



Catastrophe Modeling for Commercial Lines

Jason Nonis

Senior Actuary, Catastrophe Modeling



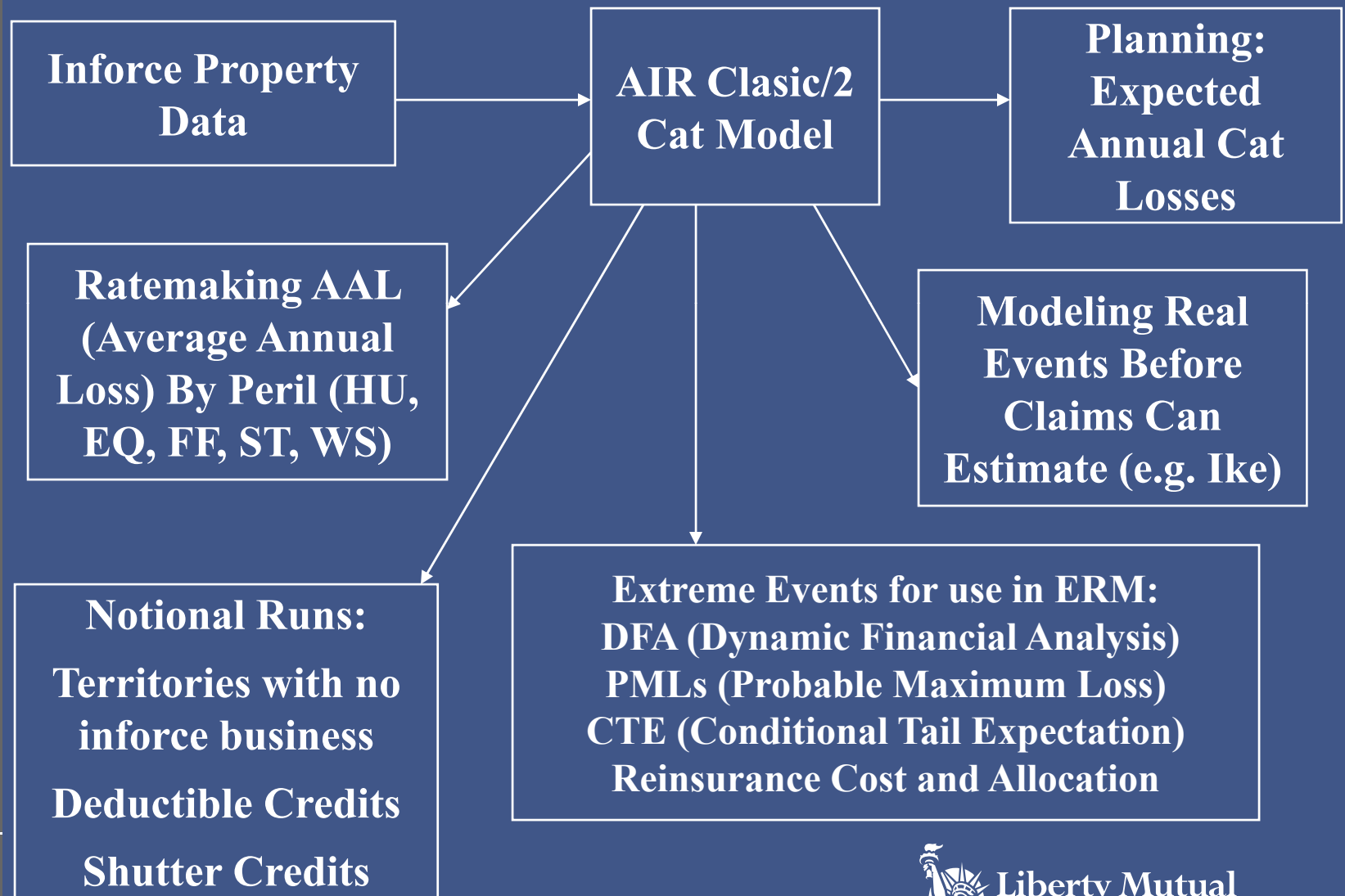
Antitrust Notice

- The Casualty Actuarial Society is committed to adhering strictly to the letter and spirit of the antitrust laws. Seminars conducted under the auspices of the CAS are designed solely to provide a forum for the expression of various points of view on topics described in the programs or agendas for such meetings.
- Under no circumstances shall CAS seminars be used as a means for competing companies or firms to reach any understanding – expressed or implied – that restricts competition or in any way impairs the ability of members to exercise independent business judgment regarding matters affecting competition.
- It is the responsibility of all seminar participants to be aware of antitrust regulations, to prevent any written or verbal discussions that appear to violate these laws, and to adhere in every respect to the CAS antitrust compliance policy.

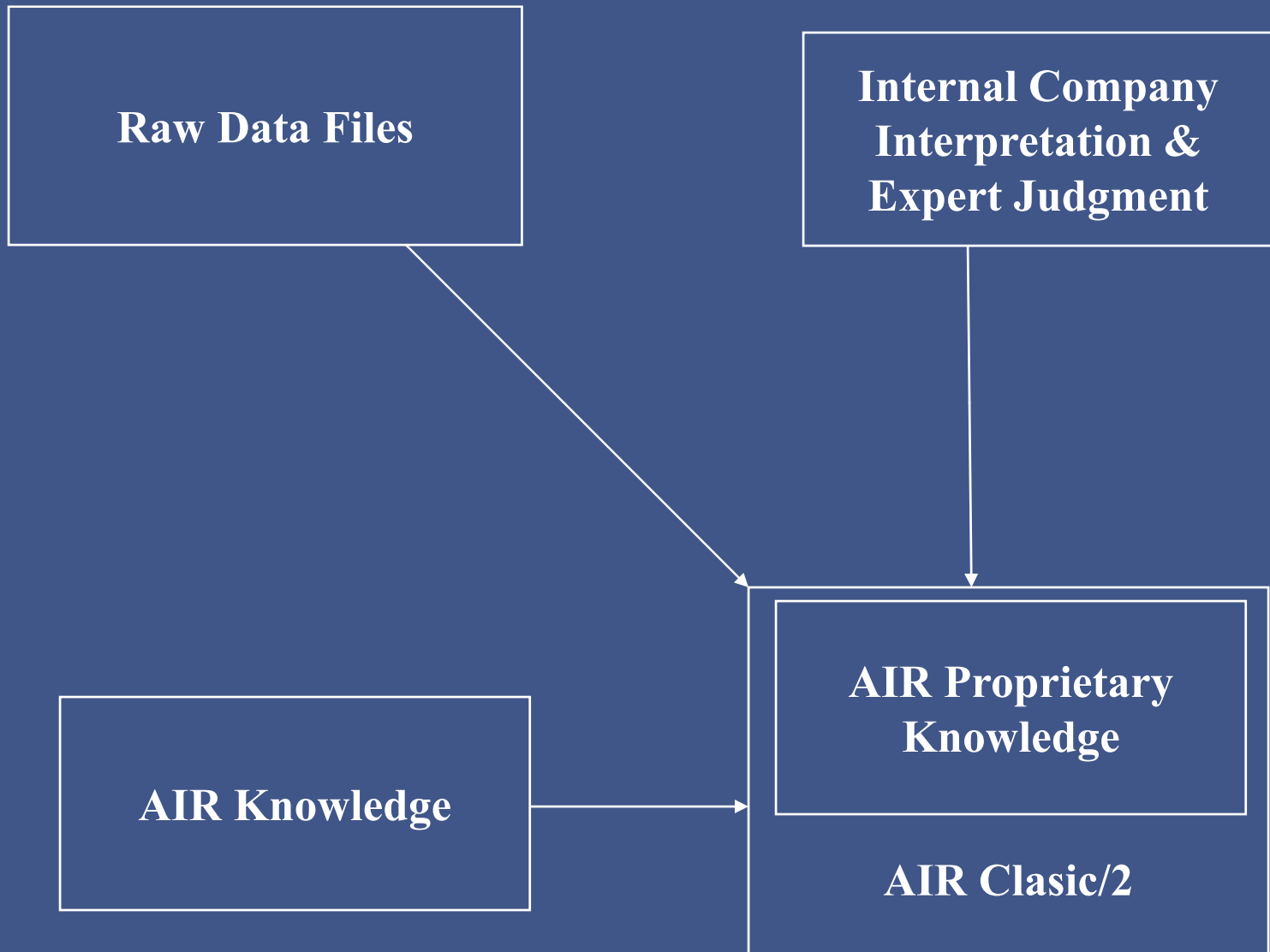
Goals

- A quick, basic, survey of how a primary company might use cat models
- Quality Assurance – which fields are important
- Case studies of difficulties encountered in some fields:
 - Deductibles
 - Construction
 - Occupancy
 - Limits/Values

Primary Company Catastrophe Model Uses



Model Inputs



Sample Raw Data Fields (Whew!?!)

Account Number Account Name Policy Number Policy Premium Policy Earthquake Premium Line of Business Agent Name Profit Center Policy Inception Date Policy Expiration Date Policy Earthquake Endorsed Flag Policy Wind Coverage Flag Policy EQSL Flag Policy Terror Endorsement Flag Policy Limit Policy Layer Amount Policy Attachment Point Policy Building Coverage Limit Policy Other Structures Coverage Limit Policy Contents Coverage Limit Policy Loss of Use/Business Interruption Coverage Limit Policy Blanket Deductible Policy Blanket Deductible Policy Minimum Deductible Policy Maximum Deductible Policy Earthquake Sublimit Policy Earthquake Deductible Policy Earthquake Deductible Minimum Policy Wind Sublimit Policy Wind Deductible Policy Wind Deductible Minimum Policy Hurricane Deductible Policy Hurricane Deductible Minimum Policy EQSL Sublimit Policy EQSL Deductible Policy EQSL Deductible Minimum As-of Submission Date Data Type Source System User-Defined Account Number Policy Number Line of Business Region Special Condition ID Peril Indicator Sublimit Deductible Deductible Minimum Source System Account Number Policy Number Line of Business Site ID or Location Name or Platform Name Special Condition ID Building Number or Platform Number Number of Buildings Street Address City State Abbreviation ZIP Code ZIP Code Extension Latitude Longitude Earthquake Endorsed Flag Wind Coverage Flag Earthquake Sprinkler Leakage Endorsed Flag Insurance to Value Site Limit Site Deductible Building Coverage Limit Other Structures Coverage Limit Contents Coverage Limit Loss of Use (Business Interruption) Coverage Limit ALE/(Business Interruption) Time Limit Building Coverage Deductible Other Structures Coverage Deductible Contents Coverage Deductible Loss of Use/Business Interruption Coverage Deductible Earthquake Site Sublimit Earthquake Site Deductible Wind Site Sublimit Wind Site Deductible Hurricane Site Deductible EQSL Site Sublimit EQSL Site Deductible Earthquake Building Coverage Sublimit Earthquake Other Structures Coverage Sublimit Earthquake Contents Coverage Sublimit Earthquake Loss of Use/BI Coverage Sublimit Earthquake Building Coverage Deductible Earthquake Other Structures Coverage Deductible Earthquake Contents Coverage Deductible Earthquake Loss of Use/BI Coverage Deductible Wind Building Coverage Sublimit Wind Other Structures Coverage Sublimit Wind Contents Coverage Sublimit Wind Loss of Use/BI Coverage Sublimit Wind Building Coverage Deductible Wind Other Structures Coverage Deductible Wind Contents Coverage Deductible Wind Loss of Use/BI Coverage Deductible Building Replacement Value Other Structures Replacement Value Contents Replacement Value Loss of Use/Business Interruption Replacement Value Construction Class Construction Class scheme Occupancy Type Occupancy Class Scheme Number of Stories Year Built Square Footage Floor Occupied Percent Complete Contents Vulnerability to Wind Contents Vulnerability to Water Construction Quality and Maintenance Roof Framing Type Roof System Covering Roof Maintenance Roof Age Roof Geometry Roof Parapets Roof Anchor Mechanical and Electrical Systems (roof only) Basement External Ornamentation Cladding Type Roof Sheathing Attachment Foundation Systems Architecture Elements Mechanical & Electrical Equipment (Building Side Only) Mechanical & Electrical Equipment (Ground Level Only) Wind Resistance-Windows Wind Resistance –Doors Wind Driven Missile Exposure Flood Carried Missile Exposure (surge only) Flood Protection (surge only) Soft Story Retrofit Measures Roof Deck Appurtenant Structures As-of Submission Date: Data Type Source System User-Defined Account Number Policy Number Line of Business Site ID or Location Name or Platform Name Building Number or Platform Number Reinsurance Contract ID Reinsurance Type Reinsurance Participation Reinsurance Participation % Reinsurance Limit Reinsurance Region Reinsurance Retention/Attachment Retrocession Type Reinsured Peril As-of Submission Date Data Type

Key Database Inputs

- Replacement Values (RV) and Total Insured Value (TIV) by Building, Other Structures, Contents, BI/Loss of Use
- Peril Indicators (Wind Exclusions, EQ Coverage)
- Geocoding Info (Address, Zip, City, State, etc.)
- Construction (Frame, Masonry Veneer, etc.)
- Occupancy (Golf Course, Church, etc)
- Deductibles
- Year Built
- Number of Stories
- Square Footage (for some models)
- Other Model Info: Shutters, Roof Age,
- User Info: Source System, Line, Company, etc.

Deductibles

Must obtain “forms” and read the actual policy language

D. DEDUCTIBLE

1. The following is applicable to all Coverage Forms except:
 - (1) Business Income (And Extra Expense) Coverage Form;
 - (2) Business Income (Without Extra Expense) Coverage Form;
 - (3) Extra Expense Coverage Form.

This clause tells us not to apply the deductible to BI
Confirms information obtained by “word of mouth”

Deductibles – Case Study

How would you interpret this?

“We will subtract a sum from the amount of loss or damage in any one occurrence which is the lesser of:

- a) a % of the value of each separate item.**
- b) a % of the limit of EQ Coverage**

The deductible applies separately to:

- (1) Each building or structure**
- (2) The contents of each building or structure”**

Intention:

**\$10M sub-limit on \$100M value with 10% deductible.
Do you want to cover \$10M xs \$10M or \$10M xs \$1M?**

Deductibles – Case Study (cont)

Policy form has an actual example:

Policy Sub-Limit \$250,000

Value: \$1,000,000

5% Deductible

\$20,000 Loss

Step (a) $\$1,000,000 * 5\% = \$50,000$

Step (b) $\$250,000 * 5\% = \$12,500$

Therefore use \$12,500

Simple, right?

Deductibles – Case Study (cont)

What about a more complex situation?

Policy Sub-Limit \$10,000,000 (\$10M)

Location 1 Value: \$20M Building, \$5M Contents

Location 2 Value: \$20M Building, \$5M Contents

10% Deductible

Complete Loss

Step (a) $(\$25M + \$25M) * 10\% = \$5M$

Step (b) $\$10M * 10\% = \$1M$

Therefore use \$1M

Insured recovers \$10M xs \$1M. Right?

Deductibles – Case Study (cont)

Wrong! According to Claims:

Policy Sub-Limit \$10M , 10%

Location 1 & 2 Value: \$20M Building, \$5M Contents

Step (a) $\$20M * 10\% = \$2M$

Step (b) $\$10M * 10\% = \$1M$

Therefore use \$1M for Location 1, Building

Step (a) $\$5M * 10\% = \$0.5M$

Step (b) $\$10M * 10\% = \$1M$

Therefore use \$0.5M for Location 1, Contents

Total Deductible \$3M, Insured recovers \$10M xs \$3M.

Deductibles – Wrap Up

- Very Important Input – For a \$50M Building, costs rise 400% for \$10M xs \$2.5M vs \$10M xs \$1M
- Must review forms to understand what is going on.
- Have your adjusters ever paid an EQ Claim?
- Models allow for multiple deductibles at policy, location or coverage level.
- Deductibles can apply to BI (Loss of Use) or not.
- Minimum, maximum, and other flavors can handle integrating peril specific codes with All Other Perils.
- Models vary by Peril (e.g. Named Storm)

Construction

- Very Important Input – Moving from Steel to Non-Combustible could increase losses 400-500%
- Often taken for granted
- ATC and ISO Fire are often used:
 - Applied Technology Council – Designed for California EQ
 - Insurance Services Office – Designed for Fire
- On the surface, mapping is simple....

ISO Fire Commercial Lines			AIR Code	AIR Description
ISF	1	Frame	101	Wood Frame
ISF	2	Joisted Masonry	119	Joisted Masonry
ISF	3	Non-Combustible	152	Light Metal
ISF	4	Masonry Non-Combustible	111	Masonry
ISF	5	Modified Fire Resistive	151	Steel
ISF	6	Fire Resistive	131	Reinforced concrete

Construction (cont.)

Select ISO Definitions:

Non-combustible (ISO 3) - Exterior walls, floors and roof are constructed of and supported by metal, asbestos, gypsum or other non-combustible materials.

Modified Fire Resistive (ISO 5) – Exterior walls, floors and roof are constructed of masonry or fire resistive material. 1-2 hour fire rating.

Fire Resistive (ISO 6) – Exterior walls, floors and roof are constructed of masonry or fire resistive material. 2+ hour fire rating.

ISO Code	AIR Code	AIR Category	Construction Description
3	152	Light Metal	Light metal buildings are made of light gauge steel frame and are usually clad with lightweight metal or asbestos siding and roof, often corrugated. They typically are low-rise structures.
5	151	Steel	Steel frame buildings consist of steel columns and beams. Use this if the other technical characteristics of the building are unknown.
6	131	Reinforced Concrete	Reinforced concrete buildings consist of reinforced concrete columns and beams. Use this if the other technical characteristics of the building are unknown.

From a wind perspective, are codes 5 & 6 really that different?

Construction (Cont.)

- ISO Has Basic Group II Wind Construction:
 - AA = Superior Construction A = Wind Resistive
 - AB = Semi-Wind Resistive B = Ordinary

BG I Construction Type	BG I Construction Code	BG II Symbol			
		Low Rise	High Rise	Low Rise	High Rise
		Light Steel		Other Than Light Steel	
Non-Combustive	3	B	AB	AB	AB
	3 with Wind Uplift 90 MPH	AB	AB	AB	AB
		Other Than Reinforced Masonry		Reinforced Masonry	
Fire Resistive	5 Light Steel	AB	A	A	A
	5 Other Than Light Steel	A	AA	AA	AA

ISO Code	AIR Code	AIR Category	Construction Description
3	152	Light Metal	Light metal buildings are made of light gauge steel frame and are usually clad with lightweight metal or asbestos siding and roof, often corrugated. They typically are low-rise structures.
5	151	Steel	Steel frame buildings consist of steel columns and beams. Use this if the other technical characteristics of the building are unknown.

Construction – Wrap Up

- Capturing ISO Fire Codes results in only 5-6 classes
- ISO BG II Coding of AA, A, AB, B combinations may not relate to model classification.
- However, if systems capture all the BG II combinations, may be able to improve on ISO Fire.
- Some combinations are tough to sort out:
 - 90 MPH Non-Combustible vs normal Non-Combustible (used to be ISO Class 7 “Heavy Timber”)
 - Compare:
 - Light Steel, Low-Rise, Non-Combustible -> B
 - Light Steel, Low-Rise, Fire-Resistive, Other than RM -> AB

Occupancy

- Very Important Input – Changing from a Bank to a Gas Station could increase losses 50-60%
- Class Code, SIC, or NAICS often used
- Class Code: Often multiple codes per location. BOP, Farm, CMP can have same codes.
- NAICS (North American Industry Classification System) from OMB and used by Census Bureau
- SIC from OSHA (Occupational Safety and Health)
- Cat modeling not original purpose, often not well understood by coding.

Look up SIC code at OSHA:

http://www.osha.gov/pls/imis/sicsearch.html?p_sic=6512&p_search=

Occupancy – Lessors Risk Only

- SIC 6512 may represent a large share of your book
- Operators of buildings, a.k.a. Lessors Risk Only
- Does not represent underlying risk very well (banks, piers, etc. Could be a gas station.)
- LRO tends to have high building limits, low contents, hence higher cat loss relative to limits

6512 Operators of Nonresidential Buildings

Establishments primarily engaged in the operation of nonresidential buildings.

- Bank buildings, operation of
- Insurance buildings, operation of
- Lessors of piers, docks, and associated buildings and facilities
- Operators of commercial and industrial buildings
- Operators of nonresidential buildings
- Retail establishments, property operation only
- Shopping centers, property operation only
- Theater buildings (ownership and operation)

Obtain class code override for these risks?



Liberty Mutual
Agency Corporation™

Occupancy – Golf Courses

7992 Public Golf Courses

Establishments primarily engaged in the operation of golf courses open to the general public on a contract or fee basis. Membership golf and country clubs are classified in Industry 7997. Miniature golf courses and golf driving ranges are classified in Industry 7999.

- Golf club, nonmembership
- Golf courses, public: operation of

Golf Courses
7992 Easy

What about
7997?

7997 Membership Sports and Recreation Clubs

Sports and recreation clubs which are restricted to use by members and their guests. Country, golf, tennis, yacht, and amateur sports and recreation clubs are included in this industry. Physical fitness facilities are classified in Industry 7991.

- Aviation clubs, membership
- Baseball clubs except professional and semiprofessional
- Bathing beaches, membership
- Beach clubs, membership
- Boating clubs, membership
- Bowling leagues or teams, except professional and semiprofessional
- Bridge clubs, membership
- Club, membership: sports and recreation, except physical fitness
- Country clubs, membership
- Flying fields maintained by aviation club
- Football club, except professional and semiprofessional
- Golf clubs, membership
- Gun clubs, membership

Occupancy – Churches

AIR Code	AIR Category	SIC 2-Digit	Occupancy Description
341	Religion and Non-profit	86	Includes organizations operating on a membership basis for the promotion of the interests of their members. Included are organizations such as trade associations; professional membership organizations; labor unions and similar labor organizations; and political and religious organizations.
342	Church		Establishments of religious organizations operated for worship, religious training or study, government or administration of an organized religion, or for promotion of religious activities.

- Important distinction between 341 & 342 – True Church model losses are 15-20% higher:
 - Stained Glass Windows
 - Bell Towers
 - Signage
 - Gabled Roofs
- Unicede default recommendation is to 341
- Our initial response was....how would you know?

Occupancy – Churches (cont.)

8661 looks very much like a true “Church” (AIR Code 341)

8661 Religious Organizations

Establishments of religious organizations operated for worship, religious training or study, government or administration of an organized religion, or for promotion of religious activities. Other establishments maintained by religious organizations, such as educational institutions, hospitals, publishing houses, reading rooms, social services, and secondhand stores, are classified according to their primary activity. Also included in this industry are religious groups which reach the public through radio or television media. Establishments of such religious groups which produce taped religious programming for television are classified in Industry 7812, and those which produce live religious programs are classified in Industry 7922. Establishments of such groups which operate radio or television stations are classified in Communications, Major Group 48.

- Churches
- Convents
- Monasteries
- Religious instruction, provided by religious organizations
- Religious organizations
- Shrines, religious
- Temples

8641 Civic, Social, and Fraternal Associations

Membership organizations engaged in civic, social, or fraternal activities. Membership sports and recreation clubs are classified in Industry Group 799, and insurance offices maintained by fraternal organizations are classified in Insurance, Major Group 63. Homeowner, tenant, and condominium associations primarily engaged in managing real estate are classified in Real Estate, Industry 6531.

- Alumni associations and club
- Bars and restaurants owned and operated for members of
- Booster clubs
- Business persons clubs, civic and social
- Citizens'unions
- Civic associations
- Community membership clubs, other than amusement and recreation
- Condominium associations, except property management
- Fraternal associations, other than insurance offices
- Fraternal lodges
- Fraternities and sororities, except residential
- Homeowner associations, except property management
- Parent-teacher associations
- Singing societies
- Social club, membership
- Taxpayers'associations
- Tenant associations, except property management
- University club
- Veterans'organizations
- Youth associations, except hotel units

8641 (and other 86xx SIC codes) look like professional organizations (AIR Code 342)



Liberty Mutual Agency Corporation™

Value/Limits – A Smorgasbord of Issues

Limits seem obvious, but often they are not:

- Added coverage included in the price of the product:
 - Valuable papers, ordinance & law, signs, etc.
 - The insured may have no actual exposure
 - Can add to multiples of the base purchased coverage
 - One possibility: How is the product priced? If the “all perils” rate is +10% over a base policy, bulk up TIV by 10%
- Items purchased specifically seem different:
 - An insured purchases \$50K additional limits for sign coverage...they probably do have an expensive sign
- Seasonal coverage could provide higher limits.
- Automatic inflation factors (often small, but easy to find)
- Debris Removal, Guaranteed Replacement Value, etc.

Conclusion – Food for Thought

When modelers physically investigate damage, how do they match observed loss to policy characteristics?

- Internal Assessment?
- Insurer Data?
- Third Party Data? (e.g. tax records)
- Probably a mixture of all of these.

To model losses precisely for a real event we need to calibrate industry to internal claims practices:

- Suppose model calibration data is distributed:
 - 25% from a company including sign values in full limits
 - 50% from a company that does not include sign values
 - 25% from a company that estimates true sign values
- Chicken and the egg Limit/Value definitions?

Would clear industry standards help?

Recap

- Primary companies use models for many purposes.
- There is plenty of room for improvement in fields we might think of as basic and non-controversial.
- Work on the most important fields first.
- It is important to dig into coding details.
- Best practices include:
 - Looking at actual forms
 - Comparing internal and model definitions
 - Evaluating what goes into values and limits