Homeowners Modeling

2006 CAS Seminar on Predictive Modeling

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Agenda

- Case for unbundling the perils
- Traditional rating variables
- New rating variables

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Legacy of indivisible premium for residential property lines

- Package policy formed when Fire was major % of total losses (1950s)
- Remnant of paper manuals and inflexible quoting systems
- Lack of attention to specific cause of loss trends
- Comfort in status quo

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In contrast, personal auto premium

- Coverages are priced with modular approach
- Accepted by customers, agents, regulators, etc.
- In general, more pricing segmentation than homeowners
- More responsive trend detection (eg liability trends vs parts/labor trends)
- Matches how experience is monitored

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Unbundling the analysis

Loss data
Fire
Wind
Theft
Other

Total Expected Losses

Fire data → Fire exp'd loss

Wind data → Wind exp'd loss

Theft data → Theft exp'd loss

Other data → Other exp'd loss

= Total Expected Losses

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Why unbundle?

- Improved rating accuracy
  - rate classification equity
  - favorable selection
  - better competitive position
  - improved profitability
- Improved ability to monitor and respond to trends and emerging causes of loss

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More detailed reasons…

- The share of loss costs by peril varies considerably by geography
- Effect of rating factors varies considerably by peril
  - traditional rating factors
  - territory
  - inhabitant info
  - external info

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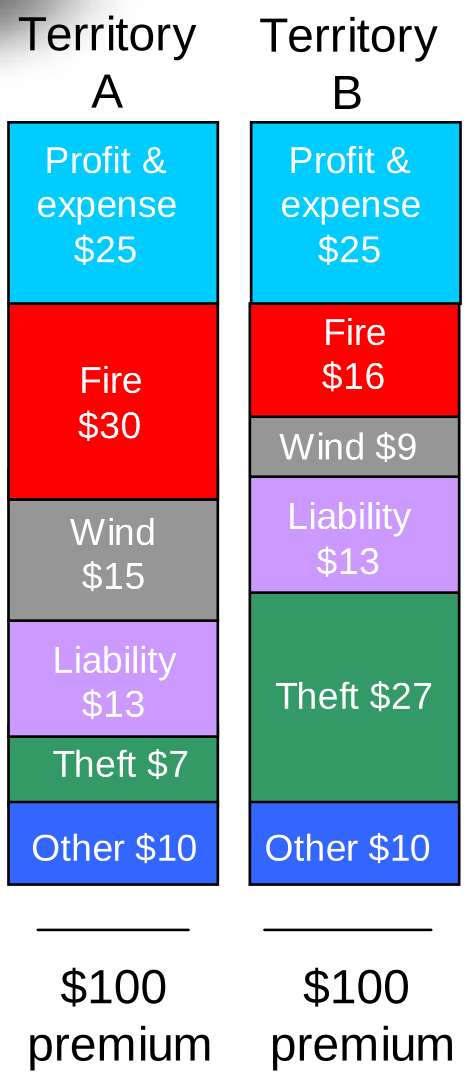
Percent of losses by peril varies across territories



10% Theft system discount

- Territory A: credits more premium ($10) than losses expected from theft ($7)
- Territory B: credit ($10) may represent appropriate amount of savings in total theft losses ($27)

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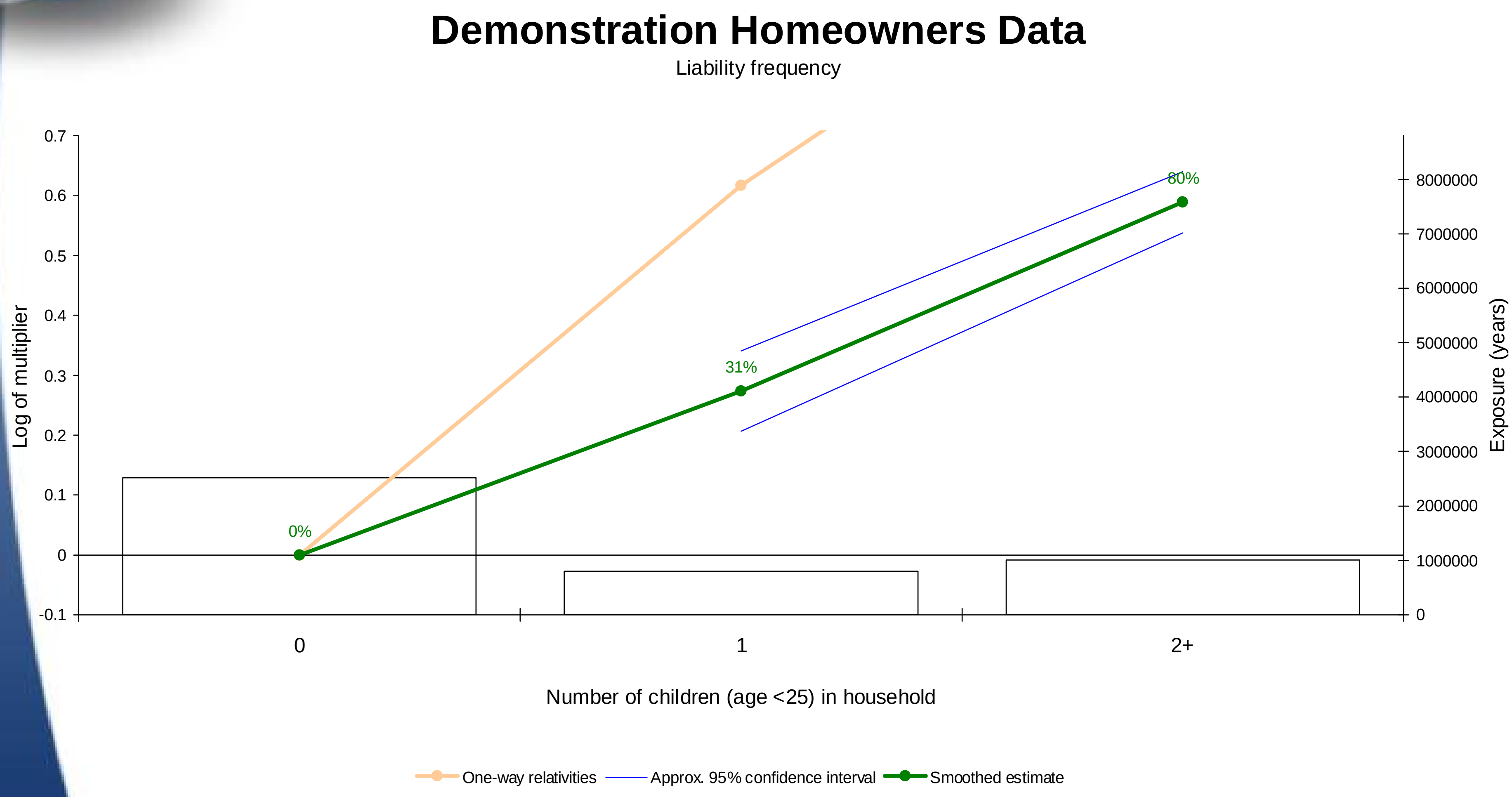
Inhabitant information: Effect of children on Liability



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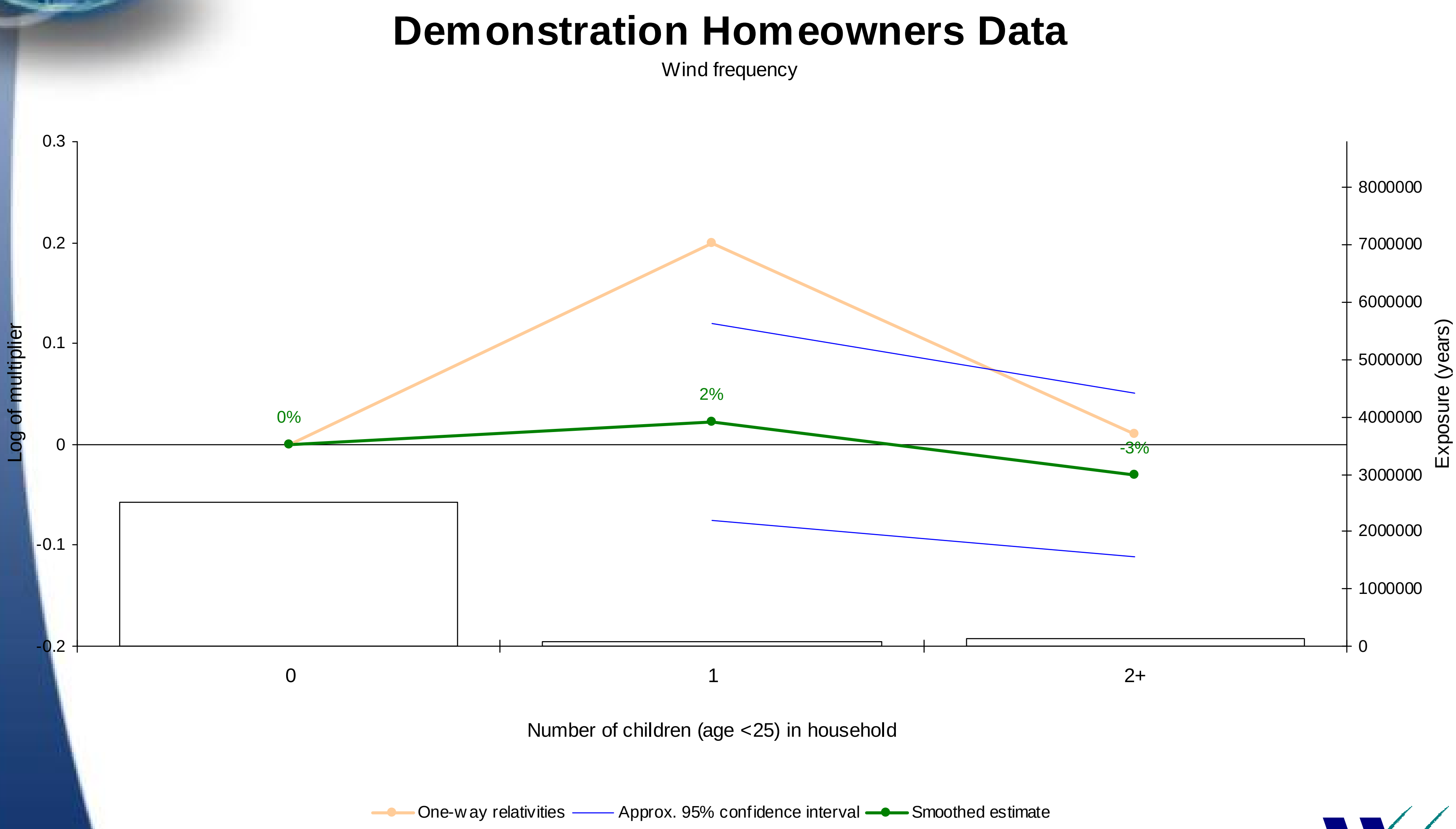
Inhabitant information: Effect of children on Wind



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More detailed reasons (cont'd)

- Model dwelling and contents separately
- Separate territories by peril
  - liability affected by demographics, but sinkhole affected by meteorological and geological phenomena
  - level of needed granularity may differ by peril
- Variable categorization by peril
  - AOI granularity may differ by peril
  - deductible options may differ by peril
- Large loss thresholds by peril

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More detailed reasons (cont'd)

- Different ratemaking analysis methods to be applied to each peril
  - loss trends and development
  - data used (eg company experience for non-cat and simulated data for cat)
  - expenses allocation
  - cost of capital considerations
- Benchmark rate relativities are often based on specific peril (eg windstorm mitigation credits in FL apply only to windstorm premium)

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More detailed reasons (cont'd)

- Facilitates separation of liability for loss reserving and monitoring
- Facilitates endorsement pricing (for those tied to specific peril)

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Practical considerations for by-peril pricing

- Volume required
- Point of sale algorithm
- IT concerns (eg separate territory definitions by peril?)
- Complication by form
- Lack of competitive benchmarks by peril
- Endorsements priced as % of base premium
- Incorporating catastrophe loads
- Statistical plan requirements

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Volume

- Generally seek a few thousand claims per claim type to attain meaningful models
- Depends on the number of variables to be examined

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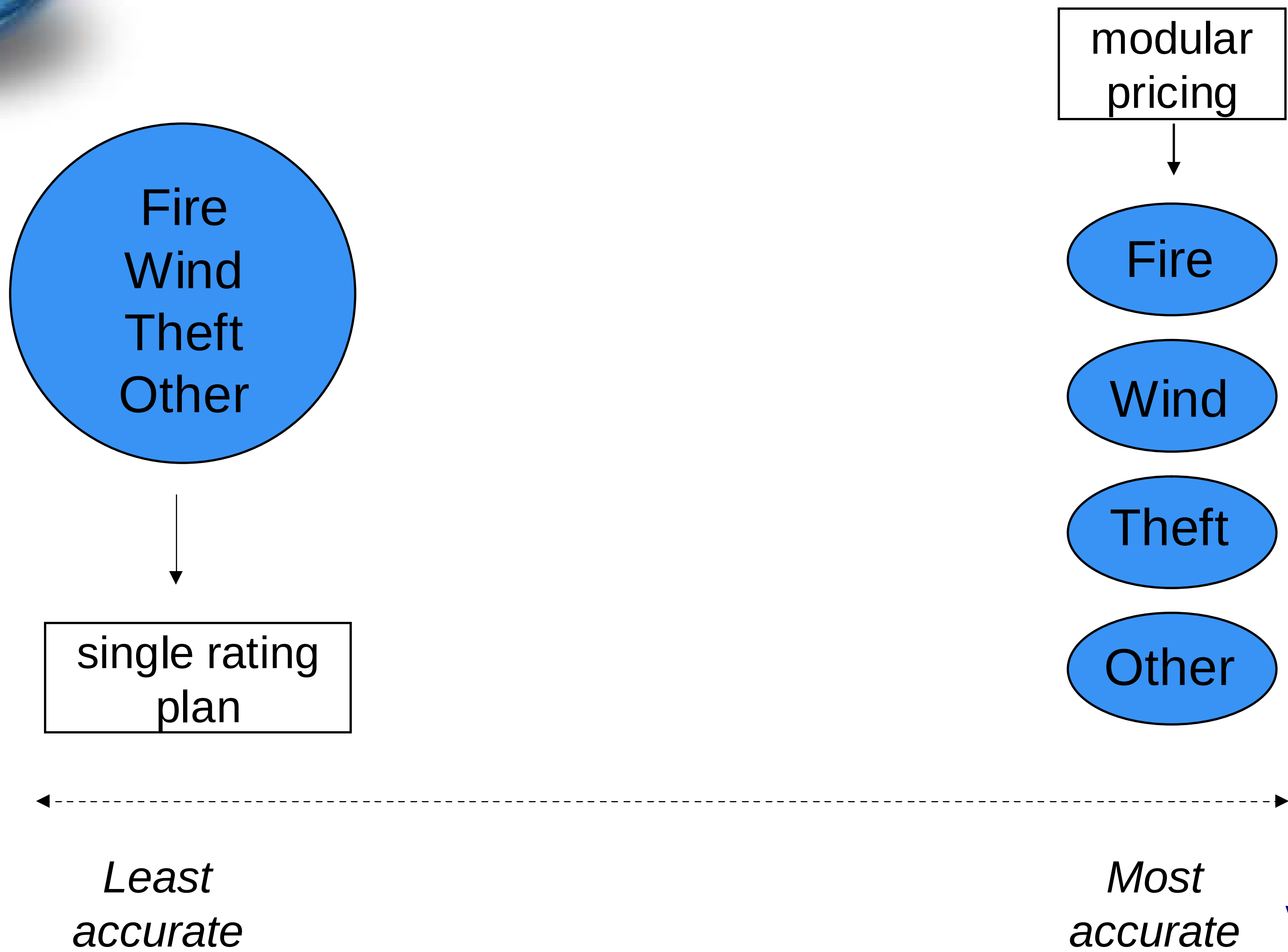
Point of sale options



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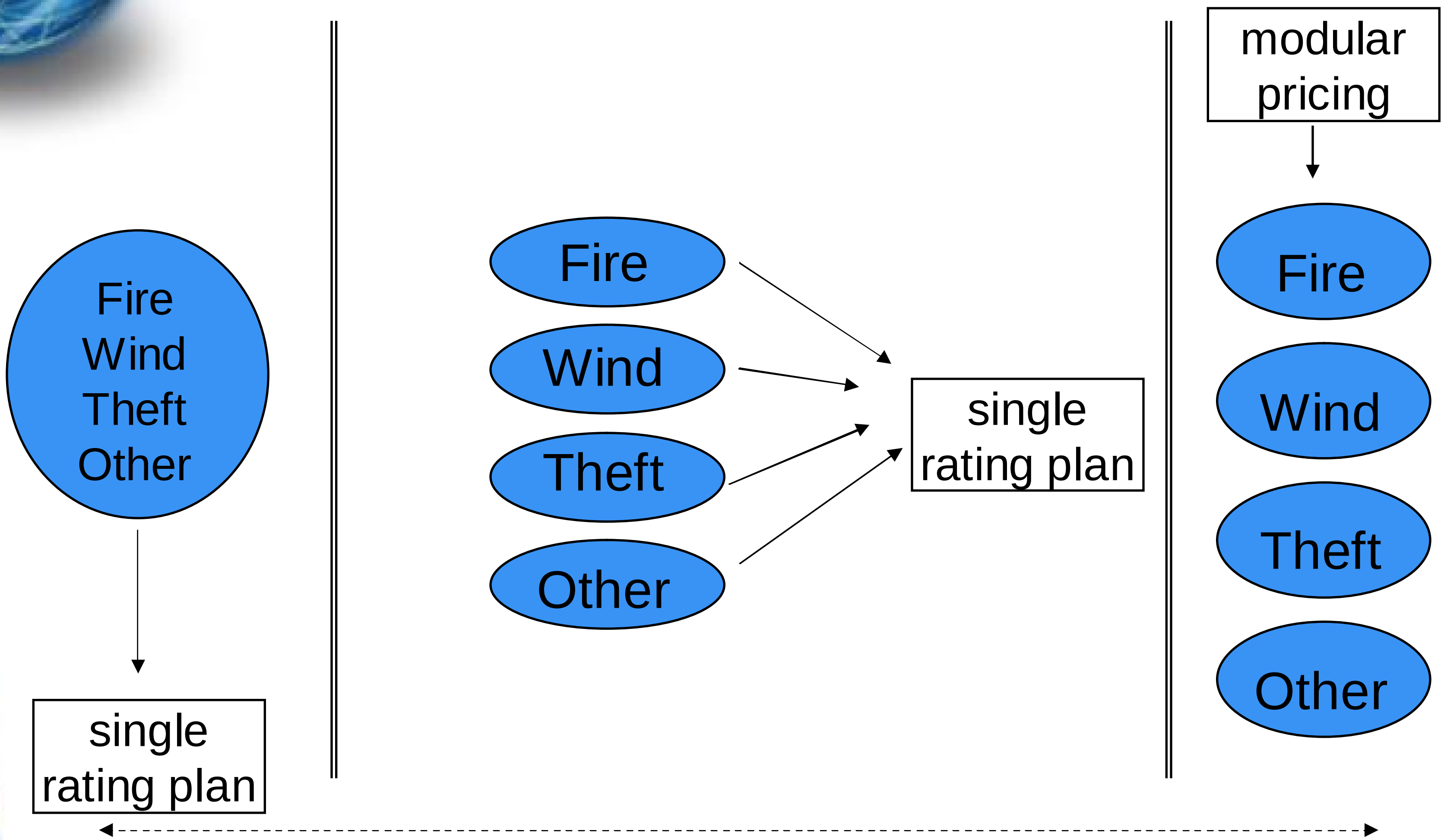
Point of sale options



Least accurate

Investigation of practical compromise

Most accurate

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Investigating practical compromise

- Global risk premium across all perils
  - populate fitted values by peril for each individual record
  - fit model to field representing sum of expected loss costs by peril
  - somewhat analogous to a single loss-weighted average of underlying by-peril models
- Investigate loss of accuracy in global risk premium model

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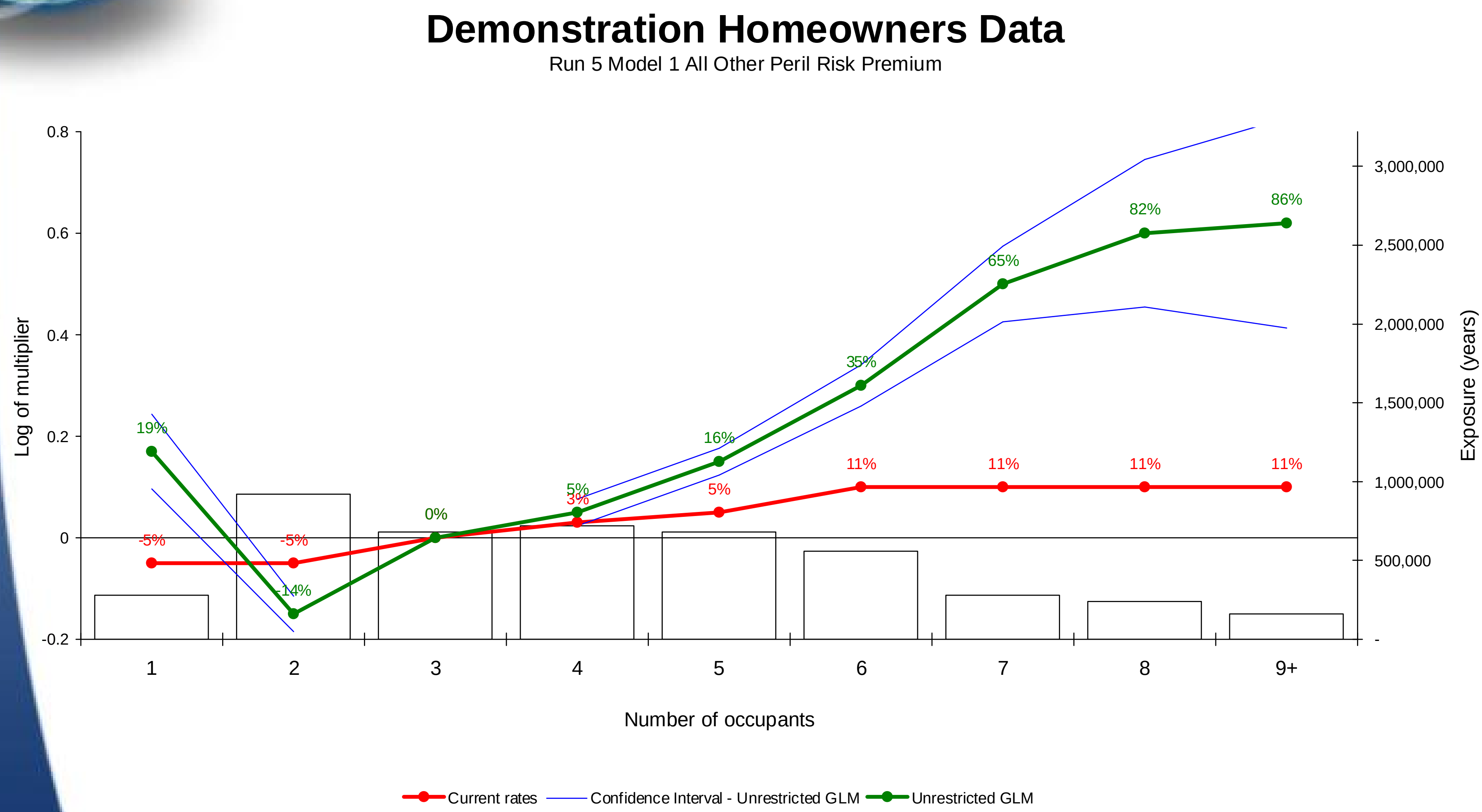
Sample output - risk premium by peril



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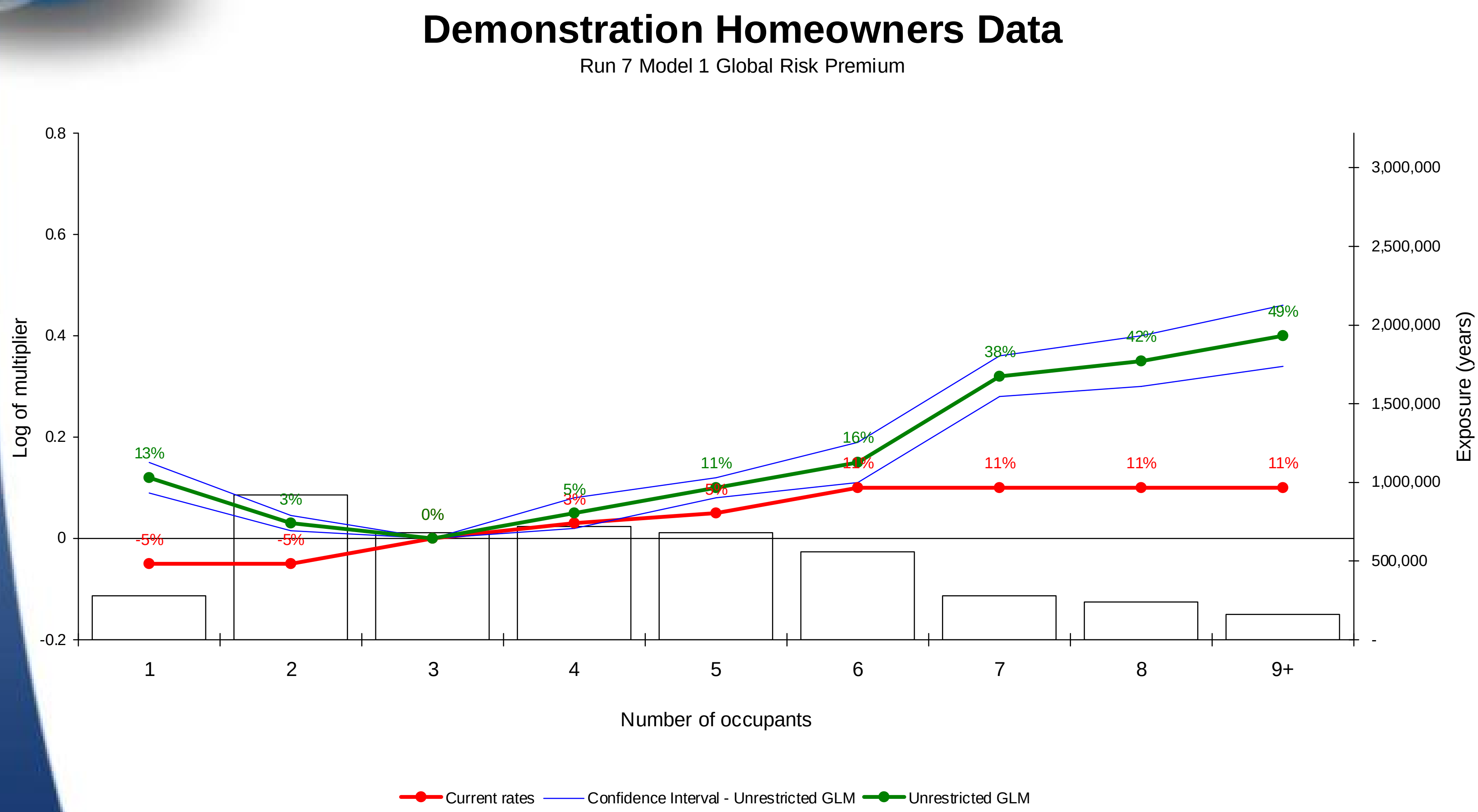
Sample output - global risk premium



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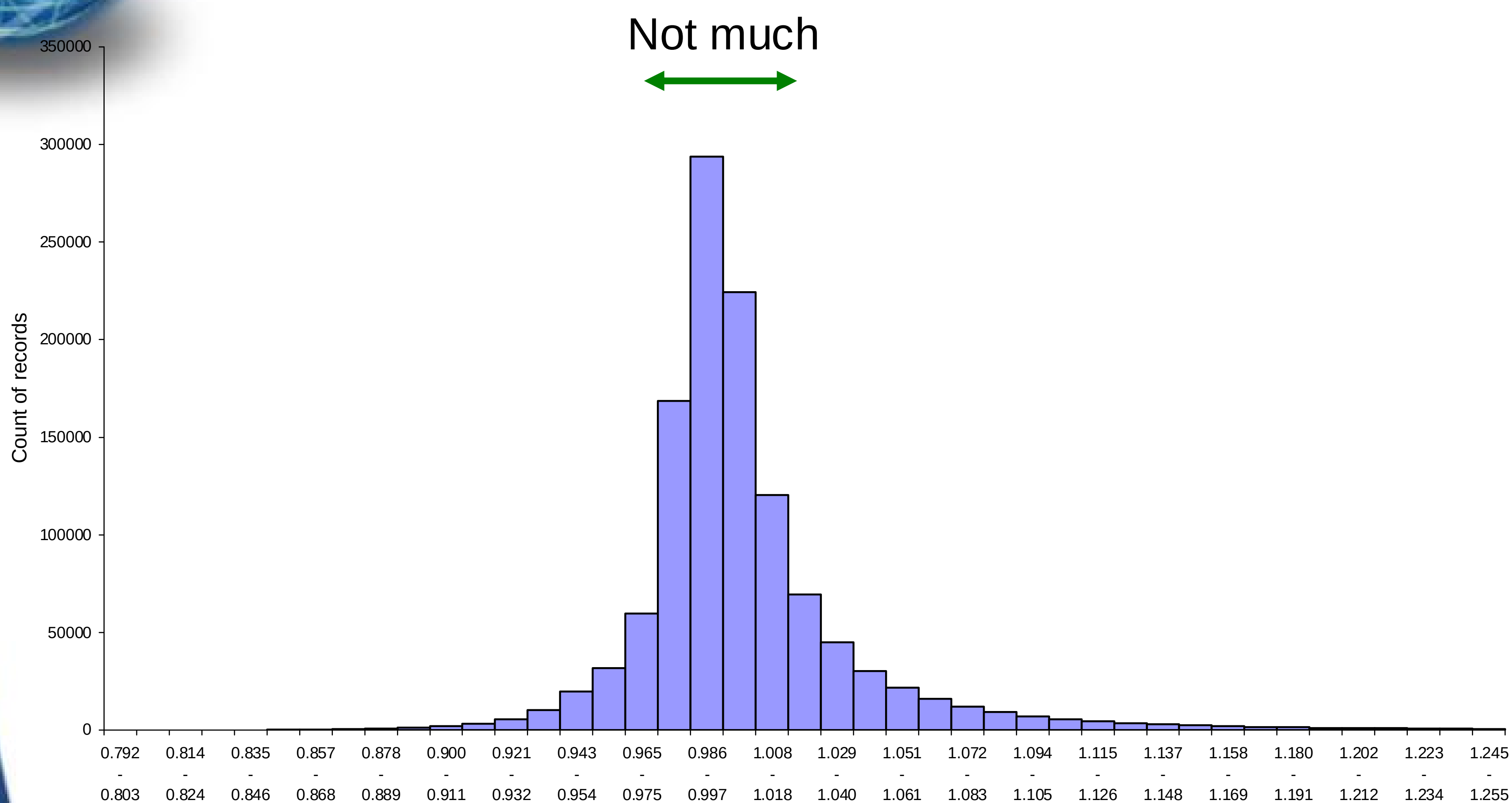
Investigating loss of accuracy



Ratio of fitted values from global risk premium to sum of fitted values from individual by-peril models

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Other practical considerations for by-peril pricing

- Volume required
- Point of sale algorithm
- IT concerns (eg separate territory definitions by peril)
- Lack of competitive benchmarks by peril
- Complication by policy form
- Endorsements priced as % of base premium
- Incorporating catastrophe loads
- Statistical plan requirements

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Agenda

- Case for unbundling the perils
- Traditional rating variables – for example:
  - policy form
  - AOI
  - deductible
- New rating variables

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Policy form

- Model separately by form allows
  - different variable categorization by form (eg amount of insurance)
  - different large loss thresholds
  - understanding loss cost effects by form
- Model homeowners and renters/condo separately and include form as an independent variable
- Model all combined with form as an independent variable
- Consider interactions by form

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Amount of insurance (AOI)

- Could model AOI as a categorical factor with many levels (consider categories that straddle common AOIs eg $98.5-101.5K)
  - this allows the true effect to be seen for both frequency and amounts models
  - smooth the relativities carefully so that the risk premium result for AOI shows a sensible progression
  - either charge a premium based on interpolated banded AOI, or perform simple interpolation between exposure weighted mid points of the bands to get a continuous scale
- Alternatively fit a regression spline to AOI and incorporate in rating algorithm or use to populate a detailed table

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Deductible

- Model incurred losses net of deductible
- Include in underlying frequency and severity models
- If results counter-intuitive, may need to remove factor and offset model by log of relativities from external study (eg current relativities or results from LER)
- Careful of changing selection behavior in future

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Agenda

- Case for unbundling the perils
- Traditional rating variables
- New rating variables
  - concern over missing levels
  - investigate consistency over time
  - internal information (eg inhabitant info)
  - external information (eg geodemographics)

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Factors with missing levels

- Common problem as information may not be collected on every exposure
- Do not choose "missing" as base level
- Investigate exposure distribution of missing level with other factors - eg does missing occur only on older years or older houses?
  - consider altering data to alleviate problem (eg use more recent years)
  - consider changing order of factors in the model to force alias in another variable
- Model with and without factor to understand effect

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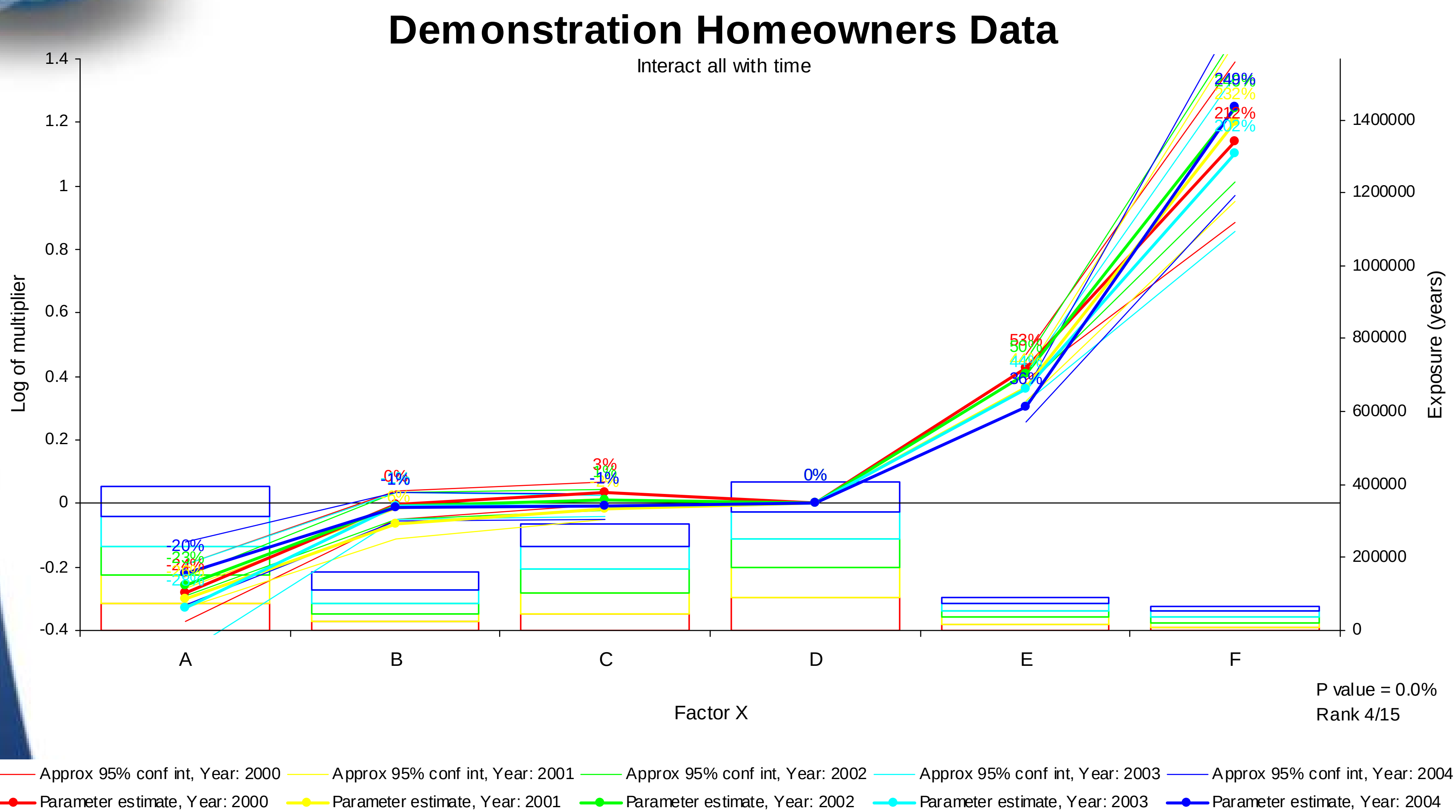
Consistency over time



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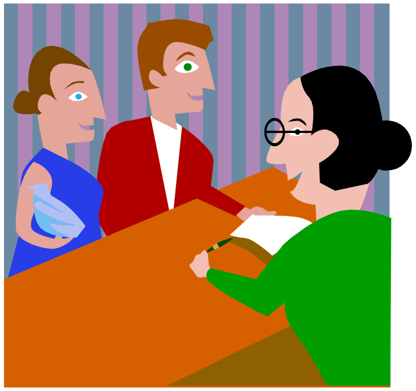
Internal variables

- Inhabitant information
  - # occupants
  - age, gender, marital status
  - unusual exposure (eg dogs)
- Relationship with company
  - optional endorsements
  - products held
  - # years with company
  - affinity membership



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Internal variables

- Detailed information on property
  - square feet
  - number of rooms
  - foundation shape
  - roof attributes (shape, covering)
  - interior construction materials
  - pool/spa

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Property characteristics

- Consider correlation with AOI – ie could something inherent to AOI algorithm actually predict risk better than AOI?

- Could you live without AOI?

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Score based on property characteristics

- Fit GLM with traditional rating factors and several property characteristics (eg $R_1xR_2xR_3xP_1xP_2xP_3$)
- Transform model results for property variables ($P_1xP_2xP_3$) into points-based score variable = R_4
- Categorize score variable appropriately
  - consider # of categories & proportion of business in each
- Include new score variable in claims model (ie $R_1xR_2xR_3xR_4$) and consider interacting with other variables

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External information

- Geodemographics (avg characteristics in an area)
  - population density
  - length of home ownership
  - average age of residents
  - financial information
- Weather data per area (relating to vulnerability of buildings)
  - max wind speed
  - avg rainfall

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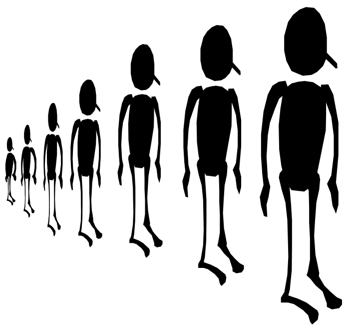
Geodemographic data

- Often designed for marketing retail products
- Attaches to zip code therefore easy to use at point of sale
- Marketing segment types often not predictive
- Underlying data often more interesting
- Simple measure of urban density often predictive



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Example of effect of urban density on homeowners theft frequency

Real GLM output cannot be disclosed in handouts

Graph in presentation showed strong multivariate effect of urban density

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Effect of density varies

- Effect of increasing density on risk:

	Frequency	Severity
Theft	↑	↑
Fire	↓	↑
"Other"	↑	↑

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Geodemographics can be rather related!

	R1	R2	R3	R4	G1	G2	G3	G4	G5	G6
R1										
R2	11%									
R3	32%	3%								
R4	17%	7%	58%							
G1	8%	2%	57%	16%						
G2	8%	2%	53%	15%	49%					
G3	7%	3%	44%	14%	33%	33%				
G4	5%	4%	21%	8%	30%	30%	30%			
G5	3%	2%	31%	6%	36%	35%	34%	31%		
G6	8%	2%	65%	16%	37%	35%	31%	29%	34%	
G7	8%	2%	65%	16%	36%	34%	30%	30%	34%	71%

Cramer's V for a selection of standard rating factors (R1, .., R4) and geodemographic factors (G1, …, G4)

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Coping with related factors

- Can be hard to interpret output from a GLM that includes a very large number of related characteristics
- Options
  - test related factors (within "families") one at a time to find most predictive member (eg # of late pays in 60 days may be most predictive of "late pay" family)
  - apply principal components analysis first

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Example of geodemographic factors

Real GLM output cannot be disclosed in handouts

Graph in presentation showed strong multivariate effect of geodemographic factor related to average life-stage of an area

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Example of geodemographic factors

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Graph in presentation showed strong multivariate effect of another geodemographic factor

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Example of geodemographic factors

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Graph in presentation showed strong multivariate effect of average type of building in area

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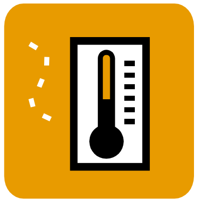
External information

- Geodemographics (avg characteristics in an area)
  - population density
  - length of home ownership
  - average age of residents
- Weather data per area (relating to vulnerability of buildings)
  - max wind speed
  - avg rainfall
  - soil type



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Examples of geophysical data

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Graph in presentation showed strong multivariate effect of weather-related geophysical data item

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External data

- Can add predictive power and thus give competitive pricing edge
- Can improve speed and accuracy of quotation process
- Can help assess risk when own data insufficient
- New philosophy for agents, regulators, etc.
- May complicate ability to compare to existing rates on factor by factor basis (eg comparing "old" territory to "new" territory plus population density)

Must balance accuracy with model parsimony and point of sale concerns.

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Example homeowners rating factors UK

- Post code (so geodemographic and geophysical factors can be derived)
- Amount of insurance
- Number of rooms / bedrooms
- Wall type
- Roof type
- State of repair
- Extensions
- Ownership status (rent/own)
- Occupancy in day
- Neighborhood watch scheme
- Approved locks, alarms, smoke detectors
- Deductibles
- Riders purchased, value> £x
- How long held insurance / when last claimed
- Policyholder details
  - Age
  - Sex
  - Marital status
  - Number of children
  - Occupation
  - Residency
  - Criminal convictions
  - Claims in past 2/5 years
- Smokers present in house
- Non family members sharing house
- Length of time living at property
- Use (principal/ second / business / let)
- Cover selected (buildings/contents/both)
- Source business (eg internet)

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Organizational insights

- Review/discuss variables in advance with other areas of the company (underwriting, legal, marketing, IT)
- Review integrity of data (especially if can't explain effects)
- Aim for visual aids (including maps)
- Address what matters most to the organization (removal of cross-subsidy, change in competitive position, policyholder dislocation, etc)
- Examine effect of commercial decisions (i.e. penalty to theoretical)

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