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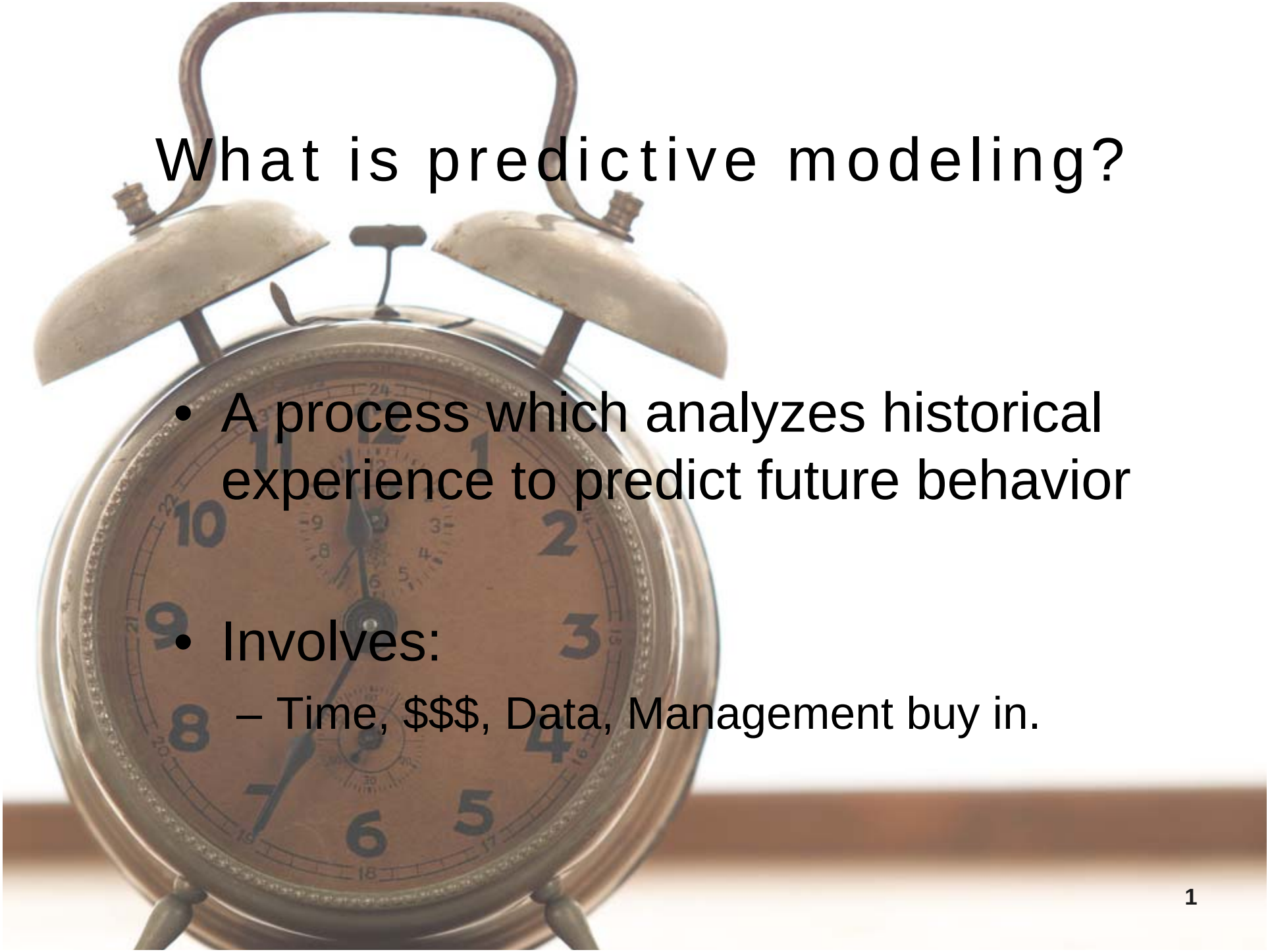
Predictive Modeling for Commercial Lines with Schedule Rating

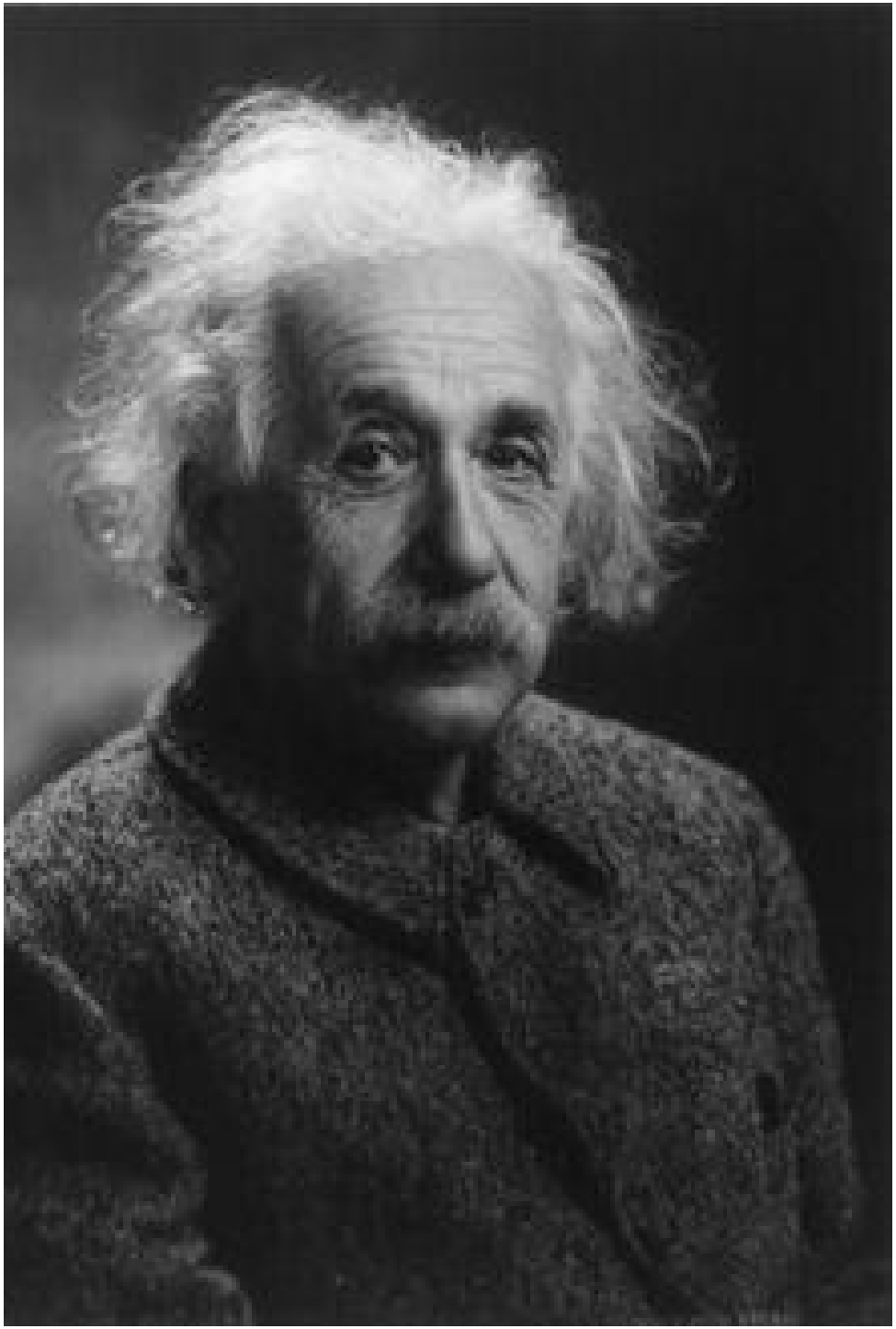
Larry Seymour
FCAS, MAAA

CAPITOL INSURANCE COMPANIES®



What is predictive modeling?

- A process which analyzes historical experience to predict future behavior
- Involves:
  - Time, $$$, Data, Management buy in.



What is Experience Rating?

- A method used to adjust premiums up or down based on an account's loss history.

[Ap + WAe + (1-W)Ee + B] / [Ep + WEe + (1-W)Ee + B]

- ISO CGL formula

What is Schedule Rating?

- A provision to adjust premiums ⬆ or ⬇ to reflect characteristics of a risk which are not otherwise reflected in the premium.

ISO GL Schedule Rating Modifications:

Risk Characteristic	Description	Mod Range	
		Credit	Debit
Location	Exposure inside premises	5%	5%
Location	Exposure outside premises	5%	5%
Premises	Condition and care of premises	10%	10%
Equipment	Type, condition and care of equipment	10%	10%
Classification	Peculiarities of classification	10%	10%
Employees	Selection, training, supervision, experience	6%	6%
Cooperation	Medical Facilities	2%	2%
Cooperation	Safety Program	2%	2%
Maximum Credit or Debit (varies by state) --->		25%	25%

Do these three ideas conflict, collide or corroborate ?

- Will modeling replace the rating bureaus?
- Are we creating our own perfect storm?
- Get a grip - it's only insurance!

Pricing Assumptions

- Rating bureaus are a decent starting point
- Experience rating is appropriate
- Your predictive model is appropriate

Two areas of thought for implementing a model:

- The model is the price (i.e. a filed u/w scoring model), now go sell it
- The model is another U/W tool in the tool box (i.e. an u/w guideline)

Case Study – Underwriter Variance

- Hotel/Motel, >30 units, w/o Cooking, $1M/$2M General Liability, Standard Premium = $10,000.

Underwriter:	Written Premium:	
1	$6,000	(BOP, preferred pricing)
2	$7,500	(Package, preferred pricing)
3	$7,500	(Package, preferred pricing)
4	$8,100	(Package, preferred pricing)
5	$10,000	(Package, standard pricing)
6	$10,000	(Package, standard pricing)

Various Observations:

1. Hail risk
2. Crime statistics
3. Historical restaurant exposure – verify class code
4. Age of building (some say old some say new)
5. Area specific rates higher than average
6. Tripadvisor.com (credibility issue)
7. Pool/Sauna exposure

What did a predictive underwriting model say?

- $11,000 (10% debit)
- Ignores current market pressure
- Remembers hotel loss experience

Differences between Models and Schedule Rating

- **Pros**

Models

- Consistent treatment
- Works 24 / 7

Schedule Rating

- Provides flexibility
- Can follow the market

- **Cons**

Models

- Dwells on the past
- Removes the “art” in U/W

Schedule Rating

- Varies by underwriter
- Allows for the “art” in U/W

Can a predictive model capture all of the risk characteristics of a risk?

- On average, hopefully yes
- For each individual risk, ?????

TOWERS PERRIN

Predictive Modeling for Commercial Lines with Schedule Rating

Benefits and Methods

Alex Laurie, FCAS, MAAA

March 11, 2009

Predictive Modeling for Commercial Lines with Schedule Rating

- Benefits of predictive modeling
- Leveraging underwriting knowledge
- Handling heterogeneity
- Model result formats
- Implementation methods

Benefits of Adding Predictive Models

Benefits of Adding Predictive Models

- Consistency of Process
  - Underwriting Judgment can vary:
    - — From person to person
    - — From policy to policy

Benefits of Adding Predictive Models

- Consistency of Process
  - Predictive model:
    - Looks at same characteristics each time
    - Facilitates consideration of interactions among factors
    - Gives the same result for two risks with the same characteristics
- Efficiently considers more factors than manual process

Benefits of Adding Predictive Models

- More precise and consistent evaluation of loss drivers can yield:
  - Increased profit
  - Expanded underwriting appetite

Benefits for Commercial Lines?

- Does predictive modeling offer more lift for personal lines or commercial lines?
  - This depends on:
    - Sophistication of current pricing/underwriting
    - Additional data sources available (both internal and external)
    - Ability to model patterns in data
    - Ability to implement model into processes
  - In some cases, this is more powerful for commercial lines, owing to greater variation in individual risk quality within a rating class.

Leveraging Underwriting Knowledge

Leveraging Underwriting Knowledge

- For **First** Generation Predictive Models:
  - Talk to underwriters
  - What do underwriters consider important for assessing risk?
  - How can these things be sourced and quantified?
  - Do proxies exist for these risk characteristics?

Leveraging Underwriting Knowledge

- What types of internal and external data I can use?
  - Data related to:
    - Geography / Demography
    - Industry of risk
    - Individual Enterprise (including financial and prior claim data)
    - Agent / Broker / Producer
    - Other products purchased by risk
    - Competitor rating plans

Leveraging Underwriting Knowledge

- For **Subsequent** Generations of Predictive Models, in addition to quantitative model monitoring:
  - Ask underwriters about when the models disagree with their judgment
  - Use system to record underwriters' observations & concerns (e.g. "help line" or "e-mail box")
  - Anecdotes may improve models via:
    - New variables or
    - Different treatment of existing variables

Modeling and Implementation Considerations

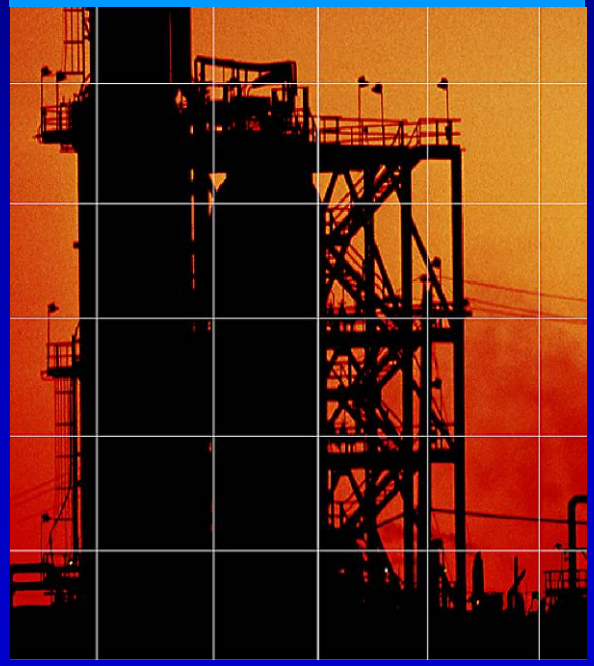
- Handling heterogeneity
- Model result formats
- Implementation methods

Using Models to Improve Pricing / Underwriting

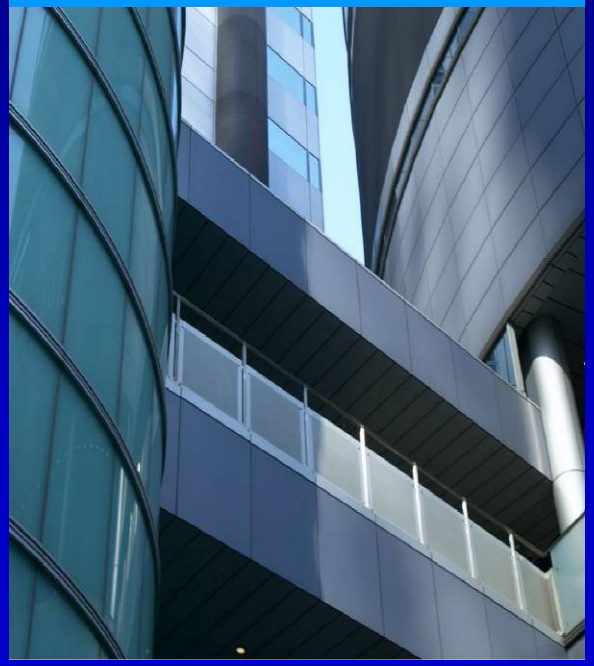
- How do I deal with heterogeneous risks?
  - Segmented Models – To the extent data is credible, separate models can be built for specific types of business.

Small Business

Large Manufacturers



Large Non-Manufacturers



Using Models to Improve Pricing / Underwriting

- How do I deal with heterogeneous risks?
  - Interaction Variables – Allow the effects of one variable to differ based on another variable.
    - Example: If state annual snowfall > 5 inches, use variable based on type of snow/ice removal equipment.
    - Example: Interact number of employees with employee turnover.

Relative Risk			
# of Employees	Employee Turnover		
	Low	Medium	High
Under 50	0.8	1.0	1.2
50 – 500	0.7	1.1	1.4
Over 500	0.7	1.2	1.6

Illustrative Data

Using Models to Improve Pricing / Underwriting

- What does model result look like?
  - Model indication of risk:
    - One of 10 tiers
    - A three-digit score
    - A suggested schedule modifier
    - A separate indicated rating factor

Using Models to Improve Pricing / Underwriting

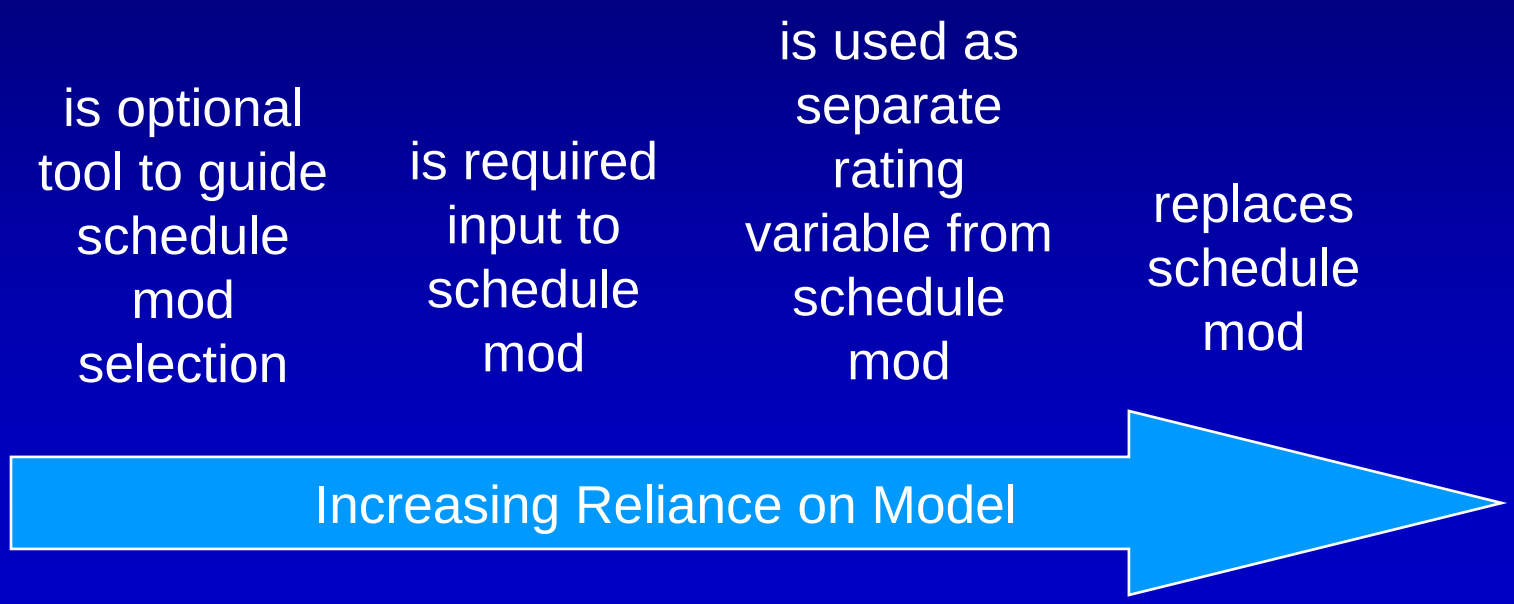
- **One of 10 Tiers**
  - Pros:
    - Simple to understand (e.g., tier 10 = highest expected loss costs)
    - Can choose desired number of tiers
    - Can adjust definitions of tiers over time
  - Con:
    - Adjusting definitions can cause confusion (e.g., “Why does Tier 1 mean a different level of risk this year than it did last year?”)
- **Suggested Schedule Modifier**
  - Pro:
    - Easy to interpret
  - Con:
    - If model captures different characteristics from schedule rating plan, it may not make sense for model to affect schedule rating
- **Three-digit Score**
  - Pros:
    - Can create mapping of scores to rate factors (e.g., score of 400 yields 1.20 rate factor)
    - Can set minimum eligibility scores for different products or companies (underwriting)
    - Can adjust rate factor mappings or cut-off scores over time, without changing meaning of scores
  - Con:
    - Results are more complex than an indicated tier
- **Separate Indicated Rating Factor**
  - Pro:
    - Little or no judgment required
  - Cons:
    - Allows underwriter no control over how model result is used
    - May introduce competitive disadvantage

Using Models to Improve Pricing / Underwriting

- What does model result look like?
  - Reason codes:
    - What variables, or classes of variables, most influenced the model's indication?

Using Models to Improve Pricing / Underwriting

- Should use of model result be mandatory?
  - Implementation Methods:
    - Model result…



Using Models to Improve Pricing / Underwriting

- **Optional Tool to Guide Schedule Mod Selection**
  - Pros:
    - Most conservative option
    - Most similar to current processes
    - Gives underwriters maximum discretion
  - Cons:
    - Underwriters may ignore model
    - May not reduce manual work
- **Required Input to Schedule Mod**
  - Pros:
    - Ensures model affects pricing and/or underwriting decision
    - Still allows underwriting judgment
    - Forces collection of data if model use required
  - Cons:
    - Depending on design, model may only affect some of the risks
    - May restrict underwriting from applying judgment in areas where their judgment works
- **Separate Rating Variable**
  - Pros:
    - Makes sense when model and schedule rating seems to identify different characteristics
    - Model results always influences pricing
  - Con:
    - If model results and schedule rating are correlated, might not properly reflect risk
- **Model Replaces Schedule Mod**
  - Pro:
    - Eliminates need for manual schedule rating
  - Cons:
    - Removes underwriting judgment from process
    - Should only be used if:
      - Schedule rating has been ineffective, or
      - Schedule rating will have little value once predictive model is implemented

How could model be required input to schedule mod?

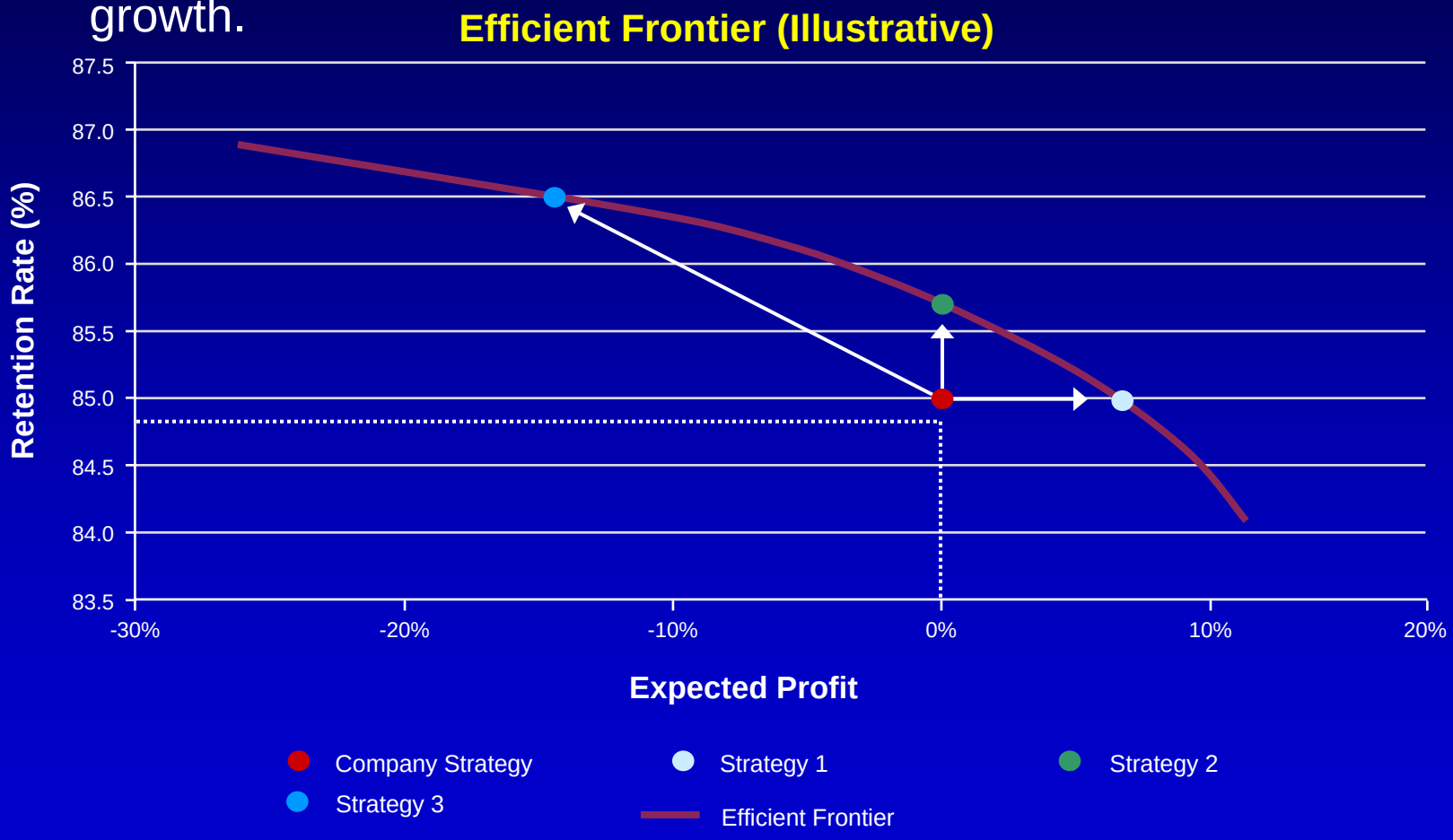
Examples:

- Underwriter cannot deviate more than X% from the modifier the model gives
- Underwriter can only choose modifier based on three of the original six characteristics
- Underwriter cannot give schedule rating discount to a risk with score worse than XXX
- Underwriter cannot give schedule rating discount to a risk in the worst three tiers

Key Point: Know when model works better than schedule rating and vice versa. Design implementation plan accordingly. (Helpful measurement techniques to follow!)

Price Optimization

- Price Optimization can leverage information about the competitive landscape and demand for the product to increase profit and/or growth.



Predictive Modeling for Commercial Lines with Schedule Rating

Adam Sherwin

March 11, 2009

Topics

- General Measurement Issues
- Quality of Current Underwriting
- Quality of the Predictive model
- Overlap Model and Underwriting
- Combining
- Determining Value

All tests of model should be on a hold-out

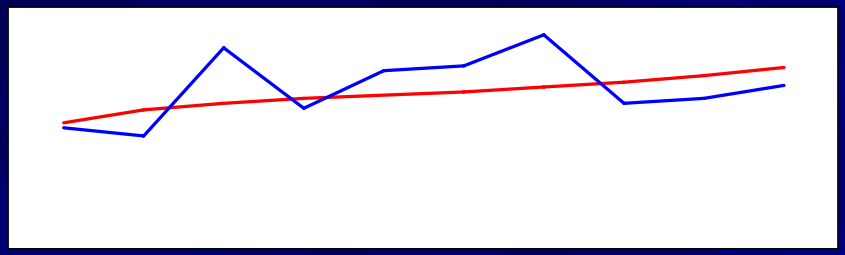
- Random hold-out
  - Are all observations really independent?
  - Catastrophes
  - Lawsuits
- Future hold-out
  - Cyclicality/Inter-period correlation
  - Unbiased
  - Worse than contemporaneous
  - Guide to degradation
  - Different risk

Interaction with experience

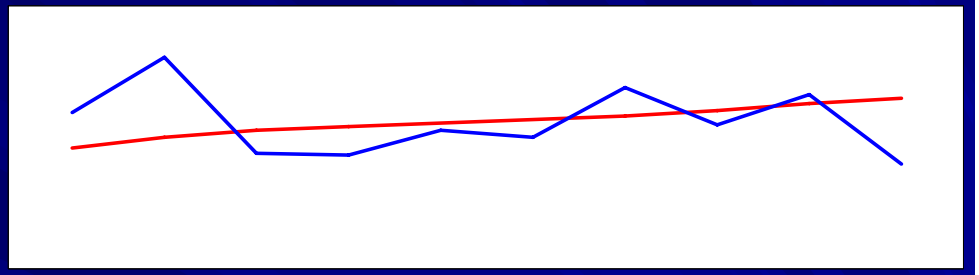
- Ignore: Use manual LR's with schedule or model—Not recommended
- Adjust each for experience
- Solve experience in model (Predictive Modeling for Commercial Lines with Schedule *and Experience* Rating)

How good is the current UW?

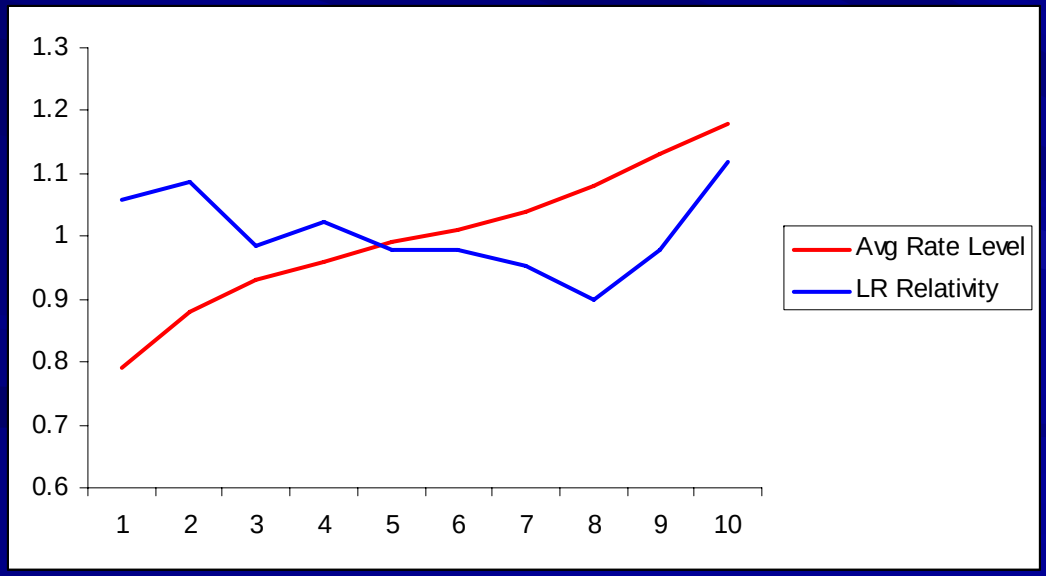
Some Variable line up well…



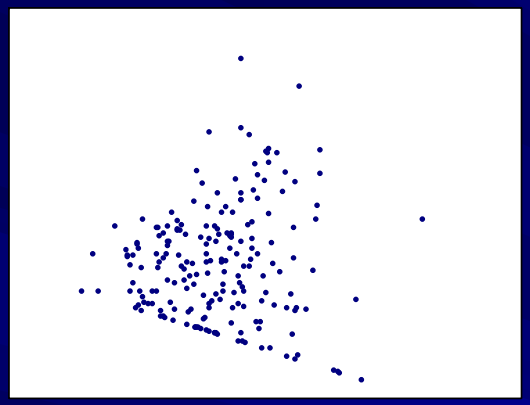
Others may not…



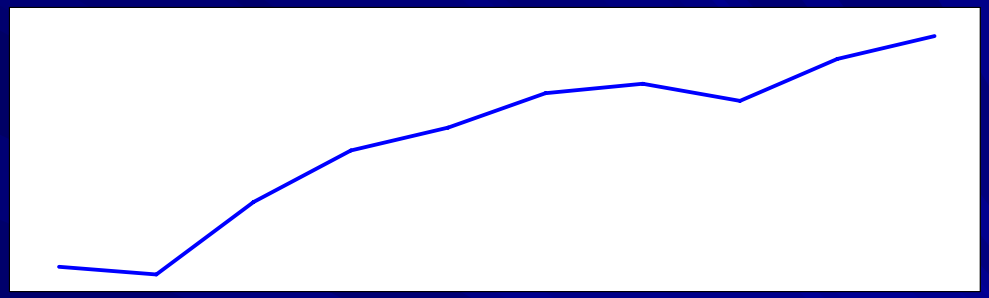
Overall results are somewhat mixed…



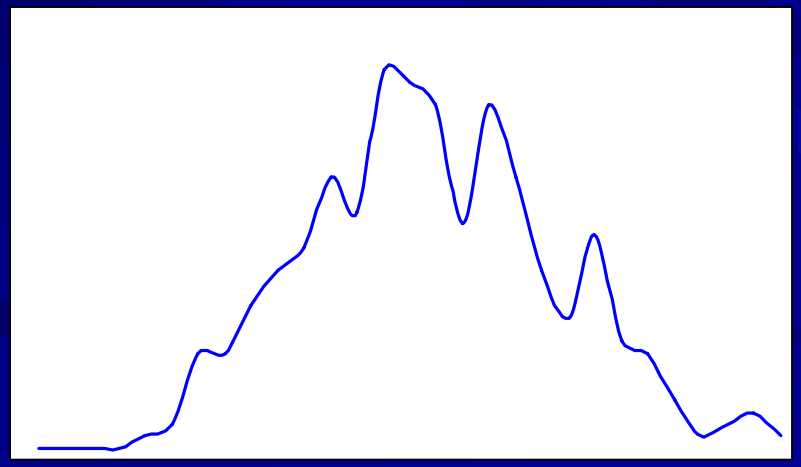
Does the predictive model work?



Residuals

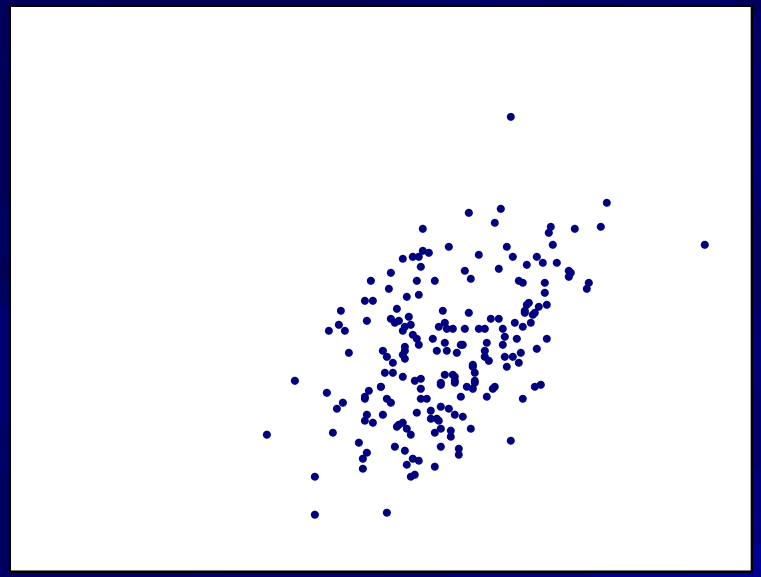


Lift



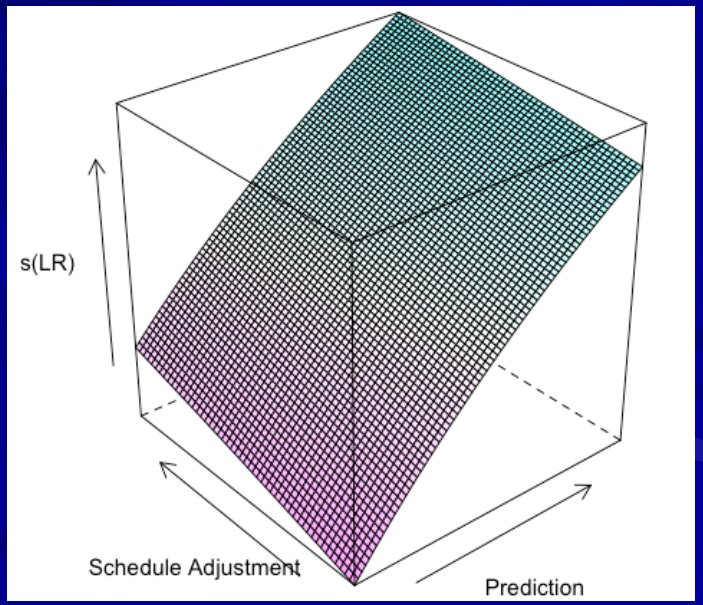
Stability

Comparison with Underwriting



Correlation

Both Predictive with predictive model stronger:



How to Combine

- Blended
  - Simultaneous: LR=Var1+Var2+Var3+…+a*ScheduleModifier
  - Post-hoc: LR=a*PredictiveModel+b*ScheduleModfifier
- Residual
  - LR/Prediction=a*ScheduleModifier
  - LR/(1-ScheduleModifier)=a*Prediction
- Full Combination
  - LR=Var1+Var2+Var3+Adj1+Adj2+Adj3
  - Change ranges or convert to score?
- Does it differ by segment?
  - Classic interaction test
  - UW characteristics can segment too

Are all Underwriters Equal?

- Quality varies
  - Education
  - Experience
  - Subjective Evaluations
- Beware of confounding variables
  - Line
  - Region
  - Business Type

Valuing the Model

- Short-term:
  - Maximize Profit: (Selected/Indicated-1)*Retention(Selected,Current)
  - Value: Sum(Premium*Change/IndicatedChange*Retention(Selected,Current)/Retention(Current,Current))
- Long-term:
  - Adverse selection on competitors
  - Avoidance of adverse selection
  - Assessed by Simulation

Underwriting Optimization

- Value of UW Input > Cost of UW
  - Value may vary by segment
  - Value may vary by underwriter
  - E.g. UW if f(Vars)*f(UW)*Premium>k
- Many variations:
  - If abs(Cost-Value)<k quick evaluation
  - Manual flagging
  - Automatic exceptions