parameter range be extended. This can be seen in Figures 10 and 11.

The actual data underlying each of these additional distributions is given in Exhibits 9 through 12. The format of these exhibits is the same as Exhibit 1.

Increasing the Mean

For both the primary and layered loss ratios the load does not vary substantially when the mean is increased (Exhibit 5 and Figure 3 with -0.36 0.11 0.5). This would intuitively make sense. The shape of the distribution has not changed, but is just shifted upwards.

Increasing the Standard Deviation

For the alternative with the higher standard deviation (Exhibit 6 with -0.45 0.2 0.5) the difference in indicated ground-up rate changes increased significantly. The ground-up fitted loss ratio went from 65.1% for the best-fit pricing to 66.5% for the parameter set pricing. The difference between rate change indications based on the same 63% permissible loss ratio rose to 2.23%, or 43.16% of a 5% margin. This implies that having a block of information with loss ratios that are less stable has a substantial impact on the ground-up parameter risk.

The load by layer is somewhat higher for the distribution with the higher standard deviation (Figure 3 -0.45 0.2 0.5). One possible explanation for this is that increasing the standard deviation shifts the parameter set distribution more than the best-fit distribution.

Increasing the Skewness

Increasing the skewness (Exhibit 7 with 0.45 0.11 1.5) does not seem to have a large impact on the ground-up loss ratios. The difference in rate change indications rose to 0.79%, or 15.53% of a 5% margin.

Looking at Figure 3 (0.45 .11 1.5) the load for excess layers seems to track closely with the loads for the higher standard deviation. It appears that increasing the skewness has an impact similar as increasing the standard deviation of the actual data on the excess layers.

Five Years of Data Available

Only having five years of data (Exhibit 8 with –0.45, 0.11 0.5 5Yr) has a significant impact on the indicated primary loss ratio parameter risk load. The ground-up loss ratio went from 64.1% for the best-fit pricing to 65.7% for the parameter set pricing. The difference in rate change indications rose to 2.54% or 49.93% of a 5% margin.

Looking at the five-year distribution (Figure 3 –0.45 0.11 0.5 5Yr) it can be seen that for every expected loss on line that the load by layer is significantly higher for the five-year distribution. It appears that having fewer years of data has a much larger impact on loads for the higher layers than increasing the standard deviation or skewness.

The number of years of data is a key input into the model. The actuary should attempt to find additional years of data, or find other alternative sources of data that are reasonably consistent with the available data. Integrating this additional data into the analysis should bring the parameter risk down.

Comments on Determining Viable Parameter Sets

It is noted that the above process does contain a fair amount of judgment. The distance of the steps in the parameter ranges, the size of the parameter ranges and the definition of close should be discussed. Also the use of mean, standard deviation and skewness as the criteria to judge if a parameter set is close should be considered.

Step Size

The size of the steps through the parameter ranges should be considered. Running the Excel macro several times using increasingly smaller step sizes each time can help determine an appropriate step size. When the results don't change substantially the step size is small enough to be a reasonable estimate of the infinite number of possible parameter sets. The macro used to calculate the information in Exhibit 4 took around 8 hours to run. When the step sizes were cut in half and the macro was rerun it took 36 hours to complete the macro. The results are presented in Exhibit 13. The expected primary loss ratio stayed at 64.5%, and there was an increase of only 0.001% when the loss ratios are rounded to hundred-thousandths. The expected loss to the layer from 72.5% to 75.0% went from 0.342% to 0.345%, or an increase of 0.703%. The change in results does not seem to justify the increase in processing time.

Size of Ranges

The parameter set ranges that the Excel macro loops through should be wide enough so that at the edges of the ranges very few simulated ten-year blocks have a mean, standard deviation and a skewness close to the actual mean, standard deviation and skewness.

Close to Original Distribution

The intent of close should also be considered. The definition of close selected was based on practical considerations. How close does the simulated ten-year block need to be to the actual mean and standard deviation in order to be comfortable while pricing the underlying cover. Skewness was included to make sure that the distribution had the correct skew around the mean. These considerations have to be balanced against the frequency needed to minimize the impact that random simulations could have on the outcome.

To be consistent the final definition of close was that when using the best-fit parameters about 21%-22% of the simulated means, standard deviations and skews were within a band centered at the actual mean, standard deviations and skewness of the actual data. For the distribution in Exhibit 2 this was a mean centered at 64.1% with a band from 63.52% to 64.77%. The standard deviation was centered at 0.0712 with a band from 0.0662 to 0.0762. The skewness was centered at 0.5 with a band from 0.29 to 0.71. This translates into roughly 100 simulated viable 10-year blocks when using the best-fit parameters (10,000 simulations x 21% x 21% x 21%).

Criteria Used

The mean, standard deviation and skewness were used as the criteria to determine if the parameter set is viable. Other measures could have been used in place of or in addition to these. The mean, standard deviation and skewness were used because they are well known, are simple to work with, and capture the basic characteristics of the underlying loss ratio distribution. Other measures should be considered.

Conclusion

Viable parameter sets and their relative probabilities were determined, and then used to directly calculate the expected primary loss ratios and the expected loss by layer. The concept is that any one of the viable parameter sets could have produced the actual loss ratio experience of the ceding company. By comparing the expected losses of the parameter sets to the expected losses of the original best-fit an estimate of the parameter risk of using just one set of parameters can be determined.

The process requires a fair amount of judgment, but actuarial pricing cannot be completed without some level of judgment. The assumptions that need to be made are relatively straightforward and can easily be changed to measure the impact.

It should also be mentioned that this methodology only estimates the parameter risk of the loss experience that is present in the prospective loss ratios. Actuaries hope that modeling will account for some of the potential variation that could occur in the experience. There are exposures that did not have loss experience within the data set, and that are not anticipated nor reflected in the adjusted loss ratios. This risk is still present and not measured directly by the methodology. The catastrophe and other risk that was removed in the beginning still need to be taken into account. Expected losses for these exposures need to be determined and included in the overall expected loss.

In addition the original data set likely has process risk included in the experience. Even when using the best-fit parameters to simulate 10-year blocks of loss ratios only a small number of the 10-year blocks had a mean, standard deviations and skewness close to the actual data. This would imply that the process risk could be substantial. This paper assumes that the given data provides a good representation of the true underlying distribution.

This methodology could be adapted to most statistical distributions. It therefore could apply to a wide variety of situation where statistical distributions are used. Property and casualty primary loss ratios and an aggregate stop loss reinsurance layer were looked at in this paper, but there is no reason it can't be used in other situations to estimate parameter risk.

References

[1] Hayne, R.M., "Modeling Parameter Uncertainty in Cash Flow Projections", *Casualty Actuarial Society Forum*, Summer 1999, pp. 133-151.

[2] Meyers, G.G., Schenker, N., "Parameter Uncertainty in the Collective Risk Model", *Proceedings of the Casualty Actuarial Society*, LXX, 1983, pp.111-143.

[3] Hogg, R. and Klugman, S. (1984). *Loss Distributions.* John Wiley & Sons, Inc.

Loss Ratio Distribution

Exhibit 1

	Actual LR	Actual Ln(LR)
	58.4%	
1	58.4%	(0.5376)
2	64.5%	(0.4388)
3	67.3%	(0.3953)
4	52.6%	(0.6415)
5	58.4%	(0.5376)
6	64.5%	(0.4388)
7	78.3%	(0.2440)
8	70.6%	(0.3488)
9	62.0%	(0.4786)
10	64.5%	(0.4388)
Average	64.1%	(0.4500)
Stdev	0.0712	0.1100
Skew	0.5000	
Expected		64.1%

Min	72.5%
Max	75.0%
	Loss
	0.0%
	0.0%
	0.0%
	0.0%
	0.0%
	0.0%
	2.5%
	0.0%
	0.0%
	0.0%
Average	0.250%
Stdev	0.0079
Expected Loss On Line	10.0%
Fitted Expected Loss	0.235%
Fitted Expected Loss On Line	9.389%

Simulating Loss Distributions

Exhibit 2

		Sample Values	Expected Value of X	LN(X)	
Distributi	LnN	64.1%	64.1%	(0.4500)	Mean
Param 1	(0.4500)	0.0712		0.1100	Standard Devation
Param 2	0.1100	0.5000			Skewness
Prob XS			0.625%	0.6352	Min Target Range Mean
Count	4000			0.6477	Max Target Range Mean
			0.500%	0.0662	Min Target Range Std Dev
				0.0762	Max Target Range Std Dev
			21.000%	0.2900	Min Target Range Skew
				0.7100	Max Target Range Skew

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Simulated Year

										Mean	StdDev	Skewness	Mu	Std Dev	Skew	**Frequency**
													(0.4500)	0.1100	0.50000	
1	2	3	4	5	6	7	8	9	10	**0.6411**			22.00%	21.97%	21.36%	1.17%
59.7%	67.5%	59.7%	72.8%	67.9%	70.0%	63.5%	71.6%	70.0%	70.4%	0.6730	0.047	(0.8060)	0	0	0	0
67.9%	59.0%	61.1%	62.1%	63.7%	55.6%	66.9%	71.4%	66.8%	64.6%	0.6390	0.046	(0.2625)	1	0	0	0
72.3%	58.4%	49.1%	61.0%	51.8%	75.1%	53.6%	67.2%	79.4%	59.3%	0.6270	0.104	0.3481	0	0	1	0
67.0%	61.5%	70.3%	57.2%	75.0%	61.8%	72.9%	61.6%	54.3%	66.2%	0.6478	0.067	0.0551	0	1	0	0
80.2%	77.3%	61.5%	66.8%	72.5%	72.7%	69.9%	61.1%	65.6%	78.6%	0.7063	0.068	(0.0387)	0	1	0	0
65.2%	67.4%	62.3%	60.4%	62.5%	58.0%	64.9%	62.7%	60.1%	62.2%	0.6259	0.027	0.1428	0	0	0	0
64.5%	49.1%	56.5%	54.4%	70.3%	71.4%	60.8%	57.7%	63.1%	55.7%	0.6033	0.071	0.2402	0	1	0	0
63.7%	66.3%	70.7%	68.0%	58.3%	73.6%	60.6%	59.3%	62.8%	68.8%	0.6521	0.051	0.1746	0	0	0	0
69.1%	63.9%	65.5%	70.5%	62.3%	76.7%	66.0%	59.7%	68.7%	50.9%	0.6532	0.069	(0.6321)	0	1	0	0
60.4%	50.3%	54.8%	73.9%	52.9%	56.0%	65.0%	87.8%	55.8%	55.7%	0.6124	0.115	1.6355	0	0	0	0
67.1%	63.0%	66.8%	55.3%	68.1%	72.6%	60.5%	55.6%	53.6%	53.0%	0.6157	0.070	0.1487	0	1	0	0
69.3%	54.5%	58.6%	66.4%	52.1%	67.9%	70.5%	68.6%	59.0%	81.9%	0.6487	0.089	0.3172	0	0	1	0
60.8%	69.1%	69.4%	65.3%	69.4%	69.0%	59.4%	73.2%	61.7%	64.7%	0.6623	0.045	(0.1600)	0	0	0	0
68.7%	63.4%	60.0%	64.2%	71.6%	63.0%	71.4%	63.4%	63.8%	57.2%	0.6466	0.046	0.2322	1	0	0	0
60.6%	57.7%	57.6%	70.9%	55.7%	74.9%	66.6%	63.9%	61.1%	73.9%	0.6428	0.070	0.4429	1	1	1	1
56.9%	61.4%	58.2%	69.7%	72.7%	61.4%	66.9%	70.1%	61.8%	76.5%	0.6556	0.066	0.2973	0	0	1	0
56.8%	62.2%	59.7%	67.5%	64.3%	69.2%	59.0%	70.7%	62.1%	61.6%	0.6331	0.046	0.3840	0	0	1	0
58.8%	54.2%	50.6%	62.1%	61.3%	79.8%	69.7%	57.3%	58.2%	53.0%	0.6050	0.086	1.3500	0	0	0	0
62.7%	66.4%	69.7%	73.3%	65.1%	72.3%	61.9%	60.0%	70.7%	76.5%	0.6789	0.055	0.0395	0	0	0	0
61.6%	67.9%	66.6%	63.3%	63.0%	65.0%	65.9%	57.9%	71.7%	72.7%	0.6557	0.045	0.1061	0	0	0	0
66.2%	60.3%	61.2%	66.5%	75.5%	55.4%	67.8%	61.8%	50.3%	55.9%	0.6209	0.073	0.2043	0	1	0	0
72.5%	46.4%	69.1%	75.4%	54.4%	78.9%	58.2%	85.2%	73.5%	66.9%	0.6804	0.119	(0.5527)	0	0	0	0
55.5%	59.9%	62.4%	60.7%	65.6%	49.7%	50.5%	62.2%	52.5%	57.3%	0.5763	0.055	(0.2139)	0	0	0	0
63.1%	65.8%	61.7%	59.9%	60.4%	60.4%	64.9%	59.3%	64.9%	56.9%	0.6175	0.029	(0.0099)	0	0	0	0
71.4%	63.7%	65.3%	59.2%	74.3%	52.1%	72.7%	72.2%	65.1%	59.9%	0.6558	0.072	(0.5295)	0	1	0	0
61.4%	72.7%	65.1%	63.0%	61.0%	68.0%	74.5%	56.5%	64.1%	59.5%	0.6458	0.057	0.6148	1	0	1	0
54.9%	59.8%	70.8%	62.4%	68.7%	59.9%	58.7%	63.0%	63.9%	64.7%	0.6268	0.047	0.2350	0	0	0	0
59.4%	68.7%	71.9%	66.1%	71.2%	63.8%	56.5%	61.9%	69.5%	65.9%	0.6550	0.051	(0.4868)	0	0	0	0
63.8%	64.0%	59.5%	56.8%	54.0%	80.4%	54.1%	54.3%	58.9%	59.1%	0.6051	0.079	2.0171	0	0	0	0
64.5%	69.4%	73.6%	72.0%	80.4%	71.9%	56.3%	60.7%	57.3%	68.9%	0.6750	0.077	(0.0749)	0	0	0	0
66.2%	54.7%	62.0%	68.5%	64.5%	66.9%	55.7%	52.0%	60.5%	54.5%	0.6055	0.060	(0.0986)	0	0	0	0
80.6%	59.7%	59.9%	59.4%	62.7%	57.7%	70.1%	51.4%	59.3%	55.7%	0.6164	0.082	1.5169	0	0	0	0
62.8%	54.7%	62.3%	58.9%	71.4%	65.1%	70.9%	64.7%	68.0%	56.8%	0.6356	0.057	(0.1001)	1	0	0	0
57.2%	69.7%	63.9%	71.4%	66.7%	61.7%	52.5%	74.0%	66.5%	57.3%	0.6408	0.069	(0.2704)	1	1	0	0
75.2%	61.1%	63.2%	59.7%	53.4%	68.0%	57.1%	60.3%	69.0%	65.1%	0.6322	0.063	0.4329	0	0	1	0

Sample of Simulated Outcomes Exhibit 3

Parameter Set Test Number	Mu	Sigma	Frequency	Relative Probability
1581	-0.45	0.0055	-	0.000%
1582	-0.45	0.0110	-	0.000%
....	....	....	....	....
1592	-0.45	0.0660	10	0.255%
1593	-0.45	0.0715	22	0.561%
1594	-0.45	0.0770	43	1.097%
1595	-0.45	0.0825	82	2.092%
1596	-0.45	0.0880	99	2.526%
1597	-0.45	0.0935	103	2.628%
1598	-0.45	0.0990	121	3.087%
1599	-0.45	0.1045	118	3.010%
1600	-0.45	0.1100	117	2.985%
1601	-0.45	0.1155	102	2.602%
1602	-0.45	0.1210	89	2.270%
1603	-0.45	0.1265	90	2.296%
1604	-0.45	0.1320	79	2.015%
1605	-0.45	0.1375	59	1.505%
1606	-0.45	0.1430	38	0.969%
1607	-0.45	0.1485	49	1.250%
1608	-0.45	0.1540	28	0.714%
1609	-0.45	0.1595	30	0.765%
1610	-0.45	0.1650	19	0.485%
1611	-0.45	0.1705	24	0.612%
1612	-0.45	0.1760	15	0.383%
1613	-0.45	0.1815	13	0.332%
1614	-0.45	0.1870	10	0.255%
1615	-0.45	0.1925	11	0.281%
1616	-0.45	0.1980	6	0.153%
1617	-0.45	0.2035	5	0.128%
1618	-0.45	0.2090	6	0.153%
1619	-0.45	0.2145	5	0.128%
1620	-0.45	0.2200	-	0.000%
1621	-0.45	0.2255	5	0.128%
1622	-0.45	0.2310	2	0.051%
1623	-0.45	0.2365	2	0.051%
....	....	....	....	....
1658	-0.45	0.4290	-	0.000%
1659	-0.45	0.4345	-	0.000%

Fitted Distributions - LnNormal Exhibit 4

Base

	E(X)	Mu	Sigma	Skew
Fitted	64.1%	(0.4500)	0.11	0.5

Fitted Original Distribution	**Ground-Up**	**Stop Loss Contract**												
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**64.1%**	**0.235%**	49.975%	4.785%	4.105%	2.858%	1.532%	0.629%	0.201%	0.052%	0.011%	0.002%	0.000%
Expected Loss On Line		**9.389%**	99.950%	95.707%	82.091%	57.152%	30.637%	12.572%	4.030%	1.040%	0.223%	0.041%	0.007%
Parameter Set Distributions	**Ground-Up**	**Stop Loss**											
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**64.5%**	**0.342%**	49.860%	4.622%	3.955%	2.850%	1.677%	0.841%	0.388%	0.176%	0.082%	0.039%	0.020%
Expected Loss On Line		**13.693%**	99.719%	92.445%	79.103%	56.994%	33.544%	16.812%	7.754%	3.516%	1.630%	0.788%	0.401%
Difference Parameter Set to Fitted	**0.60%**	**45.85%**	-0.23%	-3.41%	-3.64%	-0.28%	9.49%	33.73%	92.41%	238.17%	632.45%	1838.02%	6058.85%

Mu	**Sigma**	**Freq**	**Relative Prob**														
(0.4500)	0.0990	1.210%	3.087%	1.978%	0.006%	1.543%	0.150%	0.130%	0.089%	0.044%	0.016%	0.004%	0.001%	0.000%	0.000%	0.000%
(0.4500)	0.1045	1.180%	3.010%	1.930%	0.006%	1.505%	0.145%	0.125%	0.087%	0.045%	0.017%	0.005%	0.001%	0.000%	0.000%	0.000%
(0.4500)	0.1100	1.170%	2.985%	1.915%	0.007%	1.492%	0.143%	0.123%	0.085%	0.046%	0.019%	0.006%	0.002%	0.000%	0.000%	0.000%
(0.4500)	0.0935	1.030%	2.628%	1.683%	0.004%	1.314%	0.128%	0.113%	0.077%	0.036%	0.012%	0.003%	0.000%	0.000%	0.000%	0.000%
(0.4500)	0.1155	1.020%	2.602%	1.670%	0.007%	1.300%	0.124%	0.105%	0.074%	0.041%	0.018%	0.006%	0.002%	0.000%	0.000%	0.000%
(0.4500)	0.0880	0.990%	2.526%	1.617%	0.003%	1.263%	0.124%	0.110%	0.074%	0.034%	0.010%	0.002%	0.000%	0.000%	0.000%	0.000%
(0.4500)	0.1265	0.900%	2.296%	1.476%	0.007%	1.147%	0.107%	0.091%	0.065%	0.038%	0.018%	0.007%	0.003%	0.001%	0.000%	0.000%
(0.4500)	0.1210	0.890%	2.270%	1.458%	0.007%	1.134%	0.107%	0.091%	0.064%	0.037%	0.017%	0.006%	0.002%	0.001%	0.000%	0.000%
(0.4172)	0.1100	0.830%	2.117%	1.404%	0.008%	1.058%	0.103%	0.094%	0.072%	0.044%	0.021%	0.008%	0.002%	0.001%	0.000%	0.000%
(0.4500)	0.0825	0.820%	2.092%	1.338%	0.002%	1.046%	0.103%	0.093%	0.062%	0.026%	0.007%	0.001%	0.000%	0.000%	0.000%	0.000%
(0.4172)	0.1045	0.800%	2.041%	1.352%	0.007%	1.020%	0.100%	0.092%	0.070%	0.042%	0.019%	0.006%	0.002%	0.000%	0.000%	0.000%
(0.4500)	0.1320	0.790%	2.015%	1.296%	0.007%	1.006%	0.093%	0.079%	0.056%	0.034%	0.017%	0.007%	0.003%	0.001%	0.000%	0.000%
(0.4839)	0.1155	0.720%	1.837%	1.140%	0.003%	0.917%	0.084%	0.066%	0.042%	0.020%	0.008%	0.002%	0.001%	0.000%	0.000%	0.000%
(0.4839)	0.1210	0.690%	1.760%	1.093%	0.003%	0.878%	0.079%	0.063%	0.040%	0.020%	0.008%	0.003%	0.001%	0.000%	0.000%	0.000%
(0.4172)	0.1210	0.670%	1.709%	1.134%	0.008%	0.854%	0.083%	0.074%	0.057%	0.036%	0.019%	0.008%	0.003%	0.001%	0.000%	0.000%
(0.4839)	0.1100	0.650%	1.658%	1.028%	0.002%	0.828%	0.076%	0.061%	0.037%	0.017%	0.006%	0.002%	0.000%	0.000%	0.000%	0.000%
(0.4172)	0.1320	0.640%	1.633%	1.085%	0.008%	0.816%	0.078%	0.069%	0.053%	0.035%	0.019%	0.009%	0.004%	0.001%	0.000%	0.000%
(0.4172)	0.0990	0.630%	1.607%	1.064%	0.005%	0.804%	0.079%	0.073%	0.056%	0.033%	0.014%	0.004%	0.001%	0.000%	0.000%	0.000%
(0.4172)	0.1155	0.630%	1.607%	1.066%	0.007%	0.803%	0.078%	0.070%	0.054%	0.034%	0.017%	0.007%	0.002%	0.001%	0.000%	0.000%

Fitted Distributions - LnNormal
Higher Mean

Exhibit 5

	E(X)	Mu	Sigma	Skew
Fitted	70.2%	(0.3600)	0.11	0.5

Fitted Original Distribution	**Ground-Up**	**Stop Loss Contract**											
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**70.2%**	**0.769%**	49.998%	4.970%	4.785%	4.183%	3.083%	1.831%	0.867%	0.332%	0.105%	0.028%	0.006%
Expected Loss On Line		**30.775%**	99.996%	99.402%	95.700%	83.667%	61.670%	36.623%	17.349%	6.635%	2.093%	0.558%	0.129%
Parameter Set Distributions	**Ground-Up**	**Stop Loss**											
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**70.6%**	**0.842%**	49.951%	4.875%	4.615%	4.018%	3.041%	1.942%	1.070%	0.539%	0.263%	0.130%	0.067%
Expected Loss On Line		**33.675%**	99.903%	97.508%	92.292%	80.358%	60.820%	38.850%	21.406%	10.776%	5.263%	2.604%	1.337%
Difference Parameter Set to Fitted	**0.59%**	**9.42%**	-0.09%	-1.91%	-3.56%	-3.96%	-1.38%	6.08%	23.39%	62.41%	151.42%	366.63%	939.02%

Mu	**Sigma**	**Freq**	**Relative Prob**													
-36.0%	11.0%	1.240%	3.273%	0.023	0.025%	1.636%	0.163%	0.157%	0.137%	0.101%	0.060%	0.028%	0.011%	0.003%	0.001%	0.000%
-36.0%	9.9%	1.170%	3.088%	0.022	0.022%	1.544%	0.154%	0.150%	0.133%	0.097%	0.054%	0.023%	0.007%	0.002%	0.000%	0.000%
-36.0%	10.5%	1.140%	3.009%	0.021	0.022%	1.504%	0.150%	0.145%	0.128%	0.094%	0.054%	0.024%	0.009%	0.002%	0.001%	0.000%
-36.0%	12.1%	1.010%	2.666%	0.019	0.022%	1.333%	0.132%	0.125%	0.109%	0.081%	0.050%	0.026%	0.011%	0.004%	0.001%	0.000%
-36.0%	11.6%	0.950%	2.507%	0.018	0.020%	1.254%	0.124%	0.119%	0.103%	0.077%	0.047%	0.023%	0.010%	0.003%	0.001%	0.000%
-36.0%	9.4%	0.830%	2.191%	0.015	0.015%	1.095%	0.109%	0.107%	0.096%	0.070%	0.038%	0.015%	0.004%	0.001%	0.000%	0.000%
-36.0%	12.7%	0.780%	2.059%	0.014	0.017%	1.029%	0.101%	0.096%	0.083%	0.062%	0.039%	0.021%	0.010%	0.004%	0.001%	0.000%
-36.0%	8.8%	0.760%	2.006%	0.014	0.013%	1.003%	0.100%	0.099%	0.089%	0.065%	0.034%	0.012%	0.003%	0.001%	0.000%	0.000%
-32.7%	11.0%	0.720%	1.900%	0.014	0.020%	0.950%	0.095%	0.093%	0.085%	0.069%	0.046%	0.025%	0.011%	0.004%	0.001%	0.000%
-32.7%	9.9%	0.710%	1.874%	0.014	0.019%	0.937%	0.094%	0.092%	0.086%	0.070%	0.045%	0.022%	0.008%	0.003%	0.001%	0.000%
-32.7%	10.5%	0.710%	1.874%	0.014	0.019%	0.937%	0.094%	0.092%	0.085%	0.069%	0.045%	0.023%	0.010%	0.003%	0.001%	0.000%
-32.7%	11.6%	0.710%	1.874%	0.014	0.020%	0.937%	0.093%	0.091%	0.083%	0.067%	0.045%	0.025%	0.012%	0.005%	0.002%	0.000%
-39.4%	11.6%	0.670%	1.768%	0.012	0.010%	0.884%	0.087%	0.081%	0.066%	0.044%	0.024%	0.010%	0.004%	0.001%	0.000%	0.000%
-32.7%	12.1%	0.660%	1.742%	0.013	0.019%	0.871%	0.087%	0.084%	0.076%	0.061%	0.042%	0.024%	0.012%	0.005%	0.002%	0.001%
-39.4%	9.9%	0.650%	1.715%	0.012	0.008%	0.858%	0.085%	0.081%	0.066%	0.043%	0.020%	0.007%	0.002%	0.000%	0.000%	0.000%
-39.4%	12.7%	0.650%	1.715%	0.012	0.010%	0.857%	0.084%	0.077%	0.062%	0.043%	0.025%	0.012%	0.005%	0.002%	0.001%	0.000%
-39.4%	13.8%	0.650%	1.715%	0.012	0.011%	0.857%	0.083%	0.075%	0.061%	0.043%	0.026%	0.014%	0.006%	0.003%	0.001%	0.000%
-36.0%	13.2%	0.610%	1.610%	0.011	0.014%	0.805%	0.079%	0.074%	0.064%	0.048%	0.031%	0.017%	0.008%	0.004%	0.001%	0.000%
-39.4%	12.1%	0.600%	1.584%	0.011	0.009%	0.792%	0.077%	0.071%	0.058%	0.039%	0.022%	0.010%	0.004%	0.001%	0.000%	0.000%

Fitted Distributions - LnNormal
Higher Standard Deviation

Exhibit 6

	E(X)	Mu	Sigma	Skew
Fitted	65.1%	(0.4500)	0.2000	0.5

				Ground-Up	Stop Loss Contract											
Fitted Original Distribution																
Loss Ratio Minimum Range					**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum					**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer				**65.1%**	**0.584%**	49.500%	4.163%	3.483%	2.700%	1.945%	1.309%	0.830%	0.499%	0.287%	0.159%	0.086%
Expected Loss On Line					**23.379%**	98.999%	83.262%	69.653%	54.009%	38.896%	26.176%	16.591%	9.984%	5.748%	3.187%	1.713%
Parameter Set Distributions				**Ground-Up**	**Stop Loss**											
Loss Ratio Minimum Range					**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum					**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer				**66.5%**	**0.695%**	49.041%	4.013%	3.414%	2.737%	2.081%	1.516%	1.074%	0.749%	0.520%	0.362%	0.254%
Expected Loss On Line					**27.793%**	98.082%	80.258%	68.272%	54.749%	41.610%	30.318%	21.473%	14.977%	10.398%	7.242%	5.087%
Difference Parameter Set to Fitted				**2.23%**	**18.88%**	-0.93%	-3.61%	-1.98%	1.37%	6.98%	15.82%	29.43%	50.02%	80.91%	127.21%	196.99%
Mu	**Sigma**	**Freq**	**Relative Prob**													
-45.0%	19.0%	1.2%	1.665%	0.011	0.009%	0.826%	0.070%	0.059%	0.045%	0.032%	0.021%	0.013%	0.007%	0.004%	0.002%	0.001%
-41.7%	19.0%	1.2%	1.610%	0.011	0.011%	0.801%	0.071%	0.061%	0.049%	0.036%	0.025%	0.016%	0.010%	0.006%	0.003%	0.002%
-41.7%	18.0%	1.2%	1.583%	0.011	0.011%	0.788%	0.071%	0.061%	0.049%	0.035%	0.024%	0.015%	0.008%	0.005%	0.002%	0.001%
-45.0%	20.0%	1.1%	1.542%	0.010	0.009%	0.763%	0.064%	0.054%	0.042%	0.030%	0.020%	0.013%	0.008%	0.004%	0.002%	0.001%
-48.4%	21.0%	1.1%	1.501%	0.009	0.007%	0.739%	0.058%	0.047%	0.036%	0.025%	0.017%	0.010%	0.006%	0.004%	0.002%	0.001%
-48.4%	19.0%	1.0%	1.419%	0.009	0.006%	0.701%	0.057%	0.046%	0.033%	0.023%	0.014%	0.008%	0.004%	0.002%	0.001%	0.001%
-45.0%	22.0%	1.0%	1.392%	0.009	0.009%	0.687%	0.056%	0.047%	0.037%	0.028%	0.020%	0.013%	0.008%	0.005%	0.003%	0.002%
-45.0%	17.0%	1.0%	1.365%	0.009	0.007%	0.679%	0.059%	0.050%	0.037%	0.025%	0.015%	0.009%	0.005%	0.002%	0.001%	0.000%
-45.0%	18.0%	1.0%	1.351%	0.009	0.007%	0.671%	0.058%	0.048%	0.037%	0.025%	0.016%	0.010%	0.005%	0.003%	0.001%	0.001%
-41.7%	21.0%	1.0%	1.338%	0.009	0.010%	0.663%	0.057%	0.050%	0.040%	0.030%	0.022%	0.015%	0.010%	0.006%	0.004%	0.002%
-45.0%	21.0%	1.0%	1.297%	0.008	0.008%	0.641%	0.053%	0.045%	0.035%	0.026%	0.018%	0.012%	0.007%	0.004%	0.003%	0.001%
-48.4%	20.0%	0.9%	1.269%	0.008	0.006%	0.626%	0.050%	0.040%	0.030%	0.021%	0.013%	0.008%	0.005%	0.003%	0.001%	0.001%
-41.7%	20.0%	0.9%	1.269%	0.009	0.009%	0.630%	0.055%	0.048%	0.038%	0.029%	0.020%	0.013%	0.008%	0.005%	0.003%	0.002%
-41.7%	23.0%	0.9%	1.242%	0.008	0.010%	0.614%	0.052%	0.045%	0.037%	0.028%	0.021%	0.015%	0.010%	0.007%	0.004%	0.003%
-45.0%	24.0%	0.9%	1.228%	0.008	0.008%	0.603%	0.049%	0.041%	0.033%	0.025%	0.018%	0.013%	0.009%	0.006%	0.004%	0.002%
-45.0%	25.0%	0.9%	1.201%	0.008	0.008%	0.589%	0.047%	0.040%	0.032%	0.025%	0.018%	0.013%	0.009%	0.006%	0.004%	0.003%
-48.4%	23.0%	0.9%	1.187%	0.008	0.006%	0.582%	0.045%	0.037%	0.028%	0.021%	0.014%	0.010%	0.006%	0.004%	0.002%	0.001%
-41.7%	22.0%	0.9%	1.174%	0.008	0.009%	0.581%	0.050%	0.043%	0.035%	0.027%	0.020%	0.014%	0.009%	0.006%	0.004%	0.002%
-48.4%	17.0%	0.9%	1.160%	0.007	0.004%	0.575%	0.048%	0.038%	0.027%	0.017%	0.010%	0.005%	0.003%	0.001%	0.001%	0.000%

Fitted Distributions - LnNormal Exhibit 7

Higher Skew

	E(X)	Mu	Sigma	Skew
Fitted	64.1%	(0.4500)	0.11	1.5

Fitted Original Distribution	Ground-Up	Stop Loss Contract												
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**64.1%**	**0.235%**	49.975%	4.785%	4.105%	2.858%	1.532%	0.629%	0.201%	0.052%	0.011%	0.002%	0.000%
Expected Loss On Line		**9.389%**	99.950%	95.707%	82.091%	57.152%	30.637%	12.572%	4.030%	1.040%	0.223%	0.041%	0.007%

Parameter Set Distributions	Ground-Up	Stop Loss											
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**64.6%**	**0.356%**	49.846%	4.610%	3.940%	2.847%	1.695%	0.868%	0.412%	0.193%	0.094%	0.048%	0.026%
Expected Loss On Line		**14.240%**	99.691%	92.198%	78.798%	56.937%	33.906%	17.353%	8.233%	3.868%	1.874%	0.955%	0.514%

Difference Parameter Set to Fitted	**0.73%**	**51.67%**	-0.26%	-3.67%	-4.01%	-0.38%	10.67%	38.03%	104.29%	272.02%	742.00%	2246.96%	7799.28%

Mu	Sigma	Freq	Relative Prob														
(0.4500)	0.0990	0.990%	2.787%	1.786%	0.005%	1.393%	0.135%	0.118%	0.081%	0.040%	0.014%	0.004%	0.001%	0.000%	0.000%	0.000%
(0.4500)	0.1045	0.960%	2.703%	1.733%	0.006%	1.351%	0.130%	0.113%	0.078%	0.040%	0.015%	0.004%	0.001%	0.000%	0.000%	0.000%
(0.4500)	0.1155	0.960%	2.703%	1.735%	0.007%	1.350%	0.128%	0.109%	0.077%	0.043%	0.019%	0.006%	0.002%	0.000%	0.000%	0.000%
(0.4500)	0.1100	0.950%	2.675%	1.716%	0.006%	1.337%	0.128%	0.110%	0.076%	0.041%	0.017%	0.005%	0.001%	0.000%	0.000%	0.000%
(0.4500)	0.1210	0.870%	2.449%	1.573%	0.007%	1.223%	0.115%	0.098%	0.069%	0.039%	0.018%	0.007%	0.002%	0.001%	0.000%	0.000%
(0.4500)	0.1265	0.850%	2.393%	1.538%	0.008%	1.195%	0.112%	0.094%	0.067%	0.039%	0.019%	0.008%	0.003%	0.001%	0.000%	0.000%
(0.4500)	0.0935	0.780%	2.196%	1.406%	0.003%	1.098%	0.107%	0.094%	0.064%	0.030%	0.010%	0.002%	0.000%	0.000%	0.000%	0.000%
(0.4500)	0.0880	0.730%	2.055%	1.316%	0.003%	1.028%	0.101%	0.090%	0.060%	0.027%	0.008%	0.002%	0.000%	0.000%	0.000%	0.000%
(0.4172)	0.1155	0.710%	1.999%	1.326%	0.008%	0.999%	0.097%	0.088%	0.067%	0.042%	0.021%	0.008%	0.003%	0.001%	0.000%	0.000%
(0.4172)	0.1100	0.670%	1.886%	1.250%	0.007%	0.943%	0.092%	0.084%	0.064%	0.039%	0.019%	0.007%	0.002%	0.001%	0.000%	0.000%
(0.4172)	0.1265	0.620%	1.745%	1.159%	0.008%	0.872%	0.084%	0.075%	0.058%	0.037%	0.020%	0.009%	0.003%	0.001%	0.000%	0.000%
(0.4500)	0.1320	0.610%	1.717%	1.105%	0.006%	0.857%	0.079%	0.067%	0.048%	0.029%	0.014%	0.006%	0.002%	0.001%	0.000%	0.000%
(0.4500)	0.1375	0.610%	1.717%	1.105%	0.006%	0.857%	0.079%	0.066%	0.048%	0.029%	0.015%	0.007%	0.003%	0.001%	0.000%	0.000%
(0.4839)	0.0935	0.600%	1.689%	1.046%	0.001%	0.844%	0.080%	0.065%	0.037%	0.015%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%
(0.4172)	0.1210	0.600%	1.689%	1.121%	0.007%	0.844%	0.082%	0.073%	0.056%	0.036%	0.018%	0.008%	0.003%	0.001%	0.000%	0.000%
(0.4839)	0.0990	0.570%	1.605%	0.994%	0.001%	0.802%	0.076%	0.060%	0.036%	0.015%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%
(0.4839)	0.1100	0.560%	1.577%	0.978%	0.002%	0.787%	0.073%	0.058%	0.036%	0.017%	0.006%	0.002%	0.000%	0.000%	0.000%	0.000%
(0.4839)	0.1210	0.560%	1.577%	0.979%	0.003%	0.787%	0.071%	0.056%	0.036%	0.018%	0.007%	0.002%	0.001%	0.000%	0.000%	0.000%
(0.4839)	0.1045	0.550%	1.548%	0.960%	0.002%	0.774%	0.072%	0.057%	0.035%	0.015%	0.005%	0.001%	0.000%	0.000%	0.000%	0.000%

Fitted Distributions - LnNormal Exhibit 8

Five Years of Data

	E(X)	Mu	Sigma	Skew
Fitted	64.1%	(0.4500)	0.11	0.5

Fitted Original Distribution	**Ground-Up**	**Stop Loss Contract**											
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**64.1%**	**0.235%**	49.975%	4.785%	4.105%	2.858%	1.532%	0.629%	0.201%	0.052%	0.011%	0.002%	0.000%
Expected Loss On Line		**9.389%**	99.950%	95.707%	82.091%	57.152%	30.637%	12.572%	4.030%	1.040%	0.223%	0.041%	0.007%
Parameter Set Distributions	**Ground-Up**	**Stop Loss**											
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**65.7%**	**0.489%**	49.475%	4.393%	3.773%	2.837%	1.853%	1.121%	0.677%	0.424%	0.279%	0.192%	0.137%
Expected Loss On Line		**19.545%**	98.950%	87.862%	75.456%	56.743%	37.067%	22.414%	13.534%	8.488%	5.583%	3.840%	2.745%
Difference Parameter Set to Fitted	**2.43%**	**108.17%**	-1.00%	-8.20%	-8.08%	-0.72%	20.99%	78.29%	235.82%	716.34%	2407.96%	9339.89%	42089.69%

Mu	**Sigma**	**Freq**	**Relative Prob**													
-45.0%	9.9%	1.190%	1.246%	0.008	0.002%	0.623%	0.061%	0.053%	0.036%	0.018%	0.006%	0.002%	0.000%	0.000%	0.000%	0.000%
-45.0%	10.5%	1.140%	1.194%	0.008	0.002%	0.597%	0.058%	0.050%	0.034%	0.018%	0.007%	0.002%	0.000%	0.000%	0.000%	0.000%
-45.0%	8.3%	1.120%	1.173%	0.008	0.001%	0.586%	0.058%	0.052%	0.035%	0.015%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%
-45.0%	*9.4%*	*1.120%*	*1.173%*	*0.008*	*0.002%*	*0.586%*	*0.057%*	*0.050%*	*0.034%*	*0.016%*	*0.005%*	*0.001%*	*0.000%*	*0.000%*	*0.000%*	0.000%
-45.0%	11.0%	1.100%	1.152%	0.007	0.003%	0.576%	0.055%	0.047%	0.033%	0.018%	0.007%	0.002%	0.001%	0.000%	0.000%	0.000%
-41.7%	9.4%	1.080%	1.131%	0.007	0.003%	0.566%	0.056%	0.052%	0.040%	0.023%	0.009%	0.003%	0.001%	0.000%	0.000%	0.000%
-48.4%	11.0%	1.030%	1.079%	0.007	0.001%	0.539%	0.050%	0.039%	0.024%	0.011%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%
-45.0%	8.8%	1.000%	1.047%	0.007	0.001%	0.524%	0.051%	0.046%	0.031%	0.014%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%
-48.4%	10.5%	0.960%	1.005%	0.006	0.001%	0.502%	0.047%	0.037%	0.023%	0.010%	0.003%	0.001%	0.000%	0.000%	0.000%	0.000%
-41.7%	11.6%	0.940%	0.984%	0.007	0.004%	0.492%	0.048%	0.043%	0.033%	0.021%	0.010%	0.004%	0.001%	0.000%	0.000%	0.000%
-41.7%	11.0%	0.920%	0.964%	0.006	0.004%	0.482%	0.047%	0.043%	0.033%	0.020%	0.009%	0.004%	0.001%	0.000%	0.000%	0.000%
-41.7%	10.5%	0.900%	0.943%	0.006	0.003%	0.471%	0.046%	0.042%	0.033%	0.019%	0.009%	0.003%	0.001%	0.000%	0.000%	0.000%
-45.0%	7.7%	0.880%	0.922%	0.006	0.001%	0.461%	0.046%	0.041%	0.028%	0.011%	0.002%	0.000%	0.000%	0.000%	0.000%	0.000%
-45.0%	11.6%	0.880%	0.922%	0.006	0.002%	0.461%	0.044%	0.037%	0.026%	0.014%	0.006%	0.002%	0.001%	0.000%	0.000%	0.000%
-45.0%	13.2%	0.870%	0.911%	0.006	0.003%	0.455%	0.042%	0.036%	0.026%	0.015%	0.008%	0.003%	0.001%	0.000%	0.000%	0.000%
-45.0%	12.7%	0.830%	0.869%	0.006	0.003%	0.434%	0.041%	0.034%	0.024%	0.014%	0.007%	0.003%	0.001%	0.000%	0.000%	0.000%
-41.7%	8.8%	0.800%	0.838%	0.006	0.002%	0.419%	0.042%	0.039%	0.030%	0.017%	0.006%	0.001%	0.000%	0.000%	0.000%	0.000%
-48.4%	9.4%	0.780%	0.817%	0.005	0.001%	0.408%	0.039%	0.031%	0.018%	0.007%	0.002%	0.000%	0.000%	0.000%	0.000%	0.000%
-48.4%	9.9%	0.780%	0.817%	0.005	0.001%	0.408%	0.038%	0.031%	0.018%	0.008%	0.002%	0.000%	0.000%	0.000%	0.000%	0.000%

Higher Mean
Loss Ratio Distribution

Exhibit 9

			Min	72.5%
	Actual	Actual	Max	75.0%
	LR	Ln(LR)		Loss
1	60.0%	(0.5107)		0.0%
2	70.9%	(0.3445)		0.0%
3	74.4%	(0.2955)		1.9%
4	64.9%	(0.4321)		0.0%
5	60.0%	(0.5113)		0.0%
6	70.9%	(0.3445)		0.0%
7	85.4%	(0.1580)		2.5%
8	77.4%	(0.2568)		2.5%
9	66.9%	(0.4020)		0.0%
10	70.9%	(0.3445)		0.0%
Average	70.2%	(0.3600)	Average	0.692%
Stdev	0.0780	0.1100	Stdev	0.0112
Skew	0.5000		Expected Loss On Line	27.7%
Expected		70.2%		
			Fitted Expected Loss	0.769%
			Fitted Expected Loss On Line	30.775%

Higher Standard Deviation
Loss Ratio Distribution

Exhibit 10

	Actual LR	Actual Ln(LR)
1	51.2%	(0.6695)
2	57.7%	(0.5504)
3	74.7%	(0.2920)
4	53.3%	(0.6299)
5	74.2%	(0.2985)
6	80.8%	(0.2137)
7	62.4%	(0.4724)
8	87.1%	(0.1380)
9	50.0%	(0.6933)
10	58.1%	(0.5424)
Average	64.9%	(0.4500)
Stdev	0.1324	0.2000
Skew	0.5000	
Expected		65.1%

Min	72.5%
Max	75.0%
	Loss
	0.0%
	0.0%
	2.2%
	0.0%
	1.7%
	2.5%
	0.0%
	2.5%
	0.0%
	0.0%
Average	0.887%
Stdev	0.0117
Expected Loss On Line	35.5%
Fitted Expected Loss	0.584%
Fitted Expected Loss On Line	23.379%

Higher Skewness
Loss Ratio Distribution

Exhibit 11

	Actual LR	Actual Ln(LR)		
			Min	72.5%
			Max	75.0%
				Loss
1	61.6%	(0.4842)		0.0%
2	58.7%	(0.5327)		0.0%
3	64.5%	(0.4379)		0.0%
4	56.3%	(0.5746)		0.0%
5	67.4%	(0.3946)		0.0%
6	61.1%	(0.4921)		0.0%
7	81.3%	(0.2071)		2.5%
8	70.9%	(0.3437)		0.0%
9	58.2%	(0.5411)		0.0%
10	61.1%	(0.4921)		0.0%
Average	64.1%	(0.4500)	Average	0.250%
Stdev	0.0747	0.1100	Stdev	0.0079
Skew	1.5000		Expected Loss On Line	10.0%
Expected		64.1%		
			Fitted Expected Loss	0.235%
			Fitted Expected Loss On Line	9.389%

Five Years of Data
Loss Ratio Distribution

Exhibit 12

	Actual LR	Actual Ln(LR)
1	58.1%	(0.5425)
2	67.3%	(0.3961)
3	74.2%	(0.2990)
4	56.6%	(0.5687)
5	64.2%	(0.4436)
6		
7		
8		
9		
10		
Average	64.1%	(0.4500)
Stdev	0.0712	0.1100
Skew	0.5000	
Expected		64.1%

Min	72.5%
Max	75.0%
	Loss
	0.0%
	0.0%
	1.7%
	0.0%
	0.0%
	0.0%
	0.0%
	0.0%
	0.0%
	0.0%
Average	0.165%
Stdev	0.0052
Expected Loss On Line	6.6%
Fitted Expected Loss	0.235%
Fitted Expected Loss On Line	9.389%

Fitted Distributions - LnNormal
Half Steps

Exhibit 13

	E(X)	Mu	Sigma	Skew
Fitted	64.1%	(0.4500)	0.11	0.5

Fitted Original Distribution	**Ground-Up**	**Stop Loss Contract**											
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer	**64.1%**	**0.235%**	49.975%	4.785%	4.105%	2.858%	1.532%	0.629%	0.201%	0.052%	0.011%	0.002%	0.000%
Expected Loss on Line		**9.389%**	99.950%	95.707%	82.091%	57.152%	30.637%	12.572%	4.030%	1.040%	0.223%	0.041%	0.007%
Parameter Set Distributions	***Ground-Up***												
Loss Ratio Minimum Range		**72.5%**	0.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%
Loss Ratio Maximum		**75.0%**	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Expected Loss to Layer Half Steps	**64.537%**	**0.345%**	49.855%	4.617%	3.946%	2.842%	1.676%	0.845%	0.393%	0.181%	0.086%	0.043%	0.022%
Exp Loss Original Steps	**64.536%**	**0.342%**	49.860%	4.622%	3.955%	2.850%	1.677%	0.841%	0.388%	0.176%	0.082%	0.039%	0.020%
Expected Loss On Line Half Steps		**13.790%**	*99.709%*	*92.339%*	*78.922%*	*56.838%*	*33.522%*	*16.893%*	*7.867%*	*3.624%*	*1.719%*	*0.854%*	*0.447%*
Expected Loss On Line Original Steps		**13.693%**	99.719%	92.445%	79.103%	56.994%	33.544%	16.812%	7.754%	3.516%	1.630%	0.788%	0.401%
Comparison with Larger Steps													
Diff in Exp Loss with Original Steps	**0.001%**	**0.002%**	-0.005%	-0.005%	-0.009%	-0.008%	-0.001%	0.004%	0.006%	0.005%	0.004%	0.003%	0.002%
Diff in ELOL's with Original Steps		**0.096%**	-0.010%	-0.106%	-0.182%	-0.156%	-0.022%	0.081%	0.113%	0.108%	0.089%	0.066%	0.046%
% Diff With Original Steps	**0.002%**	**0.703%**	-0.010%	-0.115%	-0.230%	-0.274%	-0.065%	0.480%	1.456%	3.070%	5.437%	8.372%	11.479%

ln x	**y**	**Freq**	**Relative Prob**														
(0.45000)	0.10725	0.0123	0.787%	0.50%	0.002%	0.393%	0.038%	0.033%	0.023%	0.012%	0.005%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.45000)	0.11000	0.0123	0.787%	0.50%	0.002%	0.393%	0.038%	0.032%	0.022%	0.012%	0.005%	0.002%	0.000%	0.000%	0.000%	0.000%	
(0.45000)	0.10450	0.012	0.767%	0.49%	0.002%	0.384%	0.037%	0.032%	0.022%	0.011%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.45000)	*0.10175*	*0.0115*	*0.735%*	*0.47%*	*0.001%*	*0.368%*	*0.036%*	*0.031%*	0.021%	0.011%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.43347)	0.09900	0.011	0.703%	0.46%	0.002%	0.352%	0.034%	0.031%	0.023%	0.012%	0.005%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.46681)	0.12100	0.0109	0.697%	0.44%	0.002%	0.348%	0.032%	0.026%	0.018%	0.010%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.43347)	0.09350	0.0107	0.684%	0.45%	0.001%	0.342%	0.034%	0.031%	0.022%	0.012%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.45000)	0.11275	0.0105	0.671%	0.43%	0.002%	0.336%	0.032%	0.027%	0.019%	0.010%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.46681)	0.11000	0.0104	0.665%	0.42%	0.001%	0.332%	*0.031%*	*0.026%*	*0.017%*	*0.009%*	*0.003%*	*0.001%*	*0.000%*	*0.000%*	*0.000%*	*0.000%*	
(0.46681)	0.10450	0.0103	0.659%	0.42%	0.001%	0.329%	0.031%	0.026%	0.017%	0.008%	0.003%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.45000)	0.09075	0.0103	0.659%	0.42%	0.001%	0.329%	0.032%	0.028%	0.019%	0.009%	0.003%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.45000)	0.11550	0.0103	0.659%	0.42%	0.002%	0.329%	0.031%	0.027%	0.019%	0.010%	0.005%	0.002%	0.000%	0.000%	0.000%	0.000%	
(0.46681)	0.10175	0.0102	0.652%	0.41%	0.001%	0.326%	0.031%	0.026%	0.017%	0.008%	0.003%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.46681)	0.11550	0.0101	0.646%	0.41%	0.001%	0.323%	0.030%	0.025%	0.017%	0.009%	0.003%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.45000)	0.09625	0.01	0.639%	0.41%	0.001%	0.320%	0.031%	0.027%	0.019%	0.009%	0.003%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.43347)	0.10725	0.01	0.639%	0.42%	0.002%	0.320%	0.031%	0.028%	0.020%	0.011%	0.005%	0.002%	0.000%	0.000%	0.000%	0.000%	
(0.45000)	0.09350	0.0099	0.633%	0.41%	0.001%	0.316%	0.031%	0.027%	0.018%	0.009%	0.003%	0.001%	0.000%	0.000%	0.000%	0.000%	
(0.43347)	0.09075	0.0099	0.633%	0.41%	0.001%	0.317%	0.031%	0.028%	0.021%	0.011%	0.004%	0.001%	0.000%	0.000%	0.000%	0.000%	

Figure 1

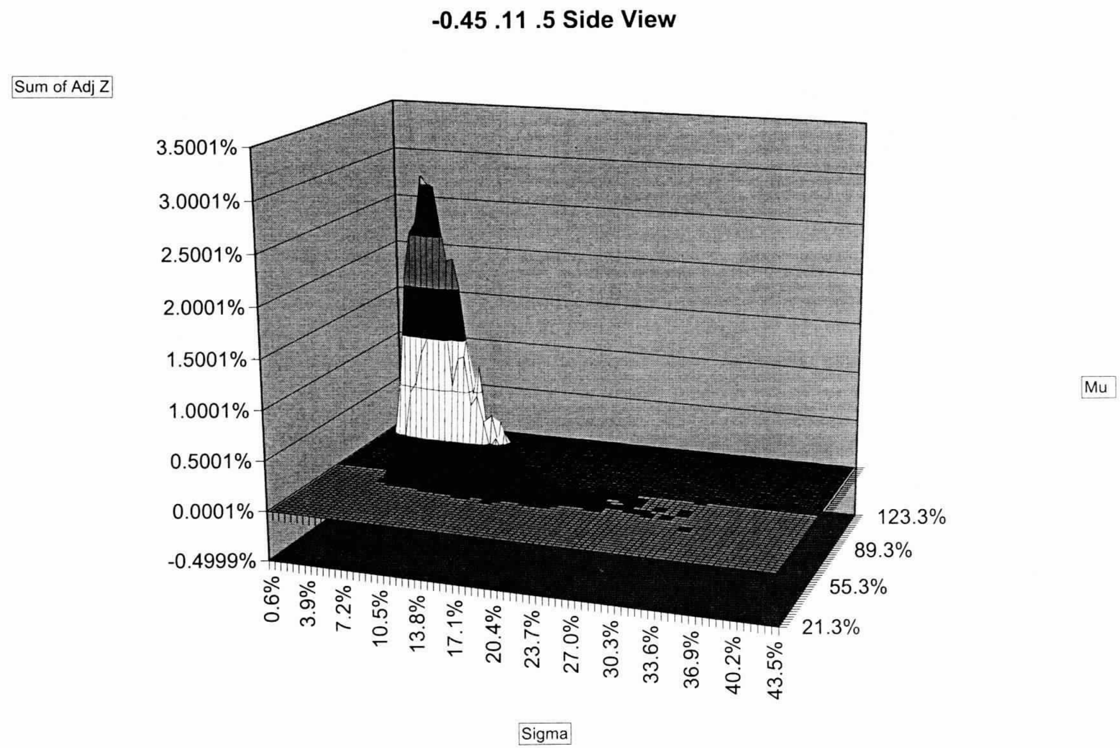

-0.45 .11 .5 Side View
Sum of Adj Z
3.5001%
3.0001%
2.5001%
2.0001%
1.5001%
1.0001%
0.5001%
0.0001%
-0.4999%
0.6%
3.9%
7.2%
10.5%
13.8%
17.1%
20.4%
23.7%
27.0%
30.3%
33.6%
36.9%
40.2%
43.5%
Sigma
123.3%
89.3%
55.3%
21.3%
Mu

Figure 2

-0.45 .11 .05 Top View

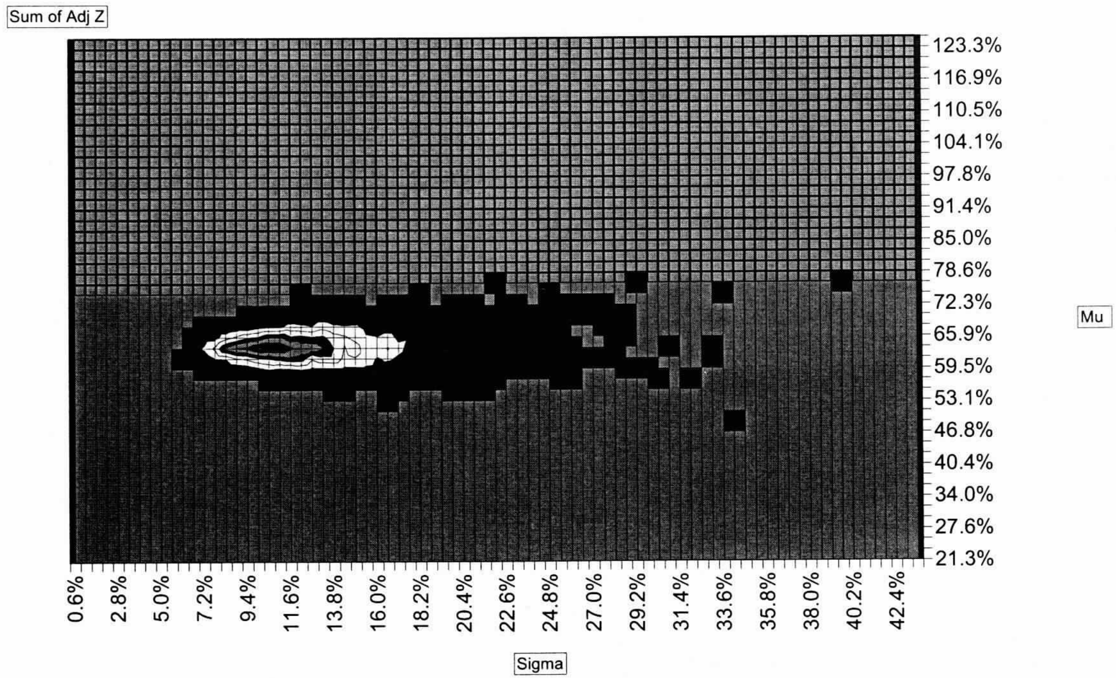


Figure 3

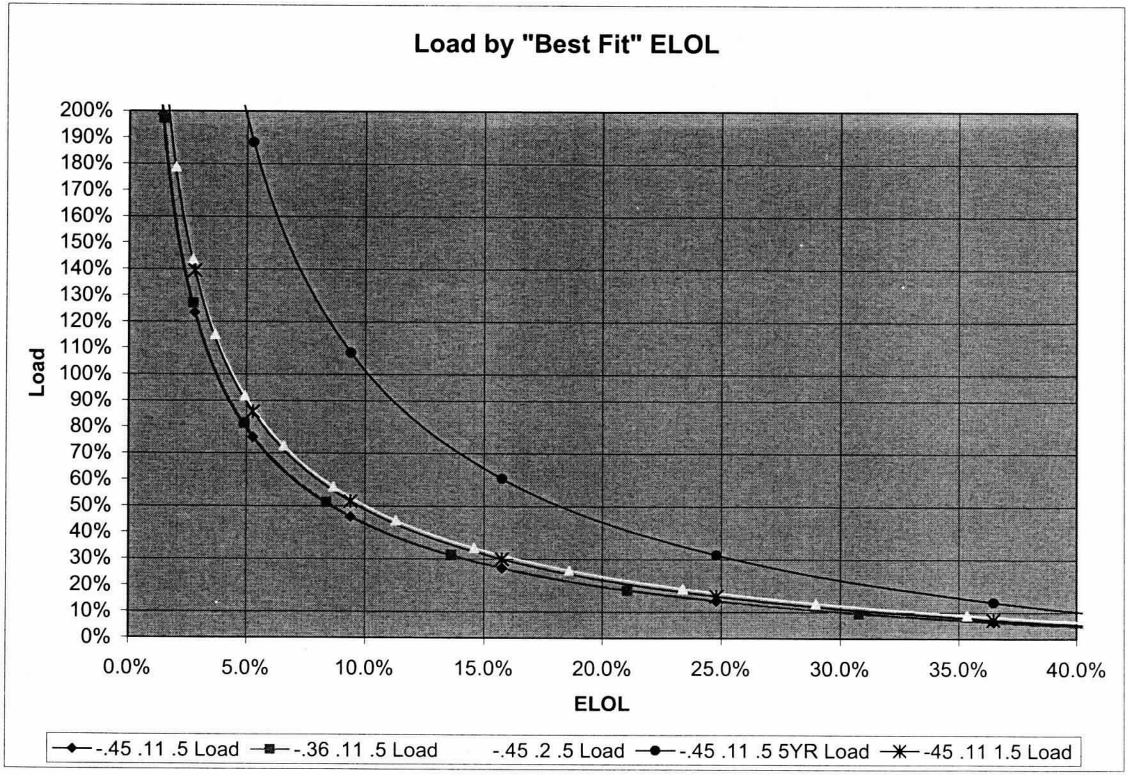

Load by "Best Fit" ELOL
200%
190%
180%
170%
160%
150%
140%
130%
120%
110%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Load
0.0%
5.0%
10.0%
15.0%
20.0%
25.0%
30.0%
35.0%
40.0%
ELOL
-.45 .11 .5 Load
-.36 .11 .5 Load
-.45 .2 .5 Load
-.45 .11 .5 5YR Load
-45 .11 1.5 Load

Figure 4

-0.36 0.11 0.5 Side View

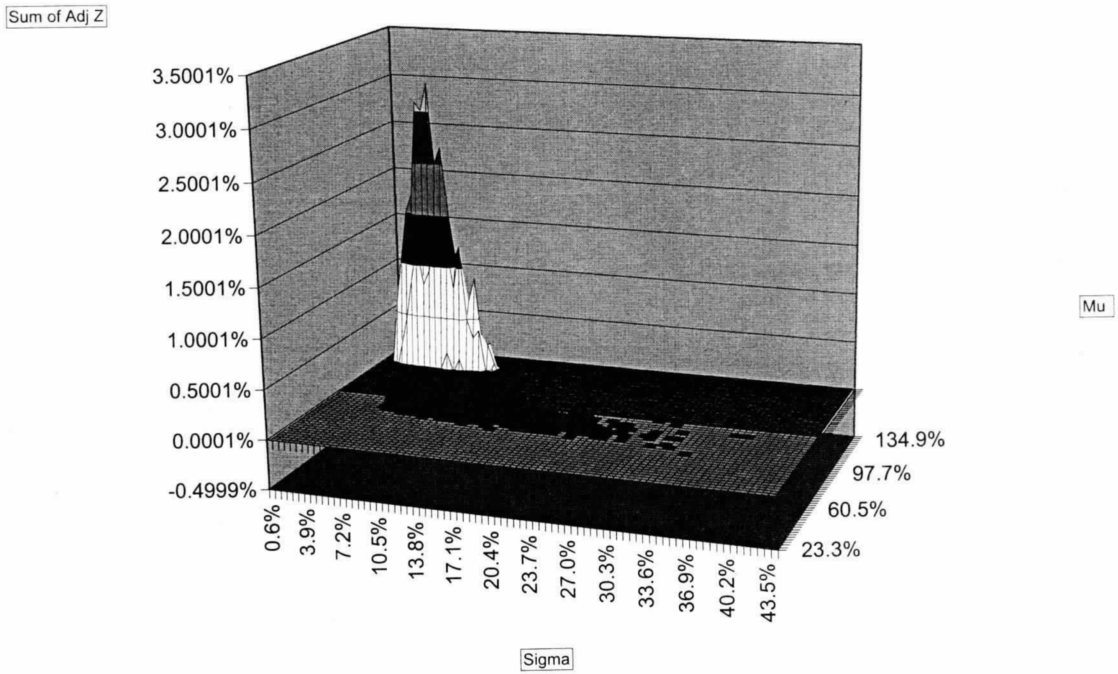


Figure 5

-0.36 0.11 0.5 Top View

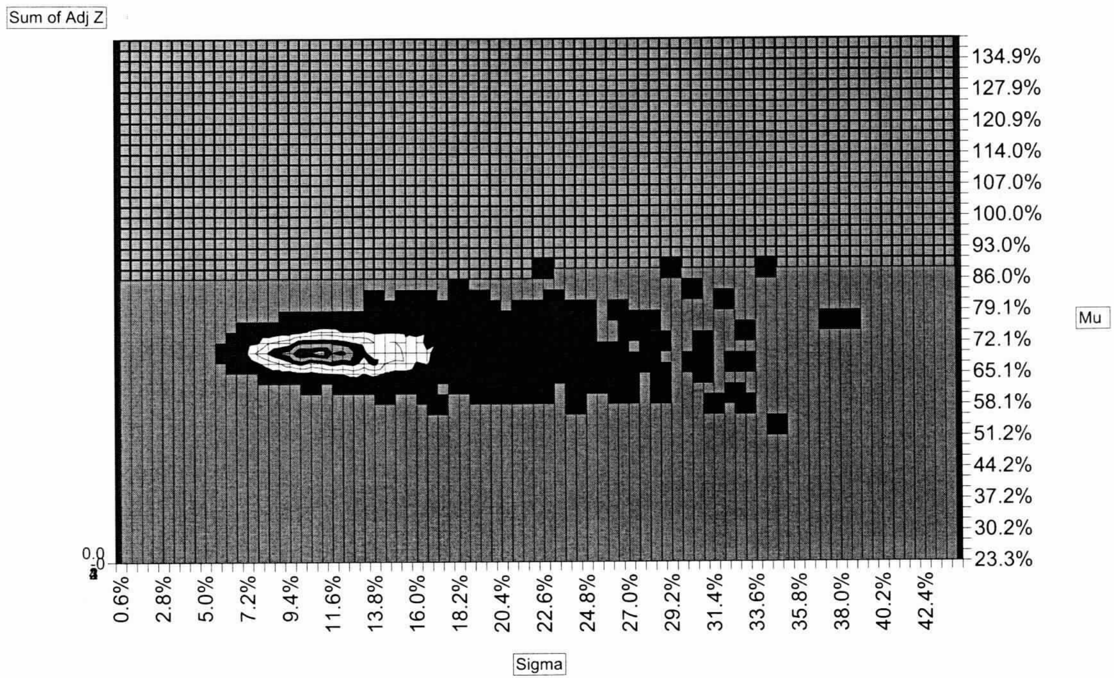


Figure 6

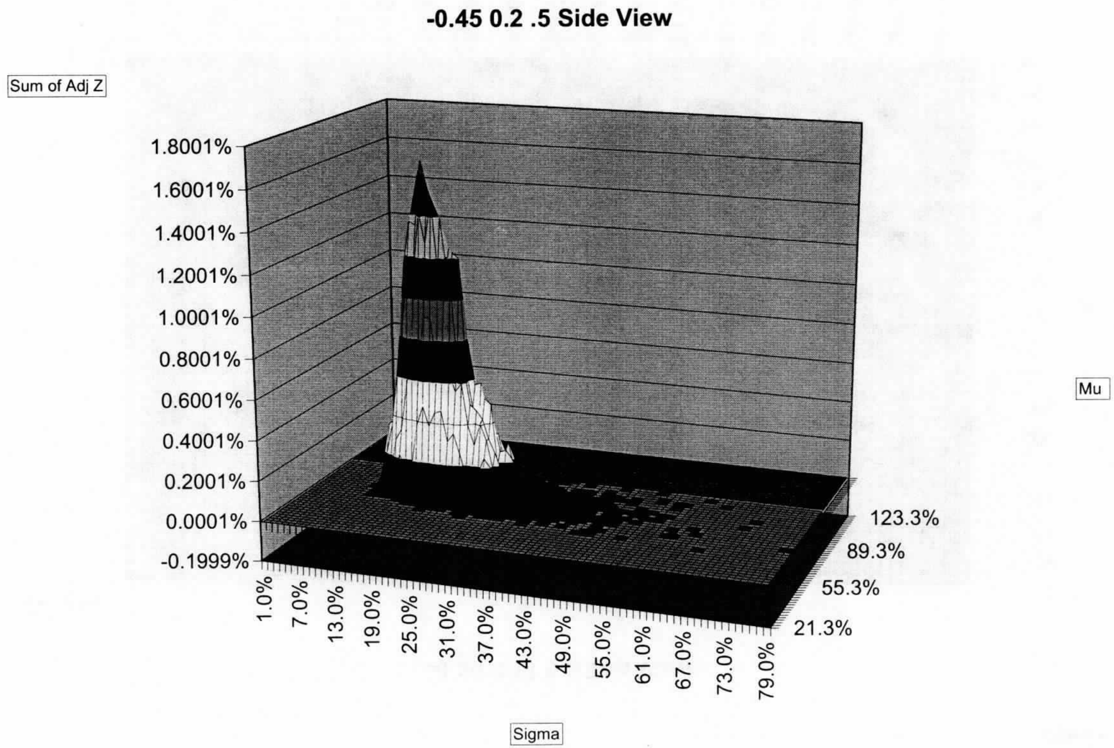

-0.45 0.2 .5 Side View
Sum of Adj Z
1.8001%
1.6001%
1.4001%
1.2001%
1.0001%
0.8001%
0.6001%
0.4001%
0.2001%
0.0001%
-0.1999%
1.0%
7.0%
13.0%
19.0%
25.0%
31.0%
37.0%
43.0%
49.0%
55.0%
61.0%
67.0%
73.0%
79.0%
Sigma
123.3%
89.3%
55.3%
21.3%
Mu

Figure 7

-0.45 0.2 0.5 Top View

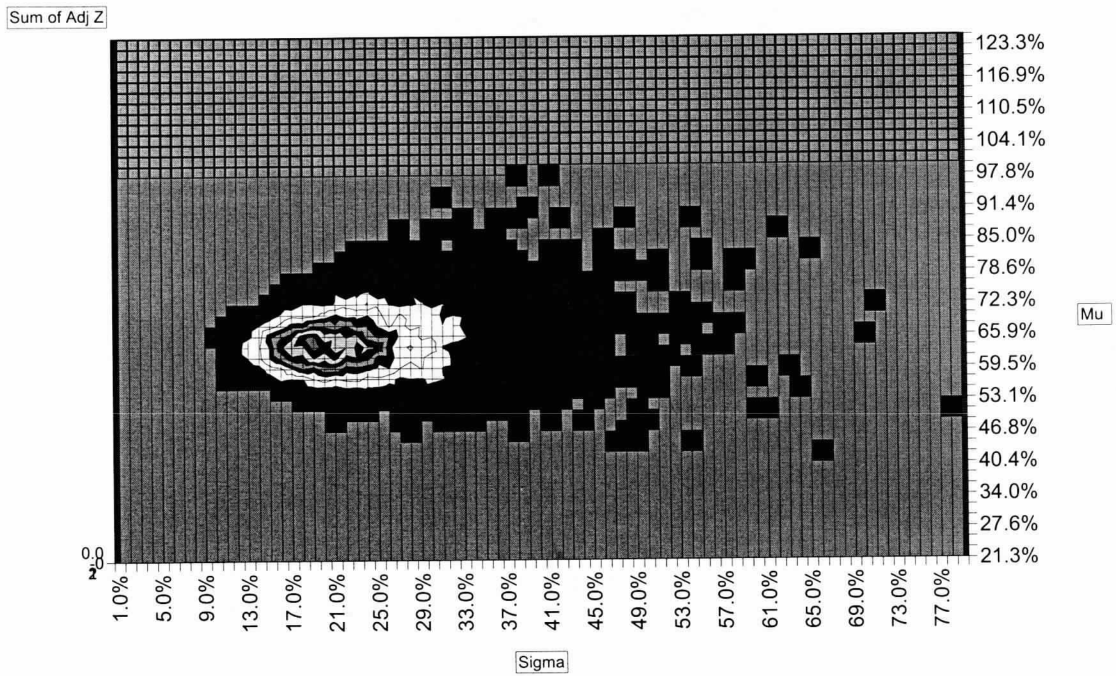


Figure 8

-0.45 0.11 1.5 Side View

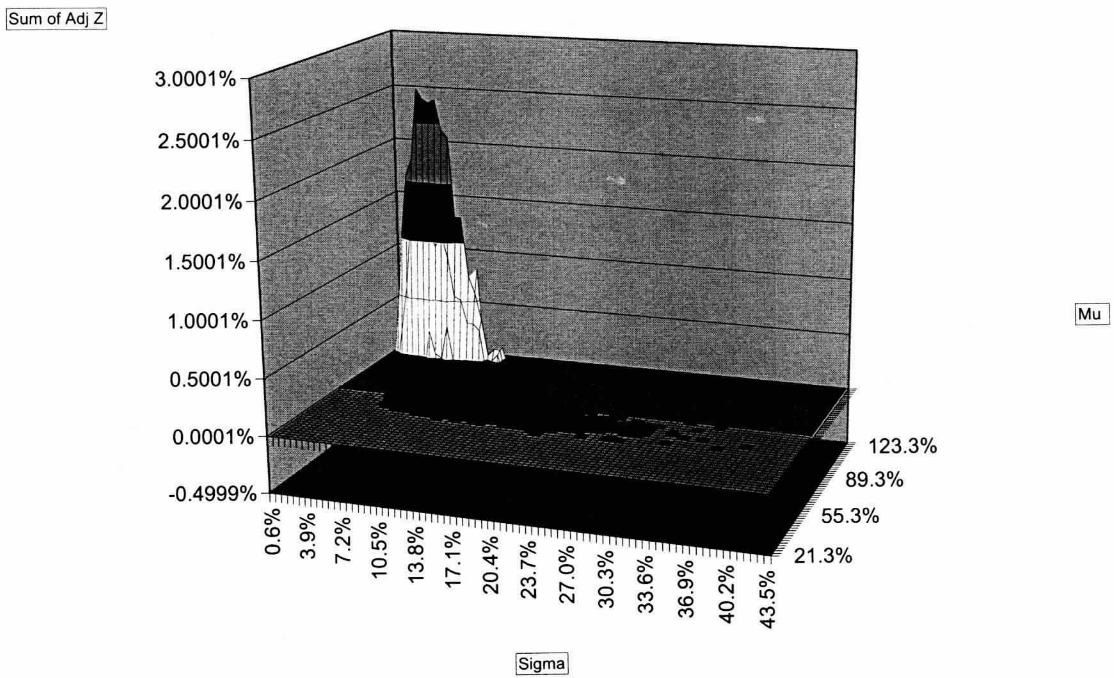
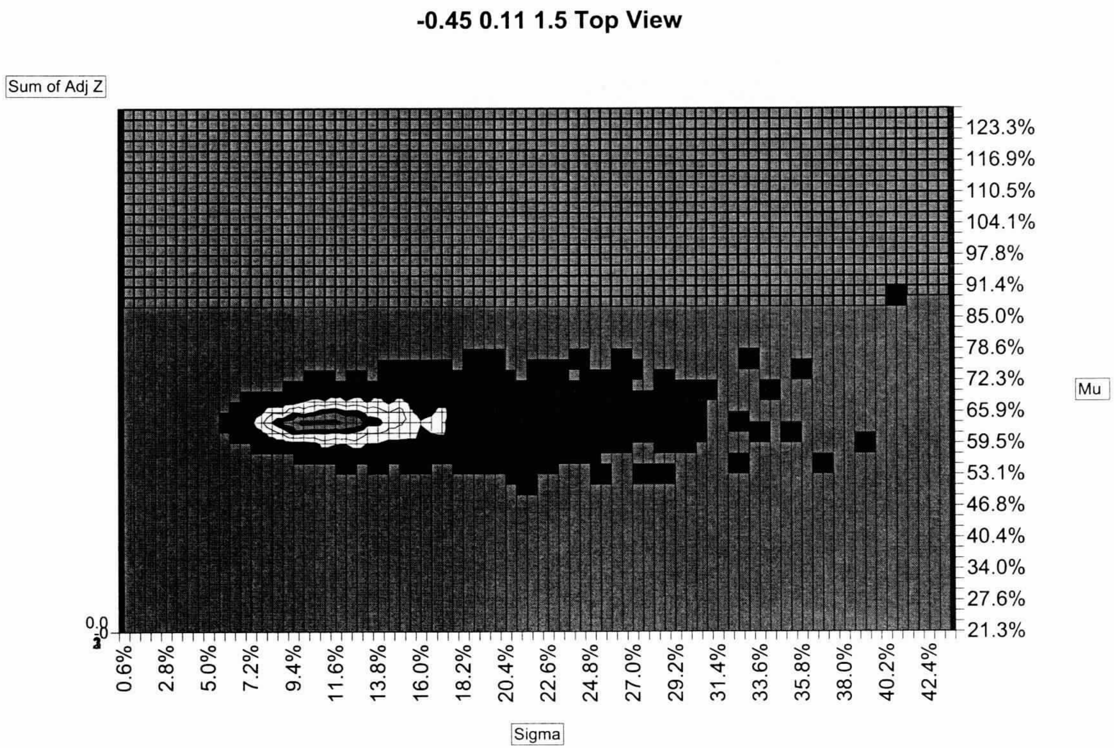


Figure 9



-0.45 0.11 1.5 Top View
Sum of Adj Z
123.3%
116.9%
110.5%
104.1%
97.8%
91.4%
85.0%
78.6%
72.3%
65.9%
59.5%
53.1%
46.8%
40.4%
34.0%
27.6%
21.3%
Mu
0.6%
2.8%
5.0%
7.2%
9.4%
11.6%
13.8%
16.0%
18.2%
20.4%
22.6%
24.8%
27.0%
29.2%
31.4%
33.6%
35.8%
38.0%
40.2%
42.4%
Sigma

Figure 10

-0.45 0.11 0.5 5Yr Side View

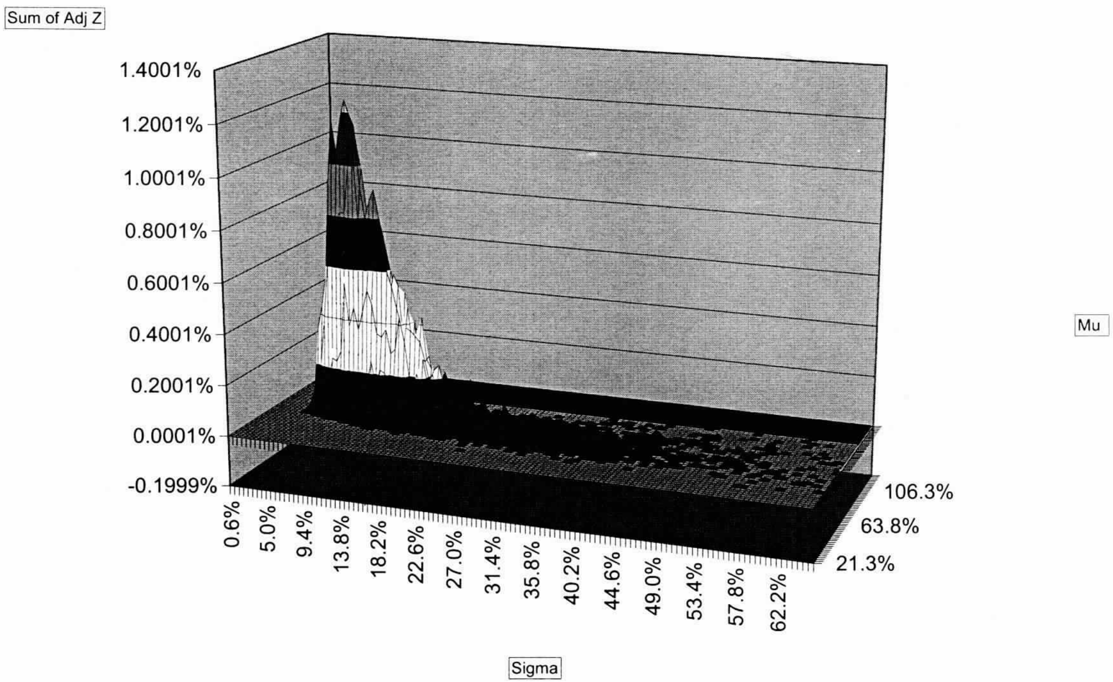


Figure 11

-0.45 0.11 0.5 5Yr Top View