Circular

RULES - IMPLEMENTATION MAY 15, 2013

FROM: JOSEPH AMEEN, SENIOR ANALYST

COMMERCIAL PROPERTY LI-CF-2013-065

COMMERCIAL PROPERTY ENHANCED WIND RATING PROGRAM TO BE IMPLEMENTED FOR NON-RESIDENTIAL RISKS IN FLORIDA

This circular announces the implementation of the Commercial Property Enhanced Wind Rating Program in Florida, for non-residential risks.

BACKGROUND

Enhanced Wind Rating Program

In circular LI-CF-2011-136, we announced our plans for the introduction of an enhanced wind rating program for the Commercial Property line of business, featuring Basic Group II (BG II) specific rating for eligible properties.

In circular SP-CF-2012-002, we provided statistical reporting information for BG II specific rating under the Commercial Fire and Allied Lines (COMFAL) module of the Commercial Statistical Plan (CSP) and the Commercial Statistical Plan - Intermediate (CSP-i).

In circular LI-CF-2012-227, we provided sample SPI Plus quote screens to familiarize you with the new format and content that accommodates the introduction of the Enhanced Wind Rating Program. For eligible properties in states where the Program has been introduced, the quote screen displays the BG II class (manual) loss cost, indicated wind factor, capped wind factor and BG II specific loss cost.

Filing Requirements

Section 627.062(3) (d), Florida Statutes, effective October 1, 2011, serves to expand the scope of modified filing procedures for loss cost and rating rule filings to additional commercial lines of insurance, including non-residential Commercial Property.

ISO ACTION

In accordance with the filing requirements of Section 627.062(3) (d) 4, Florida Statutes, we submitted the following material and information to the Florida Office of Insurance Regulation (FLOIR) under Filing Designation CF-2013-REWR1:

- A copy of the Enhanced Wind Rating Program manual rule and a copy of the final printed manual pages displaying that rule. The rule describes the program, explains applicability criteria for the program in Florida, provides eligibility criteria for Basic Group II specific rating and addresses adjustments that apply to the Basic Group II specific rate;
- A statement advising of the latest total loss costs at current level for Basic Group II for Florida; and

- A statement advising that the average statewide change in Florida Basic Group II non-residential loss costs is 0% for both building and contents, as a result of introducing the Enhanced Wind Rating Program.

Please refer to Attachment 2 for a copy of the submitted rule.

INSURANCE DEPARTMENT ACTION

The FLOIR acknowledged this submission.

SUMMARY OF FLORIDA ENHANCED WIND RATING INTRODUCTION

The Enhanced Wind Rating Program for Florida **applies only to non-residential risks**. The Enhanced Wind Rating Program does **not** apply to residential risks as defined by Section 627.4025(1), Florida Statutes. CF-2013-REWR1 addresses Phase I of the Enhanced Wind Rating Program, which draws on building attributes already compiled or readily available. The program will use the existing Basic Group II loss costs (by state, territory and wind symbol) as a starting point. Then, credits and debits will be assigned to each building based on site-specific information. These credits/debits are being introduced on a revenue-neutral basis.

The debit/credit applied to an individual property loss cost will be capped at +25%/-20% for the first year. Later revisions will further phase-in the implementation of the full debits/credits for individual properties.

In this circular, we are including supporting information, which was **not** part of the submission to the FLOIR. Please refer to Attachments 1 and 3 for details.

EFFECTIVE DATE

The ISO revision is subject to the following rule of application:

These changes are applicable to all policies effective on or after November 1, 2013.

COMPANY ACTION

If you have authorized us to file on your behalf and decide:

- to use our revision and effective date, you are not required to file anything with the Insurance Department.
- to use our revision with a different effective date, to use our revision with modification, or to not use our revision, you must make an appropriate submission with the Insurance Department.

For guidance on submission requirements, consult the ISO State Filing Handbook.

In all correspondence with the Florida Office of Insurance Regulation on this revision, you should refer to ISO Filing Designation Number CF-2013-REWR1 and FLOIR Number FCC 13-08024, NOT this circular number.

CAUTION: To assist you in your review of this submission, we have attached supporting information related to CF-2013-REWR1. The supporting information, which has **not** been submitted to the FLOIR, is provided in Attachments 1 and 3.

RATING SOFTWARE IMPACT

Specific rating is being introduced for Basic Group II, for non-residential properties in Florida which meet certain eligibility criteria.

POLICYHOLDER NOTIFICATION

If you decide to implement this revision, you should check all applicable laws for the state(s) to which this revision applies, to determine whether or not a specific policyholder notice requirement may apply. Please note that circular LI-CL-2012-049 contains the ISO Guide To Renewals With Changed Conditions For Commercial Lines, which is available only as a guide to assist participating companies in complying with various conditional renewal statutes or regulations, for the major commercial lines of insurance serviced by ISO. The information in the Guide does not necessarily reflect all requirements or exceptions that may apply, and it is not intended as a substitute for your review of all applicable statutes and regulations concerning policyholder notification.

REVISION DISTRIBUTION

- Manual and ISO Suite

We will distribute a Notice to Manualholders with an edition date of 11-13 (or the earliest possible subsequent date), along with any new and/or revised manual pages, and update our electronic deliveries to include this information.

- SPI Plus on the Internet

Basic Group II specific property information will be available on SPI Plus beginning on June 30, 2013. The Basic Group II specific loss costs will be shown at the then-current experience level as well as all available prior levels.

- ProMetrix Network Connection

The Basic Group II specific loss costs are deliverable as part of the loss cost quote via a network connection, which delivers data in an Extensible Markup Language (XML) format.

- Toll-free Telephone Service

Basic Group II specific property information will be available beginning on June 30, 2013 by calling toll-free 1-800-444-4554. The Basic Group II specific loss costs will be available at the then-current experience level as well as all available prior levels.

SURVEYS AND ESTIMATED LOSS COSTS

ISO surveys collect up-to-date information on conditions and hazards for property in the United States. This information is building-specific. With respect to non-residential properties in Florida which are currently recognized in the Commercial Property Information database, information will now include Basic Group II specific rating information if the property is eligible for Basic Group II specific rating. If a non-residential property is eligible for Basic Group II specific rating but is not currently in the Commercial Property Information database, you may request a survey and develop an Estimated Loss Cost in the interim before the survey is delivered. (Program applicability to non-residential risks and eligibility criteria for Basic Group II specific rating are addressed in the manual rule shown in filing CF-2013-REWR1.)

Surveys and Estimated Loss Costs can be ordered through ISO's SPI Plus system, or by phone, fax, e-mail and mail order. Refer to the PERSON(S) TO CONTACT block for ordering information.

REFERENCE(S)

- LI-CL-2012-049 (12/17/2012) Revised Lead Time Requirements Listing For States That Require Advance Notification To Policyholders Is Updated
- LI-CF-2012-227 (09/18/2012) SPI Plus Quote Screen Reformatted To Accommodate Information Relating To Basic Group II Specific Loss Costs; Sample Quote Screens Furnished For Information
- SP-CF-2012-002 (06/07/2012) Commercial Fire And Allied Lines Basic Group II Specific Wind Rated Coding Options Added
- LI-CF-2011-136 (10/21/2011) Commercial Property Enhanced Wind Rating Program To Be Introduced

ATTACHMENT(S)

- Attachment 1 – Explanatory Memorandum (**not** submitted to FLOIR)
- Attachment 2 – Manual Pages (submitted under CF-2013-REWR1)
- Attachment 3 – Actuarial Support (**not** submitted to FLOIR)

We send attachments only to recipients who asked to be put on the mailing list for attachments. If you need the attachment(s) for this circular, contact your company's circular coordinator.

COPYRIGHT EXPLANATION

ACKNOWLEDGMENT OF ACTUARIAL QUALIFICATIONS

The American Academy of Actuaries' "Qualifications Standards for Actuaries Issuing Statements of Actuarial Opinion in the United States" requires that an actuary issuing a Statement of Actuarial Opinion should include an acknowledgment with the opinion that he/she has met the qualification standards of the AAA. ISO considers the attached material a Statement of Actuarial Opinion; therefore we are including the following acknowledgment:

I, Joseph Palmer, FCAS, am Assistant Vice President and Actuary for ISO, and I, Richard Haines, ACAS, am Manager and Assistant Actuary for ISO. We are jointly responsible for the content of this Statement of Actuarial Opinion. We are both members of the American Academy of Actuaries and we meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

AIR WORLDWIDE CORPORATION

The attached material incorporates use of AIR Worldwide Corporation's (AIR) Severe Thunderstorm Model for the United States and, where applicable, the AIR Worldwide Hurricane Model. The debits and credits included in the Enhanced Wind Rating Program are based, in part, on these models.

AIR is the world's premiere risk modeling and technology firm specializing in risks associated with natural and man-made catastrophes, weather and climate. AIR has developed models covering all major natural hazards, including hurricanes and earthquakes, and man-made perils (terrorist events) for more than 40 countries throughout North America, the Caribbean, South America, Europe, and the Asia-Pacific region. AIR provides a full suite of integrated products for underwriting, pricing, portfolio management, risk transfer and financing.

For more information concerning AIR Worldwide Corporation, please see the PERSON(S) TO CONTACT block in this circular.

PERSON(S) TO CONTACT

If you have any questions concerning:

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- other products or services, please contact either Customer Support or your ISO representative.

To order a survey or estimated loss cost, you may use one of the following options:

SPI Plus: https://spinet.iso.com
Phone: 800-444-4554
Fax: 800-777-3929
Email: npc-telecom@iso.com
Write: Insurance Services Office, Inc.
National Processing Center
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Marlton, NJ 08053

Callers outside the United States, Canada, and the Caribbean may contact us using our global toll-free number (International Access Code + 800 48977489) or by e-mail at info.global@iso.com. For information on all ISO products, visit us at www.iso.com. To keep abreast of the latest Insurance Lines Services updates, view www.iso.com/ils/.

Introduction of Enhanced Wind Rating Program

About This Filing

ISO's current loss costs for Basic Group II are provided for each state, territory, and wind symbol. These loss costs are annually reviewed based on the latest available information reported under the Commercial Statistical Plan (CSP) and the Commercial Minimum Statistical Plan (CMSP). Over time, there has been an increase in both the number of significant wind events and the annual volume of losses due to wind. This has been accompanied by an increase in the number of buildings in geographic areas exposed to high wind. The purpose of this filing is to introduce the Enhanced Wind Rating Program, to provide additional risk-by-risk differentiation in wind loss costs that are reflective of a building's underlying exposure to losses due to wind.

The Enhanced Wind Rating Program applies only to non-residential risks in Florida. Residential risks as defined by Section 627.4025(1), Florida Statutes are not eligible for the Enhanced Wind Rating Program. (A schedule of wind mitigation credits is currently in place in the ISO manual for residential risks in response to Florida Statutes, subsection (1) of 627.0629.)

Overview

The Enhanced Wind Rating Program uses the current Basic Group II (BGII) loss cost --- by state, territory and wind symbol --- as a starting point for eligible individual risks. The program then applies a composite debit or credit to the loss cost to develop an enhanced loss cost for the specific property. ISO's ProMetrix® commercial property database will be used to deliver the base loss cost, composite debit/credit, and enhanced loss cost for each eligible property.

The composite debit/credit is based on 7 key characteristics of each specific property:

- Distance to Coast
- Surrounding Terrain
- Building Height
- Age of Building (Year Built)

- Building Construction
- Superior Roof Construction (if applicable)
- Building Code Effectiveness Grade

This program is being filed as "Phase I" of a longer-term initiative. At this time, the seven variables being used are readily available for a wide range of eligible properties. This enables swift introduction and use of this rating program --- which will provide building-specific loss costs that more accurately reflect the building's underlying exposure to losses due to wind. ISO is currently conducting surveys of eligible buildings to capture data and information on roof, building envelope, and exposure characteristics --- currently a total of 37 data elements are being collected. At a later date, this information will form the basis of a more comprehensive rating program.

Eligibility For The Program

In order to maximize the usefulness and efficiency of on-site building inspections, properties are considered eligible for the program if they meet certain geographic criteria and size criteria.

The Enhanced Wind Rating Program targets properties that are exposed to the risk of damage due to high winds. As this exposure varies greatly by geographic region, we analyzed historical wind loss experience in order to ascertain states, and areas within states, that are highly exposed to losses due to wind. Areas were classified into 4 levels of exposure. Properties of different sizes are eligible for the program in each area. The following chart displays the eligibility criteria:

Geographic Risk Factor	**Building Size (square feet)**		
	10,000 - 25,000	**25,001 - 50,000**	**50,001 and over**
Low	-	-	-
Medium	-	-	Eligible
High	-	Eligible	Eligible
Severe	Eligible	Eligible	Eligible

Impact: Introduction on a Revenue Neutral Basis

As noted earlier, the program uses the existing filed Basic Group II loss costs ---- by state, territory, and wind symbol --- as a starting point. Individual eligible properties will receive a composite debit/credit as part of the program, based on an individual building's characteristics. These debits and credits will be introduced on a revenue-neutral basis. Off-balance factors will be applied --- at the state and territory level --- to ensure that the overall effect is 0.0% for each state/territory combination.

In order to phase-in the effects of the Enhanced Wind Rating Program, any changes to the loss costs for individual risks will be capped at +25%/-20% for the initial year of the program. Later filings will further phase-in the implementation of the full debits/credits for individual properties.

Commercial Lines Manual Division Five - Manual Rule

We are introducing a rule on the Enhanced Wind Rating Program for inclusion in Division Five of the Commercial Lines Manual.

This rule provides a general description of the program, explains the applicability criteria for the Program in Florida, displays the eligibility criteria for BGII specific rating (geographic wind hazard level and building size), and addresses adjustments that apply to the BGII specific rate. With respect to building size, the rule explains what areas of the building should be considered in determining the total square footage.

Copyright Explanation

Important Note

Insurance Services Office, Inc. (ISO) makes available advisory services to property/casualty insurers. ISO has no adherence requirements. ISO rules and explanatory materials are intended solely for the information and use of ISO's participating insurers and their representatives, and insurance regulators. Neither ISO's general explanations of rules intent nor opinions expressed by members of ISO's staff necessarily reflect every insurer's view or control any insurer's application of manual rules.

Attachment 2

Manual Pages

ENHANCED WIND RATING PROGRAM

ENHANCED WIND RATING PROGRAM (BASIC GROUP II SPECIFIC RATING)

A. Description

The Enhanced Wind Rating Program develops Basic Group II specific loss costs for eligible buildings based on site-specific information. This program uses a schedule to determine debits and credits based on wind-loss characteristics of the building and surrounding environment. The debits and credits are combined to determine a total debit/credit factor which is applied to the Basic Group II manual loss costs to produce Basic Group II loss costs specific to the building and its contents. The Specific Property Information quote displays the Basic Group II manual loss costs, debit/credit factor and resulting specific loss costs, as well as the Basic Group II community building code effectiveness grade if such grading program applies in this state.

B. Program Applicability – Non-residential Risks

1. In Florida, the Enhanced Wind Rating Program applies to **non-residential risks** in accordance with the terms of Paragraphs **B.2.** through **B.4.**

2. The following classifications identify **residential** occupancies:

CSP Class Codes

0074	0079	0312	0331	0343
0075	0196	0313	0332	
0076	0197	0321	0333	
0077	0198	0322	0341	
0078	0311	0323	0342	

The Enhanced Wind Rating Program does not apply to residential risks as defined by Section 627.4025(1), Florida Statutes.

3. With respect to Sole Occupancy buildings, the Enhanced Wind Rating Program applies to all classifications **other than** those listed in Paragraph **B.2.**

4. With respect to Multiple Occupancy buildings:

a. If the building is classified under one of the classes listed in Paragraph **B.2.,** then the building is considered to be Residential, and in such case the building and all occupancies in the building are **not** eligible for the Enhanced Wind Rating Program;

b. If the building is classified under a class **other than** one of those listed in Paragraph **B.2.,** then the building is considered to be Non-residential and is eligible for the Enhanced Wind Rating Program. **However**, residential occupants of that building, meaning those classified by any of the codes listed in Paragraph **B.2.,** are not eligible for the Enhanced Wind Rating Program.

C. Eligibility Criteria

Geographic wind hazard level and building size, as provided in Paragraphs **C.1.** and **C.2.,** determine eligibility for specific rating for Basic Group II, provided that the risk qualifies for the Program under the terms of Paragraph **B.**

1. Geographic Wind Hazard Level

Determine the Geographic Wind Hazard Level from Table **C.1.**

Geographic Wind Hazard Level	Territory
Severe	Entire State

Table C.1. Geographic Wind Hazard Level

ENHANCED WIND RATING PROGRAM (BASIC GROUP II SPECIFIC RATING) (Cont'd)

2. Building Size

a. Buildings that meet the applicable size criterion indicated in Table **C.2.a.,** and their contents, are specifically rated for Basic Group II if they are located in an area with a Geographic Wind Hazard Level of Severe, High or Medium.

Geographic Wind Hazard Level	Square Footage Of Building
Severe	10,000 square feet and over
High	25,001 square feet and over
Medium	50,001 square feet and over

Table C.2.a. Building Size

b. In determining square footage of the building for the purpose of establishing eligibility for Basic Group II specific rating, the following criteria apply:

(1) With respect to basements, sub-basements and mezzanines, disregard the areas used for general service or maintenance of the building, such as heating and air conditioning equipment or janitorial supplies. Do **not** disregard areas that directly relate to business operations, such as storage or assembly areas and areas open to customers or the public.

(2) Do **not** disregard any areas of the building on the basis of type of occupancy. The areas of all occupancy classes are included in the determination of square footage for the purpose of eligibility under the Enhanced Wind Rating Program.

D. Adjustments To The Basic Group II Specific Rate

Adjustments, credits and charges that apply to Basic Group II class-rated risks, such as coinsurance, deductible, and optional coverages, as well as limit of insurance relativities and building code effectiveness grading if applicable in this state, also apply to Basic Group II specifically-rated risks.

Attachment 3 – Actuarial Support

This section provides support for the selections of debits/credits for each of the variables outlined in the Overview on pages 1 and 2 of this filing, namely:

Distance to Coast
Surrounding Terrain
Building Height
Age of Building (Year Built)
Building Construction
Superior Roof Construction (if applicable)
Building Code Effectiveness Grade

The Enhanced Wind Rating Program applies only to non-residential risks in Florida. Residential risks as defined by Section 627.4025(1), Florida Statutes are not eligible for the Enhanced Wind Rating Program.

Data Sources

The Enhanced Wind Rating Program draws on three main sources of information:

- Data reported under the ISO Commercial Statistical Plan (CSP) and Commercial Minimum Statistical Plan (CMSP)
- The AIR Worldwide Hurricane (where applicable) and Severe Thunderstorm Models
- Building-specific surveys performed by ISO Risk Decision Services

<u>Commercial Statistical Plan (CSP) / Commercial Minimum Statistical Plan (CMSP)</u>

The construction analysis was based on 13 years of multistate calendar/accident year data ending December 31, 2009, evaluated as of March 31, 2010. Incurred losses were not smoothed so that variations in severe losses by construction would be retained. In addition, the underlying data were adjusted by the limit of insurance relativities, to account for loss variations related to policy limits. This statistical data was used to develop relativities for detailed building construction, superior (UL90 certified) roof, and also contributed to the analysis of building height. This analysis of the statistical plan information was performed using a Generalized Linear Model (or GLM) approach, as described below.

The wind hazard area analysis was based on 25 years of multistate calendar/accident year data ending December 31, 2009, evaluated as of March 31, 2010. Incurred losses were not smoothed so that variations in severe losses by county would be retained. In addition, the underlying data were adjusted by the limit of insurance relativities, to account for loss variations related to policy limits. This data was used to determine areas of higher/lower wind hazard than is currently captured in the BG II territory structure, and the results are used to determine whether risks are eligible for the Enhanced Wind Rating Program.

AIR Worldwide (AIR) Models

State-specific distance-to-coast, terrain and year built relativities were derived from analysis of output of the AIR Hurricane Model for the United States (Version 12). Additional refinement of height relativities was derived from an analysis of the output of both the AIR Hurricane and Severe Thunderstorm model (Version 6.2). A detailed description of the models used is provided in Appendices A and B.

Risk Decision Services

The ProMetrix® commercial property database and ISO's Location® product have been used to ascertain the specific individual risk characteristics of eligible properties. The distribution of risks by rating element has also been used to determine the territorial off-balance to implement the program on a revenue-neutral basis.

Determination of Wind Hazard Areas

Reported data for the 25 year period ending 12/31/2009 was compiled by county, and a county experience ratio (trended losses divided by aggregate loss costs at a current level) was calculated. Where experience ratios were evaluated across territories, they were adjusted to a base territory level.

High and low experience ratios were marked on a state map to find areas with generally higher or lower experience ratios. Known patterns for wind (e.g., coastal proximity in coastal states or, "tornado alley" in plains states) and geographic features affecting wind patterns (e.g., mountain ranges or the Great Lakes) were considered in grouping counties. Wind loss experience in neighboring states was also considered for counties along state boundaries. Once counties were grouped, the areas were tested for year-to-year consistency in showing high or low experience ratios.

An average manual loss cost for the base limit for symbol B was calculated for each state by multiplying the average manual loss cost by the implicit policy modification factor and dividing by the average limit of insurance factor. These were further adjusted by the indicated experience differentials based on the analysis of 25 years of data for each area in the state. The wind hazard level was assigned based on the size of the resulting average loss cost reflecting the regional wind experience.

Rating Program Development

Construction Variables

Basic Group II construction is reported using 49 codes which reflect:

- Fire Construction (1-6)
- Building height (Low: 1-4 stories vs. High Rise: 5+ stories)
- Masonry Reinforcement (Reinforced vs. Non-Reinforced) (Not applicable to constructions 1 & 3)
- Steel Weight (Light vs. Other Than Light) (Not applicable to constructions 1 & 2)
- Superior or "UL90" roof (Applicable only to constructions 2, 3, & 4)

The relativities for the various elements of construction were developed using generalized linear models (GLMs). GLMs can simultaneously review multiple explanatory variables so that any correlation among the variables is removed and interactions among the variables can be measured. GLMs also produce statistics useful in determining which explanatory variables and interactions are significant and to help assess goodness-of-fit statistics. See Appendix C for more technical information regarding GLMs.

Indicated pure premiums by limit of insurance were calculated by fitting pure premiums (losses / exposure) using a Tweedie distribution with a parameter of 1.667. The other explanatory variables, besides the elements of construction being evaluated, were year, location of the risk (by rating territory and Enhanced Wind Rating eligibility area), and coverage (building vs. contents). Year was included in the analysis in order to remove the impacts of trend and year-to-year fluctuations in the pure premiums. The location of the risk was a key element in that risk location is by far the largest single factor in wind hazard, and wind resistant construction elements are more common where the wind hazard is greater.

The experience included in the analysis was adjusted by the region-specific limit of insurance factors to account for loss variations related to policy limits. This adjustment also avoids double counting of the effect of risk size in the evaluation of risks by height and type of construction, which are both correlated with risk size.

The GLM analysis revealed the need for an additional variable to address a particular interaction of the variables with a distinct pattern not explained by the underlying features. This is a variable to indicate risks that were light steel, low rise structures with reinforced masonry. Each of the four construction codes meeting these criteria showed experience significantly worse than predicted based on a model that assumed the variables were independent. Engineering input indicated that risks of this type tend to have poor roof attachment, which leads to the phenomenon observed in the data.

Construction Class

The relativities for Construction Class were selected as to be equal to the indicated relativities from the GLM analysis, rounded to the second decimal. The selected relativities are as follows

Frame	**1.00**
Joisted Masonry	**0.97**
Non-Combustible	**0.62**
Masonry Non-Combustible	**0.68**
Modified Fire Resistive	**0.58**
Fire Resistive	**0.52**

Superior Roof

The relativity for the variable for superior roof or UL 90 certification was selected at the indicated value of **0.70.** This relativity applies to those risks identified by the Basic Group II construction as having superior roofs, as well as to construction 1, 5 and 6 buildings risks with UL90-certified roofs.

Masonry Reinforcement

Based on the GLM analysis, a relativity value of **0.85** was selected.

Steel Weight

Based on the GLM analysis, a relativity value of **0.90** was selected.

Light Steel, Low Rise, Reinforced Masonry

The value for this variable was selected as **1.80**. This is the value indicated by GLM runs reflecting the factors selected for the other variables, rounded to the nearest .05.

Building Height

The statistical data was used to set the overall relativity between low rise (1-4 stories) and high rise (over 4 stories). Based on the GLM analysis, a relativity of **0.62** was selected.

The AIR models were analyzed to determine further refinements in the relationship between the loss costs for buildings of different heights. Model output for masonry and steel buildings provided modeled results for different ranges of building height. Relativities were derived for the following height bands:

- Masonry:
  - Band 1: 1 story
  - Band 2: 2-3 stories
  - Band 3: 4 stories and higher
- Steel:
  - Band 4: 1-3 stories
  - Band 5: 4-7 stories
  - Band 6: 8 stories and higher

The results for masonry were used to determine finer relativities for 1-4 stories, and steel was used to develop finer relativities above 4 stories.

The AIR model indicated relativities were determined by first summing the modeled loss cost for hurricane (where applicable) and severe thunderstorm models and then calculating the ratio of the expected losses for different height categories. From these, averages by state and region were calculated.
The following table shows the final selections:

Number Of Stories	Selected Factor
1	1.100
2	1.000
3	0.950
4	0.800
5	0.744
6	0.682
7	0.651
8	0.620
9	0.589
10	0.558
11	0.527
12 and higher	0.496

Year-Built Relativity

Output of the AIR Tropical Cyclone model was generated for benchmark years that were selected based on general and state-specific changes in building codes and construction materials and practices. Ratios of the model indicated loss costs by benchmark year were calculated as indicated year-built factors. Because some building features which are given explicit credit in this plan (e.g. Superior Roof) are implicit in the year-built factors indicated by the model, the selected factors were tempered from those indicated. Credits are awarded based on on-site verification of building features.

To reflect the phase-in of building code adoption and updates to construction practices, and to give consideration to buildings already under construction at the time of code changes, changes in the year-built factors are phased in over two to three years -- the year(s) preceding the benchmark year and the benchmark year.

In Florida, the benchmark years are 1994, 1997 and 2003 and there are five year-built relativity areas:

County Group	**Counties**
County Group 1	Broward, Miami-Dade.
County Group 2	Calhoun, DeSoto, Dixie, Duval, Flagler, Glades, Gulf, Hendry, Hernando, Levy, Liberty, Okeechobee, St. Johns, Taylor, Volusia, Washington.
County Group 3	Alachua, Bay, Bradford, Brevard, Charlotte, Citrus, Clay, Collier, Escambia, Franklin, Gilchrist, Hardee, Highlands, Hillsborough, Holmes, Indian River, Lafayette, Lake, Lee, Leon, Manatee, Marion, Martin, Monroe, Okaloosa, Orange, Osceola, Palm Beach, Pasco, Pinellas, Polk, Putnam, St. Lucie, Santa Rosa, Sarasota, Seminole, Sumter, Union, Wakulla, Walton.
County Group 4	Columbia, Gadsden, Jackson, Jefferson, Nassau, Suwannee.
County Group 5	Baker, Hamilton, Madison.

The selected year-built factors for Florida are:

	1994 & Prior	**1995**	**1996**	**1997-2001**	**2002**	**2003 & after**
County Group 1	1.00	0.90	0.75	0.60	0.40	0.35
County Group 2	1.00	0.95	0.85	0.70	0.70	0.65
County Group 3	1.00	0.95	0.85	0.75	0.70	0.65
County Group 4	1.00	0.95	0.90	0.80	0.70	0.65
County Group 5	1.00	1.00	0.95	0.90	0.75	0.65

These year-built relativities are further tempered based on the percent of losses attributable to wind.

Distance to Coast and Surrounding Terrain

Output of the AIR Tropical Cyclone model for each unit of a refined grid of geographic area was analyzed to determine the relationship between the indicated model loss costs for buildings at different ranges of distance to coast. The modeled losses reflected wind losses only, and not losses due to storm surge. The indicated relativities between distance-to-coast bands were calculated as the ratio of the model indicated loss cost by grid unit across distance-to-coast bands.

Because characteristics of the surrounding terrain also impact the expected loss costs by location, indicated distance-to-coast relativities were calculated using only grid units in different distance-to-coast bands but within the same ZIP code.

The indicated relativities were used to select the following distance-to-coast relativities for Florida:

Distance to Coast	Relativity
0 - 500 feet	1.00
501 - 1000 feet	0.95
1001 - 1500 feet	0.95
1501 - 2000 feet	0.95
2001 - 2500 feet	0.95
2501 feet - 1 mile	0.90
Over 1 mile - 2 miles	0.90
Over 2 miles - 3 miles	0.75
Over 3 miles - 4 miles	0.60
Over 4 miles - 5 miles	0.50
Over 5 miles	0.45

An average distance-to-coast relativity was determined for each territory based on the distribution of risks by distance to coast in ISO Risk Decision Service' specific commercial property database. These average relativities by territory were used as the base to calculate the final relativity for each territory.

These distance to coast relativities are further tempered based on the percent of losses attributable to wind.

Building Code Enforcement Grading

In addition to these other elements, the Building Code Enforcement Grade rating factor applicable to the building will be presented as part of the loss cost quote, but the factor will not be applied in the development of the specific property loss cost. This is so that the specific property loss cost is comparable to the manual loss cost, for ease of use in rating systems.

Assembling the Model

The relativities based on the statistical data were individually balanced before the factors were multiplied together. The AIR model-based factors were then multiplied together and a tempering factor was applied to reflect that these wind based relativities are being applied to the Basic Group II loss cost, which includes additional perils other than wind, such as aircraft and vehicles, riot and civil commotion and sinkhole collapse.

As the basic construction relativity has Frame construction as its base, the building loss cost indicated under the program is calculated by multiplying the relativities by the symbol B building loss cost for the state/territory.

The debit/credit for the risk is then restated relative to the underlying loss costs by state/territory and wind symbol, by dividing the indicated loss cost by the building loss cost by symbol. The contents loss cost is calculated as the contents loss cost times the debit/credit factor.

Implementation

The debit/credit under the program will be capped at + 25% / - 20% for the first year. Later filings will further phase-in the implementation of the full debits/credits for individual properties.

APPENDIX A

AIR Worldwide Hurricane Model

INTRODUCTION

The Enhanced Wind Rating Program incorporates the use of a computerized hurricane model which can estimate hurricane losses more accurately and with greater geographic specificity than traditional experience-based techniques. The model uses a meteorological database of both landfalling and non-landfalling tropical cyclones since 1900, a sophisticated wind field model, and engineering and insurance-based damage relationships to develop reliable estimates of expected hurricane losses. The model evaluates the probability of a hurricane at a specific location, the duration of the wind speeds at that location and the relative damageability by type of structure for the current distribution of exposures. The building specific debits and credits included in the Enhanced Wind Rating Program as presented in this filing are based, in part, on Version 12 of AIR Worldwide Corporation's (AIR) Hurricane Model for the United States. The model provides hurricane loss costs (expected hurricane losses per $100 of replacement cost value) by ZIP code, construction class, coverage (building vs. contents), height, and year built.

DESCRIPTION OF THE HURRICANE MODEL

HURRICANE DEFINED

A hurricane is a tropical cyclone technically defined as a non-frontal, low pressure synoptic-scale system in which the maximum sustained surface wind speed is at least 74 miles per hour.

HURRICANE MODEL

The model consists of several components or modules - an event generation module, local intensity module, and damage module.

The event generation module is used to create the stochastic storm catalog. Over 100 years of historical data on the frequency of hurricanes and their meteorological characteristics were used to fit statistical distributions for each parameter used. These parameters include storm track, landfall location and track angle at landfall, and the intensity variables of central pressure, radius of maximum winds, and forward speed. By stochastically drawing from these statistical distributions, the fundamental characteristics of each simulated storm are generated. The result is a large, representative catalog of potential events.

Once the model generates the characteristics of a simulated event, it propagates the event along its track. Peak gust wind speeds and wind duration are estimated for each geographical location affected by the storm, and the local intensity is estimated as a function of the magnitude of the event, distance from the source of the event, and a variety of local conditions.

Damageability functions are then used to determine the relationship between the local intensity and the resulting damage to buildings and contents. Expected hurricane losses are calculated by applying the appropriate damage functions to the replacement value of the insured properties.

Following is a discussion of those elements reflected in the AIR tropical cyclone model for the Gulf and Atlantic Coasts of the continental United States.

EVENT GENERATION MODULE

The following storm characteristics are modeled as part of the event generation module:

Frequency of Occurrence - The model estimates frequency of occurrence based on tropical cyclones occurring since 1900.

Landfall Location - The model estimates the probability of a hurricane occurring at points along the smoothed coastline from Texas to Maine.

Central Pressure - Central pressure is the primary determinant of hurricane wind speed and therefore of intensity. All else being equal, as central pressure decreases, wind speeds increase or, more precisely, wind speed is an increasing function of the difference between the central and peripheral pressure.

Radius of Maximum Winds (Rmax) - The radius of maximum winds is the distance from the storm's center, or eye, to where the strongest winds are found. On average, the radius of maximum winds tends to be larger at higher latitudes. Similarly, the radius will be smaller, on average, for more intense storms. These relationships are explicitly accounted for in the model. While a smaller radius of maximum winds corresponds to greater storm intensity, it does not necessarily follow that losses will be greater. This is because a smaller radius usually results in a smaller affected area.

Forward Speed - Forward, or translational, speed is the rate at which a hurricane moves from point to point along its track. In general, the higher the latitude, the faster the hurricane's translational speed. Faster moving storms result in higher losses further inland. On the other hand, the faster a storm travels, the shorter the duration that a building is subjected to high wind speeds. In some areas, particularly along the coast, this can lead to lower losses than would otherwise be the case.

Track Angle at Landfall - Separate distributions for track angle at landfall are estimated for segments of coastline that are variable in length, depending upon the coastal orientation of that segment.

Storm Track - Once landfall location and the track angle at landfall are identified, the simulated storm track is generated using conditional probability matrices which resemble the curving and recurving tracks actually observed from the stochastic storm database.

Multiple-Landfalling Storms - In order to model multiple landfalling events as single storms, simulated storm tracks are joined statistically based on consistency of certain storm parameters.

LOCAL INTENSITY MODULE

Once the model probabilistically generates the hurricane's meteorological characteristics, it simulates the storm's movement along its track. Calculations of local intensity begin with the maximum over-water windspeed, and then adjustments are made for the asymmetric nature of the hurricane windfield, storm filling over land, surface friction, and relative wind speed profiles.

Asymmetry Effect - In the Northern Hemisphere, hurricane winds rotate in a counter-clockwise direction. The combined effects of hurricane winds and forward motion produce higher wind speeds on the right side of the storm, as viewed facing the storm's forward direction. The model accounts for the dynamic interaction of the forward (translational) and rotational speeds, as well as the inflow angle.

Filling Effect - As the storm moves inland its intensity begins to dissipate. Central pressure rises and the eye of the hurricane begins to "fill" as it moves away from its energy source, i.e., warm ocean water. The model filling equations are a function of the geographic location (particularly distance from coastline) and the time elapsed since landfall. Rates of filling vary by region, consistent with historical observations.

Surface Friction Effect - Differences in surface terrain (or land use/land cover) also affect windspeeds. Wind velocity profiles typically show higher wind speeds at higher elevations. Winds travel more slowly at ground-level because of the horizontal drag force of the earth's surface, or surface friction. The addition of obstacles such as buildings will further degrade wind speed. In general, the rougher the terrain, due to both natural and man-made obstacles, the more quickly wind speeds dissipate.

Relative Wind Speeds - The wind speed at any particular location is dependent on the radial distance between the eye of the storm and the location of interest.

DAMAGE ESTIMATION MODULE

The tropical cyclone model develops a complete time profile of wind speeds for each location affected by the storm, thus capturing the effect of wind duration on structures as well as the effect of peak wind speed. Damage estimation for hurricanes begins at sustained wind speeds of 40 mph and is calculated cumulatively until sustained winds are once again below 40 mph.

Separate damage functions exist by construction type (e.g., frame, joisted masonry, masonry non-combustible) and coverage (buildings vs. contents). Estimated hurricane damage is measured as the ratio of repair cost (i.e., expected hurricane losses) to the replacement cost of the property, capped at 80% of the replacement cost. 80% replacement cost is the exposure base, or limit of insurance, used in ISO's commercial property program.

APPENDIX B

AIR Worldwide Severe Thunderstorm Model

INTRODUCTION

The Enhanced Wind Rating Program incorporates the use of a computerized severe thunderstorm model which can estimate severe thunderstorm losses more accurately and with greater geographic specificity than traditional experience-based techniques. The model uses a meteorological database of severe thunderstorms producing tornadoes, hailstorms and straight-line windstorms since 1955, a sophisticated data augmentation and smoothing technique, and engineering and insurance-based damage relationships to develop reliable estimates of expected losses. The model accounts for the probability of severe thunderstorms at a specific location, the intensity of wind speeds or the impact energy of hail at that location, and the relative damageability by type of structure.

The building specific debits and credits included in the Enhanced Wind Rating Program as presented in this filing are based, in part, on Version 6.2 of AIR Worldwide's (AIR) Severe Thunderstorm Model for the United States. The model provides severe thunderstorm loss costs (expected severe thunderstorm losses per $100 of replacement cost value) by ZIP code, construction class, and building height.

DESCRIPTION OF THE SEVERE THUNDERSTORM MODEL

SEVERE THUNDERSTORM DEFINED

As defined by the National Weather Service (NWS), a severe thunderstorm is a storm which produces a tornado, winds of at least 58 mph (50 knots) and/or hail measuring a minimum of 0.75 inches in diameter. This definition was used in the development of the AIR severe thunderstorm model.

Tornadoes

Tornadoes are columns of air that rapidly rotate around a small area of low pressure. They often develop when heavy rainfall drags a downdraft to the ground, which brings with it rotating winds. As these winds touch the ground, a condensation funnel from the base of the cloud descends from a rotating wall cloud. When the vortex of a tornado extends to the ground, its circulation is marked by a funnel-shaped cloud of swirling dust and debris.

Tornadoes range from being stationary to having forward wind speeds up to 70 mph and have rotational wind speeds generally ranging from 40 mph to 110 mph, although sometimes up to 300 mph. Weaker tornadoes generally last about ten minutes and travel only short distances, while stronger tornadoes can last for several hours and can travel hundreds of miles.

Directly measuring tornado wind speeds by conventional methods is difficult, as the storms are usually small, brief, and occur out of range of anemometers. Also, instruments in a tornado's path are often destroyed by the wind intensity. Tornado intensity is classified by an indirect method based upon observed damage known as the Fujita scale, or F-scale, which was developed in 1971. In 2007, this scale was updated to the enhanced Fujita scale, or EF-scale (below), by a panel of experts who believed the original F-scale overestimated winds for tornadoes F-3 and higher.

The Enhanced Fujita Tornado Damage Scale

Scale	3 Second Gust (mph)	Potential Damage
EF0	65-85	Light damage to roofs, gutters, and siding. Tree branches broken. Confirmed storms with no reported damage are recorded as EF0.
EF1	86-110	Moderate damage to roofs. Mobile homes badly damaged. Exterior doors and windows lost. Glass broken.
EF2	111-135	Considerable damage to buildings. Roofs torn off well-constructed houses, foundations of frame homes shifted, and mobile homes completely destroyed. Large trees snapped or uprooted, light-object missiles generated, and cars lifted off the ground.
EF3	136-165	Severe damage to well-constructed homes and large buildings, trains overturned, and trees debarked. Heavy cars lifted off the ground and structures with weak foundations blown some distance.
EF4	166-200	Devastating damage to well-constructed houses, whole frame houses completely leveled. Cars thrown and small missiles generated.
EF5	Over 200	Incredible damage as strong frame houses leveled off foundations and automobile-sized missiles are airborne. Steel reinforced concrete structures badly damaged and high-rise buildings have significant structural deformation.

Hailstorms

Hailstones are supercooled liquid droplets that freeze after contact with condensation nuclei (such as an insect, dust particle, or ice crystal). Violent updrafts hold these particles aloft in the cloud. When air currents tilt, the droplets pass through varying levels of water content and develop coats of ice. The hailstones are lifted and dropped throughout the cloud repeatedly, each time accumulating another layer of ice. Once the particles grow too large and heavy to be supported by the rising air, they fall as hail.

Straight-Line Windstorms

The damage from straight-line winds can be as severe as that from a moderate to strong tornado and are often responsible for damage that is falsely attributed to tornadoes. Unlike tornadoes, a straight-line windstorm exhibits no circular motion because it lacks a central vortex. These events have wind speeds of more than 58 mph with maximum wind speeds that can exceed 100 mph.

Examples of straight-line wind events range from widespread events such as derechos or squall-line events to localized events such as downbursts, which occur when an area within a cumulonimbus cloud is cooled by evaporating rain or melting hail, becomes heavy, and begins to sink. These currents rapidly accelerate into the ground and then radiate from the impact area.

Straight-line wind is the most frequent of the three modeled perils (tornadoes, hail, and straight-line winds). Over the last twenty-five years, they are on average seven times more common than tornadoes and nearly one and a half times more common than hail events.

SEVERE THUNDERSTORM MODEL

The model consists of several components or modules - an event generation module, local intensity module, and damage estimation module.

The AIR Severe Thunderstorm Model for the United States captures the effects of hail, tornadoes, and straight-line windstorms (microevents) resulting from severe thunderstorms (macroevents) on properties in the U.S. A microevent is an individual tornado, hailstorm, or straight-line windstorm; a macroevent is a set or cluster of tornadoes, hailstorms, or straight-line windstorms occurring over the course of one or more days and resulting from the same atmospheric event or frontal system. A macroevent may include several hundred microevents. In the AIR model, however, a macroevent is considered a single occurrence.

The model contains a catalog of macro- and microevents that are based on a smoothed and augmented historical storm set which act as seed storms for the stochastic severe thunderstorm events.

Damage functions are then used to determine the relationship between the local intensity of each modeled type of event and the resulting damage to buildings and contents. Expected losses are calculated by applying the appropriate damage functions to the replacement value of the insured properties.

Following is a discussion of those elements reflected in the AIR severe thunderstorm model for the United States.

EVENT GENERATION MODULE

The following storm characteristics are modeled as part of the event generation model:

<u>Frequency of Occurrence</u> -- The model estimates the frequency of occurrence based on the severe thunderstorm database maintained by NOAA's SPC (Storm Prediction Center). This database includes information on more than 47,500 tornadoes, 212,000 hailstorms, and 241,000 straight-line windstorms from 1955 to the present. AIR scientists analyze geographical and temporal patterns in these microevents to identify clusters that comprise macroevents.

Microevents are significantly underreported in the historical data. No formal reporting system existed until the early 1970s, although numerous improvements have been made over time since then. To compensate for this underreporting, AIR scientists employ a combination of statistical smoothing and data augmentation techniques to get a more realistic assessment of the true occurrence rate of tornadoes, hailstorms, and straight-line windstorms.

<u>Starting Location</u> - The model estimates the probability of tornadoes, hailstorms, and straight-line windstorms starting at specific locations based on the smoothed and augmented historical database.

<u>Storm-Track Direction</u> - Storm-track direction is simulated using an empirical distribution based on historical data. Historically, tornadoes have generally followed a southwest to northeast path.

Storm Length and Width - The length and width of straight-line windstorms and hailstorms are generated by drawing values from a lognormal distribution. The length and width of tornado tracks are drawn from an empirical distribution derived from the historical database.

Storm Duration - The duration of simulated straight-line windstorms and hailstorms is estimated using a lognormal distribution based on the augmented and smoothed data; the duration of hailstorms is correlated with hailstone size. The model assumes constant wind speeds and hail intensity for the entire duration of straight-line windstorms and hailstorms, respectively. The duration of simulated tornadoes is not explicitly modeled.

Hailstone Size - The maximum size of a hailstone and variation within the hailstorm are determined based on empirical distributions derived from the historical databases.

Hailstone Rate - The number of hailstones per minute per unit area that strike an object depends on the hailstone density and velocity, wind conditions, and the orientation of the object's exposed surfaces.

Once the historical data are smoothed and augmented using the modeled storm variables above, the stochastic catalog is generated using these seed events. To simulate a potential future event, a historical event is picked at random and is spatially perturbed by offsetting the original latitude and longitude of each microevent within the storm. The process is repeated many times to produce a large stochastic catalog of potential, future severe thunderstorm events. The simulation approach has the advantage of reproducing the spatial frequency and seasonal variation in the geographic locations of each microevent. Note that the event catalog does not include macroevents for which the total estimated industry loss falls below $25 million.

LOCAL INTENSITY MODULE

For tornadoes and straight-line winds, local intensity is measured by wind speed; for hailstorms, it is measured by wind speed and hail impact energy.

Tornado Wind Speeds - The maximum wind speed is drawn from an exponential distribution whose mean is determined by the EF-scale value. Intensity varies linearly along the tornado track with the maximum wind speed occurring in the middle of the track and tapering off toward the beginning and end points of the track.

Straight-Line Wind Speeds - Wind speeds for straight-line windstorms are drawn from an exponential distribution fitted to the historical data. The parameters of the distribution are grid-dependent with a grid-cell size of one degree.

Hailstorm Wind Speeds - The damage resulting from hail depends not only on the size of the hailstones, but also on the wind speed that accompanies the storm. In light winds, most damage occurs on roofs; in strong winds hail also damages windows and siding. The wind speeds that accompany simulated hailstorms are drawn from an exponential distribution.

Hail Impact Energy - The energy with which a hailstone strikes an object determines the damage from hail storms. The hail impact energy contains a gravitational component, due to the falling weight of the hailstone, plus a wind component, due to propulsion of the hailstone by accompanying winds. Both are functions of the size (weight) of the hailstones, and the wind component increases with the wind speed.

DAMAGE ESTIMATION MODULE

Separate damage functions exist by peril (tornado, hail or straight-line wind), construction type (e.g., frame, joisted masonry, masonry non-combustible), occupancy and coverage (buildings vs. contents). Estimated damage is measured as the ratio of repair cost (i.e., expected losses) to the replacement cost of the property.

Damage Functions by Peril

Tornado damageability is modeled as a function of the fastest quarter-mile wind speed, which is the highest speed with which a quarter-mile of wind passes an observation point.

The severity of hail damage depends on the impact energy of hail, which in turn is a function of hailstone size and the accompanying wind speed. It is also a function of the spacing between hailstones (hailstone rate), the hailstorm area, and storm duration.

Damageability for straight-line windstorms is a function of 3-second gust speed and storm duration.

APPENDIX C

GENERALIZED LINEAR MODEL METHODOLOGY

Before setting forth what a generalized linear model (GLM) is, it is useful to discuss two background concepts: classical linear models and the exponential family of probability distributions.

CLASSICAL LINEAR MODEL

A classical linear model explains a dependent variable y by independent variables $x_1, x_2, \ldots, x_p$. "Linear" means that $x_1, x_2, \ldots, x_p$ are linearly combined to arrive at an estimate of y. In symbol form:

$$y \approx \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p \quad (1)$$

Given n observations:

$$\begin{aligned} y_1 &\approx \beta_0 + \beta_1 x_{11} + \ldots + \beta_p x_{1p} \\ y_2 &\approx \beta_0 + \beta_1 x_{21} + \ldots + \beta_p x_{2p} \\ &\vdots \\ y_n &\approx \beta_0 + \beta_1 x_{n1} + \ldots + \beta_p x_{np} \end{aligned}$$

Parameters $\beta_0, \beta_1, \ldots, \beta_p$ are determined by minimizing the sum of squared error:

$$S = \sum_{i=1}^{n} [y_i - (\beta_0 + \beta_1 x_{i1} + \ldots + \beta_p x_{ip})]^2$$

Using matrix notation to simplify:

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}, \quad X = \begin{bmatrix} 1 & x_{11} \ldots x_{1p} \\ 1 & x_{21} \ldots x_{2p} \\ \vdots & \vdots \\ 1 & x_{n1} \ldots x_{np} \end{bmatrix}, \quad \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_p \end{bmatrix}$$

$$y \approx X \beta$$

$S = (y - X \beta)' (y - X \beta)$ where ' denotes transpose of matrix

It can be shown that:

$$\beta = (X' X)^{-1} X' y$$

Note (1) is an approximate relationship, alternately it can be restated as an equation:

$y = \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p + \varepsilon$, (2)
where ε is the error term

Classical linear models impose the assumption:
$\varepsilon \sim N(0, \sigma^2)$ (ε is normally distributed, with mean 0 and variance σ^2)

(2) implies y is also normally distributed.

(1) can also be restated as:

$E(y|x) = \mu = \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p = X\beta$, (3)
where E(y|x) is the expected value of y given x

(3) is the form of the classical linear model that will be "generalized" to the GLM.

EXPONENTIAL FAMILY OF PROBABILITY DISTRIBUTIONS

The exponential family of probability distributions is all distributions that can be expressed in the form:

$f(y) = c(y, \theta/\omega)\{e \wedge [(y\theta - a(\theta)) / (\varphi/\omega)]\}$

θ	= canonical parameter (usually in terms of mean μ)
φ/ω	= dispersion parameter (usually in terms of standard deviation σ)
ω	= weight
$a(\theta)$	= function in terms of θ
$c(y, \varphi/\omega)$	= function in terms of y and φ/ω (usually not of interest)

The choice of $a(\theta)$ and $c(y, \varphi/\omega)$ determines the actual probability distribution. Examples of probability distributions in the exponential family are binomial, Poisson, normal, gamma, inverse Gaussian, and negative binomial.

GENERALIZED LINEAR MODEL

Generalized linear models (GLMs) differ from classical linear models in two important ways:

1. The probability distribution of the dependent variable y is from the exponential family. Thus y can be non-normally distributed.
2. A transformation of the mean μ is linearly related to the independent variables $x_1, x_2, \ldots, x_p$. Thus μ can be non-linearly related to $x_1, x_2, \ldots, x_p$.

Therefore, a GLM is a model that can be expressed in the form:

1. $f(y) = c(y, \varphi/\omega)\{e \wedge [(y\theta - a(\theta)) / (\varphi/\omega)]\}$ (classical linear model: normal distribution)
2. $g(\mu) = X \beta$ (classical linear model: $\mu = X \beta$)

$g(\mu)$ = link function

All other variables and functions are as previously defined.

Steps in GLM Analysis

1. Select probability distribution $f(y)$ of dependent variable y and hence choose $a(\theta)$ and $c(y, \varphi/\omega)$. In our analysis $f(y)$ is Poisson for frequency, or number of claims per cell offset by exposures, and gamma for severity.
2. Select independent variables $x_1, x_2, \ldots, x_p$. For the commercial property limit of insurance analysis, an example of the independent variables includes territory group, year, and construction.
3. Select link $g(\mu)$. In our analysis $g(\mu)$ is ln (natural log) for frequency and severity.
4. Collect data. Data comprises of observations $y_1, y_2, \ldots, y_n$ and, for each y_i, corresponding values $x_{i1}, x_{i2}, \ldots, x_{ip}$.
5. Select weight ω. In our analysis no ω is used for frequency and ω is claim occurrences for severity.
6. Fit model by estimating parameters $\beta_0, \beta_1, \ldots, \beta_p$ and φ. In our analysis this was done using SAS.
7. Estimates of $\beta_0, \beta_1, \ldots, \beta_p$ and φ are used to test:
   a. How well the model fits by examining the difference between actual and fitted values
   b. Whether $x_1, x_2, \ldots, x_p$ are significant in predicting μ
8. Depending on the results in (7), adjust the model form, and repeat the analysis.