PRICING THE CATASTROPHE EXPOSURE IN HOMEOWNERS RATEMAKING

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BIOGRAPHIES:

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ABSTRACT:

According to the **STATEMENT OF PRINCIPLES REGARDING PROPERTY AND CASUALTY INSURANCE RATEMAKING**, consideration must be given to the impact catastrophes have on loss experience and procedures must be developed to include an allowance for the catastrophe exposure in the insurance rate. This paper offers an innovative approach to recognize Homeowners catastrophes potential.

Current methods using long-term average ratios of (1) catastrophe to non-catastrophe and (2) excess wind to total less excess wind losses are discussed and compared to the proposed alternative. Based on a company's historical catastrophe losses per earned exposures (as measured by Amount of Insurance Years) and projected exposure levels, the method develops provisions which allow a company to be reasonably comfortable that the catastrophe exposure is adequately rated. Provisions are determined independently for the hurricane and non-hurricane catastrophe exposures.

PRICING THE CATASTROPHE EXPOSURE IN HOMEOWNERS RATEMAKING

There has been little written on the subject of pricing catastrophe exposures in Homeowners ratemaking although the exposure to catastrophe losses is very significant indeed. One does not predict catastrophic events, yet the rate level charged insureds must adequately provide for catastrophe losses for an insurer to maintain its solvency.

One problem facing property insurers is the lack of sufficient catastrophe data on which to rely. This paper offers companies with significant data an innovative method to determine the catastrophe provision necessary in its rate level to adequately provide for its catastrophe potential.

CURRENT INDUSTRY PRACTICE

Currently the most predominant methods used in the pricing of catastrophe exposures in Homeowners insurance involve long-term ratios of catastrophe losses to non-catastrophe losses or excess wind ratios.

CAT TO NON-CAT RATIOS

Typically, a company will apply a catastrophe adjustment factor to a non-cat projected loss ratio in the determination of its indicated premium adjustment. This factor is usually a long-term average of the company's catastrophe to non-catastrophe losses. A simple exponential smoothing method is also used where the latest year's ratio of catastrophe to non-catastrophe losses is weighted with the previous year's long-term ratio.

Exhibit #1 displays calendar year loss data for State A split between catastrophe and non-catastrophe losses. Normally, a company will use as much catastrophe data as it has available.

Twenty-two (22) years are used here to be consistent with the proposed method to be presented later.

Exhibit #2 displays an indicated change calculation for State A for a rate change to be effective 9/01/89. Non-Cat losses are projected to a point one year past the effective date using a simple straight line trend of loss per policy. See Exhibit #5. Using the 22 year arithmetic average(.232) as the expected ratio of catastrophe to non-catastrophe losses results in an indicated 10.9% decrease. In this case using the weighted average or the smoothed averages(with 5% weight to the latest year) produces little difference.

XS Wind Companies also use variations of ISO's Excess Wind Procedure to incorporate catastrophes into the Homeowners rate level. Violent shifts in rate level due to large, unexpected wind losses are avoided by subtracting Excess Wind Losses from Total Losses and applying an Excess Wind Factor (based on Wind to Non-Wind Losses) for each year in the experience period. Conceptually, this is much the same as Cat/Norm procedures already discussed with the exception that catastrophes are self-defined as excess wind losses rather than occurrences which exceed a predetermined magnitude. Exhibits #3 and #4 present the development of an Excess Wind factor for State A and the resulting indicated change using an Excess Wind approach. The same experience used in the CAT/NON-CAT analysis produces an indicated decrease of 23.7%.

PROBLEMS WITH CURRENT METHODS

Some problems with today's catastrophe procedures are briefly discussed below:

(1) Non-Catastrophe Perils Unduly Affect the Catastrophe Provision.

The use of non-catastrophe or normal wind losses as an exposure base for the measurement of catastrophe exposure relies on the assumption that the ratio of catastrophe losses to non-catastrophe losses will remain constant over time, or at least relatively constant. This assumption may be tenuous at best. Non-catastrophe perils of wind, fire and other extended coverages may very well track with catastrophe losses. However, in times of economic change the non-catastrophe perils of crime and liability that bear little relationship to catastrophe losses can have a significant impact on non-cat trends in loss per policy.

For example, Exhibit #6 shows the fitted losses per policy and average risk amounts that gave rise to the indicated decreases noted above. The Cat/Non-Cat method produces an indicated catastrophe premium per policy 3.6% below the 1988 level. The Excess Wind procedure produces an indicated excess wind premium that is 13.3% below the 1988 level. At the same time, the average risk amount is increasing 4.6%.

The assumption that the ratio of catastrophe to non-catastrophe losses or excess-wind to "normal wind" is stable over time is invalid. The perils of crime and liability have been improving in the past few years and most likely are the root causes of the improving trends in non-cat and "normal wind" losses. Exposure to catastrophe losses, however, will increase as more property coverage is written. A changing crime rate should not alter an insurer's estimate of its exposure to catastrophes.

A forecast non-cat paid loss per policy in Exhibit #5 of $210 instead of $194.74 results in a catastrophe provision of $48.72 instead of $45.18 even though the estimate of exposures is not changed.

Even if the forecast of non-cat loss per policy is correct, inadequate rates will likely result due to an inadequate catastrophe provision. Of course, in times of increasing non-catastrophe trends, the opposite may be true. Consequently, there is a need to explore more appropriate exposure bases for catastrophes.

(2) Hurricane Losses

There is no independent treatment in traditional approaches of hurricanes which are a totally different exposure than non-hurricane catastrophes. Hurricanes are currently treated as any other wind loss.

(3) Variability of Catastrophe Losses

The use of a long term average of catastrophes/non-catastrophes does not recognize that the ratio may vary significantly by year. Use of the average ratio can only allow a 50% confidence in the result in each state. Unless individual state catastrophe provisions are summed and compared to companywide experience, it is not possible to determine the confidence the company can afford the resulting companywide catastrophe provision.

(4) Definition of Excess Wind

The Excess Wind procedure recognizes the variability of wind losses in the definition of excess wind years. An average excess wind factor is then used, however. The definition of excess wind years also gives rise to a problem.

Since excess wind years are determine as those years whose wind to non-wind ratios exceed 1.5 times the median ratio, what years are considered excess years could change each year. The addition of a year can change the median and thus the threshold for excess years. What was an excess year may not be an excess year in the future and the trends in normal losses may be distorted due to a change in the definition of excess loss.

(5) Non-Wind Catastrophes

Excess Wind methods ignore non-wind catastrophes such as explosions, freezing and earthquake. Earthquake losses may well be covered in a separate contract and the measurement of the exposure to quakes is beyond the scope of this paper. Explosions, such as those occurring recently in Nevada and Texas, and freezing losses are significant occurrences in Homeowners insurance and any catastrophe procedure should recognize them.

POTENTIAL CATASTROPHE EXPOSURE BASES

If, as has been suggested, losses, either non-cat or "normal wind", are not appropriate exposure bases for the catastrophe exposure, what then is?

PREMIUM Premium is not an appropriate exposure base for catastrophes for much the same reason as non-catastrophe losses. Since premium is affected by non-catastrophe as well as catastrophe losses, the movement in premium is largely the result of trends in non-catastrophe perils. The rate changes which result from the movements in non-catastrophe perils may affect the catastrophe provision contrary to logic. An example will illustrate this.

Suppose Company ABC writes 100,000 policies in year t at an average earned premium per policy of $100 and uses a 10% catastrophe provision. A 10% rate reduction is implemented for all policies effective 1/1/t+1. Normal policy growth has been 2% and it is expected that this growth rate will increase to 5%. Typically, policy limits have been increasing 1.1% resulting in a 1% increase in premium. The following table summarizes ABC's exposures and catastrophe provision in years t and t+1.

	Year t	Year t+1
Policies	100,000	105,000
EP/Policy	$ 100	$ 90.90(100x1.01x.9)
EP	$ 10,000,000	$ 9,544,500
Cat/EP	10.0%	10.0%
Cat Provision	$ 1,000,000	$ 954,450
Per Policy	$ 10.00	$ 9.09

Company ABC's exposure to catastrophe losses will increase in excess of 5%(1.011x1.05=1.06155), yet the catastrophe premium collected will decrease over 4.5%(954,450/1,000,000 = .95445).

AVERAGE POLICIES IN FORCE In the above example, Company ABC may consider $10 per policy, the year t catastrophe provision per policy, to be appropriate. Applying $10 to each policy in year t+1 results in a catastrophe premium of $1,050,000, clearly more appropriate than that resulting from the earned premium provision.

There are still logical problems using policies as an exposure base for catastrophes.

(1) A $1,000,000 house adds the same to the catastrophe provision as a $50,000 house.

(2) A policy written in December is treated the same as a policy issued in January even though the latter is exposed the entire year.

(3) There is no recognition of changes in distribution of business by amounts of insurance or inflation.

EARNED HOUSE YEARS One dwelling insured for one year is an Earned House Year. An Earned House Year represents a measure of the earned exposure rather than written exposure. Use of earned house years would alleviate the second problem listed under Average Policies In Force. However, the other problems would remain.

AMOUNT OF INS YEARS **AMOUNT OF INSURANCE YEAR(AIY)** is defined as $1,000 of building coverage in force for one year. The statistic is sensitive to inflation, policy growth and changes in building costs.

If Hypothetical Insurance Company insures a $100,000 dwelling continuously in 1974 for one year and suffers a total loss to the dwelling, the loss would be stated as $100,000/100 AIY or $1000/AIY. If Hypothetical insures the same dwelling in 1988, the policy limits will have increased to, say, $240,000. A total loss in 1988 would be $240,000/240 AIY or $1000/AIY. Consequently, a $1.00 of loss per AIY in 1974 is comparable to $1.00 of loss per AIY in 1988.

If Hypothetical now had 12 such policies in 1988 instead of the one policy in 1974, the 100 AIY of 1974 will have grown to 12 x 240 or 2,880 AIY in 1988. Hypothetical's exposure to loss is 28.8 times as great in 1988 as it was in 1974. The aggregate AIY statistic has grown by a factor of 12 for policy growth and 2.4 due to inflation and building costs or 28.8 total.

Amount of Insurance Years appears to be an appropriate base for the measurement of exposure to catastrophe loss assuming no significant changes in the average relationship of insurance to replacement values.

PROPOSED CATASTROPHE PROCEDURE

In order to adequately provide in its rate level in a particular state for catastrophe losses, a company needs to first determine its need at a companywide level. In doing so, the company can treat hurricane losses either independently or as any other catastrophe loss. Since hurricanes present an entirely different exposure and entirely different challenges than other catastrophe losses, separate treatment is warranted.

The companywide needs for hurricane and non-hurricane catastrophes must be determined with many factors in mind. Some factors which must be recognized include:

(1) Management inclination to risk

The degree to which Management is willing to risk surplus for the payment of unexpected losses must be reflected in the company's ratemaking procedure.

(2) Surplus position

The risk that a single catastrophe loss could cause a company to become insolvent must be analyzed and incorporated into the determination of an appropriate rate.

(3) Reinsurance

Although the existence or non-existence of sufficient and reliable catastrophe reinsurance does not enter the ratemaking formula directly, it must be considered in the determination of an acceptable assumption of risk to surplus.

(4) Sources/Availability of Additional Capital

A mutual which cannot issue stock to raise capital may not risk surplus for catastrophes as readily as a stock company which can raise funds through the sale of stock.

Once the companywide catastrophe need is determined, the company must incorporate catastrophe provisions into individual state rate making formulae in such a way as to meet that companywide objective. In addition to the companywide objective, considerations in the determination of statewide provisions must include:

(1) Stability

Insurance involves the removal of an uncertainty(loss) in exchange for a certainty(premium). The occurrence of a catastrophic loss should not cause an insured's premium to increase dramatically or the certainty(premium) becomes uncertain. The likely result of this would be an unsatisfied customer who seeks out another insurance carrier.

(2) Equity

Any state catastrophe procedure must at the same time adequately reflect that state's exposure to catastrophe and recognize companywide surplus is available for catastrophe losses in each and every state. The fact that a major hurricane hits South Carolina should not dramatically affect the catastrophe provision in Nebraska. Along the same lines, a tornado in Nebraska should leave the catastrophe provision in Illinois relatively unaffected.

Since surplus cannot and should not be segregated to individual states or lines, there must be a proper balance to the two schools of thought:

(a) "We're all in this together'", and

(b) "Each state stands on its own."

The proposed catastrophe provision which follows details a method to determine a company's catastrophe needs and a method to capture that need on a statewide level. The method addresses the considerations noted above in the following manners:

Companywide: After giving due consideration to financial position and reinsurance, Management can determine the confidence it demands in the companywide catastrophe provision. Hurricane losses are treated independently.

Individual States: In order to recognize that surplus is available for the protection against extremely large occurrences and that these large occurrences can threaten the stability in the rate level, individual catastrophe losses are censored (limited or capped) prior to entering an individual state's calculation. Because each occurrence of catastrophe loss is subject to capping, it is likely that a provision in excess of the censored mean is needed.

GENERAL METHOD

For each of hurricane and non-hurricane exposures a separate catastrophe provision per exposure is determined by the following formula:

Provision = **Mean** + (**t**) x (**Standard Deviation**)

where : **Mean** = average $ catastrophes per exposure

t = t - statistic for the desired confidence interval

Standard Deviation = unbiased standard deviation of the mean historical $ catastrophes per exposure

For example, if the desired confidence is 50%, then t = 0 and the catastrophe provision is the mean $ catastrophes per exposure. In addition:

PR (actual $Cat/exposure $\leq$ Cat Provision) = 50%

The provision can be multiplied by the projected exposure to determine the catastrophe provision in dollars. By the choice of confidence intervals, Company Management can determine with what certainty they desire to provide for catastrophe losses with collected premium.

NON-HURRICANE CATASTROPHE NEED

Hypothetical Insurance Company's needed catastrophe premium can be estimated by analyzing historical catastrophe data stated as a factor of Amount of Insurance Years. See Exhibit #7 which is summarized below:

Mean Annual $ Catastrophe Per AIY	=	$ 0.3151
Standard Deviation of the Mean $ Cat / AIY	=	0.0372
Standard deviation of the annual $ Cat / AIY	=	0.1703

The annual catastrophes represent a random sample from a distribution with an unknown variance. If $\bar{X}$ is the sample mean and $S^2 = \sum(X - \bar{X})^2 / n(n-1)$ then for the desired confidence (p) and corresponding t-statistic (t_0)

$PR[\ \mu \leq X + t_0 S] = p$, where μ is the theoretical annual mean catastrophe.

In other words, a provision of $\bar{X} + t_0 S$ will provide a catastrophe provision to meet the long run needs of the company with a probability of p.

The provision per AIY necessary for Hypothetical to be 90% certain that the non-hurricane catastrophe provision is sufficient in the long run is determined below:

Provision = **Mean** + (**t**) x (**Standard Deviation**)

= 0.3151 + 1.323 x 0.0372

= 0.3643

where : 0.3151 = mean $ catastrophes per exposure
1.323 = t - statistic for 90% and 21 degrees of freedom (22-1).
0.0372 = unbiased standard deviation of the mean historical $ catastrophes per exposure

So, if Hypothetical wishes to be "90% certain" that long-run catastrophe needs are adequately provided for in the rate level, current data suggests a factor of 36.43 cents per $1,000 of building coverage be used for non-hurricane catastrophes.

Hypothetical's exposures can be projected by fitting a least squares line to Amount of Insurance Years. See Exhibit #8.
To determine Hypothetical's needed catastrophe premium on a companywide basis, the 36.43 cents can be multiplied by projected exposures. For example, for Hypothetical to be 90% certain catastrophes are covered, current data suggests $130,819,558 (359,098,431 x .3643) in catastrophe premium must be collected in 1991. This amounts to approximately $19.33 per policy(.3643 x 53.048).

Although the discussion here centers on funding of long-term catastrophe needs, in solvency threatening financial situations the procedure can be used to provide the desired confidence that short term needs are also met. This is accomplished by replacing the standard deviation of the sample mean with the standard deviation of the sample. For example, if Hypothetical needs to be 90% certain that its catastrophe losses in the coming year did not exceed the catastrophe provision in its rates, current data suggests a 54.04 cents per AIY catastrophe provision be used.{1}

{1} $0.5404 = .3151 + 1.323 x .1703

HURRICANE COMPANYWIDE NEEDS Hurricane data has been removed from the analysis to this point. Hurricanes present an exposure quite different from hail, tornadoes, etc. Only the coastal states have a significant hurricane exposure. Hurricane losses are more infrequent and more severe than non-hurricane catastrophes. Consequently, a larger number of years of data is needed. Hypothetical has 30 years of hurricane data available and it is summarized in Exhibit #9.

EXPOSURE TO HURRICANES Hypothetical measures its exposure to hurricane loss as Amount Of Insurance Years in the coastal states. In the 30 years of data compiled by Hypothetical, 38 hurricanes have produced losses in the coastal states. This data may allow reasonable estimates of a hurricane hitting the coastal states or a group of states. However, the data is not sufficient to estimate the probability that a particular state incurs a hurricane loss nor is it sufficient to estimate the expected value of losses in a particular state. In addition, it is rare that hurricanes affect a single state.

Consequently, states are grouped in the analysis of hurricane needs as follows:

Group I : Gulf Coast States

Group II : Mid-Atlantic States

Group III : North Atlantic States

HURRICANE PROVISION The provision per AIY necessary for Hypothetical (See Exhibit #9) to be 90% certain that hurricane losses companywide will not exceed the hurricane premium collected over the long run is shown below:

Provision = **Mean** + (**t**) x (**Standard Deviation**)

= 0.1882 + 1.311 x 0.0553

= 0.2607

where : 0.1882 = mean $ catastrophes per exposure restated to current exposure levels
1.311 = t - statistic for 90% and 29 degrees of freedom (30-1).
0.0533 = unbiased standard deviation of the mean historical $ hurricane per exposure

Hypothetical projects exposures by state in the same manner as it does companywide(5 year least squares line). The result is a projected exposure to hurricane losses in 1991 of 133,553,635 AIY. In order for Hypothetical to be 90% certain that hurricane losses are adequately provided in the rate level it must collect $34,817,433(133,553,635 x .2607) of premium in 1991.

Therefore, Hypothetical needs to collect $165,636,991 in catastrophe premium ($130,819,558 + $34,817,433) for both non-hurricane and hurricane losses in order to meet its long-term 90% confidence in its catastrophe premium.

INDIVIDUAL STATE PROVISIONS

NON-HURRICANE

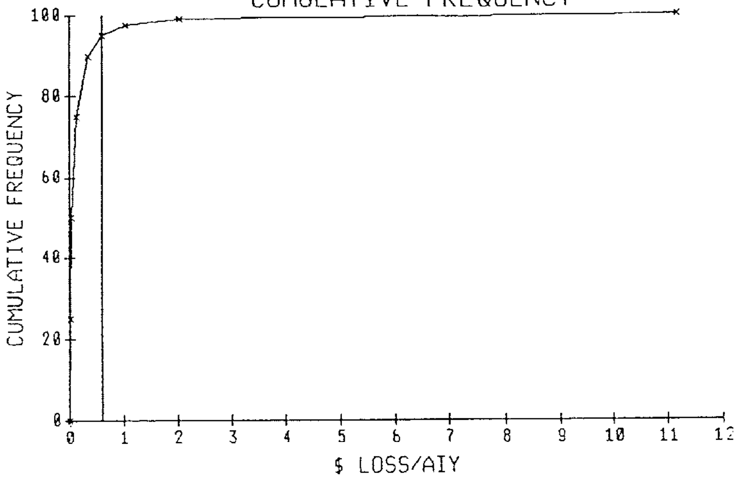
Hypothetical's needed catastrophe provision must be obtained by summing catastrophe provisions of individual states at projected exposure levels. The companywide provision(36.43 cents per AIY) could be used in each and every state. This amounts to the "We're all in this together" train of thought. An alternative is to perform an analysis similar to companywide using individual state data. This is the "Each state stands on its own" line of reasoning. The method following attempts to balance these two lines of thought.

SEVERITY LIMITED

To recognize the potentially devastating effect a single occurrence can have on a state's experience and to provide needed stability, the severity of individual catastrophes are limited prior to the analysis of a state's catastrophe losses. The "cap" on individual catastrophes should be determined such that the largest catastrophes incurred by the company are limited but not those that occur relatively frequently.

Figure #1 graphically displays the company's catastrophes stated as a $ per statewide exposure(AIY). A $300,000 catastrophe in a state where the company may have little business can be compared to a $3,000,000 catastrophe in a state where the company has significant exposure. The largest 1% of the catastrophes in the data exceeded $2.04 per Amount of Insurance Year in the state of occurrence and the largest 5% exceeded 59 cents per AIY.

FIGURE #1
HOMEOWNERS CATASTROPHES
CUMULATIVE FREQUENCY



As stated earlier, individual catastrophes should be censored, or limited, in the analysis of a state's catastrophe provision. The censor point should be chosen such that the largest and most infrequent catastrophes are limited. Figure #1 shows that the cumulative frequency "flattens" significantly at 95%, or about 59 cents per AIY. Therefore, a cap of 59 cents will be used in the remainder of this analysis. Catastrophe losses per exposure(AIY) are compared to the cap rather than aggregate dollars of catastrophe loss. In an individual state, individual catastrophes in excess of 59 cents per statewide AIY enter the analysis as 59 cents per AIY.

Exhibit #10 details non-hurricane catastrophes by year in State A. Since individual occurrences are limited to 59 cents per AIY, the $912,478 loss in 1974 will be limited to .59 x 813,750 = $480,113. Exhibit #11 displays the aggregate catastrophes by year for State A. Catastrophes are shown both capped and uncapped. Note the $432,365 difference in 1974 (912,478 - 480,113 =

1,139,874 - 707,509). Capped catastrophes enter the state's catastrophe provision.

CONFIDENCE

The statewide catastrophe provision is to be used in the development of an indicated rate level adjustment. Consequently short term needs must also be addressed. Over the period rates are to be in effect, there should be a reasonable certainty that premium adequately provides for catastrophe losses. Therefore the derivation of statewide provisions uses the mean and the standard deviation of the annual capped loss per AIY instead of the standard deviation of the mean.

Logically, a 50% certainty that catastrophe losses are provided in the rate level would be a good provision. However, two factors need be to considered:

(1) Companywide needs

The sum of the individual state provisions must provide enough premium companywide to satisfy long term needs($0.3643 per AIY). The sum of individual states' factors with no cap and a 50% confidence yields a companywide provision equal to $0.3334/AIY which is short of the long term need.

(2) Severity is limited

In addition, since the severity of individual catastrophes is limited, it is necessary to be more than 50% certain capped catastrophes are met in order to provide catastrophe needs. The lowest confidence that short term individual state needs are met with the largest 5% of catastrophe capped **AND** the long term companywide objective is also satisfied is 65%. See Table #1.

TABLE #1
Non-Hurricane Catastrophe Provisions

Confidence Interval	Sum of States Uncapped	Sum of States Capped	Companywide Uncapped
50%	0.3334	0.2682	0.3151
55	0.3825	0.2998	0.3198
60	0.4328	0.3323	0.3247
65	0.4848	0.3657	0.3297
70	0.5392	0.4008	0.3349
75	0.5988	0.4392	0.3406
80	0.6657	0.4823	0.3471
85	0.7447	0.5332	0.3546
90	0.8452	0.5981	0.3643
95	0.9999	0.6973	0.3791

The "Sum of States" column is the aggregate provision resulting from individual state provisions necessary to allow the desired confidence that the **Annual,** catastrophe losses are covered. "Capped" individual losses are limited to $0.59/AIY. The Companywide column is the provision necessary to allow the desired confidence that the **Long-Term,** uncapped catastrophe losses will be covered.(2)

The provision necessary for Hypothetical to be 65% certain that it provides for capped catastrophes in State A is shown below:

Provision = **Mean** + (**t**) x (**Standard Deviation**)
= 0.3255 + 0.391 x 0.3632
= 0.4675

where : 0.3255 = mean $ capped catastrophes per exposure
0.391 = t - statistic for 65% and 21 degrees of freedom (22-1).
0.3632 = unbiased standard deviation of the annual $ capped cat. per exposure

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(2) A computer application can be written to provide an interactive check of state sums versus companywide needs with various inputs.

The statewide need per exposure can be multiplied by the projected exposures in that state. The resulting catastrophe provision per policy can be used to determine the indicated rate level adjustment. See Exhibits #12 and #13.

$$\text{Provision Per Policy} = \begin{array}{c}\text{Projected} \\ \text{Exposure}\end{array} \times \begin{array}{c}\text{Provision} \\ \text{Per Exposure}\end{array}$$

$$= 61.142 \times \$0.4675$$

$$= \$28.58$$

If the state is exposed to hurricane losses the hurricane provision must also be included.

HURRICANE

Hurricane experience is sparse even on a companywide level. Consequently, it is not possible to treat hurricanes in the same manner as non-hurricanes in the determination of individual state provisions. One method to capture the companywide need is to allocate the needed companywide premium to the affected coastal states.

HURRICANE GROUPS

The companywide needed hurricane premium is first allocated to hurricane group based on the Group's long-term frequency (number of years the group incurred hurricane losses) times the MEDIAN hurricane losses (at current cost and exposure levels) in the years the group suffered loss.

The median severity is used so that the allocation to group will not be unduly affected by a single occurrence. Hypothetical's allocation to Group is shown in Table #2.

TABLE #2
ALLOCATION OF COMPANYWIDE HURRICANE PREMIUM TO HURRICANE GROUP

Group (A)	Number of Yrs w/Hurr. Losses (B)	Median Annual(3) Hurricane Loss (C)	(B) x (C) (D)	% (E)	Hurricane Premium (E) x TOT(E) (F)
I	20	$ 6,439,679	$128,793,575	91%	$27,818,717
II	10	424,594	4,245,940	3	917,101
III	6	1,415,314	8,491,884	6	1,834,201
Total	24	$ 5,897,142	$141,531,409	100%	$30,570,019

TO INDIVIDUAL STATES

A hurricane group's premium is allocated to states within that group according to that state's relative distribution of exposure to hurricane loss. A hurricane loses strength rapidly after reaching land. The first 100 miles of land is most severely impacted by the hurricane, although damage does occur beyond that. Consequently, relative exposure to hurricane loss is measured here as an average of the distributions statewide exposure and of coastal exposures(within 100 miles). For example, if State A has 25% of the exposures in hurricane group III states, and 10% of the group III exposures that are within 100 miles of the coast, State A receives 17.5% (35% / 2) of Group III hurricane premium.

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(3) Hurricane losses are first brought to current cost and exposure levels using Amount of Insurance Years in affected states.

Table #3 details the allocation to state of Group III hurricane premium.

TABLE #3
ALLOCATION OF GROUP III HURRICANE PREMIUM TO STATE

State (1)	Statewide Exposures (2)	% (3)	Exposures w/in 100 Mi (4)	% (5)	Relative Exposure to Hurricane (6)	Hurricane Premium 1988 $ (7)	Hurricane Premium Per AIY (8)
A	4,778,181	9.7%	940,575	3.1%	6.4%	$ 1,780,398	0.3726
B	16,900,000	34.5	16,900,000	55.7	45.1	12,546,241	0.7424
C	6,439,380	13.1	5,249,013	17.3	15.2	4,228,445	0.6567
D	1,782,420	3.6	788,869	2.6	3.1	862,380	0.4838
E	19,232,631	39.1	6,462,657	21.3	30.2	8,401,253	0.4368
Group III	49,132,612	100.0%	30,341,114	100.0%	100.0%	$27,818,717	0.5662

(2) : Amount of Insurance Years Statewide in 1988
(3) : State (2) divided by Group III (2)
(4) : Amount of Insurance Years in Counties within 100 miles of the coast in 1988
(5) : State (4) divided by Group III (4)
(6) : Average of (3) and (5)
(7) : Group III hurricane premium in 1988 times (6)
(8) : (7) divided by (2)

The Hurricane provision per Amount of Insurance Years (Column 8 above) can be multiplied by the projected average risk amount to determine a hurricane provision for future periods. The provision determined for the appropriate policy period can be used in the determination of indicated rate level adjustments. For example, if the projected average risk amount at the mid-point of the period rates are to be in effect for the State A is $61,142, the hurricane provision needed is $.3726 x 61.142 = $ 22.78.

COMPARISON WITH CURRENT METHODS

Exhibit #12 compares the result of the Amount of Insurance Years catastrophe procedure with the Cat/Non-Cat procedure in use today using the same data, same effective dates and same trending of non-cat losses used in the discussion of current techniques. Combining the non-hurricane and hurricane provisions results in a catastrophe provision of $51.36 which is 4.6% larger than the 1988 provision. This is the same increase projected in average risk amount. You may recall the Cat/Non-Cat method produced a declining catastrophe provision($45.18 vs. $46.89).

INDICATED RATE LEVEL ADJUSTMENT

Exhibit #13 details the indicated rate level adjustment for State A using the same data as used in the discussions of current methods. The catastrophe adjustment is found by dividing the two catastrophe provisions per policy (hurricane and non-hurricane) by the projected non-catastrophe loss per policy. The proposed method results in an indicated 8.5% rate level decrease.

Table #4 , below, provides a comparison of the three methods presented in this paper.

TABLE #4

	CATASTROPHE PROVISION	INDICATED CHANGE IN RATES
CAT/NON-CAT	$ 45.18	- 10.9%
EXCESS WIND	33.41	- 23.7
AMT OF INS YRS	51.36	- 8.5

The Amount Of Insurance Years procedure results in an indicated change close to that produced in the Cat/Norm procedure used today in this example. However, depending on the trends indicated in non-cat loss per policy, the disparity between the two methods may be much more pronounced. The catastrophe provision produced in the proposed procedure will not vary with the trends in non-cat losses only with trends in exposure.

CONCLUSION

This paper attempts to point out possible problems with the current treatment of the catastrophe exposures in Homeowners ratemaking and offers an alternative. The Amount of Insurance Year procedure presented allows the Actuary another statistical tool to use in Ratemaking while providing ample opportunity for judgment. There are other possible uses for the method, one of which is set out in Appendix #1. As this is a radical departure from current methodology, critical review of the procedure is necessary. A few possible areas of improvement are listed in Appendix #2.

EXHIBIT #1
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

Year (0)	Earned House Years (1)	Total Incurred Loss & LAE (2)	Catastrophe Loss & LAE (3)	Non Catastrophe Loss & LAE (4)	Cat/ Non-Cat (3)/(4) (5)	Non-Cat Per EHY (4)/(1) (6)
1967	15,366	845,412	81,609	763,802	10.7	49.71
1968	17,606	570,453	41,900	528,554	7.9	30.02
1969	20,506	1,004,641	74,612	930,029	8.0	45.35
1970	23,536	1,120,101	18,208	1,101,893	1.7	46.82
1971	26,265	1,633,075	32,535	1,600,540	2.0	60.94
1972	29,163	1,567,995	185	1,567,810	0.0	53.76
1973	32,777	3,484,358	874,257	2,610,102	33.5	79.63
1974	36,390	3,454,877	1,139,875	2,315,002	49.2	63.62
1975	40,384	4,007,423	768,428	3,238,995	23.7	80.20
1976	45,339	4,232,421	106,135	4,126,286	2.6	91.01
1977	50,147	4,921,212	420,704	4,500,508	9.3	89.75
1978	54,247	6,082,403	64,271	6,018,132	1.1	110.94
1979	57,969	23,665,259	16,540,327	7,124,932	232.1	122.91
1980	61,878	10,956,617	1,000,425	9,956,191	10.0	160.90
1981	65,504	12,439,020	771,975	11,667,044	6.6	178.11
1982	68,465	14,525,433	2,581,112	11,944,322	21.6	174.46
1983	71,959	15,803,972	1,938,096	13,865,876	14.0	192.69
1984	76,198	18,468,184	1,843,672	16,624,512	11.1	218.18
1985	79,193	22,136,911	6,009,964	16,126,947	37.3	203.64
1986	79,705	18,155,750	433,845	17,721,905	2.4	222.34
1987	79,533	15,763,875	236,993	15,526,882	1.5	195.23
1988	81,176	20,667,221	3,998,539	16,668,682	24.0	205.34

Arithmetic Average	23.2
"Smoothed"	23.2
Weighted Average	23.4
"Smoothed"	23.3

- "Smoothed" averages give 95% weight to the prior year long term average and 5% weight to the latest year ratio.

- Earned House Years equal the number of houses insured for one full year.

- LAE equals loss adjustment expenses, both Allocated and Unallocated.

EXHIBIT #2
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

INDICATED CHANGE BASED ON CAT/NORM CATASTROPHE FACTOR

YEAR (0)	NON-CAT LOSS RATIO (1)	FACTOR TO ADJUST PREMIUM (2)	FACTOR TO ADJUST LOSSES (3)	LOSS RATIO ADJUSTMENT FACTOR (4)	FORMULA LOSS RATIO (5)	WEIGHT (6)
1984	72.6%	1.3252	0.9026	0.6811	49.4%	16.7%
1985	63.1	1.2077	0.9171	0.7594	47.9	18.7
1986	63.5	1.0696	0.9320	0.8714	55.3	20.4
1987	51.9	0.9294	0.9475	1.0195	52.9	21.9
1988	54.8	0.9418	0.9635	1.0230	56.1	22.3

Weighted Formula Loss Ratio 52.6%

(1)

Loss Ratio After Catastrophe Adjustment (52.6% x 1.232) 64.8

(2)

Permissible Loss Ratio (100.0 - 25.3 - 2.0) 72.7

(3)

Indicated Change (64.8 / 72.7 - 1) -10.9%

Notes:

Column 2: Factor necessary to adjust premium for rate changes and expected amount of insurance over the period rates are to be in effect. (Exhibit #5)

Column 3: Factor to trend losses to midpoint of period rates are to be in effect. Assumes no coverage or deductible conversions in the five year period. See Exhibit #5.

Column 4: Column 3 divided by Column 2

Column 5: Column 1 times Column 4

Column 6: Weight based on actual earned premium

(1): 23.2% is the arithmetic average of cat to non-cat losse as shown on Exhibit #1.

(2): Assuming 25.3% Underwriting Expenses and 2.0% profit & contingencies, 72.7% is the permissible loss ratio.

(3): If fixed expenses are projected to be 5.3% of premium a alternative calculation might be:

Indicated Change = (64.8 + 5.3)/(100.0-20.0-2.C
= 70.1/78.0 - 1
= -10.1%

EXHIBIT #3
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A
DEVELOPMENT OF EXCESS WIND FACTOR

Year	Homeowners Total Losses (1)	Homeowners Wind Losses (2)	Total - Wind (1) - (2) (3)	Wind / (Tot-Wind) (2) / (3) (4)	(4) > 1.5M Wind/(T-W) Excess Yrs (5)	(5) - M Excess Wind Ratio (6)	(6) * (3) Excess Wind Losses (7)	Total/ Total-Excess (1)/ (1)-(7) (8)
1967	845,412	316,622	528,789	0.5988	0.5988	0.4628	244,724	1.4074
1968	570,453	228,181	342,272	0.6667	0.6667	0.5307	181,644	1.4672
1969	1,004,641	105,756	898,885	0.1177		0.0000	0	1.0000
1970	1,120,101	52,242	1,067,859	0.0489		0.0000	0	1.0000
1971	1,633,075	98,909	1,534,166	0.0645		0.0000	0	1.0000
1972	1,567,995	95,744	1,472,251	0.0650		0.0000	0	1.0000
1973	3,484,358	1,056,036	2,428,322	0.4349	0.4349	0.2989	725,826	1.2631
1974	3,454,877	1,188,445	2,266,432	0.5244	0.5244	0.3884	880,282	1.3419
1975	4,007,423	928,997	3,078,426	0.3018	0.3018	0.1658	510,403	1.1460
1976	4,232,421	221,641	4,010,781	0.0553		0.0000	0	1.0000
1977	4,921,212	547,612	4,373,600	0.1252		0.0000	0	1.0000
1978	6,082,403	349,976	5,732,426	0.0611		0.0000	0	1.0000
1979	23,665,259	17,074,756	6,590,504	2.5908	2.5908	2.4548	16,178,368	3.1609
1980	10,956,617	1,711,994	9,244,623	0.1852		0.0000	0	1.0000
1981	12,439,020	1,396,752	11,042,268	0.1265		0.0000	0	1.0000
1982	14,525,433	2,027,224	12,498,210	0.1622		0.0000	0	1.0000
1983	15,803,972	1,829,199	13,974,773	0.1309		0.0000	0	1.0000
1984	18,468,184	2,282,216	16,185,968	0.1410		0.0000	0	1.0000
1985	22,136,911	5,214,643	16,922,268	0.3082	0.3082	0.1722	2,914,015	1.1516
1986	18,155,750	1,478,320	16,677,430	0.0886		0.0000	0	1.0000
1987	15,763,875	1,152,743	14,611,132	0.0789		0.0000	0	1.0000
1988	20,667,221	6,109,378	14,557,843	0.4197	0.4197	0.2837	4,130,060	1.2497
SUM	205,506,613	45,467,386	160,039,228	7.2963		4.7573	25,765,322	26.1878

MEDIAN(M) = 0.1360

AVERAGE EXCESS WIND FACTOR(AEWR) = 4.7573/22 = 0.2162

AVERAGE WIND TO NON-WIND RATIO(AWNWR) = 7.2963/22 = 0.3317

EXCESS WIND FACTOR(EWF) = 1.00 + AEWR/(1.0 + AWNWR - AEWR)
= 1.00 + .2162/(1.0 + .3317 - .2162)
= 1.00 + .2162/1.1155
= 1.194

EXHIBIT #4
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

INDICATED CHANGE BASED ON EXCESS WIND FACTOR

YEAR (0)	TOTAL - XS WIND RATIO (1)	FACTOR TO ADJUST PREMIUM (2)	FACTOR TO ADJUST LOSSES (3)	LOSS RATIO ADJUSTMENT FACTOR (4)	FORMULA LOSS RATIO (5)	WEIGHT (6)
1984	80.7%	1.3252	0.6963	0.5254	42.4%	16.7
1985	75.2	1.2077	0.7323	0.6064	45.6	18.7
1986	65.0	1.0696	0.7724	0.7221	46.9	20.4
1987	52.7	0.9294	0.8170	0.8791	46.3	21.9
1988	54.4	0.9418	0.8671	0.9206	50.1	22.3

Weighted Formula Loss Ratio 46.5%

{1}
Loss Ratio After Excess Wind Adjustment
(46.5% x 1.194) 55.5

{2}
Permissible Loss Ratio 72.7
(100.0 - 25.3 - 2.0)

{3}
Indicated Change -23.7%
(55.5 / 72.7 - 1)

Notes:
- Column 1: Ratio of Total Losses less Excess Wind losses to Earned Premium
- Column 2: Factor necessary to adjust premium for rate changes and expected amount of insurance over the period rates are to be in effect. See Exhibit #5
- Column 3: Factor to trend losses to midpoint of period rates are to be in effect. Assumes no coverage or deductible conversions in the five year period(Exh #5
- Column 4: Column 3 divided by Column 2
- Column 5: Column 1 times Column 4
- Column 6: Weight based on actual earned premium
- {1}: 19.4% is the arithmetic average of Excess Wind to (Total less Excess Wind) as shown in Exhibit #3.
- {2}: Assuming 25.3% Underwriting Expenses and 2.0% profit & contingencies, 72.7% is the permissible loss ratio.
- {3}: If fixed expenses are projected to be 5.3% of premium an alternative calculation might be:

  Indicated Change = (55.5 + 5.3)/(100.0-20.0-2.0)
  = 60.8/78.0 - 1
  = -22.8%

EXHIBIT #5
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

DEVELOPMENT OF LOSS RATIO ADJUSTMENT FACTORS

YEAR	NON-CAT LOSS PER EHY ACTUAL	NON-CAT LOSS PER EHY FITTED	FACTOR TO 9/01/90	TOTAL - XS WIND PER EHY ACTUAL	TOTAL - XS WIND PER EHY FITTED	FACTOR TO 9/01/90
1984	218.18	215.76	0.9026	242.37	247.33	0.6963
1985	203.64	212.35	0.9171	242.73	235.15	0.7323
1986	222.34	208.94	0.9320	227.78	222.96	0.7724
1987	195.23	205.53	0.9475	198.21	210.78	0.8170
1988	205.34	202.13	0.9635	203.72	198.60	0.8671
9/01/90		194.74			172.21	

YEAR	AVERAGE RISK AMOUNT ACTUAL	AVERAGE RISK AMOUNT FITTED	FACTOR TO 3/01/90 *	RATE CHANGE FACTOR	FACTOR TO ADJUST PREMIUM
1984	52,276	51,970	1.1588	1.1436	1.3252
1985	53,579	53,588	1.1268	1.0718	1.2077
1986	54,724	55,207	1.0968	0.9752	1.0696
1987	56,594	56,826	1.0684	0.8699	0.9294
1988	58,862	58,444	1.0415	0.9043	0.9418
3/01/90		61,142			

* Assumes a 1% change in policy amount results in a 0.9% change in premium

EXHIBIT #6
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

CATASTROPHE PROVISION PER POLICY

YEAR	{1} CAT/NON-CAT Losses Per EHY Non-Cat	Cat.	{2} EXCESS WIND Losses Per EHY Normal	Excess	{3} AVERAGE RISK AMOUNT
1984	$215.76	$50.05	$247.33	$47.98	$51,970
1985	212.35	49.26	235.15	45.62	53,588
1986	208.94	48.47	222.96	43.25	55,207
1987	205.53	47.68	210.78	40.89	56,826
1988	202.13	46.89	198.60	38.53	58,444
9/01/90	$194.74	$45.18	$172.21	$33.41	$61,142

{1} Non-Cat = Fitted Non-Cat Loss Per EHY from Exhibit #5
Cat. = Non-Cat Loss Per EHY x .232

{2} Normal = Fitted Total - XS Wind Loss Per EHY from Exhibit #5
Cat. = Normal Loss Per EHY x .194

{3} Average Risk Amount = Fitted Average Risk Amount from Exhibit #5

EXHIBIT #7
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
COMPANYWIDE

NON-HURRICANE CATASTROPHES

Year	Amount Of Insurance Years	Non-Hurricane Catastrophe Losses	Cats/AIY
1967	13,172,168	3,122,628	0.2371
1968	15,676,497	2,634,634	0.1681
1969	18,193,566	2,419,517	0.1330
1970	19,876,790	1,581,906	0.0796
1971	22,342,189	2,671,583	0.1196
1972	25,508,456	3,710,755	0.1455
1973	29,119,766	6,897,827	0.2369
1974	36,987,883	21,143,432	0.5716
1975	46,855,779	13,516,388	0.2885
1976	57,983,165	8,581,363	0.1480
1977	70,591,203	12,178,704	0.1725
1978	86,821,204	29,485,971	0.3396
1979	109,434,439	61,034,982	0.5577
1980	135,437,077	67,304,534	0.4969
1981	161,691,984	49,307,525	0.3049
1982	181,397,934	100,961,843	0.5566
1983	192,656,460	124,418,629	0.6458
1984	208,849,594	104,189,018	0.4989
1985	231,392,459	90,643,935	0.3917
1986	251,541,585	77,542,265	0.3083
1987	271,398,353	70,916,918	0.2613
1988	296,090,569	80,167,984	0.2708

Mean $Cat/AIY 0.3151

Standard Deviation of the Mean $Cat/AIY 0.0372

Standard Deviation of the Annual $Cat/AIY 0.1703

EXHIBIT #8
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
COMPANYWIDE EXPOSURES

Year	Amount Of Insurance Years Actual	Amount Of Insurance Years Fitted (1)	Average Risk Amount Actual	Average Risk Amount Fitted(2)
1984	208,849,594	208,956,943	$42,935	$42,912
1985	231,392,459	230,405,727	44,367	44,360
1986	251,541,585	251,854,511	45,735	45,808
1987	271,398,353	273,303,295	47,297	47,256
1988	296,090,569	294,752,079	48,711	48,704
1989P	---	316,200,863	---	50,152
1990P	---	337,649,647	---	51,600
1991P	---	359,098,431	---	53,048

(1) $AIY_t = 187{,}508{,}159 + 21{,}448{,}784 \times t$

(2) $ARA_t = 41{,}464 + 1{,}448 \times t$

where 1984 yields $t = 1$

EXHIBIT #9
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
HURRICANE CATASTROPHES
COMPANYWIDE

Year	Hurricane Catastrophe Losses	Restated Hurricane Catastrophe Losses {1}	Cats/AIY{2}
1959	3,437	891,639	0.0076
1960	102,335	43,816,842	0.3737
1961	117,388	42,268,033	0.3604
1962	0	0	0.0000
1963	0	0	0.0000
1964	1,167,008	76,439,753	0.6518
1965	1,974,738	106,287,814	0.9064
1966	117,117	4,190,555	0.0357
1967	116,876	8,135,218	0.0694
1968	131,612	2,764,822	0.0236
1969	1,356,623	12,150,394	0.1036
1970	2,760,068	114,572,918	0.9770
1971	382,850	6,085,383	0.0519
1972	142,836	1,614,260	0.0138
1973	20,848	482,250	0.0041
1974	312,778	2,951,149	0.0252
1975	993,730	5,708,901	0.0487
1976	456,177	2,759,103	0.0235
1977	0	0	0.0000
1978	0	0	0.0000
1979	29,342,051	66,857,888	0.5701
1980	3,430,362	10,819,272	0.0923
1981	0	0	0.0000
1982	0	0	0.0000
1983	48,455,620	85,502,659	0.7291
1984	1,075,447	1,887,588	0.0161
1985	47,537,895	61,063,002	0.5207
1986	1,786,309	2,113,084	0.0180
1987	81,492	90,090	0.0008
1988	2,556,404	2,556,404	0.0218
		Mean $Cat/AIY	0.1882
		Standard Deviation of the Mean $Cat/AIY	0.0553
		Standard Deviation of the Annual $Cat/AIY	0.2977

{1} Actual Hurricane brought to 1988 exposure levels(AIY) by state
{2} 1988 Amount of Insurance Years in hurricane states = 117,266,240

EXHIBIT #10
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

NON-HURRICANE CATASTROPHE LOSSES

Year Of Occurrence	Amount Of Insurance Years	Number Of Non-Hurricane Catastrophes	Current Estimate of Loss by Individual Catastrophe						
1967	298,515	1	2,054	0	0	0	0	0	0
1968	355,394	2	88	41,812	0	0	0	0	0
1969	405,775	0	0	0	0	0	0	0	0
1970	451,157	2	17,304	904	0	0	0	0	0
1971	506,457	2	19,302	1,695	0	0	0	0	0
1972	577,555	1	185	0	0	0	0	0	0
1973	657,841	6	5,538	11,822	23,063	175,973	626,539	31,321	0
1974	813,750	4	117,738	108,863	912,478	795	0	0	0
1975	1,019,259	3	227,820	81,986	458,622	0	0	0	0
1976	1,287,302	2	1,865	49,295	0	0	0	0	0
1977	1,541,466	4	116	100,459	284,908	85,543	0	0	0
1978	1,862,945	1	10,433	0	0	0	0	0	0
1979	2,271,520	4	56,982	55,121	14,707	108,608	0	0	0
1980	2,749,970	1	110,343	0	0	0	0	0	0
1981	3,191,183	1	754,890	0	0	0	0	0	0
1982	3,468,106	5	93,188	853,843	205,979	1,295,716	737	0	0
1983	3,720,099	7	94,223	76,213	99,258	267,477	80,759	161,225	1,240,765
1984	3,983,346	6	225,324	24,094	89,279	161,946	1,040,195	7,328	0
1985	4,243,080	6	986,205	591,430	743,339	1,525,968	172,986	336,243	0
1986	4,361,727	1	410,809	0	0	0	0	0	0
1987	4,501,080	1	199,783	0	0	0	0	0	0
1988	4,778,181	4	281,047	208,615	2,955,825	542,023	0	0	0

EXHIBIT #11
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

NON-HURRICANE CATASTROPHES

Year	Amount Of Insurance Years	Non-Hurricane Catastrophes UnCapped Losses	Capped Losses	Capped Cats/AIY
1967	295,515	2,054	2,054	0.0069
1968	355,394	41,900	41,900	0.1179
1969	405,775	0	0	0.0000
1970	451,157	18,208	18,208	0.0404
1971	506,457	32,535	32,535	0.0642
1972	577,556	185	185	0.0003
1973	657,841	874,256	635,843	0.9666
1974	813,750	1,139,874	707,509	0.8694
1975	1,019,259	768,428	768,428	0.7539
1976	1,287,302	51,160	51,160	0.0397
1977	1,541,466	471,026	471,026	0.3056
1978	1,862,945	10,433	10,433	0.0056
1979	2,271,520	235,418	235,418	0.1036
1980	2,749,970	110,343	110,343	0.0401
1981	3,191,183	754,890	754,890	0.2366
1982	3,468,106	2,449,463	2,449,463	0.7063
1983	3,720,099	2,019,920	2,019,920	0.5430
1984	3,983,346	1,548,166	1,548,166	0.3887
1985	4,243,080	4,356,171	4,356,171	1.0267
1986	4,361,727	410,809	410,809	0.0942
1987	4,501,080	199,783	199,783	0.0444
1988	4,778,181	3,987,510	3,850,812	0.8059

Mean $Cat/AIY 0.3255

Standard Deviation of the Mean $Cat/AIY 0.0793

Standard Deviation of the Annual $Cat/AIY 0.3632

EXHIBIT #12
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

CATASTROPHE PROVISION PER POLICY

	CAT/NON-CAT		Amount Of Insurance Years				(6 AVERAGE
YEAR	(1) Non-Cat	(2) Cat.	(1) Normal	Total(3) Cat.	(4) Non-Hurr	(5) Hurr.	RISK AMOUNT
1984	$215.76	$50.05	$215.76	$43.62	$ 24.27	$ 19.35	$51,970
1985	212.35	49.26	212.35	45.02	25.05	19.97	53,588
1986	208.94	48.47	208.94	46.38	25.81	20.57	55,207
1987	205.53	47.68	205.53	47.74	26.57	21.17	56,826
1988	202.13	46.89	202.13	49.10	27.32	21.78	58,444
9/01/90	$194.74	$45.18	$194.74	$51.36	$ 28.58	$ 22.78	$61,142

(1) Non-Cat = Fitted Non-Cat Loss Per EHY from Exhibit #5
(2) Cat. = Non-Cat Loss Per EHY x .232
(3) Total Cat. = Sum of Non-Hurr. and Hurr
(4) Non-Hurr. = Average Risk Amount (,000's) x .4675
(5) Hurr. = Average Risk Amount (,000's) x .3726
(6) Average Risk Amount = Fitted Average Risk Amount from Exhibit #5

EXHIBIT #13
HYPOTHETICAL INSURANCE COMPANY
HOMEOWNERS INSURANCE
STATE A

INDICATED CHANGE BASED ON AMOUNT OF INSURANCE YEAR CATASTROPHE FACTOR

YEAR (0)	NON-CAT LOSS RATIO (1)	FACTOR TO ADJUST PREMIUM (2)	FACTOR TO ADJUST LOSSES (3)	LOSS RATIO ADJUSTMENT FACTOR (4)	FORMULA LOSS RATIO (5)	WEIGHT (6)
1984	72.6%	1.3252	0.9026	0.6811	49.4%	16.7%
1985	63.1	1.2077	0.9171	0.7594	47.9	18.7
1986	63.5	1.0696	0.9320	0.8714	55.3	20.4
1987	51.9	0.9294	0.9475	1.0195	52.9	21.9
1988	54.8	0.9418	0.9635	1.0230	56.1	22.3

Weighted Formula Loss Ratio 52.6%

Catastrophe Adjustment (52.6 x 1.264) 66.5% (1)
Non-Hurricane (\$28.58/\$194.74) = .147
Hurricane (\$22.78/\$194.74) = .117

Permissible Loss Ratio 72.7 (2)
(100.0 - 25.3 - 2.0)

Indicated Change - 8.5% (3)
(66.5 / 72.7 - 1)

Notes:
Column 2: Factor necessary to adjust premium for rate changes and expected amount of insurance over the period rates are to be in effect.
Column 3: Factor to trend losses to midpoint of period rates are to be in effect. Assumes no coverage or deductible conversions in the five year period. See Exhibit #5.
Column 4: Column 3 divided by Column 2
Column 5: Column 1 times Column 4
Column 6: Weight based on actual earned premium
(1): 26.4% is the sum of the hurricane and non-hurricane catastrophe provisions divided by the projected non-cat loss per policy.
(2): Assuming 25.3% Underwriting Expenses and 2.0% profit & contingencies, 72.7% is the permissible loss ratio.
(3): If fixed expenses are projected to be 5.3% of premium an alternative calculation might be:

Indicated Change = (66.5 + 5.3)/(100.0-20.0-2.0)
= 70.8/78.0 - 1
= -7.9%

APPENDIX #1
SURPLUS NEEDED TO SUPPORT CATASTROPHE EXPOSURE

Since the Amount Of Insurance Year catastrophe procedure includes a measurement of the variability of catastrophe losses, it may be possible to analyze the surplus needed to support a company's exposure to catastrophes using Probability of Ruin.

Assume that Hypothetical Management desires a 1 in 100 chance that catastrophe losses will exceed surplus. Using the data in Exhibits #7, #8 and #9 Hypothetical can determine the surplus needed to support catastrophe losses.

If the mean catastrophes are expected to be covered by premium collected in the year of occurrence, then Hypothetical must have surplus available to support losses in excess of the mean. Using the standard deviation of the experience, and assuming Normal distributions, the surplus, S needed so that the probability of excess catastrophes does not exceed S is less than or equal to 1% is determined below:

A. Non-Hurricane

S = 2.330 x .1703 x 316,200,863 (1) = $ 125,468,186

B. Hurricane

S = 2.330 x .2977 x 150,000,000 (2) = $ 104,046,150

C. Total Homeowners Catastrophes = $ 229,514,336

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(1) Hypothetical's projected exposure (AIY) in 1989 from Exhibit #8.

(2) Hypothetical's assumed projected exposure in 1989 in states exposed to hurricane losses.

Suppose Hypothetical writes $2 Billion in Net Written Premium as a Company for all lines. Absent reinsurance considerations, Hypothetical needs 11.4 cents of surplus ($229.5/$2,000) to support its **HOMEOWNERS** catastrophe exposure. Surplus is also needed to support catastrophes in other lines including Earthquake.

It is extremely important to note that this discussion has centered only on the surplus needed to support a company's exposure to catastrophe losses. Of course a company requires surplus for many other reasons, such as possible overvaluation of assets, possible undervaluation of liabilities, to support growth, unexpected variance in non-catastrophe underwriting experience, etc. The surplus needed to support these contingencies must be **ADDED** to the result above in any analysis of a company's needed surplus.

APPENDIX #2
POSSIBLE FUTURE IMPROVEMENTS

This paper offers a rather drastic departure from current procedures for incorporating the catastrophe exposure into Homeowners insurance rate levels. Hopefully, the procedure outlined will generate further thoughts on measuring the catastrophe exposure. Possible enhancements and/or improvements to the outlined procedure include:

I. Hurricane Provision

A. Experience Period

Obviously, it is desirable to have more than 30 years of hurricane experience. Even as hurricane experience becomes available, though, can one ever have enough?

B. Companywide Provision

The mean of the annual hurricane losses is assumed to be normally distributed in the determination of the required companywide hurricane provision. While this is not an unreasonable assumption for the mean of the distribution, the effect of severe occurrences on the sample mean must be continuously monitored. The normality assumption may lead to overstatement of the confidence in the mean and, thus, in the long term adequacy of the hurricane provision. The overstatement should not be material.

Appendix #1, however, outlines a method to determine surplus required to support the exposure to hurricane losses. Since the needed surplus is based on the standard deviation of the sample rather than the sample mean, the misstatement due to an invalid normality assumption might be material. The magnitude of the distribution's tail and, therefore, the surplus requirements may be significantly understated.

C. Allocation To State

Any allocation method will likely cause concern. As more data becomes available, the distribution of needed hurricane premium to state may be improved. The ultimate answer for hurricane needs may well include modelling the hurricane exposure using data external to the insurance operations.

II. Non-Hurricane Provision

A. Definition of Catastrophe

Catastrophes are accepted as coded in the analysis presented in this paper. It is assumed that $1/AIY of **coded** catastrophe loss in 1974 is equivalent to $1/AIY of loss in any other year. If there has been a change in the definition of catastrophe loss in the data such that this is not true, a method to adjust the data must be determined.

B. Normality Assumption

The companywide non-hurricane mean probably exhibits much less variation than the mean hurricane loss. Using the method of moments, one can compare the fitted normal distribution with fitted Gamma or Lognormal distributions. See the graphs which follow.

A normal approximation of annual non-hurricane catastrophes at the statewide level may be inappropriate but for the following reasons:

(1) Censored data is used, thereby eliminating long tail concerns.

(2) State needs are always reconciled to companywide needs.

As with hurricane data, the normality assumption may not be appropriate when analyzing surplus needs.

III. Exposure Base

Amount of Insurance Years may not be available for use as an exposure base. If not, any exposure base which varies with inflation and policy growth could be considered. A close approximation of Amount of Insurance Years can be made if Average Policies in Force and Average Policy Risk Amount are available.

IV. Other Lines of Business

If an appropriate exposure base is available, the procedure could be modified to fit lines of insurance other than Homeowners.

HOMEOWNERS PROGRAM - COMPANYWIDE (AGG CATS)
REL. FREQ. HISTOGRAM