The Effect of Residual Market Depopulation
on Loss Ratio
by Christopher J. Poteet

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Introduction

The workers compensation residual market has been shrinking in size. Now that rate adequacy has improved, insurance carriers are willing to voluntarily write some of the risks which in previous years would have had to seek coverage in the residual market. The loss ratios for the risks leaving the residual market are, on average, higher than for the risks which are already written in the voluntary market, but lower than for the risks which remain in the residual market. This depopulation has the effect of increasing the loss ratio for the remaining group of residual market risks and increasing the loss ratio for the new group of voluntarily written risks. This study quantifies the effect of depopulation on the loss ratio of the residual market.

Data

A study of the impact of depopulation on loss ratios requires that market status and loss experience be tracked over time on a risk by risk basis. This is possible using statistical plan data. Eight states demonstrated consistent significant depopulation for the latest policy years of data available from this database (1992, 1993, 1994). Risk Identification Number is used to identify risks because this number does not change over time. Unfortunately, this excludes the small risks because only experience rated risks (those with premiums greater than $5000) have a risk ID. Fortunately, experience rated risks account for most of the data. Risks that were in the database for all three years were included in the study. Losses are first report undeveloped paid plus case reserve unlimited losses. Premium is manual premium times experience mod. This does not include premium credits or ARAP surcharge. It is before premium discounts (or removal of discounts for assigned risks) and before expense constant. The data is attached.

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This study takes an empirical look at the average loss ratio for the risks in the residual market. It does not make any assumption about the distribution of loss ratios.

For a given particular state, risks were grouped according to market status in each of the three years. For example, AAV refers to the group of risks which were assigned to the residual market in 1992 and 1993 and found coverage in the voluntary market in 1994.

Risk Groups

Year

1992	1993	1994
A	A	A
A	A	V
A	V	A
A	V	V
V	A	A
V	A	V
V	V	A
V	V	V

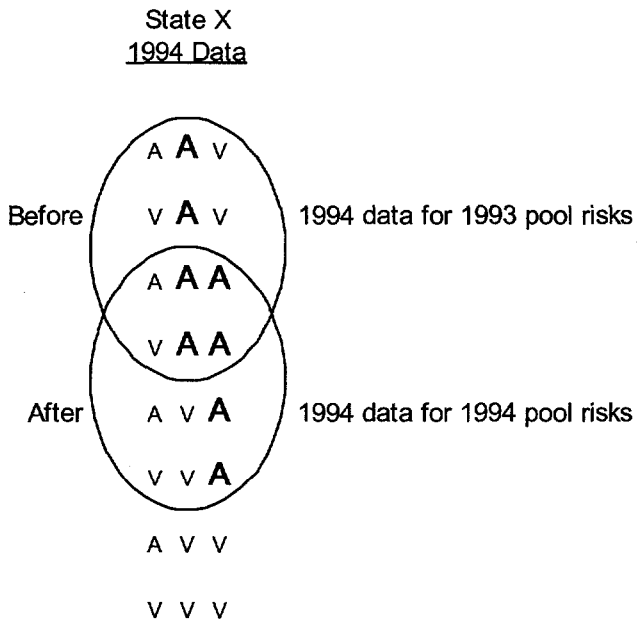Risks grouped according to market status in each year

A = Assigned Risk
V = Voluntary

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Risks were further grouped according to market status in 1992 versus market status in 1993. The "Before" group is the group of risks which were assigned risks in 1992. The "After" group is the group of risks which were assigned risks in 1993. Loss ratios were determined for policy year 1993 experience for each of these groups. Using data from just one year eliminates any change in experience, trend, changes in rate adequacy, and effects of changes in cost containment. This regrouping of the data helps to isolate the impact of depopulation.
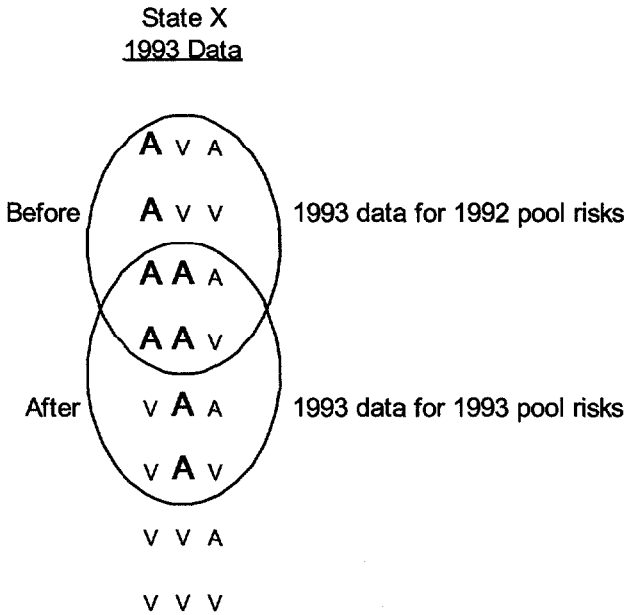
State X
1993 Data

The State X, 1993 surcharge was added in for the AVA and AVV groups to determine what the data would be if they were still in the residual market (pool). The surcharge was taken out for the VAA and VAV groups to determine what the data would be if they were still in the voluntary market.

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Risks were also grouped according to market status in 1993 versus market status in 1994. The "Before" group is the group of risks which were assigned risks in 1993. The "After" group is the group of risks which were assigned risks in 1994. Loss ratios were determined for policy year 1994 experience for each of these groups.

State X
1994 Data

Before   A **A** v
              v **A** v   1994 data for 1993 pool risks
              A **A A**
              v **A A**
After   A v **A**   1994 data for 1994 pool risks
              v v **A**

              A V V

              V V V

The State X, 1994 surcharge was added in for the AAV and VAV groups to determine what the data would be if they were still in the residual market (pool). The surcharge was taken out for the AVA and VVA groups to determine what the data would be if they were still in the voluntary market.

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<u>Initial Analysis</u>

The residual market loss ratio versus residual market share, before and after depopulation, was graphed for each state based on policy year 1993 data. An arrow was drawn connecting the "before" data point to the "after" data point (arrowhead). This was also done with 1994 data. The slope of each resultant line segment is the change in residual market loss ratio for the given change in residual market share. If the slopes were similar, then this could be used to draw a general conclusion about the effect of depopulation on the loss ratio for the countrywide residual market pool. Not all slopes are similar, however. There is a curved pattern evident in the graph.

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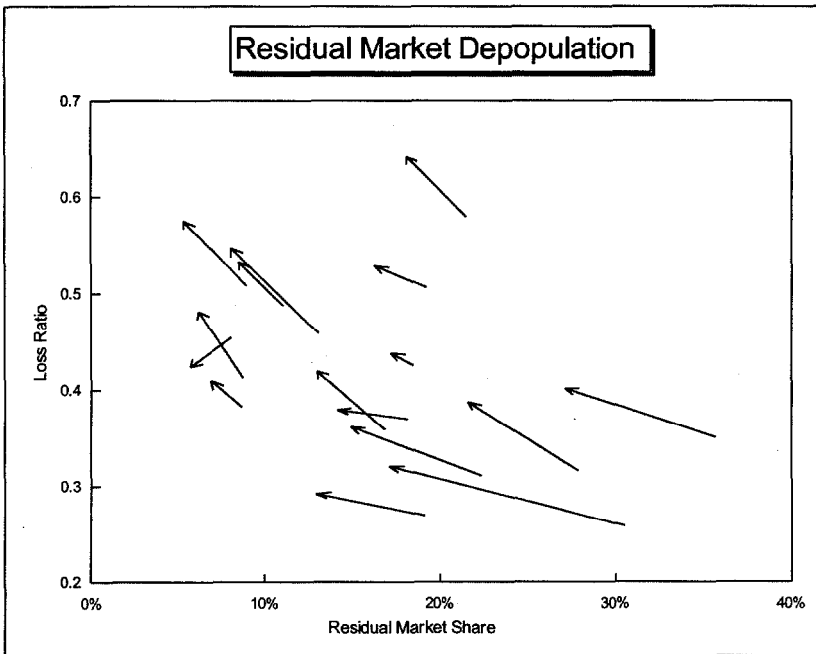
Using Relative Loss Ratios

Residual market loss ratios relative to statewide (residual market and voluntary market combined) were determined. This eliminates the need for on-level factors or loss development. Different states can be directly compared. Possible effects of unknown extraneous variables (such as relative levels of rate adequacy) are reduced. After this adjustment to the data is made, the points regraphed and the arrows redrawn, there appears to be two distinct groups (low market share and high market share) which have similar slopes within the groups.

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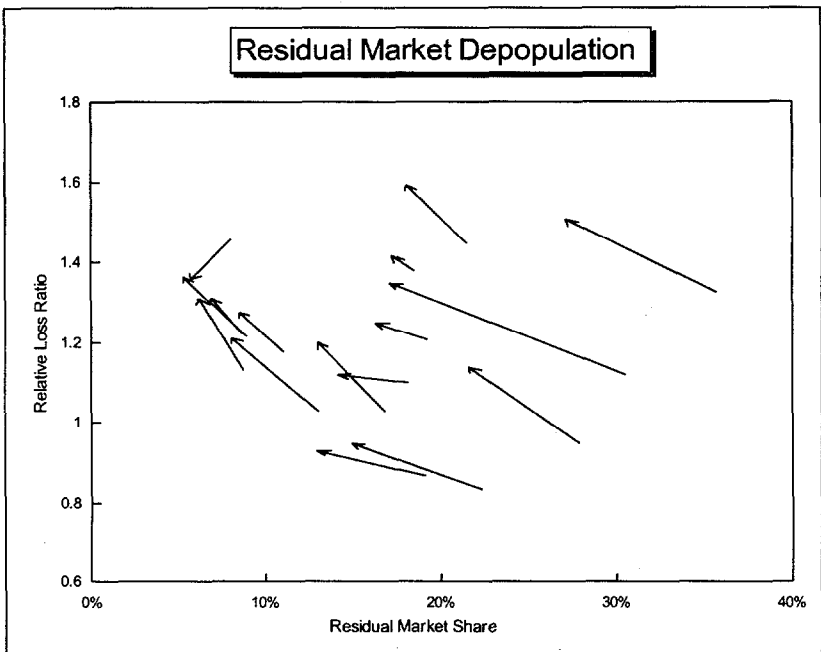
<u>Using Logarithm of Market Share</u>

Since the line segments are flatter and longer at higher market shares, taking the logarithm of the market share might make the slopes more similar. The logarithm (base 10) of the market share was computed. Relative loss ratio was compared to the logarithm of market share. The graph exhibits a distinct similarity in slopes.

Residual Market Depopulation
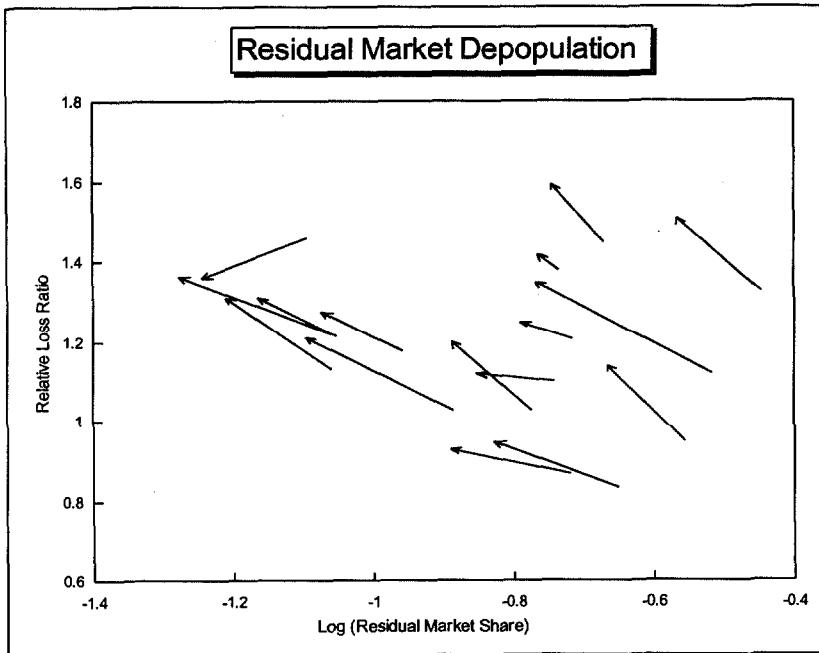
<u>Comparison of approaches</u>

The coefficient of variation of slopes was used to determine that the aforementioned data transformations improved the quantification of the slope (i.e. narrowed the confidence interval). The slopes were approximately lognormally distributed for each scenario. The two highest and two lowest observations were excluded before the average slope and coefficient of variation of slope was computed. The median is close to the mean when these outliers are excluded. The outliers did not tend to be any particular state or any particular year which indicates that there is not a bias in the results with regard to state or year.

Method	Coefficient of Variation of Slope	Average Slope
Loss Ratio & Market Share	-0.468	-1.103
Relative Loss Ratio & Market Share	-0.413	-2.842
Relative Loss Ratio & Log (Market Share)	-0.366	-0.930

use this

<u>Slope Equation</u>

Variables:

m = slope

R_1 = Relative Loss Ratio (compared to statewide) **before** depopulation
R_2 = Relative Loss Ratio (compared to statewide) **after** depopulation

S_1 = Residual Market Share **before** depopulation
S_2 = Residual Market Share **after** depopulation

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Equation:

$$m = \frac{R_2 - R_1}{\log(S_2) - \log(S_1)}$$

$$m = \frac{R_2 - R_1}{\log\left(\frac{S_2}{S_1}\right)}$$

$$R_2 = R_1 + m \log\left(\frac{S_2}{S_1}\right)$$

A change in market share from 50% to 25% will have the same additive adjustment to the loss ratio as a change in market share from 10% to 5%. Both changes are quite dramatic. The change from 50% to 25% will have a big impact on the loss ratio because this is a high volume change. The change from 10% to 5% will also have a big impact on the loss ratio because when the residual market is so small the average loss ratio for the risks which remain in the residual market is much greater than the average loss ratio for the risks which depopulate.

Property:

$$R_3 = R_2 + m \log\left(\frac{S_3}{S_2}\right)$$

$$R_3 = R_1 + m \log\left(\frac{S_2}{S_1}\right) + m \log\left(\frac{S_3}{S_2}\right)$$

$$R_3 = R_1 + m \log\left(\frac{S_3}{S_1}\right)$$

The model has the desirable property that two subsequent changes in market share will have the sum total adjustment to the loss ratio equal to the adjustment that would be made if the changes in market share were combined into one.

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The relationship $R_2 - R_1 = -.930 \log (S_2/S_1)$ is graphed for typical amounts of depopulation. The curve would take a sharp upward turn on the left if the graph were extended to include extreme amounts of depopulation. This study did not include any states which experienced extreme depopulation or states with very low residual market shares and therefore extrapolation of the results of this study for such states would be questionable.

Residual Market Depopulation

Relative to statewide loss ratio

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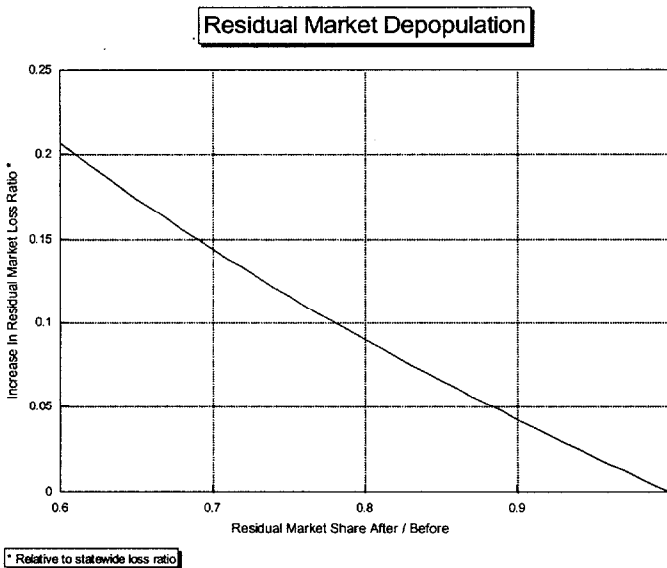
Example

Policy Year 1994 Residual Market Loss Ratio = .653
Policy Year 1994 Statewide Loss Ratio = .600
1994 Residual Market Share = 23.4%
Residual Market Share for estimated year = 16.5%

Policy Year 1994 Residual Market Loss ratio adjusted to reflect estimated depopulation =
$.653 + .600[-.930 \log(.165/.234)] = .738$

This additive adjustment should be made before other loss ratio adjustments such as trend, change in benefits and premium level changes. This adjustment can be thought of as a regrouping of the data to reflect depopulation and is not a movement forward in time to a different policy year.

Applying the results to an individual state

The results of this study have already been applied in two states to project a residual market loss ratio and the assigned risk surcharge needed with an assumed amount of depopulation. Following are some guidelines to be used in applying the results of this study.

• Look at a range of scenarios for a state

The confidence interval around the average slope of -.930 is sufficiently narrow so that the model can predict the impact of depopulation on the loss ratio for the pool with reasonable accuracy. The impact of depopulation for an individual state cannot be predicted as precisely, because of the uncertainty in calculating a state specific slope. Several scenarios should be considered. The average slope of -.930 should be considered. The two state specific slopes can also be considered for those states which were included in the study. Each of these slopes will yield a

predicted impact on the residual market loss ratio. The range of predictions can aid in selecting an impact. A chart is provided showing the individual state slopes for the Relative Loss Ratio versus Log of Market Share method.

STATE&YR	SLOPE
B94	0.666
A94	-0.167
F94	-0.357
H93	-0.604
E94	-0.640
D94	-0.661
B93	-0.849
D93	-0.864
C93	-0.869
G94	-0.918
C94	-1.187
A93	-1.222
H94	-1.478
G93	-1.509
E93	-1.745
F93	-1.916

• Use a statewide loss ratio consistent with the residual market loss ratio

The statewide loss ratio is one of the inputs used to determine the adjustment to the residual market loss ratio. Statewide losses and premium should be developed and on-level consistent with the residual market loss ratio.

• Be consistent with market shares

Since the ratio of market shares S_2/S_1 is used, market shares do not have to be based on manual premium times mod but they do have to be consistent. Use assigned risk premium on the same basis as voluntary premium (e.g. they both include expenses).

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	# policies	1993 losses	1993 premium	1994 losses	1994 premium
AAA	1,775	18,444,133	37,147,231	15,044,939	35,345,905
AAV	361	4,608,273	13,311,095	4,456,882	11,473,837
AVV	297	4,983,475	13,334,758	5,616,873	13,937,226
AVA	16	152,178	197,039	253,356	335,475
VAV	88	1,268,452	4,290,207	1,592,135	3,520,868
VAA	258	2,666,603	6,750,059	1,083,214	5,661,589
VVA	200	2,277,879	3,878,297	1,101,216	4,655,397
VVV	4,910	76,483,975	278,470,508	81,777,325	251,569,097

	1993 surcharge 15.5%	1994 surcharge 25.6%

	1993 losses	premium	loss ratio		
A**	28,188,059	66,087,552	0.427	18.5%	residual market share
V**	82,696,909	291,907,477	0.283		
			0.310		
A	26,987,461	61,498,592	0.439	17.2%	
V	83,897,507	295,880,602	0.284		
			0.310		

	1994 losses	premium	loss ratio		
A	22,177,170	59,840,843	0.371	18.2%	residual market share
V	88,748,770	269,479,947	0.329		
			0.337		
**A	17,482,725	45,998,366	0.380	14.1%	
**V	93,443,215	280,501,028	0.333		
			0.340		

A = Assigned Risk
V = Voluntary
* = either A or V

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	# policies	1993 losses	1993 premium	1994 losses	1994 premium
AAA	1,138	9,654,614	22,332,855	9,256,262	20,661,729
AAV	298	3,680,784	10,205,587	8,190,822	14,443,915
AVV	318	5,078,009	15,784,512	5,704,421	13,362,129
AVA	20	511,218	1,142,118	370,972	581,586
VAV	90	1,208,224	3,098,353	641,570	2,729,149
VAA	191	1,473,758	3,455,754	937,274	3,229,607
VVA	236	3,373,054	4,544,202	1,997,733	5,158,458
VVV	11,365	153,292,196	509,555,689	134,744,125	458,216,175

1993
surcharge
0.0%

1994
surcharge
4.6%

	1993 losses	premium	loss ratio
A**	18,924,625	49,465,072	0.383
V**	159,347,232	520,653,998	0.306
			0.313
A	16,017,380	39,092,549	0.410
V	162,254,477	531,026,521	0.306
			0.313

8.7% |residual market share

6.9% ▼

	1994 losses	premium	loss ratio
A	19,025,928	41,854,361	0.455
V	142,817,251	477,065,918	0.299
			0.312
**A	12,562,241	29,631,380	0.424
**V	149,280,938	488,751,368	0.305
			0.312

8.1% |residual market share

5.7% ▼

A = Assigned Risk
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	# policies	1993 losses	1993 premium	1994 losses	1994 premium
AAA	3,481	51,560,296	84,396,298	44,557,947	90,884,971
AAV	926	17,999,541	38,324,443	17,302,822	39,755,862
AVV	1,079	28,784,826	64,691,956	27,662,685	73,778,907
AVA	48	1,089.113	2,727.110	2,037.140	4,033.340
VAV	222	7,539,751	21,256,577	5,203,612	21,672,392
VAA	403	5,742,670	11,751,219	5,853,745	11,557,013
VVA	442	15,215,417	11,716,406	7,173,892	17,279,689
VVV	33,510	640,051,700	1,607,436,564	627,377,170	1,747,475,833

	1993 surcharge 20.0%	1994 surcharge 20.0%

	1993 losses	premium	loss ratio
A**	99,433,776	203,623,620	0.488
V**	668,549,538	1,646,659,467	0.406
			0.415
A	82,842,258	155,728,537	0.532
V	685,141,056	1,686,572,036	0.406
			0.417

11.0% residual market share
8.5%

	1994 losses	premium	loss ratio
A	72,918,126	176,155,889	0.414
V	664,250,887	1,839,015,598	0.361
			0.366
**A	59,622,724	123,755,013	0.482
**V	677,546,289	1,882,682,994	0.360
			0.367

8.7% residual market share
6.2%

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	# policies	1993 losses	1993 premium	1994 losses	1994 premium
AAA	1,638	11,888,105	20,636,259	13,516,344	20,469,725
AAV	551	8,239,524	16,571,780	10,525,854	19,449,755
AVV	624	12,790,971	28,124,000	12,408,768	29,394,934
AVA	47	661,951	677,100	198,154	717,244
VAV	118	1,813,303	3,182,520	1,241,088	3,363,612
VAA	180	2,345,250	4,106,017	1,670,046	4,019,310
VVA	176	3,910,853	6,428,236	2,667,688	6,207,385
VVV	17,800	208,314,605	475,375,142	207,786,929	509,503,229

	1993 surcharge 25.0%	1994 surcharge 25.0%

	1993 losses	premium	loss ratio	
A**	33,580,551	73,209,414	0.459	13.1%
V**	216,384,011	487,634,208	0.444	residual market share
			0.446	
A	24,286,182	44,496,576	0.546	8.0%
V	225,678,380	510,604,478	0.442	
			0.450	

	1994 losses	premium	loss ratio	
A	26,953,332	53,005,744	0.508	8.9%
V	223,061,539	544,437,866	0.410	residual market share
			0.418	
**A	18,052,232	31,413,664	0.575	5.3%
**V	231,962,639	561,711,530	0.413	
			0.422	

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	# policies	1993 losses	1993 premium	1994 losses	1994 premium
AAA	1,128	9,977,821	26,780,660	9,208,462	26,057,745
AAV	276	4,052,651	13,034,682	4,341,669	11,461,955
AVV	366	5,025,093	14,285,735	5,846,386	14,313,966
AVA	11	31,422	532,996	127,599	312,094
VAV	68	692,675	1,945,646	425,969	2,393,270
VAA	129	3,091,838	4,124,614	1,234,270	3,583,898
VVA	58	1,761,417	2,329,360	924,855	1,806,423
VVV	3,066	47,773,986	149,406,468	59,316,177	153,531,771

1993
surcharge
38.0%

1994
surcharge
38.0%

	1993		
	losses	premium	loss ratio
A**	19,086,987	60,265,191	0.317
V**	53,319,916	156,134,567	0.341
			0.335
A	17,814,985	45,885,602	0.388
V	54,591,918	166,554,559	0.328
			0.341

27.8% |residual
market
share
21.6% ▼

	1994		
	losses	premium	loss ratio
A	15,210,370	48,761,854	0.312
V	66,215,017	169,380,894	0.391
			0.373
**A	11,495,186	31,760,160	0.362
**V	69,930,201	181,700,962	0.385
			0.381

22.4% |residual
market
share
14.9% ▼

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* = either A or V

	# policies	1993 losses	1993 premium	1994 losses	1994 premium
AAA	969	19,459,557	21,022,186	7,192,841	23,211,615
AAV	294	3,270,952	12,649,709	3,166,217	11,073,141
AVV	275	3,132,432	8,909,387	2,908,688	8,999,598
AVA	9	169,822	319,349	66,713	433,722
VAV	64	502,401	1,387,493	455,804	1,436,884
VAA	125	826,403	2,441,134	732,855	3,277,952
VVA	85	1,507,714	1,382,712	343,203	1,490,004
VVV	6,589	55,106,180	160,142,906	54,712,118	170,643,350

| | 1993 surcharge 22.1% | | 1994 surcharge 30.1% |

	1993		
	losses	premium	loss ratio
A**	26,032,763	44,940,182	0.579
V**	57,942,698	164,661,267	0.352
			0.401
A	24,059,313	37,500,522	0.642
V	59,916,148	170,754,354	0.351
			0.403

21.4% | residual market share
18.0% ↓

	1994		
	losses	premium	loss ratio
A	11,547,717	42,765,110	0.270
V	58,030,722	181,121,600	0.320
			0.311
**A	8,335,612	28,413,293	0.293
**V	61,242,827	192,152,973	0.319
			0.315

19.1% | residual market share
12.9% ↓

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	# policies	1993 losses	1993 premium	1994 losses	1994 premium
AAA	976	14,810,880	28,246,446	9,038,192	28,178,911
AAV	656	4,746,490	20,105,785	4,806,808	20,235,102
AVV	473	3,864,645	17,141,331	3,158,768	16,944,457
AVA	19	329,721	430,084	183,926	382,287
VAV	65	502,611	1,712,401	303,140	1,713,267
VAA	66	403,064	780,667	473,838	840,690
VVA	44	521,440	1,615,885	189,572	1,362,151
VVV	3,731	25,037,156	117,882,960	24,741,745	110,409,025

	1993 surcharge 10.0%		1994 surcharge 25.1%

	1993		
	losses	premium	loss ratio
A**	23,751,736	67,680,788	0.351
V**	26,464,271	121,765,270	0.217
			0.265
A	20,463,045	50,845,299	0.402
V	29,752,962	137,070,260	0.217
			0.267

35.7% ⎤ residual market share

27.1% ⎦ ↓

	1994		
	losses	premium	loss ratio
A	14,621,978	56,477,011	0.259
V	28,274,011	128,747,917	0.220
			0.232
**A	9,885,528	30,764,039	0.321
**V	33,010,461	149,301,851	0.221
			0.238

30.5% ⎤ residual market share

17.1% ⎦ ↓

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V = Voluntary
* = either A or V

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	# policies	1993 losses	1993 premium	1994 losses	1994 premium
AAA	567	5,625,193	8,705,494	4,253,886	9,565,398
AAV	119	922,623	2,866,509	724,018	3,534,064
AVV	106	1,337,910	3,468,114	1,415,204	3,968,740
AVA	3	36,682	44,028	13,854	55,886
VAV	26	199,775	682,217	177,322	611,329
VAA	61	187,416	872,972	371,624	1,071,238
VVA	54	1,173,722	909,654	304,246	1,077,020
VVV	2,920	24,694,365	63,314,666	24,616,615	71,049,610

1993 surcharge 15.0%	1994 surcharge 15.0%

1993

	losses	premium	loss ratio	
A**	7,922,408	15,610,966	0.507	19.2%
V**	26,255,278	65,576,658	0.400	
			0.421	residual market share
A	6,935,007	13,127,192	0.528	16.2%
V	27,242,679	67,736,462	0.402	
			0.423	

1994

	losses	premium	loss ratio	
A	5,526,850	15,403,838	0.359	16.9%
V	26,349,919	76,003,486	0.347	
			0.349	residual market share
**A	4,943,610	11,769,542	0.420	12.9%
**V	26,933,159	79,163,743	0.340	
			0.351	

A = Assigned Risk
V = Voluntary
* = either A or V

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