



**INSURANCE  
INFORMATION**  
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# Catastrophe Models: What Can Go Wrong

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# I.I.I. Mission Statement

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...to inform and empower  
consumers.

# What is a Model?

## A Definition

- ▲ **“A simplified representation of relationships** among real world variables, entities or events using statistical, financial, economic, mathematical or scientific concepts and equations.”

## Components

- ▲ Information (Input)
- ▲ Processing Component (turns input into estimate)
- ▲ Output Component (translates estimates into useful business information)



# A Simple Model

It's in the Bible!

## Red Sky in the Morning . . .



## Red Sky at Night . . .



## Issues

### ▲ Pros

- ◆ Easy to Understand, Use
- ◆ Time-tested

### ▲ Cons

- ◆ Not Mutually Exclusive and Exhaustive
- ◆ Insufficiently Quantitative for Actuarial Analysis



Source: Photos from Wikimedia Commons.



# The Traditional Actuarial Model

## Nonwind vs. Nonexcess Wind vs. Excess Wind

| YEAR  | (1)                 | (2)                  | (3)                   | (4)                               | (5)   | (6)                           | (7)                                | (8)                     | (9)                               |
|-------|---------------------|----------------------|-----------------------|-----------------------------------|---|-------------------------------|------------------------------------|-------------------------|-----------------------------------|
|       | H.O. WIND<br>LOSSES | H.O. TOTAL<br>LOSSES | (2)-(1)<br>TOTAL-WIND | (1)/(3)<br>WIND /<br>(TOTAL-WIND) | (4) > 1.5M<br>WIND /<br>(TOTAL-WIND)<br>EXCESS YEARS* | (5)-M<br>EXCESS<br>WIND RATIO | (6) X (3)<br>EXCESS<br>WIND LOSSES | (2)-(7)<br>TOTAL-EXCESS | (3)/(8)<br>NONWIND /<br>NONEXCESS |
| 1960  | 1028703             | 3014969              | 1986266               | .518                              | .518  | .261                          | 517485                             | 2497484                 | .795                              |
| 1961  | 636310              | 1854567              | 1218257               | .522                              | .522  | .265                          | 322760                             | 1531807                 | .795                              |
| 1962  | 734743              | 2827811              | 2093068               | .351                              | --  | --                            | --                                 | 2827811                 | .749                              |
| 1963  | 1386885             | 4572674              | 3285789               | .400                              | .400  | .143                          | 466348                             | 4106326                 | .795                              |
| 1964  | 2327700             | 5804482              | 3476782               | .669                              | .669  | .412                          | 1432859                            | 4371623                 | .795                              |
| 1965  | 5297899             | 9929800              | 4631901               | 1.191                             | 1.191   | .934                          | 4231495                            | 5698305                 | .795                              |
| 1966  | 2127105             | 6559294              | 4432189               | .480                              | .480  | .223                          | 986365                             | 5572929                 | .795                              |
| 1967  | 1898337             | 6563588              | 4665251               | .497                              | .497  | .150                          | 697612                             | 5865976                 | .795                              |
| 1968  | 1748254             | 7386785              | 5648531               | .309                              | --  | --                            | --                                 | 7386785                 | .764                              |
| 1969  | 1528938             | 8086737              | 6557799               | .233                              | --  | --                            | --                                 | 8086737                 | .811                              |
| 1970  | 726350              | 6727804              | 6001454               | .121                              | --  | --                            | --                                 | 6727804                 | .892                              |
| 1971  | 3651318             | 10574212             | 6922894               | .527                              | .527  | .270                          | 1869529                            | 8704683                 | .795                              |
| 1972  | 1868665             | 9946801              | 8078136               | .231                              | --  | --                            | --                                 | 9946801                 | .812                              |
| 1973  | 997615              | 9777691              | 8780076               | .114                              | --  | --                            | --                                 | 9777691                 | .898                              |
| 1974  | 2687364             | 13128746             | 10441382              | .257                              | --  | --                            | --                                 | 13128746                | .795                              |
| 1975  | 3621079             | 15570542             | 11949463              | .303                              | --  | --                            | --                                 | 15570542                | .767                              |
| 1976  | 3143411             | 16999371             | 12955960              | .243                              | --  | --                            | --                                 | 16999371                | .805                              |
| 1977  | 2464421             | 15644809             | 13180388              | .187                              | --  | --                            | --                                 | 15644809                | .842                              |
| 1978  | 3552056             | 17489196             | 13937140              | .255                              | --  | --                            | --                                 | 17489196                | .797                              |
| 1979  | 1410289             | 16998198             | 14687909              | .096                              | --  | --                            | --                                 | 16998198                | .912                              |
| 1980  | 3801653             | 25068605             | 22266952              | .136                              | --  | --                            | --                                 | 25068605                | .888                              |
| 1981  | 6594832             | 26387819             | 19793087              | .333                              | --  | --                            | --                                 | 26387819                | .759                              |
| 1982  | 3817773             | 22716947             | 19699174              | .153                              | --  | --                            | --                                 | 22716947                | .867                              |
| 1983  | 4306411             | 31055487             | 26749076              | .161                              | --  | --                            | --                                 | 31055487                | .861                              |
| 1984  | 2627417             | 24835867             | 21408450              | .123                              | --  | --                            | --                                 | 24835867                | .891                              |
| 1985  | 8879556             | 33424449             | 25344893              | .319                              | --  | --                            | --                                 | 33424449                | .758                              |
| 1986  | 6171192             | 33349776             | 27178584              | .227                              | --  | --                            | --                                 | 33349776                | .815                              |
| TOTAL | 76652396            | 383695427            | 307043031             | 8.868                             |   | 2.656                         | 18524453                           | 373179974               | .816                              |

MEDIAN (4) = M = .257  
 AVERAGE (4) = .320  
 AVG. EXCESS WIND RATIO  
 = 2.656/27  
 = .098

EXCESS WIND FACTOR = 1.0 + (.098) X (.816)  
 = 1.080

\*THE WIND TO NONWIND RATIO FOR A YEAR ALSO MUST BE AT LEAST .250 FOR THAT YEAR TO QUALIFY AS AN EXCESS YEAR.

EXHIBIT 8



# The Traditional Actuarial Model

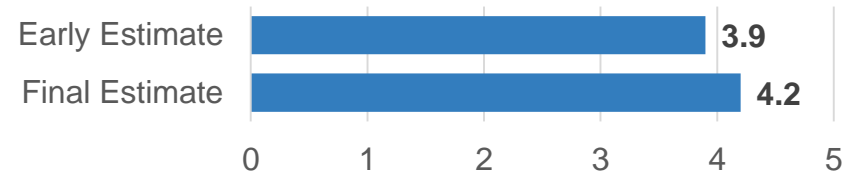
## An Assessment

### Not Too Bad for Pricing

- ▲ Leveraged Internal Data
- ▲ Worked Fairly Well – Property Lines Were Profitable Across Time
- ▲ Still in Syllabus, Still in Use
- ▲ No Projection for Individual Events (PCS Did That)
- ▲ Didn't Really Work for Capital Management

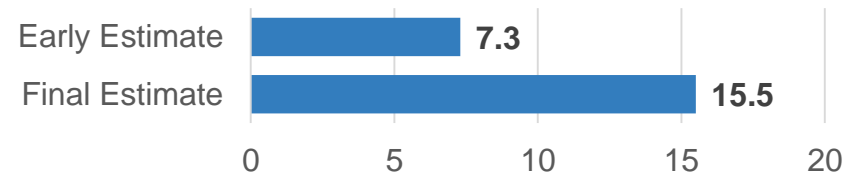
### The System Worked . . .

#### Hurricane Hugo (1989)



### . . . Until It Didn't

#### Hurricane Andrew (1992)



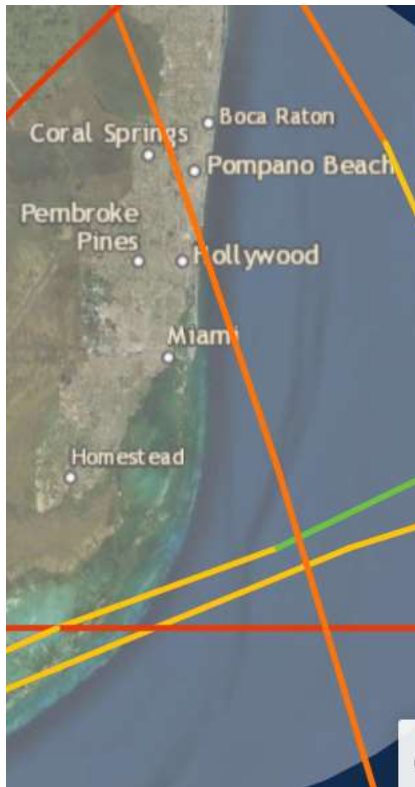
# Hurricane Andrew: What Happened?

## Why Did the Models Fail?

Hurricanes w/in 75 Miles of Miami, 1964-1990

Lots of People, Few Storms

Isbell,  
1964, Cat 3



David,  
1979, Cat 1

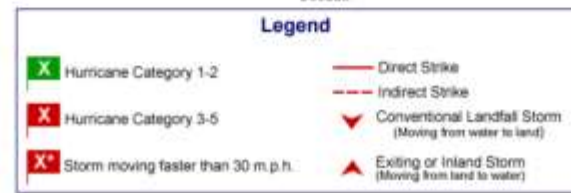
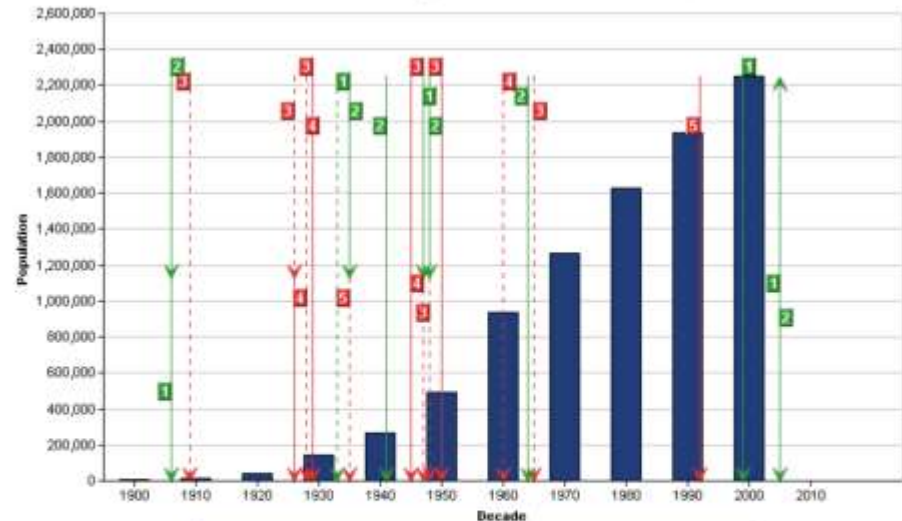
Floyd,  
1987, Cat 1

Inez,  
1966, Cat 1

Betsy,  
1965, Cat 3

Cleo,  
1964, Cat 2

Hurricane Strikes vs Population for Miami-Dade, Florida

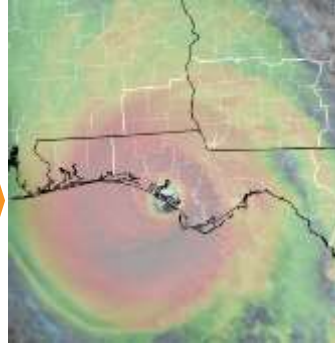


# Anatomy of a Cat Model

One Model . . . Or Six?



Event  
Generation



Intensity  
Calculation



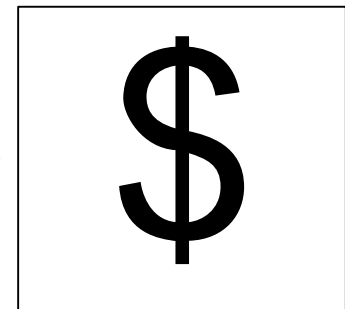
Damage  
Estimation



Exposure  
Information



Policy  
Conditions



Financial  
Calculation

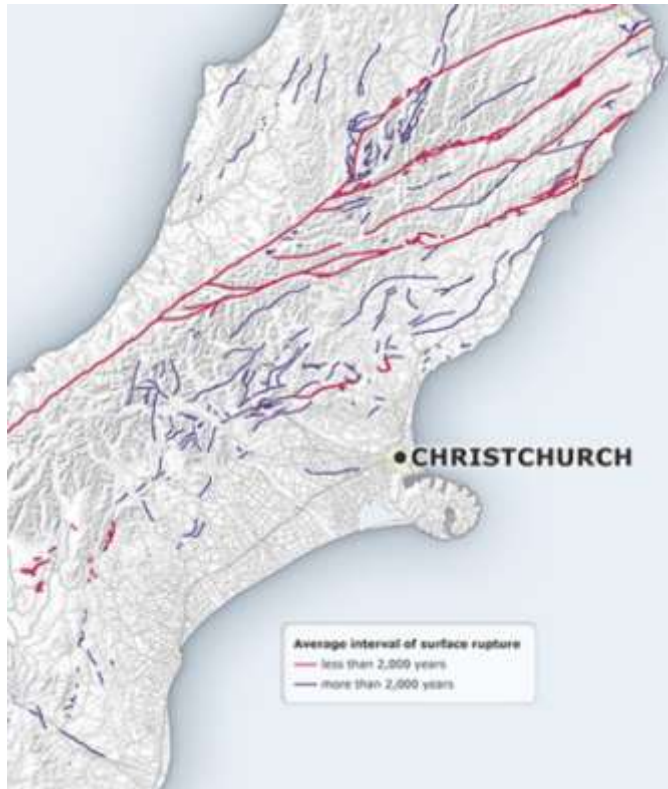




# Event Generation

## Finding Fault

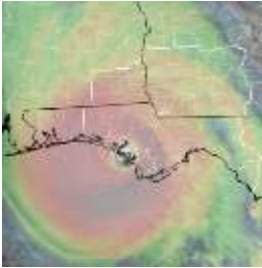
### NZ Active Faults



### Who Knew?

- Major Faults in NZ Are Far From Christchurch
- Faults That Ruptured Were Unknown
- NZ EQC Claims Staff: 49 to 1,000 One Month

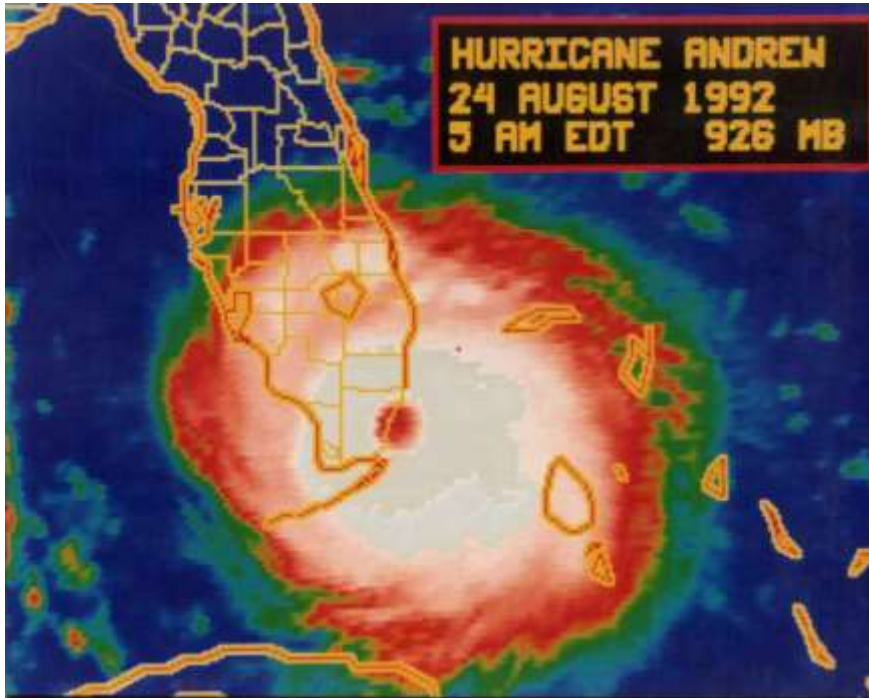




# Intensity Calculation

We Learn From Every Event ... For a Long Time

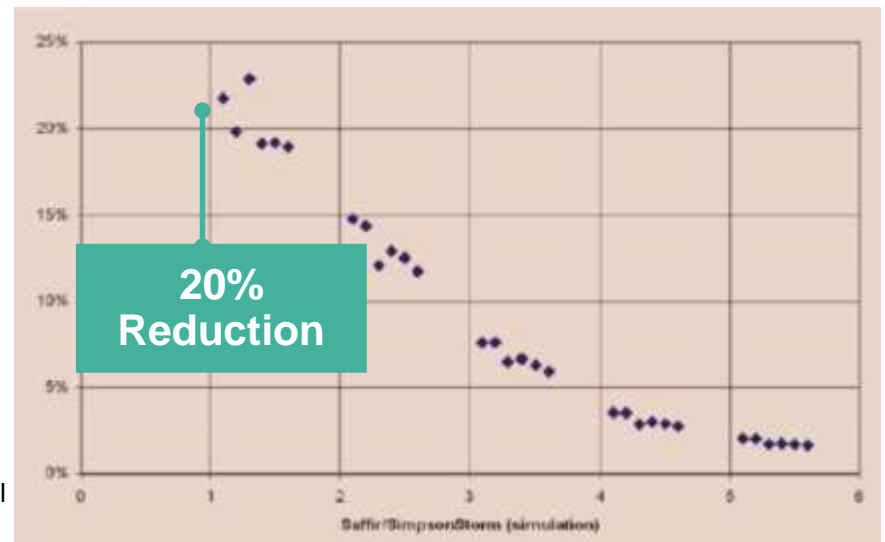
## A Silly Little Millibar



## Andrew: the Great Validator

- ▲ Ambient (Far Field) Atmospheric Pressure Lowered to 1012 From 1013 MBs

## Impact of 1 MB Change



Sources: Image from National Oceanic and Atmospheric Administration; BAMS (Bulletin of the American Meteorological Society).





# Exposures

When Is a Barge a Building?



When It's a Casino.



# Damages, Insurance & Money

Lots of Lessons

## Demand Surge

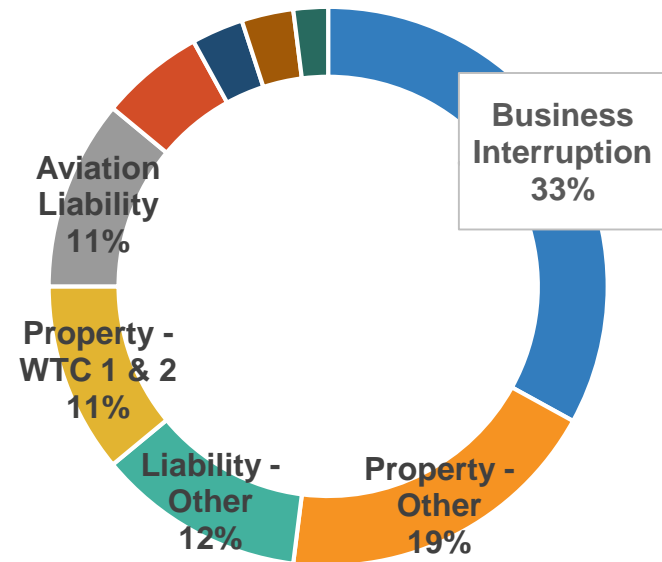
- ▲ Lessons from Andrew
- ▲ Lessons from 2004-2005

## Policy Terms

- ▲ Christchurch: Uncapped Replacement Cost (Bring Up to Code)
- ▲ RC > Insured Sum

## Business Interruption

### 9/11 Losses by Line





# Summary

- ▲ Catastrophe Models Aren't Perfect (What Is?)
- ▲ The Industry is Young
- ▲ It is Improving
- ▲ It is Much Better Than What Preceded It





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Thank you for your time  
and your attention!