RESERVES, SURPLUS, & UNCERTAINTY

Authors: **Aaron Halpert**

Mr. Halpert is a Manager with Peat Marwick Main & Co. in New York. He received his ACAS designation in 1983 and is a member of the American Academy of Actuaries. He holds a B.S. degree from Brooklyn College.

Douglas W. Oliver

Mr. Oliver is a Consultant with Peat Marwick Main & Co. in New York. Douglas graduated from Rutgers College in 1983 with B.A. degrees in both Mathematics and Business Administration.

Abstract:

With the passage of the Tax Reform Act of 1986, the topic of amending statutory and/or GAAP accounting to reflect the time value of money when stating reserves for loss and loss adjustment expenses has gained attention. In conjunction with the discounting issue, the subject of reflecting a provision for adverse claim development has also gained wider attention. The aim of this paper is to present a framework for the calculation of the size of this provision and to discuss the associated accounting issues.

Actual company loss reserve information for several lines of business as well as companies of various size was considered. Both parameter risk and process risk are discussed and reflected in the model. Conclusions arising from these models include: The familiar 2 to 1 premium to surplus ratio is not appropriate for all companies nor for all lines of insurance, and that the difference between undiscounted and discounted reserves produces a greater margin than our model suggests.

1. INTRODUCTION

The recent changes in the tax law as regards property and casualty insurers have once again prompted discussion on the issue of discounting loss and loss adjustment expense reserves. The determination of income for tax purposes now requires that reserves be discounted to reflect the time value of money, while statutory and GAAP accounting, to a large degree, still require that reserves reflect the ultimate value of an unpaid claim.[1] There is considerable discussion under way as to whether statutory and GAAP accounting should now be amended to more fully recognize the time value of money.[2]

Some believe that the time value of money is already recognized, and view the difference between discounted and undiscounted reserves as a margin for adverse developments. If this line of reasoning is followed, then current accounting automatically defines the size of this margin[3] and mandates that it be implicitly reflected as part of the liability for unpaid losses and loss adjustment expenses. The aim of this paper is to provide a framework for evaluating a reasonable margin for adverse developments and to present accounting approaches to reflect this margin.

---

[1]Currently, some exceptions to this rule exist in the area of workers' compensation and medical malpractice.

[2]Much of this discussion has been spawned by the changes in the tax laws resulting from the Tax Reform Act of 1986.

[3]By stating reserves at ultimate values, the implicit margin is equal to the present value of all future investment income.

Section 2 presents the accounting issues and, on a related note, reviews the functions of capital and surplus for a property and casualty insurance company. In Section 3 we discuss the data and statistical models used to evaluate reasonable margins for adverse developments. Section 4 illustrates how the results of the models lead to various conclusions regarding safety margins.

2. ACCOUNTING FOR RESERVE MARGINS

The need for a buffer or margin for adverse developments has long been recognized. If we subscribe to the view that reserves currently contain such a provision implicitly (in the guise of reserves stated at an undiscounted value) then we need to probe how this margin will be reflected on a company's balance sheet should statutory and/or GAAP accounting be changed to explicitly reflect the time value of money in setting reserves.

One approach would be to continue to reflect this margin as part of the liability for unpaid losses. That is, the liability would be established as:

Liability for Unpaid Losses = Discounted Reserves +

Margin for Adverse Development

Of course, the margin need not necessarily be equal to the difference between discounted and undiscounted reserves, but rather would reflect the uncertainty that is present in the book of business written by a company.

Alternatively, this margin could be reflected as part of a company's surplus. In fact, the uncertainty associated with loss reserves (and the margins necessary to meet these uncertainties) has been cited as one of the three major purposes of surplus.[4]

Of these two alternatives, we believe the latter provides a better approach for the following reasons:

1. In many instances, reserves established on an actuarial basis are viewed by non-actuaries as a "conservative" estimate of unpaid losses. A natural consequence of this reasoning is that a less conservative estimate might also be acceptable, so that which begins as an unbiased estimate of unpaid losses often gets wittled down to ostensibly remove some "conservatism" from the estimate.[5]

   If an insurance company's balance sheet were required to reflect margins as part of the liability for unpaid losses, there would be an even greater inclination to view reserves as containing an (unnecessary?) element of conservatism. The natural impulse to "remove the conservatism" would become all the more prevalent.

---

[4]A. E. Hofflander, "Minimum Capital and Surplus Requirements for Multiple Line Insurance Companies: A New Approach," Kimball and Denenberg, Insurance, Government and Social Policy, 1969.

Three sources of drains on surplus are presented, two relating to losses and loss reserves and one related to asset values. Given the recent volatility in the equity markets, one cannot ignore this last source. However, we have focused on adverse development of loss reserves as the key role for surplus.

[5]This issue has very practical applications in the audit of a property and casualty insurance company. In most cases a reasonable range of reserves is projected and a company's reserves are considered fairly stated if the balance sheet liability is within this range.

2. It is doubtful that the IRS would allow any reflection of reserve margins in the calculation of taxable income. Including a margin in GAAP and statutory reserves would therefore perpetuate a confusing difference in reserve calculations.

3. As we will demonstrate in the next section, there is considerable subjectivity involved in selecting an acceptable provision for adverse deviations.[6] Management's selection of reserve margins can therefore be expected to expand and contract in response to pressures in the marketplace. This would result in considerable uncertainty in interpreting the meaning of a company's balance sheet.

Alternatively, if standards are set to evaluate margins that are reflected as part of a company's surplus, then these margins can be regulated by determining acceptable premium to surplus ratios. Current regulations provide for considerable management discretion in setting these ratios.

We conclude that the appropriate place to reflect a provision for adverse development is in setting minimum surplus requirements and maximum premium to surplus ratios. In Section 3 we will demonstrate that these ratios should logically vary among companies writing short tail vs. long tail lines, new companies vs. mature companies, etc.

---

[6]This is analogous to the elements of classical credibility theory. The choice of a full credibility standard inevitably depends on a subjective choice of an acceptable difference between actual and expected results.

3. A MODEL FOR REFLECTING UNCERTAINTY

Risk Loading: Pricing Vs. Reserving

The concept of reflecting uncertainty in insurance pricing has received widespread attention for some time now. Most recently, a CAS exposure draft regarding "Principles of Ratemaking" maintained that an insurance rate "should include a charge for the risk of variation from the expected experience."[7] Increased limits pricing has generally reflected an explicit provision for risk loading.

A similar application of measuring uncertainty in reserve evaluations has only recently gained attention. For example, the recently issued CAS exposure draft on "Principles Regarding Loss and Loss Expense Reserves,"[8] made specific reference to reflecting a provision for uncertainty in a reserve projection. The earlier statement of principles contained no such reference.

The models underlying the measurement of risk and uncertainty for pricing purposes can, however, be generally applied to reserve evaluations. As in pricing, we need to distinguish between two primary sources of uncertainty.

---

[7]Final Exposure Document - Statement of Principles Regarding Property and Casualty Insurance Ratemaking, October 5, 1987.

[8]Final Exposure Document - Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves, October 5, 1987.

Parameter Risk

The first source of uncertainty, often referred to as parameter risk, arises from our inability to project expected future claim payments exactly. In the context of evaluating loss reserves this uncertainty arises because:

1. Various projection methods (e.g., methods applied to incurred losses, paid losses, counts and averages, etc.) may yield contradictory results.

   This uncertainty is often dealt with by establishing a range of reserve estimates. However, this range should be established only after the assumptions underlying each projection technique have been tested. Berquist and Sherman[8] have shown that the difference in results between paid and incurred projections can often be explained by changes in company operations that may render one or both of these projections inappropriate unless the underlying data is adjusted to accommodate these changes in operations.

2. There is considerable variation in observed cumulative development factors at each maturity level.

   The level of variation present in a given set of development factors will depend on:

---

[9]Berquist, J. R. and Sherman, R. E., "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach." PCAS, LXIV, 1977.

- Sample size
- The lines of business (and the regulatory environment associated with the line)
- The random occurrence of large losses for a particular exposure period

The model presented below attempts to measure the level of uncertainty in reserve projections resulting from the variation in loss development factors.

Process Risk

Process risk results from the fact that actual results will differ from expected results because of the random nature of the insurance process. Empirical tests presented below show that with regard to reserve projections, this source of risk is relatively minor when compared to parameter risk.

Data Collection

To measure the uncertainty in reserve projections we have assembled a data base of accident year loss experience with the following characteristics:

Size of Company

- Small Company
- Large Company
- Composite of Many Companies

Lines of Insurance

- Homeowners
- Auto Liability
- General Liability
- Workers Compensation

Data Elements

- Paid Losses
- Incurred Losses
- Reported Counts
- Closed Counts

This data was available in finer detail than would normally appear in schedules O and P of a company's annual statement.

Parameter Risk Model

The elements of this model appear in Exhibit A. The underlying data in this case is workers compensation experience for five insurers ranging in size from approximately $10 million to over $1 billion in annual premium. The selected ultimate values by accident year reflect a complete review of all the available experience for each of these five companies and is considered to be an unbiased estimate of ultimate losses for the group.

Accident year incurred losses at each evaluation were then divided into the projected ultimate losses for that year. The resulting factors at each age are considered random samples of the age to ultimate factors at the respective maturity levels. Each column of factors was tested to determine if one can accept the hypothesis that the sample was drawn from a normal distribution. An illustration of this test is presented in Appendix A and indicates that the hypothesis can generally be accepted. The variance in each column was calculated from the latest five sample points in the respective column (not including the last factor which is considered the mean of the column). For later ages, where less than five sample points were available, a CV (coefficient of variation) was selected by reviewing the CV at earlier stages of development.

If uncertainty is measured as a function of variance, it is clear that uncertainty is greatest at the least mature accident year and decreases as each accident year matures.[10]

The estimated means and variances (along with the assumption of normality) were used to construct the probability distribution of ultimate losses for each accident year and for all years combined. Various percentiles of the distributions (with results expressed as a percentage of the mean) appear on Exhibit B for an accident year as of 12 months and for all years combined.

If we now calculate the difference between ultimate losses at some percentile and the mean ultimate losses we can calculate various ratios as illustrated on Exhibit C. Surplus, in this context, refers to that portion of surplus that is needed to provide a margin for adverse deviations. The results are displayed for all five companies in our sample combined, and in later exhibits similar results are displayed for the largest company, and for the smallest company in the group. Also displayed are the results for a company that has written this line for all the years present in our sample, as well as for a company that has written this line for only one year. Key results at the 90th percentile are reproduced below in Table 1.

Table 1
WORKERS COMPENSATION
PARAMETER RISK MODEL
90th Percentile

	All Years		One Year	
	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
Large Company	22.2	32.6	27.3	15.3
Small Company	3.9	7.7	4.4	2.8

[10]Analogous conclusions are drawn in Khury, C. K., "Loss Reserves: Performance Standards", PCAS, LXVII, 1980.

It should be stressed that surplus serves purposes other than providing a cushion for adverse developments. The ratios presented should therefore not be viewed as absolute measures but rather as relative measures of the uncertainty associated with adverse developments.

Various conclusions can be drawn from this table.

- The familiar 2 to 1 premium to surplus ratio is not appropriate for all companies (nor as we demonstrate later for all lines of insurance).
- If premium to surplus ratios are used as an indicator of leverage, then it appears that a company newly entering a given line can afford to be more highly leveraged than a mature company. This is somewhat counter-intuitive. Reserve to surplus ratios appear to be a better measure of leverage.
- The margin calculated from this model is considerably less than the difference between discounted and undiscounted reserves. For example, for the small company, reserves discounted for future investment income were estimated to be $4.3 million less than undiscounted reserves. The estimated surplus at the 90th percentile is only $2.8 million.

Results for the other lines of insurance studied appear in similar detail in Exhibits K through AN. Also enclosed in exhibits AO through AR are the results of the model for a large and a small company writing all four of the lines tested. The model assumes the lines are statistically independent.

Process Risk Model

The design used to evaluate process risk is based on a frequency-severity model. For each accident year, in addition to estimating reserve amounts, we estimated the expected number of future claims to close with payment. This number of claims was assumed to be the mean of a poisson frequency distribution and the corresponding average reserve was assumed to be the mean of a pareto severity distribution. Given the large number of claims we have analyzed, the distribution of aggregate reserves can be adequately modeled via a normal distribution with the following moments:

$$E(T) = E(N) \cdot E(X)$$

$$Var(T) = E(N) \cdot var(X) + var(N) \cdot E(X)^2$$

where "N" and "X" are the frequency and severity variables, respectively, and the random variable "T" represents total reserves.

The results of this model for the selected group of 5 companies are displayed in Exhibit D.[11] The results indicate that at each percentile the uncertainty associated with process risk is considerably smaller than that associated with parameter risk.

Compound Model

We have also employed Monte Carlo simulation methods to evaluate surplus levels when both elements of risk are considered simultaneously. The results of this simulation technique are also summarized in Exhibits D, H, X and AH.

---

[11]For this model, we have assumed that the CV of the severity distribution is 3.0.

4. CONCLUSIONS

Three important conclusions can be drawn from our model and the results displayed in the attached exhibits:

1. The difference between reserves discounted for future investment income and undiscounted reserves appears to provide a greater margin than would be implied by our model. In most cases we tested, the sum of discounted reserves and the calculated margin at the 90th percentile were less than the undiscounted reserves. Generally, however, the lines generating more investment income also generate a greater level of uncertainty.

2. Leverage ratios (premium to surplus or reserve to surplus) vary considerably among insurers of:

    - o Different Size
    - o Different Lines of Insurance
    - o Different Age

    If reserves are to be reflected at discounted values, these differences in ratios will need to be recognized in setting reserve margin levels, or in regulating leverage ratios.[12]

3. As a source of uncertainty in evaluating reserves, process risk appears to be almost insignificant relative to parameter risk. The model incorporating both sources yields leverage ratios only slightly lower than the ratios associated with the parameter risk model.

---

[12]Such differences are reflected in the "Analysis of Surplus Quality" tests promulgated in California in 1985.

FUTURE STUDY

As is the case with many actuarial analyses, our model has helped us recognize that facets of the general problem remain to be studied. Among the issues that require further analysis are:

- Incorporating the uncertainty arising from contradictory results into the model. The range in results between paid and incurred projections can be considerable especially for a small company.
- Testing to determine whether a multi-line writer truly faces a situation where the individual lines can be modeled as independent from each other.

Parameter Risk Model — Exhibit A

Workers' Compensation — Selected Five Insurers — Incurred Loss Development — Amounts in Thousands

Years	Age of Development 12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	688,793	826,074	845,363	857,429	864,286	868,733	868,555	873,221	875,631	879,295	892,116
1978	829,778	937,983	951,679	974,468	976,349	978,391	979,753	983,492	988,098		1,011,549
1979	868,861	1,026,005	1,078,335	1,102,738	1,105,862	1,118,297	1,121,973	1,125,774			1,147,952
1980	856,874	1,039,585	1,093,760	1,113,759	1,128,365	1,132,596	1,139,682				1,173,563
1981	923,005	1,106,499	1,155,153	1,176,402	1,181,865	1,193,585					1,292,157
1982	953,056	1,145,936	1,192,317	1,213,034	1,234,559						1,317,466
1983	992,652	1,181,098	1,235,757	1,271,580							1,347,225
1984	1,111,915	1,384,930	1,481,069								1,634,397
1985	1,511,157	1,876,805									2,056,845
1986	1,913,271										2,477,407

Cumulative Loss Development Factors

Years	Age of Development 12	24	36	48	60	72	84	96	108	120
1977	1.2952	1.0799	1.0553	1.0405	1.0322	1.0269	1.0271	1.0216	1.0188	1.0146
1978	1.2191	1.0784	1.0629	1.0381	1.0361	1.0339	1.0325	1.0285	1.0237	
1979	1.3212	1.1189	1.0646	1.0410	1.0381	1.0265	1.0232	1.0197		
1980	1.3696	1.1289	1.0730	1.0537	1.0401	1.0362	1.0297			
1981	1.3999	1.1678	1.1186	1.0984	1.0933	1.0826				
1982	1.3824	1.1497	1.1050	1.0861	1.0672					
1983	1.3572	1.1407	1.0902	1.0595						
1984	1.4699	1.1801	1.1035							
1985	1.3611	1.0959								
1986	1.2949									
Selected	1.2949	1.0959	1.1035	1.0595	1.0672	1.0826	1.0297	1.0197	1.0237	1.0146
Standard Deviation	0.0457	0.0206	0.0222	0.0273	0.0255					
Coeficient of Variation	0.0353	0.0188	0.0202	0.0258	0.0239	0.0225 ‡	0.0220 ‡	0.0210 ‡	0.0200 ‡	0.0200 ‡

‡ Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit 8

Workers' Compensation

Selected Five Insurers

Percentile	Accident Year 1986	All Years Combined
50	99.96%	99.99%
55	100.42%	100.10%
60	100.88%	100.22%
65	101.34%	100.33%
70	101.84%	100.45%
75	102.37%	100.58%
80	102.97%	100.72%
85	103.64%	100.89%
90	104.52%	101.10%
95	105.79%	101.41%

Parameter Risk Model

Exhibit C

Workers' Compensation Selected Five Insurers

	All Years			One Year		
Percentile	Premium to Surplus	Reserve to Surplus	Discounted Reserves & Surplus to Undiscounted Reserves	Premium to Surplus	Reserve to Surplus	Discounted Reserves & Surplus to Undiscounted Reserves
75th	39.9	61.0	0.816	56.3	32.2	0.839
90th	20.9	31.9	0.831	29.5	16.9	0.867
95th	16.3	24.9	0.840	23.0	13.2	0.884

WORKERS COMPENSATION
PROCESS RISK

Exhibit D

Selected Five Insurers

	ALL YEARS		ONE YEAR	
E(N):	298,466		E(N):	186,834
VAR(N):	298,466		VAR(N):	186,834
E(X):	16,903		E(X):	10,108
VAR(X):	2,571,402,681		VAR(X):	919,544,976
E(T):	5,044,970,798		E(T):	1,888,518,072
[VAR(T)]^.5:	29,201,908		[VAR(T)]^.5:	13,816,346

% ' ILE	PREMIUMS TO SURPLUS	RESERVES TO SURPLUS	PREMIUMS TO SURPLUS	RESERVES TO SURPLUS
75 th	168.8	257.9	356.8	204.0
90 th	88.4	135.0	186.8	106.8
95 th	69.0	105.3	145.8	83.3

COMBINATION OF PARAMETER RISK & PROCESS RISK MODELS

	ALL YEARS		ONE YEAR	
% ' ILE	PREMIUMS TO SURPLUS	RESERVES TO SURPLUS	PREMIUMS TO SURPLUS	RESERVES TO SURPLUS
75 th	39.5	60.3	54.1	30.9
90 th	19.7	30.1	28.3	16.2
95 th	15.0	22.8	22.7	13.0

Parameter Risk Model

Exhibit E

Workers' Compensation — Large Company — Incurred Loss Development — Amounts in Thousands

Years	Age of Development 12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	507,700	603,600	609,300	613,300	614,900	615,200	612,400	615,800	618,100	620,900	631,000
1978	646,100	708,400	717,800	729,000	726,700	724,500	726,500	727,600	730,400		750,500
1979	673,400	771,600	807,500	822,700	824,500	833,700	836,200	839,400			865,000
1980	637,400	761,300	807,100	819,800	831,200	833,400	838,900				882,500
1981	680,400	806,100	840,300	855,700	860,600	869,500					927,000
1982	685,200	791,000	824,300	838,000	850,300						903,000
1983	685,100	790,600	827,000	847,600							923,000
1984	803,500	979,500	1,041,900								1,161,000
1985	1,122,800	1,368,600									1,517,000
1986	1,514,300										1,897,000

Cumulative Loss Development Factors

Years	Age of Development 12	24	36	48	60	72	84	96	108	120
1977	1.2429	1.0454	1.0356	1.0289	1.0262	1.0257	1.0304	1.0247	1.0209	1.0163
1978	1.1616	1.0594	1.0456	1.0295	1.0328	1.0359	1.0330	1.0315	1.0275	
1979	1.2845	1.1210	1.0712	1.0514	1.0491	1.0375	1.0344	1.0305		
1980	1.3845	1.1592	1.0934	1.0765	1.0617	1.0589	1.0520			
1981	1.3624	1.1500	1.1032	1.0833	1.0772	1.0661				
1982	1.3179	1.1416	1.0955	1.0776	1.0620					
1983	1.3472	1.1675	1.1161	1.0890						
1984	1.4449	1.1853	1.1143							
1985	1.3511	1.1084								
1986	1.2527									
Selected	1.2527	1.1084	1.1143	1.0890	1.0620	1.0661	1.0520	1.0305	1.0275	1.0163
Standard Deviation	0.0478	0.0168	0.0164	0.0227	0.0208					
Coeficient of Variation	0.0381	0.0152	0.0147	0.0208	0.0196	0.0200	0.0200	0.0185	0.0175	0.0160
						*	*	*	*	*

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles
as a Percent of the Expected Mean

Exhibit F

Workers' Compensation — Large Company

Percentile	Accident Year 1986	All Years Combined
50	99.96%	99.99%
55	100.46%	100.10%
60	100.95%	100.21%
65	101.45%	100.32%
70	101.98%	100.44%
75	102.55%	100.57%
80	103.20%	100.72%
85	103.93%	100.88%
90	104.88%	101.09%
95	106.25%	101.40%

Parameter Risk Model — Exhibit 6

Workers' Compensation — Large Company

	All Years		One Year	
Percentile	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
75th	42.4	62.3	52.2	29.2
90th	22.2	32.6	27.3	15.3
95th	17.3	25.5	21.3	11.9

Parameter Risk Model — Exhibit H

Workers' Compensation — Small Company — Incurred Loss Development — Amounts in Thousands

	Age of Development										
Years	12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	2,500	3,402	4,048	4,225	4,477	4,526	4,610	4,610	4,576	4,736	4,799
1978	2,569	3,816	4,464	4,675	4,908	5,120	5,194	5,290	5,340		5,457
1979	3,299	4,903	5,536	5,805	6,058	6,110	6,161	6,215			6,429
1980	2,542	4,127	5,315	5,653	5,778	6,052	6,326				6,491
1981	2,168	4,530	5,859	6,075	6,165	6,451					6,610
1982	2,815	4,930	5,441	5,929	6,307						6,800
1983	4,012	5,532	7,491	7,987							8,969
1984	4,529	6,986	7,602								9,116
1985	5,408	6,386									9,333
1986	3,853										8,075

Cumulative Loss Development Factors

	Age of Development									
Years	12	24	36	48	60	72	84	96	108	120
1977	1.9196	1.4106	1.1855	1.1359	1.0719	1.0603	1.0410	1.0410	1.0487	1.0133
1978	2.1242	1.4300	1.2224	1.1673	1.1119	1.0658	1.0506	1.0316	1.0219	
1979	1.9488	1.3112	1.1613	1.1075	1.0612	1.0522	1.0435	1.0344		
1980	2.5535	1.5728	1.2213	1.1482	1.1234	1.0725	1.0261			
1981	3.0489	1.4592	1.1282	1.0881	1.0722	1.0246				
1982	2.4156	1.3793	1.2498	1.1469	1.0782					
1983	2.2355	1.6213	1.1973	1.1229						
1984	2.0128	1.3049	1.1992							
1985	1.7258	1.4615								
1986	2.0958									
Selected	2.0958	1.4615	1.1992	1.1229	1.0782	1.0246	1.0261	1.0344	1.0219	1.0133
Standard Deviation	0.4974	0.1314	0.0481	0.0326	0.0276					
Coeficient of Variation	0.2374	0.0899	0.0401	0.0291	0.0256	0.0250 ‡	0.0225 ‡	0.0200 ‡	0.0200 ‡	0.0200 ‡

‡ Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit I

Workers' Compensation Small Company

Percentile	Accident Year 1986	All Years Combined
50	99.76%	99.97%
55	102.85%	100.36%
60	105.93%	100.75%
65	109.02%	101.14%
70	112.34%	101.56%
75	115.90%	102.01%
80	119.94%	102.53%
85	124.45%	103.10%
90	130.38%	103.85%
95	138.93%	104.93%

Parameter Risk Model

Exhibit J

Workers' Compensation Small Company

	All Years		One Year	
Percentile	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
75th	7.4	14.8	8.4	5.4
90th	3.9	7.7	4.4	2.8
95th	3.0	6.0	3.4	2.2

Parameter Risk Model

Exhibit K

General Liability — Selected Five Insurers — Incurred Loss Development — Amounts in Thousands

	Age of Development										
Years	12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	64,297	120,407	168,806	197,781	200,092	201,796	201,878	202,343	202,104	201,826	205,291
1978	58,423	114,671	155,571	180,828	189,005	191,728	188,580	190,421	191,084		192,546
1979	60,111	122,306	172,945	199,381	205,872	208,532	209,144	208,455			211,037
1980	65,841	127,156	184,976	213,158	225,001	236,296	237,231				239,826
1981	71,945	140,792	193,854	218,443	234,666	236,962					240,490
1982	74,727	157,474	197,145	226,322	250,656						258,019
1983	77,028	145,956	206,401	245,844							273,765
1984	83,548	182,876	254,511								331,197
1985	125,503	254,768									446,153
1986	153,931										521,835

Cumulative Loss Development Factors

	Age of Development									
Years	12	24	36	48	60	72	84	96	108	120
1977	3.1929	1.7050	1.2161	1.0380	1.0260	1.0173	1.0169	1.0146	1.0158	1.0172
1978	3.2957	1.6791	1.2377	1.0648	1.0187	1.0043	1.0210	1.0112	1.0077	
1979	3.5108	1.7255	1.2203	1.0585	1.0251	1.0120	1.0091	1.0124		
1980	3.6425	1.8861	1.2965	1.1251	1.0659	1.0149	1.0109			
1981	3.3427	1.7081	1.2406	1.1009	1.0248	1.0149				
1982	3.4528	1.6385	1.3088	1.1401	1.0294					
1983	3.5541	1.8757	1.3264	1.1136						
1984	3.9642	1.8110	1.3013							
1985	3.5549	1.7512								
1986	3.3901									
Selected	3.3901	1.7512	1.3013	1.1136	1.0294	1.0149	1.0109	1.0124	1.0077	1.0172
Standard Deviation	0.2351	0.1078	0.0457	0.0360	0.0191					
Coeficient of Variation	0.0694	0.0616	0.0351	0.0323	0.0186	0.0180 *	0.0175 *	0.0175 *	0.0150 *	0.0150 *

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit L

General Liability

Selected Five Insurers

Percentile	Accident Year 1986	All Years Combined
50	99.93%	99.98%
55	100.83%	100.20%
60	101.73%	100.42%
65	102.64%	100.63%
70	103.61%	100.87%
75	104.65%	101.12%
80	105.83%	101.40%
85	107.14%	101.72%
90	108.88%	102.13%
95	111.38%	102.73%

Parameter Risk Model

Exhibit M

General Liability

Selected Five Insurers

	All Years			One Year		
Percentile	Premium to Surplus	Reserve to Surplus	Discounted Reserves & Surplus to Undiscounted Reserves	Premium to Surplus	Reserve to Surplus	Discounted Reserves & Surplus to Undiscounted Reserves
75th	22.9	48.4	0.742	30.7	20.6	0.804
90th	12.0	25.3	0.761	16.1	10.8	0.848
95th	9.3	19.8	0.772	12.6	8.4	0.874

GENERAL LIABILITY
PROCESS RISK

Exhibit N

Selected Five Insurers

	ALL YEARS	ONE YEAR
E(N):	61,435	29,692
VAR(N):	61,435	29,692
E(X):	25,699	16,865
VAR(X):	5,943,947,409	2,559,854,025
E(T):	1,578,818,065	500,755,580
[VAR(T)]^.5:	20,143,000	9,189,800

% ' ILE	ALL YEARS PREMIUMS TO SURPLUS	ALL YEARS RESERVES TO SURPLUS	ONE YEAR PREMIUMS TO SURPLUS	ONE YEAR RESERVES TO SURPLUS
75 th	55.2	117.0	121.1	81.3
90 th	28.9	61.2	63.4	42.6
95 th	22.6	47.8	49.5	33.2

COMBINATION OF PARAMETER RISK & PROCESS RISK MODELS

% ' ILE	ALL YEARS PREMIUMS TO SURPLUS	ALL YEARS RESERVES TO SURPLUS	ONE YEAR PREMIUMS TO SURPLUS	ONE YEAR RESERVES TO SURPLUS
75 th	19.9	42.1	29.1	19.5
90 th	11.6	24.5	14.9	10.0
95 th	8.5	18.0	12.1	8.2

Parameter Risk Model

Exhibit D

General Liability — Large Company — Incurred Loss Development — Amounts in Thousands

	Age of Development										
Years	12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	40,900	78,500	115,000	131,700	132,800	134,000	134,900	134,300	132,400	132,500	135,000
1978	36,000	74,900	99,300	119,000	134,100	129,700	128,000	127,700	128,700		130,000
1979	37,700	74,400	112,200	133,600	138,000	138,100	136,900	134,900			136,000
1980	39,500	80,000	125,500	145,000	148,000	154,600	156,800				156,200
1981	42,900	86,900	124,600	140,200	152,000	150,800					150,000
1982	41,300	88,900	114,900	129,500	145,200						145,000
1983	46,700	86,900	123,500	148,000							160,000
1984	47,500	107,400	156,500								195,000
1985	78,600	159,900									285,000
1986	97,800										354,800

Cumulative Loss Development Factors

	Age of Development									
Years	12	24	36	48	60	72	84	96	108	120
1977	3.3007	1.7197	1.1739	1.0251	1.0166	1.0075	1.0007	1.0052	1.0196	1.0189
1978	3.6111	1.7356	1.3092	1.0924	0.9694	1.0023	1.0156	1.0180	1.0101	
1979	3.6074	1.8280	1.2121	1.0180	0.9855	0.9848	0.9934	1.0082		
1980	3.9544	1.9525	1.2446	1.0772	1.0554	1.0103	0.9962			
1981	3.4965	1.7261	1.2039	1.0699	0.9868	0.9947				
1982	3.5109	1.6310	1.2620	1.1197	0.9986					
1983	3.4261	1.8412	1.2955	1.0811						
1984	4.1053	1.8156	1.2460							
1985	3.6260	1.7824								
1986	3.6278									
Selected	3.6278	1.7824	1.2460	1.0811	0.9986	0.9947	0.9962	1.0082	1.0101	1.0189
Standard Deviation	0.2736	0.1214	0.0374	0.0374	0.0340					
Coeficient of Variation	0.0754	0.0681	0.0300	0.0346	0.0340	0.0340 *	0.0325 *	0.0300 *	0.0275 *	0.0250 *

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit P

General Liability — Large Company

Percentile	Accident Year 1986	All Years Combined
50	99.92%	99.98%
55	100.90%	100.23%
60	101.89%	100.48%
65	102.87%	100.73%
70	103.92%	101.01%
75	105.05%	101.30%
80	106.33%	101.62%
85	107.77%	101.99%
90	109.65%	102.47%
95	112.37%	103.17%

Parameter Risk Model

Exhibit 8

General Liability Large Company

	All Years		One Year	
Percentile	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
75th	21.2	41.5	28.3	19.0
90th	11.1	21.7	14.8	9.9
95th	8.7	17.0	11.6	7.7

Parameter Risk Model

Exhibit R

General Liability — Small Company — Incurred Loss Development — Amounts in Thousands

Years	Age of Development 12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	366	471	675	789	770	791	835	970	1,007	1,148	1,033
1978	418	700	866	957	1,023	1,031	1,262	1,344	1,428		1,456
1979	518	657	737	720	896	760	934	1,026			1,047
1980	463	684	835	1,028	1,157	1,204	1,292				1,419
1981	283	548	711	965	1,241	1,540					1,576
1982	372	621	669	802	948						1,319
1983	643	740	964	1,361							1,876
1984	720	1,216	1,922								3,497
1985	898	1,485									3,746
1986	646										2,916

Cumulative Loss Development Factors

Years	Age of Development 12	24	36	48	60	72	84	96	108	120
1977	2.8224	2.1932	1.5304	1.3093	1.3416	1.3059	1.2371	1.0649	1.0258	0.8998
1978	3.4833	2.0800	1.6813	1.5214	1.4233	1.4122	1.1537	1.0833	1.0196	
1979	2.0212	1.5936	1.4206	1.4542	1.5043	1.3776	1.1210	1.0205		
1980	3.0648	2.0746	1.6994	1.3804	1.2264	1.1786	1.0983			
1981	5.5689	2.8759	2.2166	1.6332	1.2699	1.0234				
1982	3.5457	2.1240	1.9716	1.6446	1.3914					
1983	2.9176	2.5351	1.9461	1.3784						
1984	4.8569	2.8758	1.8195							
1985	4.1715	2.5226								
1986	4.5139									
Selected	4.5139	2.5226	1.8195	1.3784	1.3914	1.0234	1.0983	1.0205	1.0196	0.8998
Standard Deviation	1.0462	0.3893	0.3023	0.1140	0.1128					
Coeficient of Variation	0.2318	0.1543	0.1661	0.0827	0.0811	0.0800	0.0775	0.0750	0.0700	0.0600

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit 5

General Liability

Small Company

Percentile	Accident Year 1986	All Years Combined
50	99.77%	99.94%
55	102.78%	100.66%
60	105.79%	101.38%
65	108.81%	102.10%
70	112.05%	102.88%
75	115.53%	103.71%
80	119.47%	104.65%
85	123.87%	105.70%
90	129.67%	107.09%
95	138.01%	109.08%

Parameter Risk Model Exhibit I

General Liability Small Company

	All Years		One Year	
Percentile	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
75th	5.6	14.4	9.2	6.0
90th	3.0	7.6	4.8	3.1
95th	2.3	5.9	3.8	2.4

Parameter Risk Model

Exhibit U

Auto Liability — Selected Six Insurers — Incurred Loss Development — Amounts in Thousands

	Age of Development										
Years	12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	380,314	510,217	548,131	572,049	576,854	578,156	579,966	581,691	582,536	583,503	585,979
1978	389,225	535,596	600,033	628,080	641,340	643,142	644,749	653,443	653,675		655,663
1979	426,428	607,100	686,294	718,556	725,433	724,760	726,454	725,457			728,953
1980	481,396	687,403	763,750	797,834	811,974	818,207	820,137				820,459
1981	569,897	804,803	901,118	925,486	943,228	948,671					956,511
1982	651,365	903,294	988,193	1,025,499	1,040,947						1,053,350
1983	725,010	992,073	1,102,810	1,170,169							1,199,394
1984	765,490	1,130,481	1,296,113								1,371,872
1985	887,020	1,362,646									1,600,107
1986	1,085,914										1,818,184

Cumulative Loss Development Factors

	Age of Development									
Years	12	24	36	48	60	72	84	96	108	120
1977	1.5408	1.1485	1.0690	1.0244	1.0158	1.0135	1.0104	1.0074	1.0059	1.0042
1978	1.6845	1.2242	1.0927	1.0439	1.0223	1.0195	1.0169	1.0034	1.0030	
1979	1.7094	1.2007	1.0622	1.0145	1.0049	1.0058	1.0034	1.0048		
1980	1.7043	1.1936	1.0743	1.0284	1.0104	1.0028	1.0004			
1981	1.6784	1.1885	1.0615	1.0335	1.0141	1.0083				
1982	1.6171	1.1661	1.0659	1.0272	1.0119					
1983	1.6543	1.2090	1.0876	1.0250						
1984	1.7921	1.2135	1.0585							
1985	1.8039	1.1743								
1986	1.6743									
Selected	1.6743	1.1743	1.0585	1.0250	1.0119	1.0083	1.0004	1.0048	1.0030	1.0042
Standard Deviation	0.0841	0.0188	0.0109	0.0107	0.0065					
Coeficient of Variation	0.0502	0.0160	0.0103	0.0104	0.0064	0.0060 *	0.0055 *	0.0050 *	0.0050 *	0.0050 *

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit V

Auto Liability

Selected Six Insurers

Percentile	Accident Year 1986	All Years Combined
50	99.95%	99.99%
55	100.60%	100.11%
60	101.26%	100.23%
65	101.91%	100.34%
70	102.61%	100.47%
75	103.37%	100.60%
80	104.22%	100.76%
85	105.17%	100.93%
90	106.43%	101.16%
95	108.24%	101.48%

Parameter Risk Model

Exhibit W

Auto Liability

Selected Six Insurers

Percentile	All Years			One Year		
	Premium to Surplus	Reserve to Surplus	Discounted Reserves & Surplus to Undiscounted Reserves	Premium to Surplus	Reserve to Surplus	Discounted Reserves & Surplus to Undiscounted Reserves
75th	37.2	52.7	0.844	39.6	26.1	0.909
90th	19.4	27.6	0.862	20.7	13.6	0.944
95th	15.2	21.5	0.872	16.2	10.6	0.964

Selected Six Insurers

	ALL YEARS	ONE YEAR
E(N):	243,027	164,158
VAR(N):	243,027	164,158
E(X):	14,160	9,716
VAR(X):	1,804,550,400	849,605,904
E(T):	3,441,262,320	1,594,959,128
[VAR(T)]^.5:	22,074,482	12,448,543

% ' ILE	ALL YEARS PREMIUMS TO SURPLUS	ALL YEARS RESERVES TO SURPLUS	ONE YEAR PREMIUMS TO SURPLUS	ONE YEAR RESERVES TO SURPLUS
75 th	163.9	232.7	290.7	191.2
90 th	85.8	121.8	152.1	100.1
95 th	67.0	95.1	118.7	78.1

COMBINATION OF PARAMETER RISK & PROCESS RISK MODELS

% ' ILE	ALL YEARS PREMIUMS TO SURPLUS	ALL YEARS RESERVES TO SURPLUS	ONE YEAR PREMIUMS TO SURPLUS	ONE YEAR RESERVES TO SURPLUS
75 th	36.0	51.0	38.3	25.2
90 th	19.3	27.4	20.3	13.3
95 th	13.9	19.8	15.8	10.4

Parameter Risk Model — Exhibit Y

Auto Liability — Large Company — Incurred Loss Development — Amounts in Thousands

Age of Development

Years	12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	131,000	197,900	221,000	231,900	234,300	233,500	233,900	233,700	233,000	234,400	233,200
1978	150,300	223,400	252,400	267,200	273,700	273,500	273,500	274,100	274,400		273,600
1979	177,800	253,300	295,600	311,900	314,200	313,400	314,200	312,200			311,800
1980	194,200	289,100	328,900	344,600	351,700	352,400	354,300				349,700
1981	226,600	333,200	376,600	385,400	391,500	393,600					391,000
1982	258,800	364,300	401,100	414,200	421,100						419,300
1983	262,300	389,300	443,500	465,500							475,000
1984	275,700	433,500	521,500								550,000
1985	334,100	570,800									699,500
1986	437,300										820,000

Cumulative Loss Development Factors

Age of Development

Years	12	24	36	48	60	72	84	96	108	120
1977	1.7802	1.1784	1.0552	1.0056	0.9953	0.9987	0.9970	0.9979	1.0009	0.9949
1978	1.8204	1.2247	1.0840	1.0240	0.9996	1.0004	1.0004	0.9982	0.9971	
1979	1.7537	1.2310	1.0548	0.9997	0.9924	0.9949	0.9924	0.9987		
1980	1.8007	1.2096	1.0632	1.0148	0.9943	0.9923	0.9870			
1981	1.7255	1.1735	1.0382	1.0145	0.9987	0.9934				
1982	1.6202	1.1510	1.0454	1.0123	0.9957					
1983	1.8109	1.2201	1.0710	1.0204						
1984	1.9949	1.2687	1.0547							
1985	2.0937	1.2255								
1986	1.8751									
Selected	1.8751	1.2255	1.0547	1.0204	0.9957	0.9934	0.9870	0.9987	0.9971	0.9949
Standard Deviation	0.1938	0.0453	0.0132	0.0087	0.0030					
Coeficient of Variation	0.1034	0.0370	0.0125	0.0085	0.0031	0.0030 *	0.0025 *	0.0025 *	0.0020 *	0.0020 *

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit I

Auto Liability

Large Company

Percentile	Accident Year 1986	All Years Combined
50	99.90%	99.98%
55	101.24%	100.24%
60	102.58%	100.49%
65	103.93%	100.75%
70	105.37%	101.02%
75	106.92%	101.32%
80	108.68%	101.65%
85	110.65%	102.03%
90	113.23%	102.52%
95	116.95%	103.23%

Parameter Risk Model | Exhibit AA

Auto Liability | Large Company

	All Years		One Year	
Percentile	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
75th	18.3	19.7	19.3	12.7
90th	9.6	10.3	10.1	6.7
95th	7.5	8.0	7.9	5.2

Parameter Risk Model

Exhibit A8

Auto Liability — Small Company — Incurred Loss Development — Amounts in Thousands

Years	Age of Development 12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	2,816	3,710	3,954	3,873	3,927	4,008	4,078	4,089	4,114	4,137	4,122
1978	2,359	3,068	3,421	3,383	3,480	3,463	3,529	3,534	3,560		3,546
1979	2,637	3,184	3,244	3,505	3,690	3,690	3,712	3,713			3,738
1980	2,352	3,183	3,505	3,626	3,767	3,876	3,963				3,985
1981	2,417	3,253	3,660	3,766	3,823	3,864					3,960
1982	2,370	3,615	4,181	4,318	4,330						4,572
1983	3,311	4,699	5,491	5,664							6,201
1984	4,582	7,273	8,175								9,415
1985	7,078	9,049									12,231
1986	4,668										10,396

Cumulative Loss Development Factors

Years	Age of Development 12	24	36	48	60	72	84	96	108	120
1977	1.4638	1.1111	1.0425	1.0643	1.0497	1.0284	1.0108	1.0081	1.0019	0.9964
1978	1.5032	1.1483	1.0365	1.0482	1.0190	1.0240	1.0048	1.0034	0.9961	
1979	1.4175	1.1740	1.1523	1.0665	1.0130	1.0130	1.0070	1.0067		
1980	1.6943	1.2520	1.1369	1.0990	1.0579	1.0281	1.0056			
1981	1.6384	1.2173	1.0820	1.0515	1.0358	1.0248				
1982	1.9291	1.2647	1.0935	1.0588	1.0559					
1983	1.8728	1.3196	1.1293	1.0948						
1984	2.0548	1.2945	1.1517							
1985	1.7280	1.3516								
1986	2.2271									
Selected	2.2271	1.3516	1.1517	1.0948	1.0559	1.0248	1.0056	1.0067	0.9961	0.9964
Standard Deviation	0.1645	0.0393	0.0298	0.0204	0.0192					
Coeficient of Variation	0.0739	0.0291	0.0259	0.0186	0.0182	0.0180 *	0.0175 *	0.0175 *	0.0150 *	0.0150 *

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit AC

Auto Liability

Small Company

Percentile	Accident Year 1986	All Years Combined
50	99.93%	99.99%
55	100.89%	100.17%
60	101.85%	100.36%
65	102.81%	100.55%
70	103.84%	100.76%
75	104.95%	100.97%
80	106.20%	101.22%
85	107.61%	101.50%
90	109.45%	101.86%
95	112.11%	102.38%

Parameter Risk Model

Exhibit AD

Auto Liability

Small Company

	All Years		One Year	
Percentile	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
75th	22.9	29.0	26.9	15.1
90th	12.0	15.2	14.1	7.9
95th	9.4	11.8	11.0	6.2

Parameter Risk Model

Exhibit AE

Homeowners — Selected Three Companies — Incurred Loss Development — Amounts in Thousands

Years	Age of Development 12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	111,276	129,884	130,105	130,323	130,480	130,669	130,407	130,277	130,230	130,144	130,191
1978	119,967	141,806	143,905	144,175	143,641	143,756	144,059	144,234	144,195		144,207
1979	156,620	186,839	187,340	188,096	187,314	187,324	187,898	187,724			187,779
1980	178,537	220,615	220,118	220,141	219,809	219,809	219,445				219,507
1981	188,846	222,199	222,166	221,490	221,839	221,942					222,201
1982	232,938	266,809	268,938	271,507	273,661						272,248
1983	214,112	268,605	269,650	271,615							267,356
1984	214,924	255,026	260,956								253,634
1985	205,653	242,034									238,207
1986	183,216										215,314

Cumulative Loss Development Factors

Years	Age of Development 12	24	36	48	60	72	84	96	108	120
1977	1.1700	1.0024	1.0007	0.9990	0.9978	0.9963	0.9983	0.9993	0.9997	1.0004
1978	1.2021	1.0169	1.0021	1.0002	1.0039	1.0031	1.0010	0.9998	1.0001	
1979	1.1989	1.0050	1.0023	0.9983	1.0025	1.0024	0.9994	1.0003		
1980	1.2295	0.9950	0.9972	0.9971	0.9986	0.9986	1.0003			
1981	1.1766	1.0000	1.0002	1.0032	1.0016	1.0012				
1982	1.1688	1.0204	1.0123	1.0027	0.9948					
1983	1.2487	0.9954	0.9915	0.9843						
1984	1.1801	0.9945	0.9719							
1985	1.1583	0.9842								
1986	1.1752									
Selected	1.1752	0.9842	0.9719	0.9843	0.9948	1.0012	1.0003	1.0003	1.0001	1.0004
Standard Deviation	0.0358	0.0110	0.0077	0.0027	0.0026					
Coeficient of Variation	0.0304	0.0112	0.0079	0.0027	0.0026	0.0025 *	0.0025 *	0.0020 *	0.0020 *	0.0020 *

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles
as a Percent of the Expected Mean

Exhibit AF

Homeowners

Selected Three Companies

Percentile	Accident Year 1986	All Years Combined
50	99.97%	100.00%
55	100.37%	100.04%
60	100.76%	100.09%
65	101.16%	100.13%
70	101.58%	100.18%
75	102.04%	100.23%
80	102.56%	100.29%
85	103.13%	100.36%
90	103.89%	100.45%
95	104.99%	100.57%

Parameter Risk Model

Exhibit #6

Homeowners

Selected Three Companies

Percentile	All Years			One Year		
	Premium to Surplus	Reserve to Surplus	Discounted Reserves & Surplus to Undiscounted Reserves	Premium to Surplus	Reserve to Surplus	Discounted Reserves & Surplus to Undiscounted Reserves
75th	66.1	25.5	0.970	75.5	18.7	0.980
90th	34.6	13.4	1.009	39.5	9.8	1.029
95th	27.0	10.4	1.033	30.8	7.6	1.057

HOMEOWNERS
PROCESS RISK

Selected Three Insurers

	ALL YEARS		ONE YEAR	
E(N):	31,700		E(N):	26,604
VAR(N):	31,700		VAR(N):	26,604
E(X):	4,044		E(X):	3,088
VAR(X):	147,185,424		VAR(X):	85,821,696
E(T):	128,194,800		E(T):	82,153,152
[VAR(T)]^.5:	2,276,883		[VAR(T)]^.5:	1,592,762

% ' ILE	PREMIUMS TO SURPLUS	RESERVES TO SURPLUS	PREMIUMS TO SURPLUS	RESERVES TO SURPLUS
75 th	2168.9	84.0	310.4	77.0
90 th	1135.3	44.0	162.5	40.3
95 th	886.1	34.3	126.8	31.5

COMBINATION OF PARAMETER RISK & PROCESS RISK MODELS

	ALL YEARS		ONE YEAR	
% ' ILE	PREMIUMS TO SURPLUS	RESERVES TO SURPLUS	PREMIUMS TO SURPLUS	RESERVES TO SURPLUS
75 th	63.7	24.6	75.1	18.6
90 th	31.6	12.2	38.3	9.5
95 th	25.2	9.7	27.7	6.9

Parameter Risk Model

Exhibit AI

Homeowners — Large Company — Incurred Loss Development — Amounts in Thousands

Years	Age of Development 12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	101,866	119,658	119,898	120,082	120,164	120,325	120,175	119,998	119,972	119,891	119,915
1978	110,967	131,869	133,915	134,215	133,823	133,973	134,272	134,451	134,412		134,439
1979	146,165	174,813	175,389	176,042	175,070	175,120	175,790	175,738			175,791
1980	165,789	205,631	205,002	204,986	204,668	204,735	204,459				204,479
1981	177,480	209,401	209,224	208,820	209,204	209,368					209,488
1982	216,952	251,424	253,540	256,114	258,462						257,013
1983	198,610	250,165	251,728	253,443							249,830
1984	196,159	234,017	239,820								233,000
1985	183,209	218,281									214,500
1986	164,771										195,000

Cumulative Loss Development Factors

Years	Age of Development 12	24	36	48	60	72	84	96	108	120
1977	1.1772	1.0021	1.0001	0.9986	0.9979	0.9966	0.9978	0.9993	0.9995	1.0002
1978	1.2115	1.0195	1.0039	1.0017	1.0046	1.0035	1.0012	0.9999	1.0002	
1979	1.2027	1.0056	1.0023	0.9986	1.0041	1.0038	1.0000	1.0003		
1980	1.2334	0.9944	0.9974	0.9975	0.9991	0.9987	1.0001			
1981	1.1803	1.0004	1.0013	1.0032	1.0014	1.0006				
1982	1.1847	1.0222	1.0137	1.0035	0.9944					
1983	1.2579	0.9987	0.9925	0.9857						
1984	1.1878	0.9957	0.9716							
1985	1.1708	0.9827								
1986	1.1835									
Selected	1.1835	0.9827	0.9716	0.9857	0.9944	1.0006	1.0001	1.0003	1.0002	1.0002
Standard Deviation	0.0350	0.0114	0.0079	0.0027	0.0030					
Coeficient of Variation	0.0296	0.0116	0.0081	0.0028	0.0030	0.0030 *	0.0028 *	0.0026 *	0.0025 *	0.0025 *

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit AJ

Homeowners

Large Company

Percentile	Accident Year 1986	All Years Combined
50	99.97%	100.00%
55	100.36%	100.04%
60	100.74%	100.08%
65	101.12%	100.13%
70	101.54%	100.18%
75	101.98%	100.23%
80	102.49%	100.28%
85	103.05%	100.35%
90	103.79%	100.43%
95	104.85%	100.55%

Parameter Risk Model

Exhibit AK

Homeowners

Large Company

	All Years		One Year	
Percentile	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
75th	66.6	25.7	77.6	19.4
90th	34.8	13.5	40.6	10.1
95th	27.2	10.5	31.7	7.9

Parameter Risk Model

Exhibit AL

Homeowners | Small Company | Incurred Loss Development | Amounts in Thousands

Age of Development

Years	12	24	36	48	60	72	84	96	108	120	SELECTED ULTIMATE
1977	520	630	610	625	630	647	647	675	685	685	684
1978	548	649	645	679	680	680	680	680	680		680
1979	559	691	688	697	700	719	694	694			688
1980	945	1,102	1,133	1,135	1,137	1,139	1,149				1,163
1981	680	782	822	816	824	856					850
1982	1,368	1,471	1,489	1,525	1,547						1,549
1983	1,378	1,479	1,487	1,489							1,526
1984	1,023	1,453	1,595								1,684
1985	2,081	2,296									2,528
1986	1,896										2,314

Cumulative Loss Development Factors

Age of Development

Years	12	24	36	48	60	72	84	96	108	120
1977	1.3154	1.0857	1.1213	1.0944	1.0857	1.0572	1.0572	1.0133	0.9985	0.9985
1978	1.2409	1.0478	1.0543	1.0015	1.0000	1.0000	1.0000	1.0000	1.0000	
1979	1.2308	0.9957	1.0000	0.9871	0.9829	0.9569	0.9914	0.9914		
1980	1.2307	1.0554	1.0265	1.0247	1.0229	1.0211	1.0122			
1981	1.2500	1.0870	1.0341	1.0417	1.0316	0.9930				
1982	1.1323	1.0530	1.0403	1.0157	1.0013					
1983	1.1074	1.0318	1.0262	1.0248						
1984	1.6461	1.1590	1.0558							
1985	1.2148	1.1010								
1986	1.2205									
Selected	1.2205	1.1010	1.0558	1.0248	1.0013	0.9930	1.0122	0.9914	1.0000	0.9985
Standard Deviation	0.2181	0.0498	0.0154	0.0210	0.0392					
Coeficient of Variation	0.1787	0.0452	0.0145	0.0205	0.0391	* 0.0350	* 0.0300	* 0.0275	* 0.0250	* 0.0250

* Selected after review of previous values

Parameter Risk Model

Expected Losses at selected Percentiles
as a Percent of the Expected Mean

Exhibit AM

Homeowners

Small Company

Percentile	Accident Year 1986	All Years Combined
50	99.82%	99.97%
55	102.14%	100.39%
60	104.47%	100.80%
65	106.79%	101.22%
70	109.29%	101.67%
75	111.97%	102.15%
80	115.01%	102.70%
85	118.41%	103.31%
90	122.88%	104.11%
95	129.31%	105.26%

Parameter Risk Model | Exhibit AM

Homeowners | Small Company

Percentile	All Years Premium to Surplus	All Years Reserve to Surplus	One Year Premium to Surplus	One Year Reserve to Surplus
75th	12.1	8.7	12.8	3.9
90th	6.3	4.6	6.7	2.0
95th	4.9	3.6	5.2	1.6

Parameter Risk Model

Expected Losses at selected Percentiles
as a Percent of the Expected Mean

Exhibit A0

All Lines Combined

Large Company

Percentile	Accident Year 1986	All Years Combined
50	99.96%	99.99%
55	100.42%	100.08%
60	100.88%	100.17%
65	101.33%	100.26%
70	101.83%	100.36%
75	102.35%	100.47%
80	102.95%	100.58%
85	103.62%	100.72%
90	104.50%	100.89%
95	105.76%	101.14%

Parameter Risk Model

Exhibit AP

All Lines Combined Large Company

Percentile	All Years: Premium to Surplus	All Years: Reserve to Surplus	One Year: Premium to Surplus	One Year: Reserve to Surplus
75th	50.5	68.3	57.6	33.3
90th	26.4	35.8	30.2	17.4
95th	20.6	27.9	23.5	13.6

Parameter Risk Model

Expected Losses at selected Percentiles as a Percent of the Expected Mean

Exhibit AQ

All Lines

Small Company

Percentile	Accident Year 1986	All Years Combined
50	99.91%	99.98%
55	101.12%	100.19%
60	102.33%	100.39%
65	103.55%	100.60%
70	104.85%	100.82%
75	106.25%	101.05%
80	107.84%	101.32%
85	109.61%	101.61%
90	111.94%	102.01%
95	115.30%	102.57%

All Lines Small Company

	All Years		One Year	
Percentile	Premium to Surplus	Reserve to Surplus	Premium to Surplus	Reserve to Surplus
75th	18.4	29.2	21.8	12.5
90th	9.6	15.3	11.4	6.5
95th	7.5	11.9	8.9	5.1

Support of Normal Distribution of Cumulative Loss Development Factors

Auto Liability Selected Six Insurers

Years	12	24	36	48	60	72	84	96	108	120
1977	1.5408	1.1485	1.0690	1.0244	1.0158	1.0135	1.0104	1.0074	1.0059	1.0042
1978	1.6845	1.2242	1.0927	1.0459	1.0223	1.0195	1.0169	1.0034	1.0030	
1979	1.7094	1.2007	1.0622	1.0145	1.0049	1.0058	1.0034	1.0048		
1980	1.7043	1.1936	1.0743	1.0254	1.0104	1.0028	1.0004			
1981	1.6784	1.1885	1.0615	1.0335	1.0141	1.0083				
1982	1.6171	1.1661	1.0659	1.0272	1.0119					
1983	1.6543	1.2090	1.0876	1.0250						
1984	1.7921	1.2135	1.0585							
1985	1.8039	1.1743								
1986	1.6743									
$\bar{x}$:	1.6859	1.1989	1.0715	1.0281	1.0132	1.0100	1.0078	1.0052	1.0045	1.0042
Selected:	1.6743	1.1743	1.0585	1.0250	1.0119	1.0083	1.0004	1.0048	1.0030	1.0042
Variance:	0.0071	0.0004	0.0001	0.0001	0.00004	0.00004	0.00003	0.00003	0.00003	0.00003
Statistic:	0.4368	2.6558	3.3628	0.7765	0.5043	0.6209	2.6566	0.1379	0.4089	0.0000
	Accept	Accept	Reject	Accept	Accept	Accept	Accept	Accept	Accept	Accept

@ alpha = .015. Reject if Statistic above/below +/- 2.675

Statistic: $\frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}}$

Support of Standard Deviation Calculation as shown on Exhibits A, E, H, K, ..., etc.

Specific Examples taken from Exhibit A: Workers' Compensation

Sample Standard Deviations from most recent five points within each age of development column were calculated

Example:	1.3999	x1
	1.3824	x2
	1.3572	x3
	1.4699	x4
	1.3611	x5

$$\text{Sample Mean:} \quad \frac{\sum_i x_i}{n} \qquad \text{Sample Variance:} \quad \frac{\sum_i (x_i - \text{Sample\_Mean})^2}{n-1}$$

$$\text{Sample Standard Deviation} = \sqrt{\text{Sample\_Variance}}$$

To convert the Sample Variance to a Population Variance, the Sample Variance is multiplied by the number of points in the sample (here five) and then divided by the number of points in the sample less 1.

$$\text{Pouplation Variance:} \quad \frac{(\text{Sample\_Variance})\ n}{n-1}$$

$$\text{Population Standard Deviation:} \quad \sqrt{\text{Population\_Variance}}$$