Incorporating a Hurricane Model into Property Ratemaking

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Abstract

This paper explains the procedures used to incorporate a hurricane model into the development of state loss costs by territory for personal property and state loss costs by territory and construction class for commercial property. It explains why a modeling approach was used to estimate losses for hurricane perils. Issues discussed in the procedures include the combination of modeled loss estimates with insurance data, the adjustments for deductibles/coinsurance clauses and the application of trend and credibility. The paper also discusses the continuing activities of model use and comments on other applications for hurricane models, such as its use in the redefinition of territories.

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SECTION I - DESCRIPTION OF THE WIND HAZARD

The standard personal and commercial property insurance forms provide coverage for a host of perils, several of which have the potential to generate catastrophic losses -- fire, explosion, riot or civil commotion and windstorm and hail. Of these perils, windstorm has clearly been the leading cause of catastrophic losses. Seventy - four percent of the total $112 billion insured catastrophic losses from 1950 through 1994 were due to windstorms.[1] One type of windstorm in particular stands out - hurricanes. Hurricanes are the number one generators of insured catastrophe losses in the United States. Of the 15 largest catastrophes (as measured by insured losses) in the United States, seven have been hurricanes. Hurricanes have generated 36% of the $71 billion of insured catastrophe losses from 1985 through 1994.

Windstorms

Windstorm is defined as wind, with or without rain, of sufficient velocity to cause damage. Catastrophic wind losses are generated by storms of several types:

1) Tornadoes - strong, violently rotating columns of air extending from the base of a cumulonimbus cloud to the ground

2) Hail-Storms - the falling of hailstones (balls of ice ranging from ½ to 3 inches in diameter), which are generated by the updraft of a thunderstorm

3) Nor'easters (or winter storms) - cyclonic storms of the east coast of North America

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[1] Based on Property Claim Services (PCS) estimates.

4) Tropical Cyclones - low pressure weather systems in which the central core is warmer than the surrounding atmospheres; e.g., tropical storms and hurricanes.

Hurricanes

Hurricanes are technically defined as non-frontal, low pressure synoptic scale systems or more commonly tropical cyclones, with sustained winds of 75 mph or more. Hurricanes and their cousins -- Pacific Ocean typhoons and Indian Ocean cyclones -- are the world's most violent storms.

Hurricanes are born in the most placid of climates -- the tropics. The tropics supply the essential ingredients for a hurricane -- wide expanses of warm ocean water; warm, humid air; and normally weak upper air winds blowing from the same direction as winds near the surface. Hurricanes consist of high-speed winds blowing circularly (counter-clockwise in the northern hemisphere) around a low-pressure center, known as the eye of the storm. The low-pressure center develops when the warm, humid air prevalent in the tropics is underrun and forced upward by denser cooler air. The winds attain maximum force close to the point of lowest pressure, just beyond the eye, at a distance called the radius of maximum winds. This distance, the radius of maximum winds, typically ranges from 5 to 15 miles. The central pressure in the eye of the storm is a key parameter of the storm's strength and the resulting windspeeds. The lower the pressure (or in other words the higher the differential with normal pressure) the stronger the storm. Sustained winds[2] can range from 75 mph for the mildest hurricanes (Saffir/Simpson category 1) to greater than 155 mph for the strongest hurricanes (Saffir/Simpson category 5). Hurricanes can be thought of as heat engines that convert the warmth of the tropical oceans and atmosphere

[2] Highest average windspeed over a one-minute period.

into wind and waves. They are made up of bands of thunderstorms, spiraling in toward the center - the eye. The width of a typical hurricane is approximately 300 miles.

Hurricanes inflict property damage from high wind speeds, intense rain, projected missiles, and high water. The resulting storm surge and flooding are responsible for a considerable portion of the damage and loss of life, especially within the first few hundred yards of the shoreline. While damage caused by rain, high winds, or wind-blown debris are covered by standard property insurance policy forms, damage caused by storm surge or flooding is not.

Insurance Coverages

For personal property, hurricane coverage is most frequently provided under a Homeowners policy form. A small portion of the market is serviced under Dwelling forms. The Homeowners policy form provides a package of coverages. Coverage A provides coverage for the building. Coverage B provides coverage for other appurtenant structures, such as garages, pools, barns. Coverage C provides coverage for the personal property (i.e. contents of the residence). Coverage D provides coverage for any additional living expense and/or loss of rents incurred by the policyholder and caused by a covered peril. For the Owners policy forms, the amount of insurance provided for Coverages B, C and D are usually expressed as a percentage of the amounts of insurance provided for Coverage A, the building. The typical policy provides the following:

Coverage B = 10% of the Coverage A

C = 50% - 80% of the Coverage A (selected by insured)

D = 20% of the Coverage A

Under the current ISO statistical plan only the Coverage A amount of insurance is reported by insurers electing to report statistics to Insurance Services Office (ISO) for their Homeowners policies.

For personal property written under Dwelling Forms, hurricane coverage is provided under the Extended Coverage endorsement[3]. For commercial property hurricane coverage is typically provided under the Commercial Basic Group II[4] forms as well as indivisible premium package policy forms (e.g. Businessowners). However, for Dwelling Extended Coverage (EC) and Commercial Basic Group II (BGII), separate records and amounts of insurance are reported to ISO for the building and contents coverage.

[3] Dwelling Extended Coverage is an endorsement that extends the standard fire coverage to a list of perils including windstorm and hail, riot and civil commotion, smoke aircraft, vehicles, and explosion.

[4] Commercial Basic Group II is the coverage form for commercial risks and provides coverage for windstorm and hail, riot and civil commotion, smoke aircraft, vehicle action, and sink hole collapse.

SECTION II - TRADITIONAL METHODS OF CATASTROPHE LOSS ESTIMATION

The traditional approach used by ISO and most of the industry to reflect catastrophic losses and catastrophic loss potential in the calculation of loss costs/rates has been to use various long-term smoothing techniques. This was done by establishing a cut-off for aggregate reported insurance losses above which losses were deemed excess. Losses below the cut-off were termed normal. For Homeowners, individual state cut-offs were based on the long-term average ratio of wind losses to non-wind losses. For Dwelling Extended Coverage and Commercial Basic Group II, those cut-offs were based on loss ratios, and were judgementally established. Reported loss activity that exceeded these cut-offs were deemed excess, were excluded from the ratemaking database, and were replaced with expected excess losses that were loaded in using an excess loss factor. This excess loss factor was calculated as a long-term average ratio of actual excess losses to normal losses. In some situations, the excess loss factor was calculated using both a state and regional component. The regional component provided a broader base for the loss smoothing for the higher layers of loss. States were grouped into regions based on geographical and meteorological considerations. No distinction was made in either the personal or commercial property procedures for the specific type of catastrophic event (hurricane, tornado, winter freeze, et. al.) that gave rise to the excess losses for the coverage.

Unfortunately, traditional loss smoothing approaches have five major limitations in determining loss costs in states that have significant hurricane loss potential.

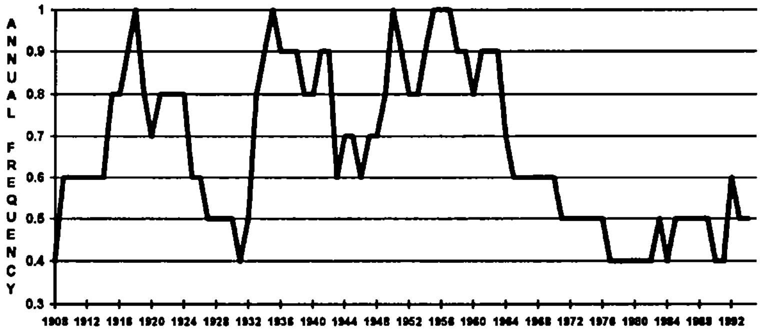
1) <u>Not enough historical insurance data</u>

The available historical insurance statistical data base (approximately 1960 to present for Homeowners, 1950 to present for Extended Coverage/Basic Group II) provides too short an experience period to measure hurricane activity on a state specific or even countrywide basis. Between 1899 and 1994, only 157 hurricanes (as defined by the sustained wind speed) made landfall in the continental United States. With only 1.6 hurricanes per year striking the entire U.S. coast, obviously in any given state many years may pass without hurricane activity.

In addition, the most recent period, 1960-1994, the only period for which we have statistical data for Homeowners, has had unusually low hurricane frequency - particularly for intense hurricanes. Chart 1 below shows that the frequency of intense hurricanes for that period is extremely low when compared with the long-term history. Consequently, any technique that makes exclusive use of meteorological or insurance experience for this period of low hurricane frequency risks understating the hurricane potential.

CHART 1

FREQUENCY@ OF INTENSE* HURRICANES



@ Ten year moving average

* Intense hurricanes are those storms achieving Saffir-Simpson 3, 4 or 5 level as defined by the sustained wind speed at landfall.

The sparsity of hurricanes, only 155 total hurricanes from 1900 to 1994 and 61 intense ones[5], makes the job of estimating prospective hurricane losses quite difficult. This difficulty is compounded by the recent low frequency, only 17 intense hurricanes from 1960 to 1994. While in theory it might be possible to adjust historical insured hurricane losses for the recent low frequency on some broad multi-state basis, this adjusted aggregation would be of little value for state or territory calculations.

[5] Tropical Cyclones of the North Atlantic Ocean - National Climatic Data Center

2) Over reliance on long-term premium and loss information

The traditional approach relies exclusively on the long-term premium and loss information contained in the ISO statistical data base. The long-term statistical data has limited applicability to future catastrophic losses because in the last thirty-five years, land use, population densities, construction techniques and materials, engineering techniques, building codes and their enforcement and the damageability of structures, have changed extensively. For example, the population density in the coastal areas has increased significantly. From 1960 to 1990, the population density of the South East Atlantic coast has increased more than 120%, while the density countrywide has increased less than 40%. Storms that might have generated only moderate losses in 1960 would now generate catastrophic losses. Thus, excess factors derived from insurance experience of the 1960's and 1970's have limited validity when applied to today's or tomorrow's insured portfolios. It would be very difficult to properly adjust the historical insurance exposure, premium, and loss data bases for all the changes that have taken place which have a significant impact on hurricane losses.

3) Grouping states into regions can mask hurricane potential

The traditional approach for Commercial Basic Group II, for example, entailed grouping states into regions in order to calculate a regional excess component in addition to the state component. While all due care was taken to optimize this grouping, in reality each state has its own hurricane potential, due to geographical and other factors. The use of a regional component distorts that potential. The Southeast Region (Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Hawaii) is a good example. Clearly all these states have significant hurricane potential; however, the hurricane potential for Florida is quite different than Alabama's or Mississippi's. A regional factor might be appropriate for the average, but it will not be for all the states in the group.

4) <u>Individual storms can have disproportionate impact</u>

The traditional approach was overly sensitive to recent individual hurricanes. When loss experience for Hurricane Hugo was reflected in the traditional analysis, the indicated loss costs needed for South Carolina increased significantly. When loss experience for Hurricane Andrew was reflected, the indicated loss costs for Florida also increased significantly. The fact that Hurricane Andrew struck Dade County, Florida and Hurricane Hugo struck Charleston, South Carolina did not change the underlying probabilities of hurricanes striking Florida or South Carolina at some future period. Clearly the traditional analysis was flawed when the occurrence or absence of individual storms had such a dramatic impact on the results.

5) <u>Not all portions of a state are equally exposed to hurricanes</u>

The traditional approach generated an excess factor to be used for the entire state. But not all portions of a state are equally exposed to hurricanes. Clearly the coastal areas have a much greater potential for hurricane losses than the inland areas. The traditional excess factor approach provided limited assistance in allocating excess losses to the individual rating territories.

For some lines, a separate territory wind analysis was performed using the available 10 to 15 years of data. Unfortunately, subdividing experience into territory detail and limited years of data available in territory detail precluded having an adequate data base to measure hurricane loss potential.

SECTION III - DESCRIPTION OF THE HURRICANE MODEL

After evaluating the limitations of the traditional loss smoothing approaches, ISO decided to use a computer simulation modeling approach for measuring the hurricane catastrophe peril. There are several models available. The one being used in ISO catastrophe procedures was developed by Risk Management Solutions, Inc. (RMS).

Establishing Probability Distributions

The RMS hurricane model uses the available meteorological data base of 107 years of hurricanes to establish the overall probability of a storm, separately for each of the 31 coastal segments that make up the United States coast from Brownsville, Texas to Maine. Each segment is 100 nautical miles long. The key characteristics of hurricanes are fit to probability distributions, separately for each coastal segment, based on the observed characteristics of historical storms that have made landfall in that segment and adjacent ones. The observed central pressure differentials (the difference between ambient central pressure and the central pressure in the eye of the storm) are fit to Weibull distributions. The observed forward velocities are fit to lognormal distributions. The track angles are fit to normal distributions.

Simulating Hurricanes

For each segment, a few discrete parameter values are selected from the probability distributions for each of the essential hurricane characteristics:

- central pressure differential - 6 values
- forward velocities - 3 values
- track angles - 3 values

These parameter values are concatenated to generate 54 (6 x 3 x 3) simulated storms per segment. The probability of each simulated storm is determined from the probability distributions and the overall probability of a storm in that segment..

Each 100 nautical mile segment is further divided into four equal subsegments. Then, for each 25 nautical mile subsegment, a landfall location is selected randomly. Each of the 54 storms are simulated to landfall in each of the four different selected locations within a 100 nautical mile segment, with one quarter of the previously established probability. Thus, there are 216 (54 x 4) simulated storms per segment. This approach is referred to as a "logic tree" (as opposed to Monte Carlo simulation) approach and results in 6,696 (216 x 31) simulated hurricanes in total. Each of the simulated storms has an associated probability of occurrence derived from the overall probability of a storm and the probability of the central pressure differential, forward velocity and track angle combination for that segment.

For each of the 6,696 simulated hurricanes, a storm track is assigned to each hurricane. The track of each simulated storm is determined by selecting the track of the historical storm in the segment or adjacent segments with meteorological characteristics at landfall closest to the simulated storm. The decay characteristics[6] (rate of energy loss) of the selected historical storm are also used for the simulated storm.

__Wind Field Model__

The maximum wind speed at a particular site due to a simulated hurricane is determined using a wind field model that is based on the meteorological characteristics of the storm near the site (e.g. central pressure difference, forward velocity), the distance/direction from the site to the storm path, distance to coast, and any natural or man-made roughness at the site.

[6] Hurricanes dissipate as they pass over land. That dissipation is termed the decay characteristics and is measured by the increase in central pressure in the eye of the storm.

Damageability

The model's estimate of damages at a particular site is based on the peak gust wind speed as calculated by the wind field model. The RMS model does not estimate any damages when the peak gust wind at a site is less than 75 miles per hour. The damage relationships were derived from a combination of engineering studies and actual insurance loss data. These damage relationships vary by construction, occupancy, number of stories, and other associated variables. Estimated hurricanes damages are measured in terms of a damage ratio, which is defined as the ratio of repair costs (i.e., losses) to the replacement cost. Separate mean damage ratios are calculated and expressed as a percent of total insurable property value for building, contents, and additional living expenses.

Each of the 6,696 simulated hurricanes is run through its assigned path with its assigned decay functions. At any point on its path, the hurricane's central pressure differential is determined by the original value at landfall as modified by the hurricane's assigned decay characteristics. Based on the key characteristics (central pressure differential and forward velocity) the wind field model calculates the peak wind gusts in all zip codes (as defined by the population-weighted centroid) around the storm reflecting distance/direction from storm, distance from coast and local area roughness. Using the damageability relationships, the peak gusts generated from each storm by location are translated into damage ratios. The sum of the products of the damage ratio and the probabilities of the simulated storms is the mean damage ratio (MDR) which is generated by zip code.

Outputs

The standard outputs to the model are a set of mean damage ratios by zip code and construction, occupancy and number of stories separately for buildings, contents and additional living expense coverages.

SECTION IV - USING THE MODEL OUTPUT IN A LOSS COST REVIEW

General Considerations

The calculation of an indicated loss cost change prior to the introduction of a hurricane model was based on using available insurance loss data to calculate prospective loss costs. Incorporating a hurricane model into property ratemaking revises that procedure by developing a prospective hurricane loss cost separately from a prospective non-hurricane loss cost and then combining the two pieces.

The hurricane loss cost is developed using MDRs that are the output of the hurricane model and converting them to an ISO ratemaking and coverage basis for the specific line of insurance. This consists of consolidating the MDRs for each zip code into broader rating territory detail for the particular coverage or policy form; adjusting the MDRs to a common deductible basis and/or coinsurance basis; and reflecting any necessary ratemaking adjustments, such as application of loss adjustment expense factors and/or trend.

The procedure for the development of the non-hurricane loss cost is similar to the prior procedure with two exceptions. First, any hurricane losses in the experience period are removed. Secondly, the traditional catastrophe smoothing procedure is adjusted to a non-hurricane basis by the removal of hurricane experience and the elimination of regional components.

Once a statewide loss cost indication reflecting the hurricane model is calculated, the next step is to calculate the territory relativities. The procedures assume that the hurricane loss costs are fully credible, since the MDRs are based on all available meteorological data on hurricanes over the past century and there is no credibility standard for the volume of data needed to determine reliable estimates from the model. There is also an absence of a source to use for the complement of credibility for the hurricane model. Credibility is thus taken into account only for the non-hurricane loss costs. A detailed description of the specific methods used for homeowners and commercial property basic group II follows.

Use of the Model in Homeowners Ratemaking

A. Development of a Prospective Hurricane Loss Cost

Since the hurricane model provides MDRs by zip code, the first step in using the model is to aggregate the MDRs to conform to broader rating territory boundaries. In the absence of insurance data by zip code, the number of residential units within each zip code available from the U.S. Census Bureau can be used for weighting the zip code MDRs to territory MDRs. (This will work well unless the distribution of risks is believed to be locally concentrated in particular zip codes.)

The MDRs that the model produces are expressed as a percent of the total insurable property value. For homeowners owners policy forms (1-3, 3w/15), the amount of insurance collected in the ISO Statistical Plan is just the Coverage A building amount of insurance. The homeowners owners forms provide coverage for the building, other appurtenant structures, contents, and additional living expenses (and/or loss of rents). For example, a policy insured for $100,000 of building coverage would typically have $10,000 of other appurtenant structures coverage, $70,000 of contents coverage, and $20,000 of additional living expense coverage--for a total amount of insurance at risk of $200,000. In order to calculate the expected hurricane losses for all coverages on the homeowners policy, either the reported amount of insurance for Coverage A needs to be increased to reflect all coverages or a weighted MDR reflecting all coverages needs to be calculated to apply to the Coverage A amount of insurance. The latter method is used in this paper. For homeowners owners policy forms, this requires weighting each building, contents and additional living expense MDR by its percent of the Coverage A amount of insurance. Table 1 shows a sample output of the hurricane model with MDRs aggregated by rating territory.

TABLE 1
SAMPLE OF HURRICANE MODEL OUTPUT FOR PERSONAL LINES

Rating Territory	Construction	----------------Single Family MDRs---------------- Building	Contents	Additional Living Expenses
A	Frame	1.0%	0.8%	0.9%
	Masonry	0.5%	0.3%	0.4%
	Superior	0.1%	0.0%	0.1%
B	Frame	2.0%	1.5%	1.8%
	Masonry	1.8%	1.2%	1.5%
	Superior	0.5%	0.3%	0.4%

Table 2 shows a typical calculation of a weighted MDR reflecting the relationship of each individual coverage's amount of insurance to the Coverage A amount of insurance. This sample calculation uses the MDRs from Table 1 for territory A, frame construction.

TABLE 2
SAMPLE CALCULATION OF WEIGHTED MDR

Coverage	(1) Relationship to Coverage A Amount of Insurance	(2) MDR	(1) x (2)
A - Buildings	1.00	.010	.010
B - Appurtenant Structures	0.10	.010	.001
C - Contents	0.70	.008	.0056
D - Additional Living Expense	0.20	.009	.0018
Weighted MDR			.0184

Referring back to our example of a policy with \$100,000 of building coverage above, the expected hurricane losses for this policy in territory A (frame) are:

$$.0184 \times \$100{,}000 = \$1{,}840$$

This is equivalent to applying the individual coverage MDRs to the amount of insurance for each coverage separately as follows:

$$(.01 * \$100{,}000) + (.01 * \$10{,}000) + (.008 * \$70{,}000) + (.009 * \$20{,}000) = \$1{,}840$$

Similarly, this weighting of each set of MDRs is done for other homeowners policy forms 4(tenants) and 6(condominiums). For these policy forms, the amount of insurance collected in the ISO Statistical Plan is just the Coverage C contents amount of insurance. See Appendix A for more details.

Deductible Adjustment

The MDRs of the hurricane model are the mean of a probability distribution of all possible damage ratios, on a first dollar basis. The MDRs have not been adjusted to account for any deductible that the insurance policy may include. But, supplementary output from the model can be used to calculate an MDR reflecting a percent deductible.

The standard ISO ratemaking deductible for homeowners is \$250 deductible. Thus, the \$250 deductible is converted into a percent deductible relative to the average amount of insurance for each territory and policy form. Then, net MDRs are calculated based on the probability distribution of the damage ratios. This calculation is accomplished by computing the net loss for each simulated hurricane event and probabilistically aggregating the net results based upon the annual rate of occurrence of each storm. The steps in this calculation of net MDRs are as follows:

Step (1): Expression of damage ratios on a first dollar basis

For each simulated hurricane event, h, there is a mean damage ratio for zip code j, for each coverage k and construction class l that can be expressed as:

$$MDR(h,j,k,l)$$

Step (2): Derivation of the beta cumulative distribution function

For each MDR(h,j,k,l), there is an associated coefficient of variation based on the probability distribution of the damage ratios. Using the mean and coefficient of variation of the damage ratios, the parameters of a beta cumulative distribution function can be derived and expressed as:

$$F(x|h,j,k,l)$$

where F(x) represents the probability that the damage ratio will be less than or equal to x.

Step (3): Calculation of net MDR for each event

Given a deductible, 100 x d %, expressed relative to the amount of insurance, and the beta cumulative distribution, integration can be performed to calculate the mean damage ratio after the deductible for each event. This can be expressed as:

$$\text{net } MDR(h,j,k,l,d) = MDR \int_d^1 (1-F(x|h,j,k,l))dx$$

Step (4): Calculation of net MDR over all events

The net mean damage ratio over all events is given by:

$$\text{net MDR}(j,k,l,d) = \sum_{h} \text{net } (\text{MDR}(h,j,k,l,d) \times P(h))$$

where P(h) is the annual probability of hurricane event h.

Calculation of Prospective Hurricane Loss Costs

Once the MDRs are adjusted for the $250 deductible, the net weighted MDRs are applied to the reported amounts of insurance for each construction type within each territory to determine expected hurricane losses. The sum of the expected hurricane losses by construction type within a territory are the territory hurricane losses. The statewide expected hurricane losses are then the sum of the hurricane losses across all territories. The results of this calculation for our sample state are shown in Table 3. The hurricane losses are calculated using the latest year earned amount of insurance (Coverage A for the owners policy forms). The hurricane loss cost can then be calculated by dividing by the latest year earned house years. This table also shows the average MDRs by territory and by state, which are calculated by dividing the hurricane losses by the earned amount of insurance.

TABLE 3
CALCULATION OF HURRICANE LOSS COST

Territory	Latest Year Coverage A Amount of Insurance (1)	Expected Hurricane Losses (2)	Latest Year House Years (3)	Average Weighted MDRs (4) = (2)/(1)	Average Hurricane Loss Cost (5) = (2)/(3)
A	10,000,000	2,000	200	0.02%	10.00
B	20,000,000	40,000	300	0.20%	133.33
C	100,000,000	100,000	1,000	0.10%	100.00
Statewide	130,000,000	142,000	1,500	0.11%	94.67

To calculate the prospective hurricane loss cost, the same trend factors (current cost/amount factor and composite projection factor) used for the latest year in the calculation of the non-hurricane loss cost are applied to the statewide hurricane loss cost. This loss cost already is adjusted to a $250 deductible basis, but excludes loss adjustment expenses. Thus, a loss adjustment expense factor must be applied. The same loss adjustment expense factor as used with the non-hurricane loss cost is used here since there is no data to derive a factor appropriate for an average hurricane provision.

Since the hurricane loss cost is an average loss cost for all classes, it must be transformed to a base class basis by dividing by the latest year classification and coverage factor[7]. Table 4 illustrates this calculation and results in a prospective hurricane base class loss cost of $88.37.

[7] The classification and coverage factor is an average rating factor based on the distribution of data by policy form, construction and protection class, and amount of insurance. The base class level for the owners policy forms is Form 3, frame protection class 5, $60,000 Coverage A amount of insurance.

TABLE 4
CALCULATION OF HURRICANE LOSS COST SAMPLE STATE

(1)	Average Modeled Hurricane Loss Cost	94.67
(2)	Loss Adjustment Expense Factor	1.150
(3)	Latest Year Current Cost/Amount Factor	1.005
(4)	Composite Projection Factor	1.050
(5)	Latest Year Class and Coverage Factor	1.300
(6)	Modeled Hurricane Base Class Loss Cost (1) x (2) x (3) x (4) / (5)	$88.37

B. *Development of a Prospective Non-Hurricane Loss Cost*

The calculation of a non-hurricane prospective loss cost begins with the reported incurred losses for the latest five accident years with hurricane losses removed. The standard ratemaking adjustments are then made to the non-hurricane losses, including a modified excess procedure based on non-hurricane experience.

Removal of Hurricane Losses

The first step in calculating the non-hurricane loss cost is to remove any actual hurricane losses from the experience period. The losses removed must be consistent with the types of losses generated by the modeling process. The model does not generate damages if the peak gust is less than 75 mph. For the calculation of state and territory loss cost level changes, the latest five accident years of experience are used. Experience from 1960 to present is used to calculate the long-term excess wind factor. Although there is no need to use the traditional ISO catastrophe procedure for the hurricane peril, there still is a need to use this procedure for other catastrophic perils, such as tornadoes, hail storms, nor'easters and other tropical cyclones below hurricane status. Thus, the hurricane losses must be removed for the period of 1960 to present.

Hurricane losses are not specifically identified in the ISO data base. The meteorological history of all hurricanes that occurred from 1960 to present including storm tracks and wind speeds at 6 hour intervals is used to assist in the removal of hurricane losses. This information identified the states and territories affected by each hurricane (i.e., peak gusts of at least 75 mph).

The details of the process for removal of the hurricane losses vary by the information available in the ISO data base. For the more recent years, monthly wind losses by territory are available. Since it is impossible to isolate the hurricane losses for these years, all the wind losses in any month effected by a hurricane are removed and replaced with average monthly wind losses for the same month from non-hurricane years. For the 1970s and early 1980s, only annual wind losses by territory were available. Here, the annual wind losses by territory are replaced with the average wind losses for that territory from the non-hurricane years. Only statewide annual wind losses were available for the 1960s. For any year in the 1960s in which a hurricane occurred, that year was excluded from the excess wind calculation.

Calculation of Non-Hurricane Excess Wind Factor

The calculation of a non-hurricane excess wind factor is similar to the traditional calculation method in effect before the use of a model--with two exceptions. First, any hurricane losses are removed from the wind losses, or the year in which a hurricane occurred is excluded from the calculation as described above. Second, the calculation no longer includes a regional component for the Southeast region[8]. The Southeast regional component smoothed large excess wind losses mainly accounted for by hurricanes. Since non-hurricane wind experience is generally more stable than experience including hurricanes, the need for a regional component is eliminated. See Exhibit 1 for a sample calculation of a non-hurricane excess wind factor.

Calculation of Prospective Non-Hurricane Loss Costs

Once the hurricane losses accounted for by the model are removed from the experience period, the standard ratemaking adjustments need to be made to calculate the prospective non-hurricane loss cost. These adjustments include the following:

- adjustment of property losses to a common $250 deductible basis using loss elimination ratios,

- application of loss development factors to bring the losses to an ultimate settlement basis,

[8] The prior procedure included a regional component for the Southeast region only.

- removal of non-hurricane excess wind losses and the application of the non-hurricane excess wind factor,

- application of a loss adjustment expense factor,

- adjustment for changes in cost levels and increases in amount of insurance by a two step application of a current cost/amount factor and a composite projection factor,

- adjustment to a base class level by dividing by the classification and coverage factor.

Table 5 displays a sample calculation of a prospective non-hurricane loss cost. Once the projected non-hurricane base class loss costs are calculated for each of the five accident years, a weighted average is determined with the weights shown giving more weight to the latest year. Thus, the weighted prospective non-hurricane base class loss cost is $239.50.

TABLE 5
CALCULATION OF A PROSPECTIVE NON-HURRICANE LOSS COST
SAMPLE STATE

Accident Year	(1) Developed Non-Hurricane Losses on a $250 Deductible Level	(2) Non-Hurricane Excess Losses on a $250 Ded. Level	(3) Non-Hurricane Losses Less Non-Hurricane Excess Losses (1)-(2)
1	325,895	5500	320,395
2	460,686	80200	380,486
3	319,819	6000	313,819
4	300,565	7000	293,565
5	381,499	0	381,499

Accident Year	(4) Non-Hurricane Losses in col. (3) x Loss Adjustment Expense Factor of 1.15	(5) Non-Hurricane Losses in col. (4) x Non-Hurricane Excess Factor of 1.053	(6) Current Cost/ Amount Factor	(7) Earned House Years
1	368,454	387,982	1.050	1,475
2	437,558	460,749	1.030	1,510
3	360,892	380,019	1.020	1,480
4	337,600	355,493	1.010	1,450
5	438,724	461,976	1.005	1,500

Accident Year	(8) Projected Average Non-Hurricane Loss Cost ((5)x(6)/(7))x Projection Factor of 1.05	(9) Classification and Coverage Factor	(10) Projected Non-Hurricane Base Class Loss Cost (8)/(9)	(11) Accident Year Weights
1	290	1.160	250	0.10
2	330	1.179	280	0.15
3	275	1.222	225	0.20
4	260	1.238	210	0.25
5	325	1.300	250	0.30

(12) Weighted Prospective Non-Hurricane Base Class Loss Cost = $239.50

C *Calculation of Statewide Indicated Loss Cost Change*

To determine the statewide indicated loss cost level change, the prospective non-hurricane base class loss cost is added to a prospective hurricane base class loss cost and is divided by the current statewide average base class loss cost.

Table 6 shows the calculation of the statewide indicated loss cost level change for our sample state. The weighted prospective non-hurricane base class loss cost is added to the prospective hurricane base class loss cost to get a total prospective base class loss cost of $327.87 which when compared to the current base class loss cost of $300, results in a +9.3% indicated loss cost change.

TABLE 6
CALCULATION OF STATE WIDE INDICATED
LOSS COST LEVEL CHANGE SAMPLE STATE

(1)	Weighted Prospective Non-Hurricane Base Class Loss Cost	239.50
(2)	Prospective Hurricane Base Class Loss Cost	88.37
(3)	Total Prospective Base Class Loss Cost (1) + (2)	327.87
(4)	Current Base Class Loss Cost	300
(5)	Indicated Loss Cost Change (3)/(4)	1.093 or + 9.3%

D. *Calculation of Indicated Loss Cost Changes By Territory*

The calculation of indicated loss cost changes by territory compares individual territory combined non-hurricane and modeled hurricane experience to statewide combined non-hurricane and modeled hurricane experience.

First, the five-year non-hurricane loss cost is calculated for each territory and statewide. These loss costs are then projected to the latest year cost level to be consistent with the modeled hurricane loss costs. For each territory that is not fully credible, the non-hurricane loss cost is credibility-weighted with the statewide non-hurricane loss cost (multiplied by the current territory relativity) to produce a credibility-weighted non-hurricane loss cost for each territory. This adjustment to the statewide pure premium for use as a complement of credibility is needed in order to bring the statewide experience to a cost and frequency level consistent with the territory's long term levels. This credibility-weighted non-hurricane loss cost is then added to the modeled hurricane loss cost. The total loss cost for each territory divided by the statewide loss cost produces a territory experience relativity. The experience relativity for each territory is then compared to the current relativity to produce indicated relative changes by territory.

Exhibit 2 shows a calculation for our sample state with three territories. In territory C, for instance, we calculate a credibility-weighted non-hurricane loss cost of $203.33 and add this to a modeled hurricane loss cost of $76.92 to get a total loss cost of $280.25. This results in an indicated territory relativity of 1.055 for territory C. Thus, the indicated loss cost change for territory C is the change in the territory relativity

(1.055/1.050) multiplied by the statewide indicated loss cost change of +9.3%, which is a +9.8% increase.

This procedure assumes that the modeled hurricane loss costs are fully credible. For the non-hurricane loss cost, the complement of credibility ideally should use the current territory relativity underlying the non-hurricane portion of the current loss cost, since we are trying to calculate only the non-hurricane portion of the loss cost for each territory. The first time that a loss cost review incorporates the hurricane model, though, it is not known what the underlying territory relativity is for just the non-hurricane portion of the current loss cost, since the existing territory relativity reflects both portions. Thus, for the first review incorporating the hurricane model, the current territory relativity for the current loss cost is used.

In subsequent loss cost reviews, the complement of credibility will use the territory non-hurricane relativity calculated in the prior loss cost review. Exhibit 3 shows the sample state's territory review in the second year. In territory C, the complement of credibility is the statewide loss cost of $221.47 multiplied by the non-hurricane relativity from the first loss cost review (see Exhibit 2) of 1.064 (203.33/191.09), which results in a credibility-weighted loss cost of $235.45.

SAMPLE STATE
TABLE 23A
HOMEOWNERS INSURANCE - FORMS 2, 3, 3W/15
DERIVATION OF NON-MODELLED EXCESS WIND FACTOR

Year	(1) Non-Modelled Reported Wind Losses	(2) Non-Modelled Reported Total Losses	(3) Non-Modelled Reported Total-Wind Losses(2) - (1)	(4) Total Wind To Non-Wind Ratio (1)/(3)	(5) Capped Wind Ratio < (5 X MED)	(6) Capped Excess Wind Ratio (5) - AVG(5)	(7) Capped Excess Wind Losses (3) X (6)	(8) Non-Modelled Excess Wind Ratio Above The Cap (4) - (5)	(9) Excess Wind Losses Above The Cap (8) X (3)	(10) Total Non-Modelled Excess Wind Losses (7) + (9)
12/60	108,781	1,799,873	1,691,092	0.064	0.064	0.000	0	0.000	0	0
12/61	338,985	3,465,992	3,127,007	0.108	0.108	0.000	1,049,213	0.000	0	0
12/62	2,123,842	7,449,796	5,325,954	0.399	0.399	0.197	0	0.000	0	1,049,213
12/63	526,094	7,417,475	6,891,381	0.076	0.076	0.000	0	0.000	0	0
12/64	880,812	7,572,784	6,691,972	0.132	0.132	0.000	0	0.000	0	0
12/65	1,023,957	8,234,603	7,210,646	0.142	0.142	0.000		0.000	0	
12/85	5,249,089	35,420,706	30,171,617	0.174	0.174	0.000	0	0.000	0	0
12/86	2,871,522	27,885,394	25,013,872	0.115	0.115	0.000	0	0.000	0	0
12/87	2,174,221	27,464,409	25,290,188	0.086	0.086	0.000	0	0.000	0	0
12/88	14,301,387	39,398,365	25,096,978	0.570	0.570	0.368	9,235,688	0.000	0	9,235,688
12/89	18,962,472	50,844,072	31,881,600	0.595	0.595	0.393	12,529,469	0.000	0	12,529,469
12/90	13,036,475	40,556,412	27,519,937	0.474	0.474	0.272	7,485,423	0.000	0	7,485,423
12/91	14,988,711	40,765,082	25,776,371	0.581	0.581	0.379	9,769,245	0.000	0	9,769,245
12/92	4,067,790	26,930,737	22,862,947	0.178	0.178	0.000	0	0.000	0	0
Total	$128,135,31	$675,234,41	547,099,108	6.449	6.449	1.967	$44,671,51	0.000	0	$44,671,512
Average				0.202	0.202	0.061		0.000		

(11) Normal Wind to Non-Wind Ratio = Average of Column (5) = 0.202

(12) Median Wind to Non-Wind Ratio = 0.148 5 X Median Wind to Non-Wind Ratio = 0.740

(13) Excess Factor = 1.0 + {(Avg. (6) + (Avg. (8)) / (1.0 + Avg. (5) - Avg. (6))}

Excess Factor = 1.0 + {(0.061 + 0.000) / (1.0 + 0.202 - 0.061)} = 1.053

EXHIBIT 2

DETERMINATION OF INDICATED BASE CLASS LOSS COSTS BY TERRITORY
First Review with Hurricane Model
Sample State

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Territory	Aggregate Loss Cost Volume At Current Level	Rel To SW of Current Base Class Loss Cost	Projected Experience Non-Hurricane Base Class Loss Cost	Credibility	Credibility Weighted Non-Hurricane Base Class Loss Cost	Modeled Hurricane Base Class Loss Cost	Total Base Class Loss Cost	Relativity of Territory (8) to Statewide (8)	Indicated Relative Change (9)/(3)	Indicated Base Class Change
A	62,500	0.750	165	0.10	148.13	7.69	155.82	0.587	0.783	-14.4%
B	105,000	0.800	180	0.10	158.40	102.56	260.96	0.983	1.229	34.3%
C	500,000	1.050	200	0.30	203.33	76.92	280.25	1.055	1.005	9.8%
Statewide	667,500		195		191.09		265.56			

EXHIBIT 3

DETERMINATION OF INDICATED BASE CLASS LOSS COSTS BY TERRITORY
Second Review with Hurricane Model
Sample State

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Territory	Aggregate Loss Cost Volume At Current Level	Non-Hurricane Rel To SW in Current Base Class Loss Cost	Projected Experience Non-Hurricane Base Class Loss Cost	Credibility	Credibility Weighted Non-Hurricane Base Class Loss Cost	Modeled Hurricane Base Class Loss Cost	Total Base Class Loss Cost	Relativity of Territory (8) to Statewide (8)	Relativity To SW Of Current Base Class Loss Cost	Indicated Relative Change (9)/(10)
A	65,000	0.775	175.00	0.10	171.98	7.75	179.73	0.605	0.587	1.031
B	115,000	0.829	183.00	0.10	183.54	103.00	286.54	0.964	0.983	0.981
C	550,000	1.064	235.00	0.30	235.45	78.00	313.45	1.054	1.055	0.999
Statewide	730,000		221.47				297.30			

Use of the Model in Commercial Property (Basic Group II)[9] Ratemaking

A. *Hurricane Loss Costs: Adjusting Modeled Output to be Compatible with ISO'S Commercial Property Program*

The modeled output is in the form of MDRs, which represent a generic, non-insurance measure of dollars of damage. Therefore, as a first step in the ISO process, it is necessary to convert these MDRs to an ISO basis. Specifically, this means recognizing the various nuances of ISO's Commercial Property Basic Group II Program (i.e. both coverage and rating), which were not reflected in the MDRs provided by the model.

The necessary adjustments are as follows:

- Consolidating the MDRs, which the model provided in refined (i.e. zip code) detail, into broader rating territory detail. This was accomplished through ISO exposure distributions available in county detail, through the Commercial Statistical Plan.

- Mapping the construction scheme (i.e. six constructions) underlying the model into ISO's scheme, which utilizes a symbol format. The ISO structure publishes loss costs for three types of construction: Ordinary (Symbol B), Semi-Wind Resistive (Symbol AB), and Wind Resistive (Symbol A).

[9] Basic Group II (BGII) provides "extended coverage" for windstorm, hail, riot, smoke, aircraft, vehicles, volcanic action, and sinkhole collapse.

- Adjusting the MDRs, which are on a full coverage basis, to a $250 deductible basis. The adjustment was made using available ISO countrywide full-coverage data to determine the $0-$250 discount. This discount is 3% (i.e. .97 factor).

- Accounting for the coinsurance requirement in Commercial Property, which typically requires insureds to insure their properties to at least 80% of value. Since the model reflects full value when calculating MDRs, it becomes necessary for us to multiply these MDRs by 1.25, since ISO loss costs are quoted based on amounts of insurance assumed to be reported at 80% of these full values.

- Loading in loss adjustment expenses, since the model considers indemnity only within their MDRs. These expenses are loaded in via a multiplicative factor.

B. Supplementing RMS Model with Non-Hurricane Experience

Since the MDRs are intended to price the hurricane hazard only, it becomes necessary to supplement these MDRs with non-hurricane (e.g. tornadoes, tropical storms, riots) loss costs based on ISO experience. Essentially, the development of an ISO non-hurricane data base requires the following four steps:

Step (1): For latest ten years, remove hurricane losses:

The experience review of non-hurricane experience will follow standard ISO methodology for BG II reviews of using ten years of experience. The removal of losses for hurricane months (i.e. any month with hurricane experience) is necessary to avoid double-counting with the hurricane-based model's loss cost. The process for accomplishing this is essentially the same as that previously outlined for Personal Lines.

Step (2): Replace (1) with average monthly non-hurricane losses:

The motivation behind this step is to retain the non-hurricane losses removed as part of the more sweeping removal in step (1). To account for this, a proxy is added for these non-hurricane losses. This proxy is an average of the territory's ten-year average of July-to-December losses that remained after the hurricane months are removed. The average is based on six months rather than one month to minimize the volatility that could result from a one-month average. The use of six months also allows for maximum data within a state, thus avoiding the need to group states with perhaps somewhat dissimilar weather patterns. The period from July to December was chosen to avoid the possible impact of tornadoes, which typically strike during the first half of the year.

Step (3): Apply an excess smoothing procedure for the non-hurricane losses:

The traditional excess procedure has been revised to smooth catastrophic BG II losses due to perils other than hurricane. The revised procedure is based on long-term (1950 to present) statewide BG II non-hurricane experience. For those years prior to 1982 (pre-CSP), any year in which a hurricane occurred has been excluded from the excess procedure, since monthly detail is not available for these years. For 1982 and later, total losses for years with a hurricane have been replaced by average non-hurricane losses as described above. The normal loss ratio cutoff for each year included in the excess procedure is 0.50. From this flow the following definitions:

The Normal incurred losses for each year are those losses which do not exceed 0.500 times the earned premium for the year. The Excess incurred losses for each year are equal to the Incurred losses minus the Normal losses for the year. Thus, we have:

$$\text{Normal Loss Ratio (NLR)} = \frac{\text{Normal Losses}}{\text{Earned Premium}}, \text{ for each year}$$

$$\text{Excess Loss Ratio (ELR)} = \frac{\text{Excess Losses}}{\text{Earned Premium}}, \text{ for each year}$$

$$\text{Excess Component} = \frac{\text{Sum of ELR's}}{\text{Sum of NLR's}}, \text{ over the long-term non-hurricane experience period.}$$

The Excess Multiplier is equal to the excess component plus 1.000 and is applied to the normal non-hurricane losses used in the statewide experience review. There is no longer a regional excess smoothing component used in the hurricane-prone states.

(Attached is Exhibit 4, illustrating the calculation of a sample state's excess multiplier.)

This procedure is essentially similar to the traditional long-term excess procedure used for BG II losses (i.e. hurricane and non-hurricane), with the exception of two points. The first point of divergence involves the use of the .50 cutoff. The second point involves the elimination of regional smoothing.

The .50 cutoff is largely judgmental and attempts to strike a balance between two considerations:

- The cutoff should be <u>low</u> enough to recognize that this ratio represents non-hurricane losses compared to <u>total</u> premiums (i.e. including the hurricane peril);

- The cutoff should be <u>high</u> enough to reflect the fact that the non-hurricane peril is not nearly as volatile as the hurricane peril.

The decision to <u>not</u> incorporate a regional component together with the statewide component in the smoothing procedure was based on the following:

- The hurricane model accounts for the majority of the excess loss dollars, reducing the need to smooth across region.

- Non-hurricane experience is more stable than experience including hurricanes.

C. *Calculating the Revised BG II Loss Costs*

The statewide experience review (Exhibit 5) is based on the latest ten years of non-hurricane loss experience. The losses are normal non-hurricane losses (i.e., hurricane losses reflected by the model have been eliminated and the remaining non-hurricane losses have been capped at 0.50 times the earned premium for each year), multiplied by the excess multiplier, loss adjustment expense factor, and trend factors. The aggregate loss costs[10] are at current manual level and have been trended to the average date of writing in the assumed effective period. Note that these current aggregate loss costs which form the denominator of the annual experience ratios[11] reflect both the hurricane and non-hurricane perils. The result of this calculation is an indicated statewide non-hurricane loss cost level change, where the change is from the total loss cost (i.e. hurricane and non-hurricane) to the non-hurricane loss cost.

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[10] *Aggregate loss costs are defined as the product of exposures and ISO published loss costs summed over all risks.*

[11] Experience ratio is defined as adjusted incurred losses ÷ aggregate loss costs.

In those states with BG II rating territories, territorial relativities are being revised to reflect both hurricane "differentials" based on modeled output, as well as non-hurricane differences based exclusively on loss experience for these other perils. The territorial review is based on the latest ten years of non-hurricane loss experience (Exhibit 6), and the resulting indicated relativities are credibility-weighted with the statewide average relativity (1.000) to determine the revised non-hurricane territorial relativities.

The non-hurricane portion of the revised BG II loss costs for each territory (where applicable), coverage, and symbol is calculated as:

$$\text{Current BG II Loss Cost} \times \left[\frac{\text{Revised Terr. Rel.}}{\text{Current Terr. Rel.}}\right] \times \text{Statewide Monoline Non-Hurr. Change}$$

where the statewide monoline non-hurricane change is the product of the statewide non-hurricane coverage change and the indicated monoline relativity, as outlined on Exhibit 5. This calculation can be found on Exhibit 7, Column (7) for the Beach territory in the sample state. The remainder of Exhibit 7 shows how the revised territorial BG II total (hurricane and non-hurricane) loss cost is derived by simply adding the modeled hurricane loss cost and ISO-experience based revised non-hurricane loss cost. Indicated loss cost changes are simply weighted across coverage/constructions to determine an overall loss cost level change for each territory. Similarly, Exhibit 8 shows the calculation of the statewide change as an average of the previously calculated territorial changes.

TABLE 31A - DEVELOPMENT OF BASIC GROUP II NON-HURRICANE EXCESS MULTIPLIER*

(1) YEAR	(2) EARNED PREMIUMS	(3) NON-HURRICANE INCURRED LOSSES	(4) NORMAL INCURRED LOSSES	(5) NORMAL LOSS RATIO	(6) EXCESS LOSS RATIO
1951	1,217,965	205,643	205,643	0.169	
1952	1,366,016	250,463	250,463	0.183	
1953	1,313,064	257,083	257,083	0.196	
1954	1,380,201	171,129	171,129	0.124	
1955	1,404,337	355,555	355,555	0.253	
1956	1,472,475	454,615	454,615	0.309	
1957	1,579,563	523,177	523,177	0.331	
1958	1,685,836	241,239	241,239	0.143	
1959	1,672,435	433,655	433,655	0.259	
1960	1,744,386	407,607	407,607	0.234	
1961	1,777,632	389,535	389,535	0.219	
1962	1,731,463	782,480	782,480	0.452	
1963	1,685,767	1,107,190	842,884	0.500	0.157
1965	1,524,306	678,493	678,493	0.445	
1966	1,523,018	430,762	430,762	0.283	
1967	1,545,246	884,886	772,623	0.500	0.073
1968	1,460,382	807,921	730,191	0.500	0.053
1970	2,194,332	717,508	717,508	0.327	
1971	2,457,195	1,018,760	1,018,760	0.415	
1972	2,905,485	1,394,539	1,394,539	0.480	
1973	3,266,668	6,195,532	1,633,334	0.500	1.397
1974	3,820,837	8,844,165	1,910,419	0.500	1.815
1976	5,796,692	2,045,130	2,045,130	0.353	
1977	8,079,010	2,786,457	2,786,457	0.345	
1978	9,835,100	3,385,756	3,385,756	0.344	
1980	10,030,050	5,113,011	5,015,025	0.500	0.010
1981	9,854,456	3,798,736	3,798,736	0.385	
1982	10,409,556	3,705,567	3,705,567	0.356	
1983	9,911,647	5,838,705	4,955,824	0.500	0.089
1984	9,523,948	3,633,728	3,633,728	0.382	
1985	10,890,755	6,662,248	5,445,378	0.500	0.112
1986	13,367,099	2,163,341	2,163,341	0.162	
1987	12,696,500	1,750,276	1,750,276	0.138	
1988	12,523,229	4,647,489	4,647,489	0.371	
1989	11,912,271	7,998,260	5,956,136	0.500	0.171
1990	11,798,355	6,110,356	5,899,178	0.500	0.018
1991	12,028,205	5,032,698	5,032,698	0.418	
1992	11,858,947	2,228,857	2,228,857	0.188	
Totals				13.264	3.895

(7) State Excess Component = (EXLR /NLR) = 0.294

(8) State Excess Multiplier = (1 + SEC) = 1.294

* Hurricane Years Have Been Excluded

EXHIBIT 5

STATEWIDE BASIC GROUP II NON-HURRICANE COVERAGE LOSS COST LEVEL EVALUATION

YEAR	(2) AGGREGATE* LOSS COSTS	(3) ADJUSTED** NON-HURRICANE INCURRED LOSSES	(4) EXPERIENCE RATIO (3) / (2)
1983	19,623,050	11,499,094	0.586
1984	17,091,854	8,122,799	0.475
1985	16,113,850	11,906,927	0.739
1986	16,732,892	4,631,881	0.277
1987	15,674,733	3,624,708	0.231
1988	16,614,603	9,377,596	0.564
1989	16,420,308	11,119,852	0.677
1990	16,046,314	10,796,382	0.673
1991	15,637,938	8,740,128	0.559
1992	14,290,651	3,673,133	0.257

(5) Weighted Experience Ratio (Equal Weights) = 0.505

(6) Indicated Non-Hurricane Coverage Change = 0.505 or -49.5%

(7) Indicated Non-Hurricane Monoline Relativity = 1.1293

(8) Indicated Non-Hurricane Monoline Change ϕ 0.505 X 1.1293 = 0.570 or -43.0%

* Aggregate loss costs are adjusted to current ISO loss cost level and 9/01/95 amount of insurance levels.

** Incurred losses are adjusted to current deductible and 3/01/96 cost levels and include all loss adjustment expenses.

Losses incurred during the month of a hurricane have been excluded and replaced with average non-hurricane losses

ϕ This change is from the total loss costs (i.e. hurricane and non-hurricane) to the non-hurricane loss costs.

EXHIBIT 6

CALCULATION OF NON-HURRICANE BGII TERRITORY DIFFERENTIALS

Territory	(1) Current Territory Differential	(2) 1992 Earned Premium at Current Manual Level	(3) Current Average Loss Costs	(4) Weights (2) / (1)	(5) 10-Year Non-Hurricane Loss Ratio	(6) Indicated Change in Differential (5) / SW (5)
Beach	2.646	563,240	0.471	1,195,839	0.079	0.210
Seacoast	1.573	1,318,885	0.280	4,710,304	0.239	0.634
Inland	0.927	10,665,523	0.165	64,639,533	0.412	1.093
Statewide/Wtd. Avg.	1.000	12,547,648		70,545,676	0.377	

Territory	(7) Indicated Territory Differential (1) * (6)	(8) Balanced Indicated Differential (7) / SW (7) (a)	(9) 10 Year Earned Risks	(10) Credibility (b)	(11) Credibility Weighted Differential (c)	(12) Revised Territory Differential (11) / SW(11) (a)
Beach	0.556	0.554	9,770	5.3%	0.976	0.970
Seacoast	0.997	0.993	55,675	24.4%	0.988	0.992
Inland	1.013	1.009	540,055	75.7%	1.007	1.001
Statewide/Wtd. Avg.	1.004	1.000	605,500		1.006	1.000

(a) Balanced to 1.000 Statewide

(b) Credibility = R / (R + 172,931), where R = 10-Year Earned Risks

(c) Credibility Weighted Differential = (10) x (8) + [1 - (10)] x (1.000), where 1.000 = Statewide Average Differential

EXHIBIT 7

CALCULATION OF TERRITORY BG II LOSS COST CHANGES (a)

Territory - Beach

Coverage	Symbol	(1) 1992 Written Premiums	(2) Current Loss Cost (b)	(3) Weights (1) / (2)	(4) Current Territory Differential	(5) Revised Territory Differential
Building	A	207,025	0.334	619,835	2.646	0.970
Building	AB	24,759	0.414	59,804	2.646	0.970
Building	B	202,141	0.790	255,875	2.646	0.970
Contents	A	10,878	0.267	40,742	2.646	0.970
Contents	AB	7,352	0.334	22,012	2.646	0.970
Contents	B	73,170	0.629	116,328	2.646	0.970
Total/Wtd. Avg.		525,325	0.471	1,114,596		

Coverage	Symbol	(6) Statewide Monoline Non-Hurricane LC Change	(7) Revised Non-Hurricane Loss Cost (2) * (5) * (6) /(4)	(8) Hurricane Modeled Loss Costs	(9) Indicated Total Loss Cost (7) + (8)	(10) Indicated Percent Change (9) / (2) - 1
Building	A	0.570	0.070	0.118	0.188	-43.7%
Building	AB	0.570	0.087	0.375	0.462	11.6%
Building	B	0.570	0.165	0.427	0.592	-25.1%
Contents	A	0.570	0.056	0.066	0.122	-54.3%
Contents	AB	0.570	0.070	0.211	0.281	-15.9%
Contents	B	0.570	0.131	0.414	0.545	-13.4%
Total/Wtd. Avg.					0.332	-29.6%

(a) All Loss Costs shown are on a per $100 Amount of Insurance basis, $250 Deductible level, 80% coinsurance.

(b) Current loss costs shown are for Non-habitational properties, Occupancy Class A.

EXHIBIT 8

CALCULATION OF STATEWIDE BG II LOSS COST CHANGE

Territory	1992 Exposure Weights (000)	Indicated Monoline Change
Beach	$ 1,114,596	-29.6%
Seacoast	4,376,754	+44.3%
Inland	60,949,343	-30.9%
Statewide		-23.1%

SECTION V - OTHER USES OF THE MODEL

A. Pricing Optional Coverages

Homeowners insurance may not always be written with the basic flat uniform property deductible on all perils, particularly in hurricane-prone areas. Various optional endorsements such as an endorsement excluding coverages for wind and hail, credit for the installation of wind resistant shutters, or higher optional wind deductibles may be offered to lower the insurer's risk of catastrophic loss. Since the output of the hurricane model better measures the long term catastrophic loss potential than the shorter historical statistical data base, it provides a tool for more accurate pricing of each of these options.

Wind Exclusion Credits

A coverage option that has been available in several southeast states in their coastal territories has been the windstorm and hail exclusion. This endorsement does just as it states - it excludes windstorm and hail coverage from the standard property policy forms. The insured is able to buy back the coverage for the excluded peril through the state's Wind Pool or Beach Plan. The excluded coverage may or may not include the additional living expense (Coverage D in an ISO homeowners policy) losses due to the wind losses.

Recognizing the nature of the coverage is a key item in developing a pricing algorithm. A second key factor in developing the pricing is to recognize the nature of the wind coverage provided and the risk of loss to each exposure in the territory under consideration. An important question to consider is whether two risks located in the same territory, the first of which is in a town that has a fire protection code of 4 and the second in an unprotected area (Code 10), have different wind peril exposure based solely on the fire protection difference. Clearly, if all other aspects of these risks in terms of exposure to the wind peril are the same, one would expect that the wind risk is the same. For this reason, the credit developed for the wind exclusion coverage will be a flat dollar credit and not a percentage credit.

To develop the pricing for the wind exclusion, it must be recalled that the loss cost was composed of two components, a modeled hurricane loss cost (H), and a non-modeled loss cost (N). The combination of these two components is the base class loss cost (BCLC). Expressed as a formula,

$$BCLC = N + H.$$

The key to determining the credit for the wind exclusion endorsement is to determine the long term wind percentage included in the non-modeled loss costs. The non-wind portion of the non-modeled loss costs (N) is estimated using the ratio of total non-wind losses to the total non-modeled losses (reflecting the long term non-hurricane wind losses). This ratio can be identified as R. The credit (C) for all protection classes is then given by the formula,

$$C = [BCLC - (N)(R)]\ PC,$$

where PC is the average protection-construction relativity.

The resulting credit C is a flat dollar credit for all protection classes and base amount of insurance. In rating each risk, it would be subtracted from the base class loss cost after application of the protection-construction and policy form relativities but before application of any of the appropriate relativities - policy amount, deductible, etc. A sample calculation of the Wind Exclusion Credit is shown on Table 7.

TABLE 7
CALCULATION OF WIND EXCLUSION CREDIT

Terr.	Base Class Loss Cost	Non-Modeled Loss Cost	Non-Wind Portion of Non-Modeled Loss Cost	Average Protection Construction Relativity	Wind Exclusive Credit
A	155	148	.95	1.06	15.26
B	261	158	.80	1.02	137.29
C	280	203	.85	.97	104.23

B. Development of Territory Definitions

When developing territory boundary definitions, a necessary piece of information is the long-term wind loss potential for small geographic areas. It is quite likely that there may not be adequate historical insurance experience to accurately measure the long-term wind loss potential. Since the output of the model provides the long-term average hurricane loss cost by zip code, these estimates can be combined with more current information from all other causes of loss to produce relative indices by zip code. These indices could be grouped, using banding or clustering techniques, to produce revised territory definitions.

C. Building Code Effectiveness Grading

Hurricane Andrew focused attention on the importance of building codes and the enforcement of these codes in potentially mitigating property damage during hurricanes and other windstorm events.

ISO, working with the Insurance Institute for Property Loss Reduction (formerly the National Committee on Property Insurance), building code officials, and academics, developed a program to grade communities on their building code enforcement activities. Risks in communities receiving a better grade will be given a reduction in their property insurance premium.

Since buildings, even when built to code, are more susceptible to damage at higher wind speeds, a key to pricing the appropriate credits is the long-term frequency and severity of hurricanes (classified by Saffir-Simpson scale). The use of a hurricane model provides the necessary measure of loss potential that, when combined with engineering estimates of the effectiveness of the building code, produces an estimate of the appropriate credit.

D. *Risk Load*

While the focus of this paper has been on the development of expected costs, it should be noted that the distribution of losses around this average (i.e. variance) often has as much impact on the insurer's pricing and underwriting decisions as the average. This is true because the distribution around the average determines the degree of risk underlying the coverage. For Property catastrophe coverage, this risk is magnified because of the high concentration of properties in areas prone to catastrophic events (e.g. South Florida). Risk load is the charge in excess of the expected losses required to cover the cost of the capital needed to support the risk of providing the coverage. Since risk load is ultimately a variance-based concept, a model can be indispensable in providing mathematical-based distributions of losses for calculating such variances.

SECTION VI - LIMITATIONS OF THE MODEL/PROCEDURE

While we are confident that the ISO new procedure employing the RMS computer hurricane model is a dramatic improvement over the prior loss smoothing procedures, we recognize that there are limitations to the model.

1) Limitations of Meteorological History

While the model uses the broadest history for which hurricanes characteristics are available, this is still a very limited history, with a total of only 157 hurricanes and approximately 650 tropical storms making landfall in the continental United States in the period from 1899 to 1994. Not one of the 31 coastal segments have experienced all five Saffir-Simpson categories of hurricanes in that period. Some segments have not experienced a severe storm in the 96 years. Expanding from the available insurance database to the available meteorological data base has not totally solved the problem of sparse data. In the absence of a more complete meteorological history, significant assumptions and extrapolations have to be made, particularly with respect to the central pressure differential distribution.

In addition, it is quite plausible that hurricane frequency is impacted or correlated with large scale climatic and geological cycles that are currently not fully understood The model does not attempt to incorporate any cyclical or other time dependent interpretation of the meteorological data.

2) Limitation of the Understanding of Hurricanes

The model estimates the damages generated from an average hurricane with a given central pressure differential and forward velocity. In reality each hurricane is unique. Due to limited understanding of hurricanes, the complicated physics at the core of the storm (which are difficult to parameterize), and the absence of data for more sophisticated modeling, the model is not able to capture unique features.

3) Limitations of the Exposure Inventory

While the model can produce MDRs by specific location, construction, and other variables, the exposure inventory (amount of insurance data), is rarely available in as fine detail. Of particular importance is the location of the risk. While zip code detail is now being reported for personal lines, only statistical territory detail was available for experience prior to 1994. For commercial lines, county detail is reported under the current ISO statistical plans. For coastal areas the variation of MDRs within an individual zip code can be quite significant. Only three wind-based categories of construction are reported to ISO. Information such as number of stories, roofing type, and other details that can impact hurricane vulnerability are not reported. To the extent that the exposure inventory is not available in fine location detail (as well as other variables), averaging will be required. Thus, the output of the model will always be constrained by the limitations of the input.

4) Demand Surge

The model assumes that the cost of repair -- materials and services -- will be relatively normal. One of the lessons of Hurricane Andrew is that a severe catastrophe can dramatically affect those costs -- a phenomenon described as demand surge. While the current model does not reflect demand surge, it is being considered.

5) Limitations of Damageability Information

Unlike earthquake for which public, government-sponsored studies of damageability (such as the Applied Technology Council publication 13) are available, there is no broadly-accepted and publicly-released analysis of damageability from hurricanes to use as reference or starting point. Thus, the modelers must rely on more limited proprietary information from individual clients.

6) Limitations of the model in specific pricing situations

The output of the hurricane model may not be appropriate for use in all pricing or ratemaking situations. It is necessary to check the assumptions underlying the model before using the output in the pricing.

An example of where this may be true is in developing policy amount relativity factors. The Mean Damage Ratio is generally defined as the ratio of the structure's repair cost divided by its replacement cost. If the hurricane model's Mean Damage Ratio is calculated by averaging the damage ratios which are available for each combination of construction materials (frame, masonry, etc.), building usage (residential, commercial) or unit type (single family, multi family) but does not vary by amount of insurance or value of the property, then it is unclear if the Mean Damage Ratio would be appropriate for use in determining amount of insurance relativities. This may be particularly true if the data underlying the table that was used in calculating the damage ratios can be shown to be some function of the amount of insurance.

The key fact in this situation is to know what data, assumptions and calculations underlie the results of the model.

SECTION VII - RESULTS OF THE MODEL

Observations for Personal Property

In examining the indicated loss cost changes within a state, after introduction of the model, a relationship emerged between the statewide indications and the frequency of hurricanes within the experience period. In states where the 33 years of experience had infrequent hurricanes (vs. the nearly 100 years of meteorological history), the indications were for loss cost level increases and in some cases significant ones. In other states, the indications were negligible or negative if the recent 33 years of hurricane frequency was more frequent than the 100 year meteorological history.

One important advantage of the model is the more accurate estimation of the hurricane peril by territory within a state. Although up to 33 years of wind experience was traditionally used in ISO's catastrophe procedure for the statewide loss cost changes, the distribution of the catastrophe wind losses to territory has been based on a shorter time period of 10-20 years of wind losses.

In reviewing the modeled hurricane loss costs by territory, there is a very strong relationship in the severity of the modeled hurricane loss cost and the territory's distance to coast. The territories on or near the coast typically have the highest modeled hurricane loss cost, with this loss cost decreasing as the territories get further from the coast. This is due to two factors. One, the hurricane will most likely be strongest when passing through the coastal territory. Two, independent of the storm's path, winds are higher by the coast due the absence of local roughness which would have a tempering effect on the wind speeds.

SECTION VII - RESULTS OF THE MODEL

Observations for Commercial Property

In examining the Basic Group II statewide indications, upon introduction of the model, two basic patterns emerged by region. In the Northeast, most states showed clearly positive indications, with some indicating very substantial increases. The Southeastern states generally indicated moderate decreases, with the major exception to this pattern being Florida, which had a large positive indication. The explanations for these patterns fall into two categories, both related to the experience-based methodology used prior to the introduction of the model:

1) Experience Period: As alluded to previously in this paper, a problem with the experience-based procedure is the limited period available for hurricane insurance statistics. While for BG II, this period covers as much as 43 years (i.e. 1950-1992), this still leaves a gap when contrasted with the nearly 100 years of meteorological history underlying hurricane models. The gap between these two periods has opposite impacts on the indications, by region. In the Northeast, the experience period is too recent to reflect major hurricane activity that struck the Northeast throughout the 1930's and 1940's. Hence, the model's inclusion of this period has, in effect, corrected for this via upward indications. In the Southeast, on the other hand, major hurricanes in the 1950's and early 1960's, and in particular the two prominent recent events (Hurricane Hugo and Andrew) have been captured by the experience period, hence resulting in no particular need to "true up" overall loss cost level within the region as a whole.

2) Regional Smoothing: An integral part of the previous methodology was the inclusion of a significant regional component (supplementing the statewide component) within the excess factor meant to account for catastrophic losses. First of all, this had the impact of keeping the southeastern and northeastern regions totally separate, thus preventing at least some spreading of the more recent hurricane activity in the former to the latter. Secondly, the emphasis of the regional component, particularly for highly severe occurrences such as Andrew, may have contributed to an over-spreading of these losses throughout the southeastern region, and away from Florida. The model is likely correcting for this by producing a high increase in Florida, at the expense of loss cost level in the other states within the region.

SECTION VIII - CONTINUING ACTIVITIES

As a user of a hurricane model, it is important to maintain an ongoing relationship with the developers of the model. It is expected that the models will undergo improvements over time, as a result of additional meteorological data becoming available as new hurricanes occur or new meteorological research is done. Any change in the relationship between the meteorological characteristics and the damageability of property could occur either based on new engineering studies or on additional insurance statistics that become available. Thus, it is important to keep up-to-date with any new information that could be reflected in future versions of a model.

APPENDIX A - WEIGHTING MEAN DAMAGE RATIOS FOR HOMEOWNERS TENANTS AND CONDOMINIUM POLICY FORMS

For HO-4 and HO-6, the amount of insurance collected in the Statistical Plan is for Coverage C(contents).

The homeowners tenants policy form (Form 4) provides coverage for contents and additional living expenses and the additional living expenses is usually 20% of the Coverage C amount. Thus, the building MDR is given a weight of 0 for Coverage A and B; the contents MDR is given a weight of 1.0 for Coverage C; and the additional living expenses MDR is given a weight of .2 for Coverage D. The tenants form is written on single-family and multi-family units. Thus, the single-family and multi-family MDRs are weighted together using the distribution of single-family and multi-family houses obtained from the Census Bureau for the state.

The homeowners condominium policy form (Form 6) provides coverage for applicable building structures, contents and additional living expenses and the additional living expenses are usually 40% of Coverage C. Thus, the building MDR is given a weight based on the reported Coverage A amount of insurance limit collected in the Statistical Plan as a percent of the reported Coverage C amount of insurance for each territory and construction class. The content MDR is given a weight of 1.00 for Coverage C; and the additional living expense MDR is given a weight of .40 for Coverage D. Since the condominium policy form is written primarily on multi-family units, only the multi-family MDRs are used.

Glossary:

Additional Living Expenses - a form of coverage which may be included in a Homeowners or Dwelling policy, providing funds to pay for increased living costs which result from damage covered by the policy.

Appurtenant Structures - a structure pertaining or belonging to the insured structure, such as a tool shed.

Base Class Loss Cost - for the homeowners owners forms, the territory loss cost for Policy Form 3, Protection Class 5, Frame Construction and Policy Amount of $60,000. The base class loss cost does not reflect the application of Policy Amount relativities (or Key Factors), Protection/Construction relativities, Policy Form relativities or other applicable discounts or surcharges for a particular policy.

Basic Group II (BGII) - the extension of commercial property insurance to the perils of windstorm, hail, riot, smoke, aircraft, volcanic action and sinkhole collapse.

Classification and Coverage Factor - an average rating factor in homeowners representing the distribution of earned house years by policy form, protection/construction, policy amount and other applicable policy provisions relative to the base class loss cost.

Composite Projection Factor - a trending factor that reflects external loss projection, total loss trend adjustment (if applicable), adjustment for trend from first dollar and amount of insurance projection. The composite projection factor is applied to the loss costs on a current cost/amount level to project losses to the average date of loss (12 months past the effective date) and amount of insurance to the average date of writing for policies written during the period the new loss costs are assumed to be in effect (6 months past the effective date).

Current Cost/Amount Factor - a trending factor which reflects the combined loss trend as measured by the external index and amount of insurance trend on the loss cost from a given accident year to the point in time corresponding to the mid-point of the latest available quarter of the Current Cost Index.

Central Pressure Differential - the difference between the ambient sea-level pressure at the outer limits of hurricane and the lowest sea-level pressure at the center of a hurricane. As this differential increases, the strength of the storm and velocity of the winds generated by the storm increases.

Decay - the reduction in wind speeds of a hurricane due to removal of the oceanic heat/energy source as the hurricane moves from sea to land or over cooler water.

Damage Ratio - the ratio of losses due to a hurricane to the replacement cost.

Dwelling Extended Coverage - a common extension of dwelling property insurance beyond fire and lightning. Extended coverage adds insurance against loss by the perils of windstorm, hail, explosion, riot and riot attending a strike (civil commotion), aircraft damage, vehicle damage, smoke damage and volcanic eruption.

Expected Hurricane Losses - the expected losses due to the hurricane peril as estimated from the hurricane computer model using the latest year amount of insurance years. The losses are on a $250 deductible level and are calculated by multiplying the homeowners Coverage A amount of insurance years by each territory's weighted mean damage ratios for each construction class.

Eye ("of a storm") - the roughly circular area of comparatively light winds and fair weather found at the center of a tropical cyclone (hurricane or tropical storm). The diameter of the eye typically ranges from 10 to 30 miles.

Forward Velocity - the rate of movement of the hurricane center.

Hurricane - a tropical cyclone with sustained winds of 74 mph or more.

Hurricane Loss Cost - the portion of the loss cost attributable to the hurricane peril. The loss cost is determined by dividing the expected hurricane losses by the latest number of house years.

Indicated Loss Cost Change - the percent change that must be made to the current loss costs to achieve adequacy to pay for losses and loss adjustment expenses in the prospective period.

Loss Adjustment Expense Factor - a factor applied to the indemnity losses to load for allocated and unallocated loss adjustment expenses. The factor represents the ratio of the sum of the incurred indemnity losses plus all loss adjustment expenses to the sum of the incurred indemnity losses.

Mean Damage Ratio (MDR) - the expected damage ratio across all simulated storms, calculated as the sum of the products of the individual storm probabilities and damage ratios.

Net Mean Damage Ratio - an MDR adjusted to reflect a deductible. For homeowners, the common ratemaking deductible is $250.

Net Weighted Mean Damage Ratio - an MDR used for Homeowners reflecting the appropriate building, other appurtenant structures, contents and additional living expenses MDRs and weighing them together based on the relationship of their amount of insurance weight to the Coverage A (building) amount of insurance. The net weighted MDR is applied to the Coverage A amount of insurance to develop expected hurricane losses for all coverages on a homeowners policy.

Non-hurricane Loss Cost - the portion of the loss cost that is attributable to all covered perils other than the hurricane peril.

Population-Weighted Centroid - the central location (latitude/longitude) of a zip code based on census tract population weights.

Prospective Loss Cost - the portion of a rate that does not include provisions for expenses (other than loss adjustment expenses) or profit, and is based on historical aggregate losses and loss adjustment expenses adjusted through development to their ultimate value as well as a model-generated hurricane loss provision, both projected through trending to a future point in time.

Radius of Maximum Winds - the radial distance from the hurricane center to the band of strongest winds, the area immediately past the eye.

Roughness - characteristics of a local area (e.g. uneven elevation) which modify the hurricane windspeeds near the surface.

Saffir-Simpson - a scale (from 1-5) used to measure hurricane intensity, with 1 being the least severe and 5 being the most severe.

Territory Relativity - the factor which relates the territory loss cost for a particular territory to the statewide loss cost.

Track Angle - the angle that the forward path of the hurricane makes at landfall as measured clockwise from due North.