DISCUSSION BY HOWARD C. MAHLER

Robert Bender develops an equation for the relationship between the aggregate incurred loss ratio and the aggregate retrospective return premium. This discussion will illustrate this relationship using data for groups of actual insureds.

The data examined in each case are workers' compensation Unit Statistical Plan data at third report from one state.[1] It should be noted that, commonly, retrospective rating involves exposure in more than one state and/or exposure to lines of insurance in addition to workers' compensation. Also, retrospective rating plans commonly remain open beyond third report.[2] Thus the results shown here merely illustrate types of expected behavior, rather than the particular behavior that will occur in individual situations.

In each case, a particular retrospective rating plan was examined for a group of risks.[3] The retrospective premium was calculated for each risk based on its losses. The losses used were the reported losses multiplied by a factor chosen to adjust the overall loss ratio to a given value.[4] For example, if the reported loss ratio for the group of risks was 50 percent and the desired overall loss ratio was 60 percent, then each risk's losses were multiplied by $60/50 = 1.2$. Thus we retain the shape of the reported loss ratio distribution, but adjust the mean by

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[1] The data available was for 1988 at third report for all Massachusetts workers' compensation risks. Subsets of the data are examined by size of risk and by voluntary versus assigned risks.

[2] For workers' compensation incurred losses (paid losses plus case reserves), there is generally upward development on average beyond third report. Not only would this raise the mean incurred loss ratio, it would also change the distribution of loss ratios around the mean. The coefficient of variation usually increases; i.e., the distribution gets more dispersed.

[3] No attempt was made to select retrospective rating plans that are in balance. (Each plan will be in balance for some incurred loss ratio, but that is not the focus of Bender's paper.)

[4] This could have been accomplished by multiplying the reported standard premium rather than the reported losses by a factor.

adjusting the overall scale. This adjustment to the loss ratios was made in order to yield average loss ratios ranging from 30 percent to 120 percent, to see how the total retrospective premium responds to changing loss ratios.

Exhibit 1 shows the results for a retrospective rating plan applied to all assigned risks with $150,000 or more in standard premium. The particular plan parameters are those used in the Massachusetts Assigned Risk Rating Program (MARRP). It should be noted that this plan was specifically designed *not* to be in balance, but rather to generate extra revenue for the assigned risk pool (in contrast to guaranteed cost policies).[5] However, this issue is beyond the scope of this review.[6]

As can be seen in Exhibit 1, the responsiveness of the MARRP depends on the incurred loss ratio. Bender defines the "slope" as the change in retrospective return premium per change in incurred loss ratio.[7] The larger the magnitude of the slope, the more responsive the plan.[8] The slopes for MARRP range from about $-\frac{1}{3}$ to $-\frac{3}{4}$ depending on the loss ratio.

For a given loss ratio distribution, the slope depends chiefly upon the "swing limits" of the plan. For those risks between the maximum and minimum premiums, the slope is minus the tax multiplier (*TM*) times the loss conversion factor (*LCF*). For risks either above the maximum or below the minimum premium, the slope is zero. The

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[5] No consideration has been given here to potential collection problems that may result with a mandatory assigned risk retrospective rating program such as MARRP, which was in effect during 1993.

[6] This subject is discussed, for example, in William R. Gillam's discussion of David Skurnick's paper, "The California Table L," *PCAS* 1993.

[7] Since slope is defined in terms of return premiums, it is negative.

[8] It should be noted that not only are retrospective rating plans sensitive to individual loss experience. So is the standard premium which forms the starting point of retrospective rating. The standard premium includes the impact of the (prospective) experience rating plan. However, the standard premium is sensitive to prior years' losses, while the retrospective rating plan uses the loss experience on the policy to which it applies.

average slope for the whole set of risks examined is a weighted average of these two quantities. As the swing of the plan becomes wider due to higher maximums and lower minimums, more risks contribute $-TM \times LCF$ to the slope rather than zero. Thus, the wider the swing limits, the greater the magnitude of the slope.

The slope also increases in magnitude as either the tax multiplier or loss conversion factor is increased.

Exhibit 2 displays the results of a retrospective rating plan similar to that examined by Bender. The risks are voluntary risks with annual premium between $50,000 and $75,000. For these relatively small risks, the selected plan is relatively unresponsive. The slopes are very similar to those shown in Bender's analysis of a plan with (approximately) these parameters.

Part of the reason for the low responsiveness is the choice of plan parameters. However, part of the reason is that for these smaller risks (for retrospective rating), the loss ratio distribution is more dispersed.[9] Therefore, relatively few risks are between the maximum and minimum premiums.[10] If the loss ratio distribution were more compact, there would be generally more risks between the maximum and minimum premiums, resulting in a slope of larger magnitude.

This can be seen in Exhibit 3, where the same plan as in Exhibit 2 is examined, but for larger risks. This plan is more responsive for risks between $250,000 and $500,000 than for risks between $50,000 and $75,000.[11] This is due to the larger percentage of risks between the minimum and maximum premiums.

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[9] In Bender's analysis, the dispersion of the loss ratio distribution is quantified via Table M.

[10] For a 60 percent loss ratio, only 15 percent of the risks are between the minimum and maximum premiums.

[11] This is not to imply that the same maximum, minimum, and basic premium would be appropriate for both sizes of risk. All retrospective rating plan parameters have been chosen solely for illustrative purposes.

For these same voluntary risks between $250,000 and $500,000, Exhibit 4 shows the results for a more responsive plan.

The retrospective premiums for the plans examined in Exhibits 1 through 4 are graphed in Figures 1 through 4, respectively. Similarly, Figures 5 through 8, respectively, graph the percent of policies at the minimum and the maximum premiums. One can see how the percentage of risks between the minimum and the maximum varies by loss ratio, as well as between the different examples. Generally, the larger this percentage, the more responsive the plan.

Conclusion

The general ideas in Bender's paper have been illustrated utilizing a particular set of actual data. The examples provided in Bender's paper were relatively unresponsive retrospective rating plans due to the size of the risks and particular plans he was considering.

The methodology in Bender's paper is particularly useful when there is a lack of sufficient data to allow the type of calculations performed in this discussion. The results of using the methodology should not be very sensitive to the precise details of how the table of insurance charges, Table M, has been constructed. Provided Table M is consistent with a reasonable overall estimate of the number of risks at the maximum and minimum premiums, the Bender methodology will provide good estimates of the responsiveness of the retrospective plans.

EXHIBIT 1

MARRP PLAN PARAMETERS

Incurred Loss Ratio (Third Report)	Percent of Risks at Maximum Premium	Percent of Risks at Minimum Premium	Ratio of Retrospective Premium to Standard Premium	Slope*
120%	46%	17%	138.7%	
110	42	18	135.2	-37%
100	40	19	131.3	-42
90	35	21	126.8	-49
80	30	24	121.6	-55
70	24	27	115.8	-62
60	18	32	109.2	-70
50	12	38	101.8	-76
40	9	43	94.1	-77
30	5	55	86.5	

Maximum Premium = 175%
Minimum Premium = 75%
Tax Multiplier = 1.15
Loss Conversion Factor = 1.1
Basic Premium Factor = 35%

Data: All assigned risks with $150,000 or more in Massachusetts workers' compensation standard premium (907 risks).

*Per Bender, the slope is the change in retrospective *return* premium per change in incurred loss ratio.

EXHIBIT 2

SMALL VOLUNTARY RISKS

Incurred Loss Ratio (Third Report)	Percent of Risks at Maximum Premium	Percent of Risks at Minimum Premium	Ratio of Retrospective Premium to Standard Premium	Slope*
120%	32%	57%	100.6%	
110	31	59	99.4	-12%
100	30	61	98.3	-12
90	28	62	97.0	-14
80	25	63	95.5	-16
70	23	65	93.8	-16
60	20	65	92.3	-16
50	18	68	90.6	-23
40	15	71	87.8	-33
30	11	77	84.0	

Maximum Premium = 135%
Minimum Premium = 75%
Tax Multiplier = 1.05
Loss Conversion Factor = 1.1
Basic Premium Factor = 30%

Data: All voluntary risks with between $50,000 and $75,000 in Massachusetts workers' compensation standard premium (519 risks).

*Per Bender, the slope is the change in retrospective *return* premium per change in incurred loss ratio.

EXHIBIT 3

LARGE VOLUNTARY RISKS

Incurred Loss Ratio (Third Report)	Percent of Risks at Maximum Premium	Percent of Risks at Minimum Premium	Ratio of Retrospective Premium to Standard Premium	Slope*
120%	51%	22%	113.4%	
110	49	25	111.6	-21%
100	46	25	109.3	-24
90	43	29	106.8	-27
80	37	32	103.9	-34
70	30	34	100.0	-41
60	24	40	95.8	-44
50	17	49	91.2	-49
40	10	56	86.0	-52
30	6	69	80.8	

Maximum Premium = 135%
Minimum Premium = 75%
Tax Multiplier = 1.05
Loss Conversion Factor = 1.1
Basic Premium Factor = 30%

Data: All voluntary risks with between $250,000 and $500,000 in Massachusetts workers' compensation standard premium (264 risks).

*Per Bender, the slope is the change in retrospective *return* premium per change in incurred loss ratio.

EXHIBIT 4

MORE RESPONSIVE PLAN

Incurred Loss Ratio (Third Report)	Percent of Risks at Maximum Premium	Percent of Risks at Minimum Premium	Ratio of Retrospective Premium to Standard Premium	Slope*
120%	46%	16%	114.2%	
110	43	16	111.3	-31%
100	39	17	108.0	-37
90	34	18	103.9	-45
80	29	18	99.0	-52
70	23	19	93.5	-59
60	17	25	87.2	-67
50	12	28	80.1	-76
40	8	33	72.0	-82
30	5	47	63.8	

Maximum Premium = 150%
Minimum Premium = 50%
Tax Multiplier = 1.05
Loss Conversion Factor = 1.1
Basic Premium Factor = 25%

Data: All voluntary risks with between $250,000 and $500,000 in Massachusetts workers' compensation standard premium (264 risks).

*Per Bender, the slope is the change in retrospective *return* premium per change in incurred loss ratio.

FIGURE 1

PLAN PER EXHIBIT 1, ASSIGNED RISKS: OVER $150,000
175 MAX AND 75 MIN

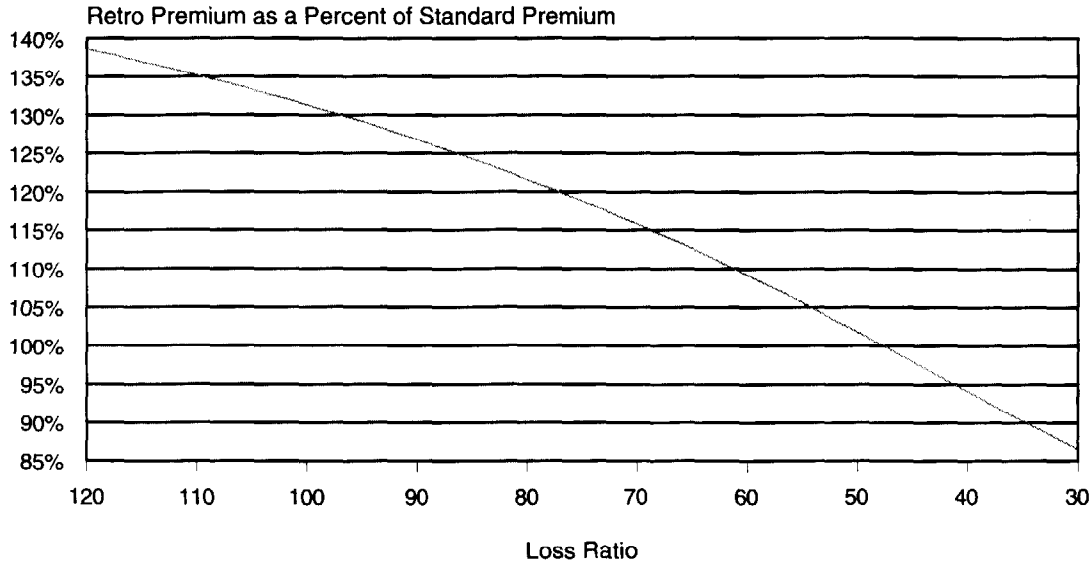

FIGURE 2

PLAN PER EXHIBIT 2, VOLUNTARY RISKS: $50,000 TO $75,000
135 MAX AND 75 MIN

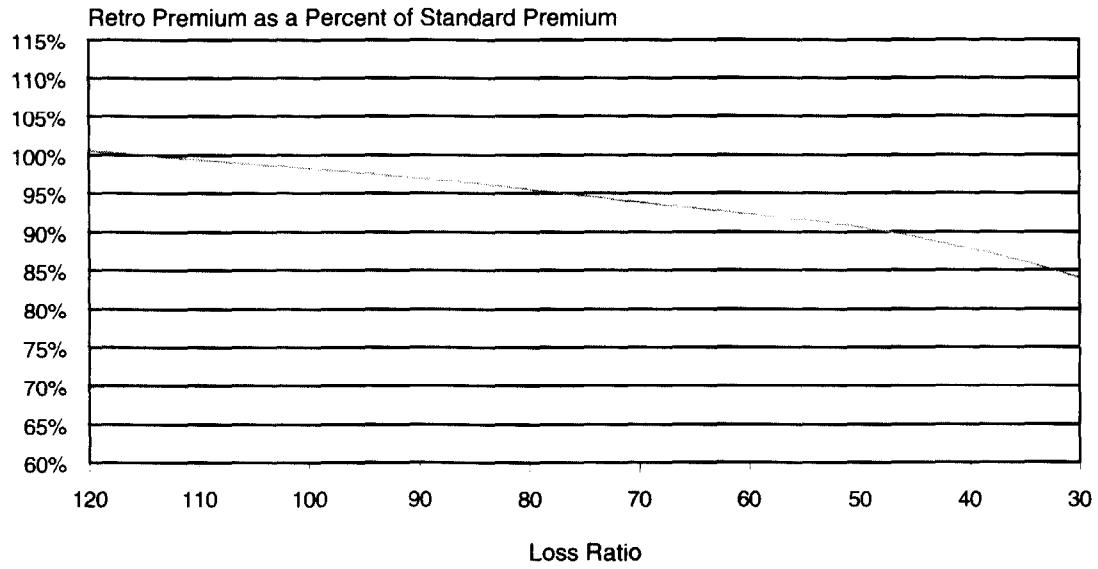

FIGURE 3

PLAN PER EXHIBIT 3, VOLUNTARY RISKS: $250,000 TO $500,000
135 MAX AND 75 MIN

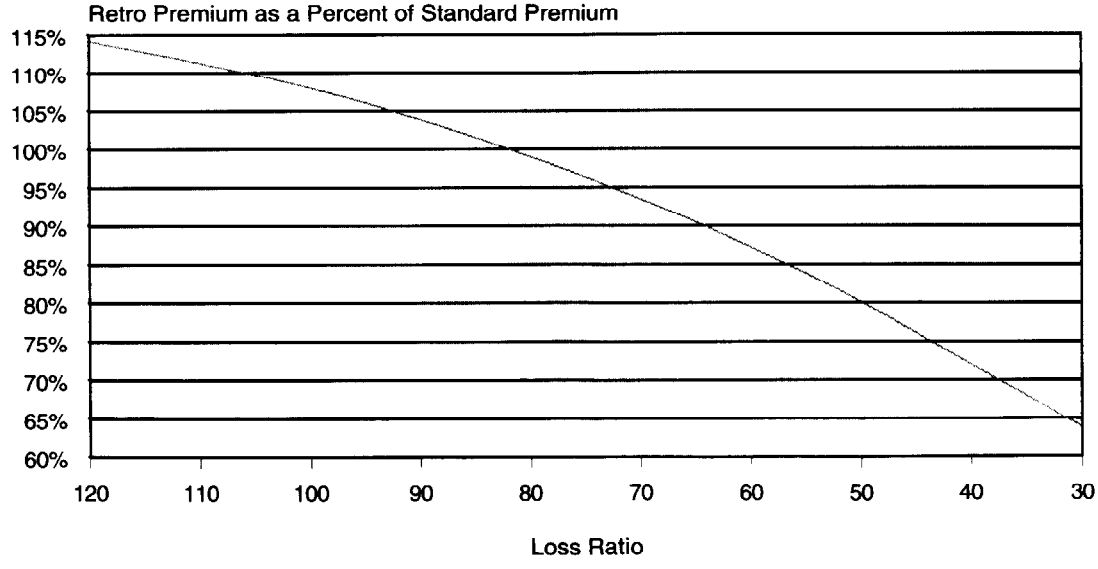

FIGURE 4

PLAN PER EXHIBIT 4, VOLUNTARY RISKS: $250,000 TO $500,000
150 MAX AND 50 MIN

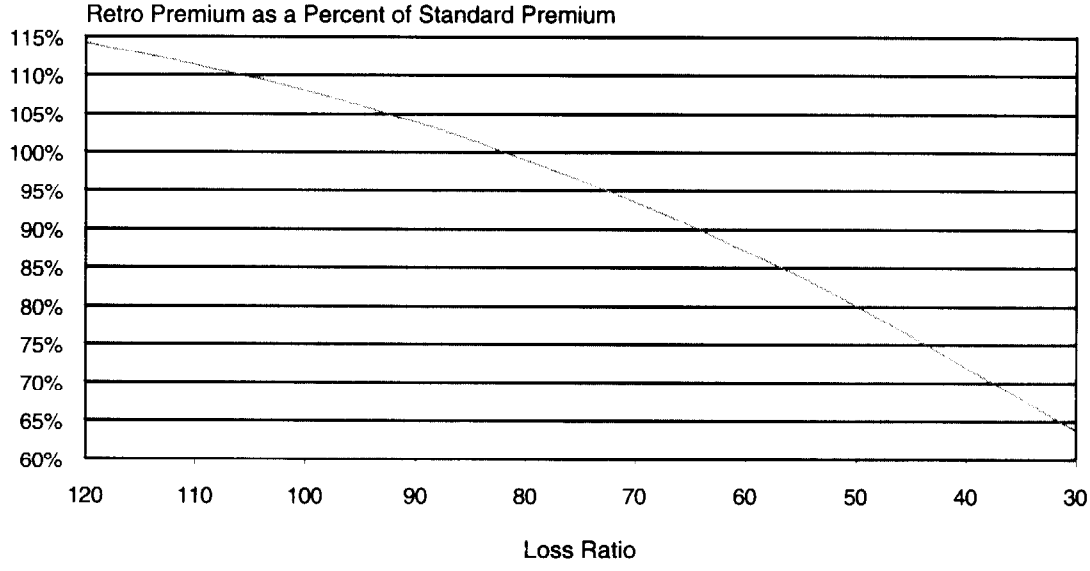

FIGURE 5

PLAN PER EXHIBIT 1, ASSIGNED RISKS: OVER $150,000
175 MAX AND 75 MIN

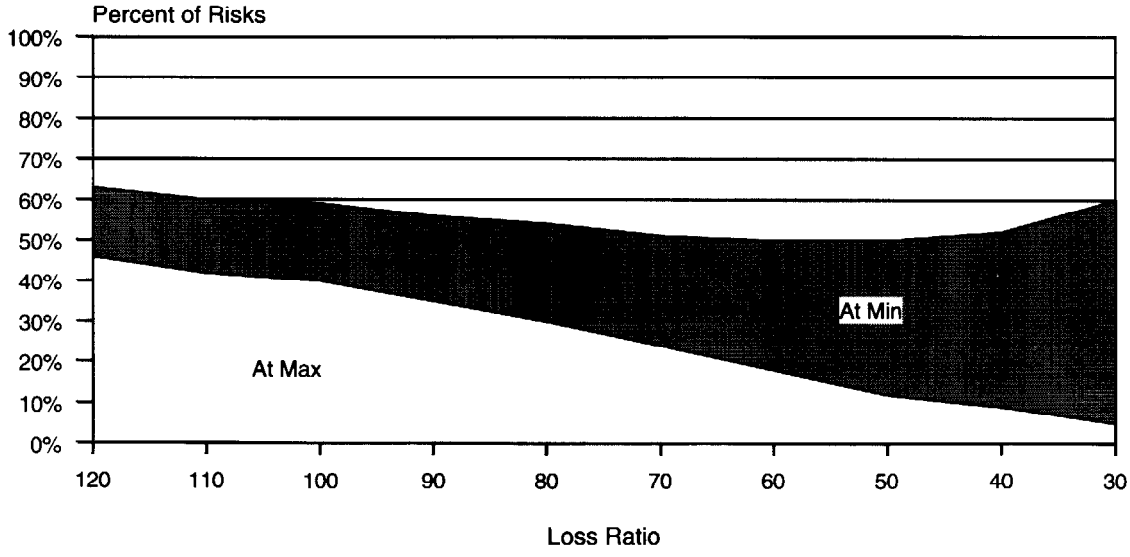

FIGURE 6

PLAN PER EXHIBIT 2, VOLUNTARY RISKS: $50,000 TO $75,000
135 MAX AND 75 MIN

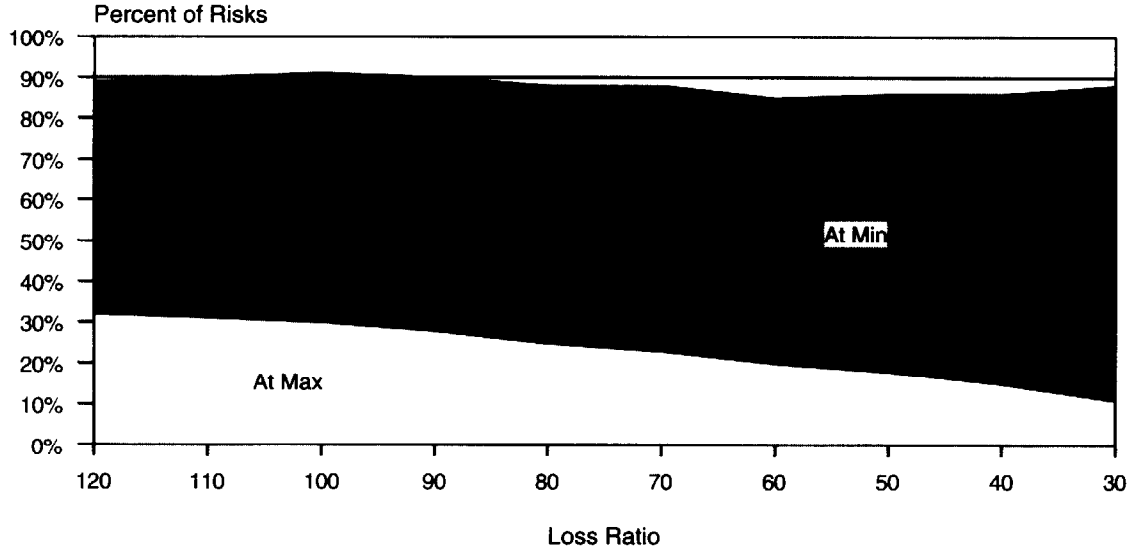

FIGURE 7

PLAN PER EXHIBIT 3, VOLUNTARY RISKS: $250,000 TO $500,000
135 MAX AND 75 MIN

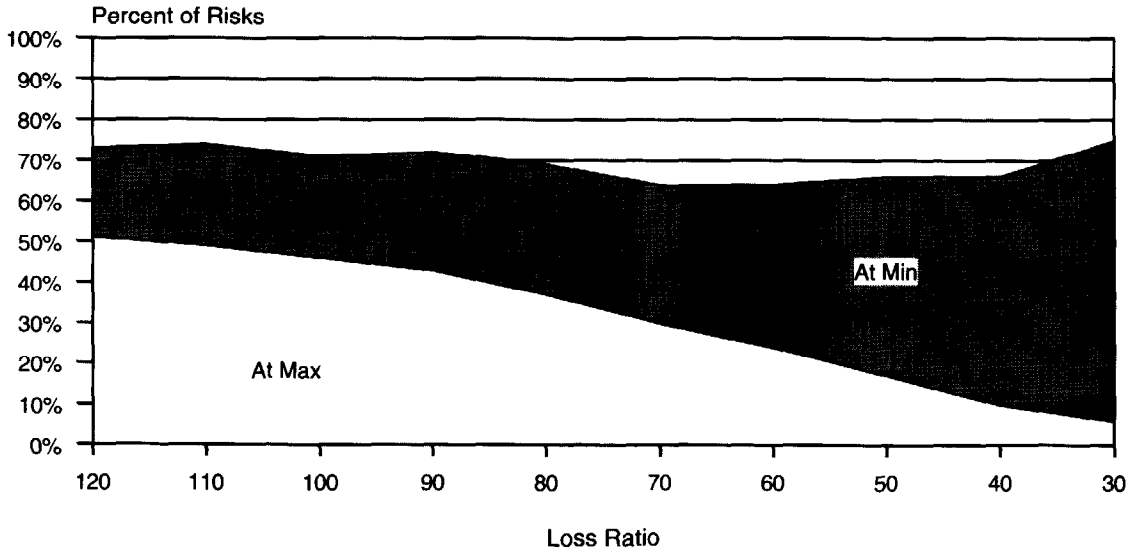

FIGURE 8

PLAN PER EXHIBIT 4, VOLUNTARY RISKS: $250,000 TO $500,000
150 MAX AND 50 MIN