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Beyond the Buzzword
Realizing Value From Predictive Modeling

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Casualty Actuarial Society
2012 Seminar on Reinsurance

Predictive Modeling – It's not Rocket Science

▸ Agenda:

1. Practical advice when model shopping
2. Common mistakes to avoid
3. Adding value to the reinsurance transaction

Models: Picking the Right Tool

(Helpful shopping tips)

From Investigation to Implementation in 5 Steps

1. Will the model work?

2. Will it be better?

3. How will you implement this?

4. Will benefits justify costs?

5. Should you implement this?

From Investigation to Implementation

1. **Will the model work?**   Verify that the model works on your own data

2. **Will it be better?**   Benchmark your historical performance vs. model's ability to score policies

3. **How will you implement this?** Assess execution risk

4. **Will benefits justify costs?** Quantify the potential benefit using an implementation strategy selected by you

5. **Should I implement this?**   Allow rapid resolution of "Go/No Go" decision

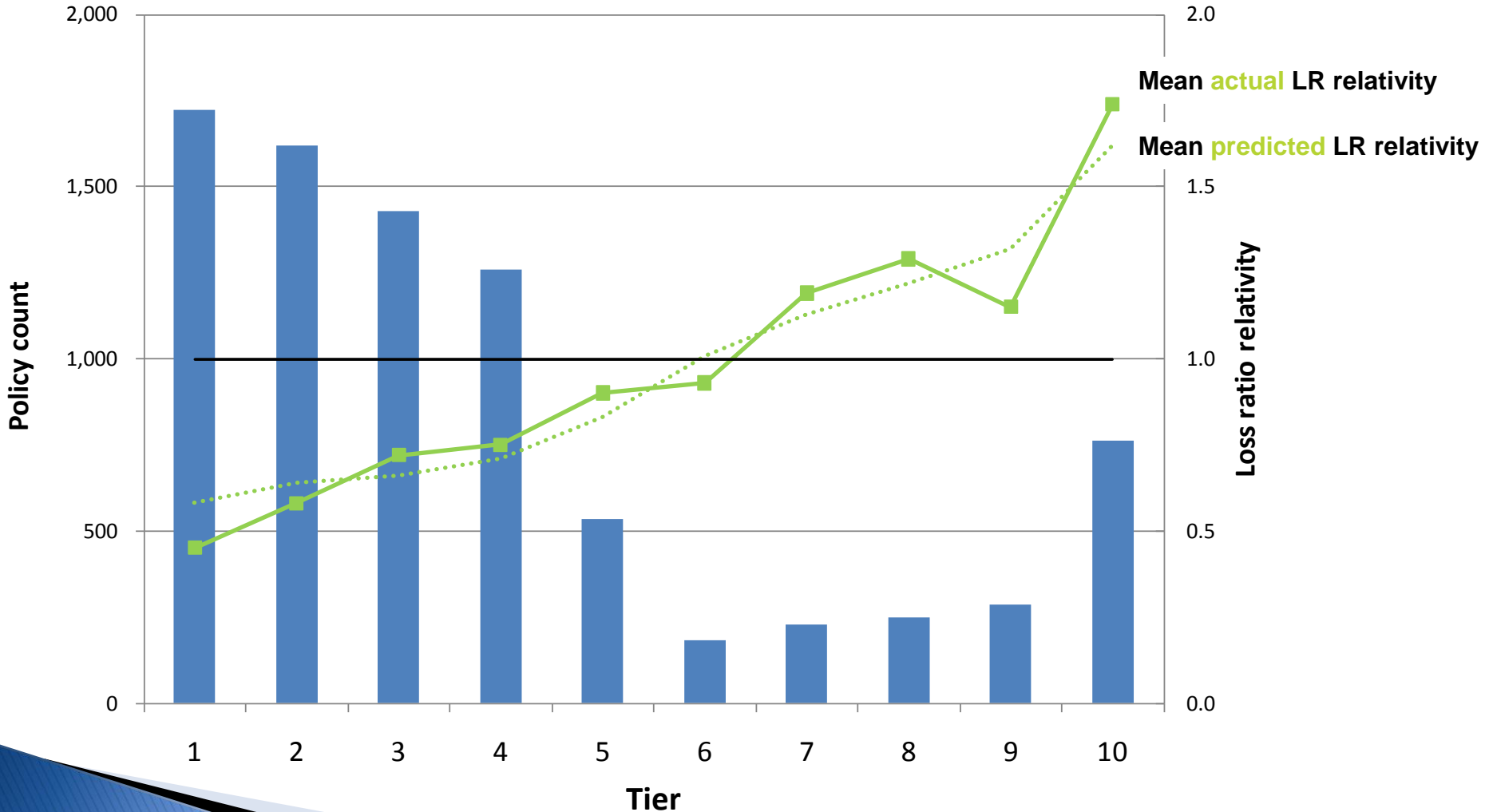# 5 QUESTIONS

Will the model work?

Will it be better?

How will you implement this?

Will benefits justify costs?

Should you implement this?

Verify via lift analysis

Mean **actual** LR relativity

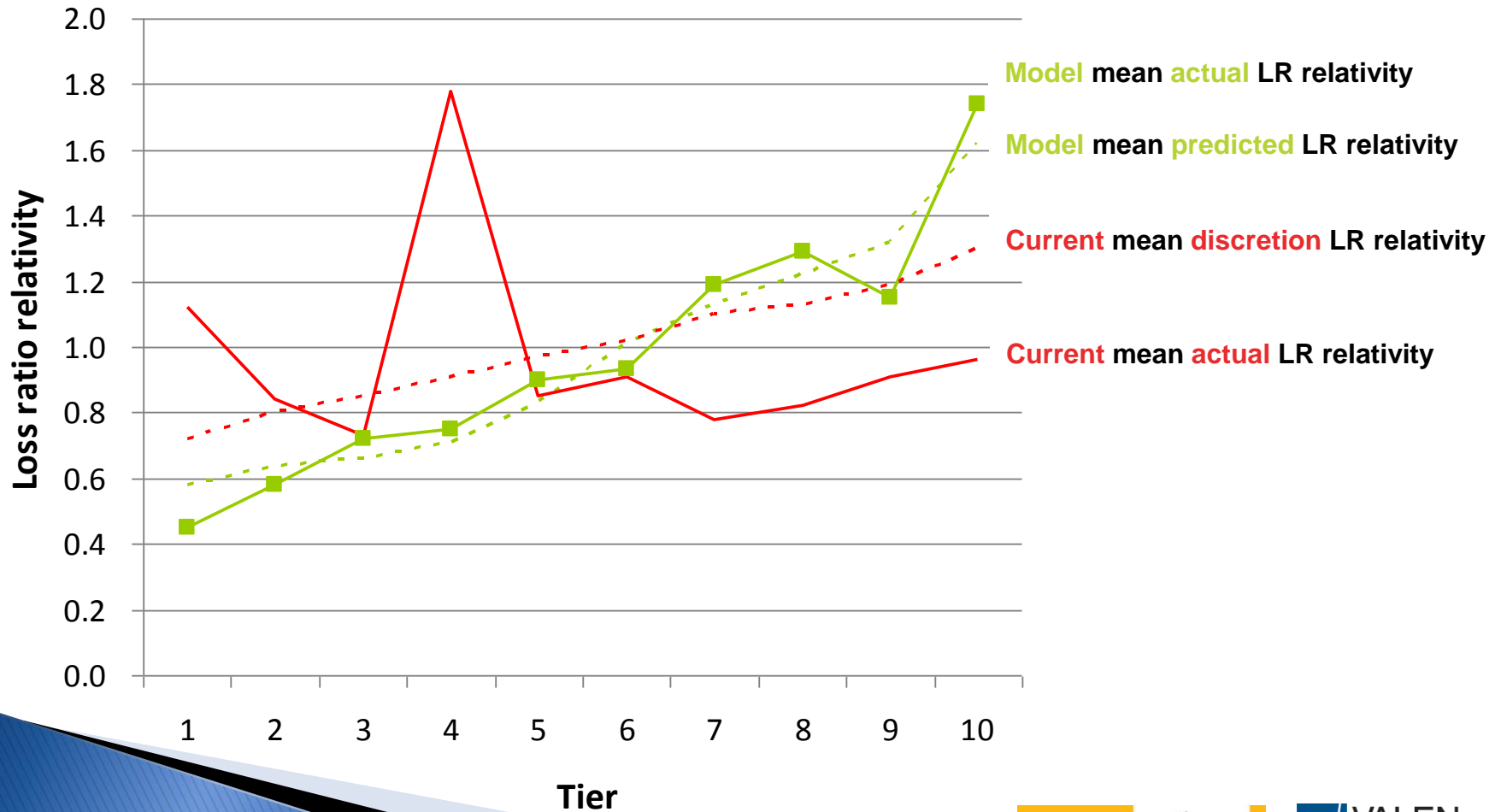Mean **predicted** LR relativity

5 QUESTIONS

Will the model work?

Will it be better?

How will you implement this?

Will benefits justify costs?

Should you implement this?

Performance comparison

Model mean **actual** LR relativity

Model mean **predicted** LR relativity

Current mean **discretion** LR relativity

Current mean **actual** LR relativity

5 QUESTIONS

Will the model work?

Will it be better?

» How will you implement this?

Will benefits justify costs?

Should you implement this?

Visualize the endpoint

- **Define implementation options**
  - Choose one or two reasonable strategies
- **Generate policy scores**
- **Simulate implementation actions**
  - Calculate impact on profitability
  - Identify affected policies
  - Visualize impact on portfolio
  - Assess reasonableness of implementation
- **Visualize the post-implementation portfolio**
  - Internal managers are aware of their departments' impacts
  - C-Suite has pro-forma financial impact

5 QUESTIONS

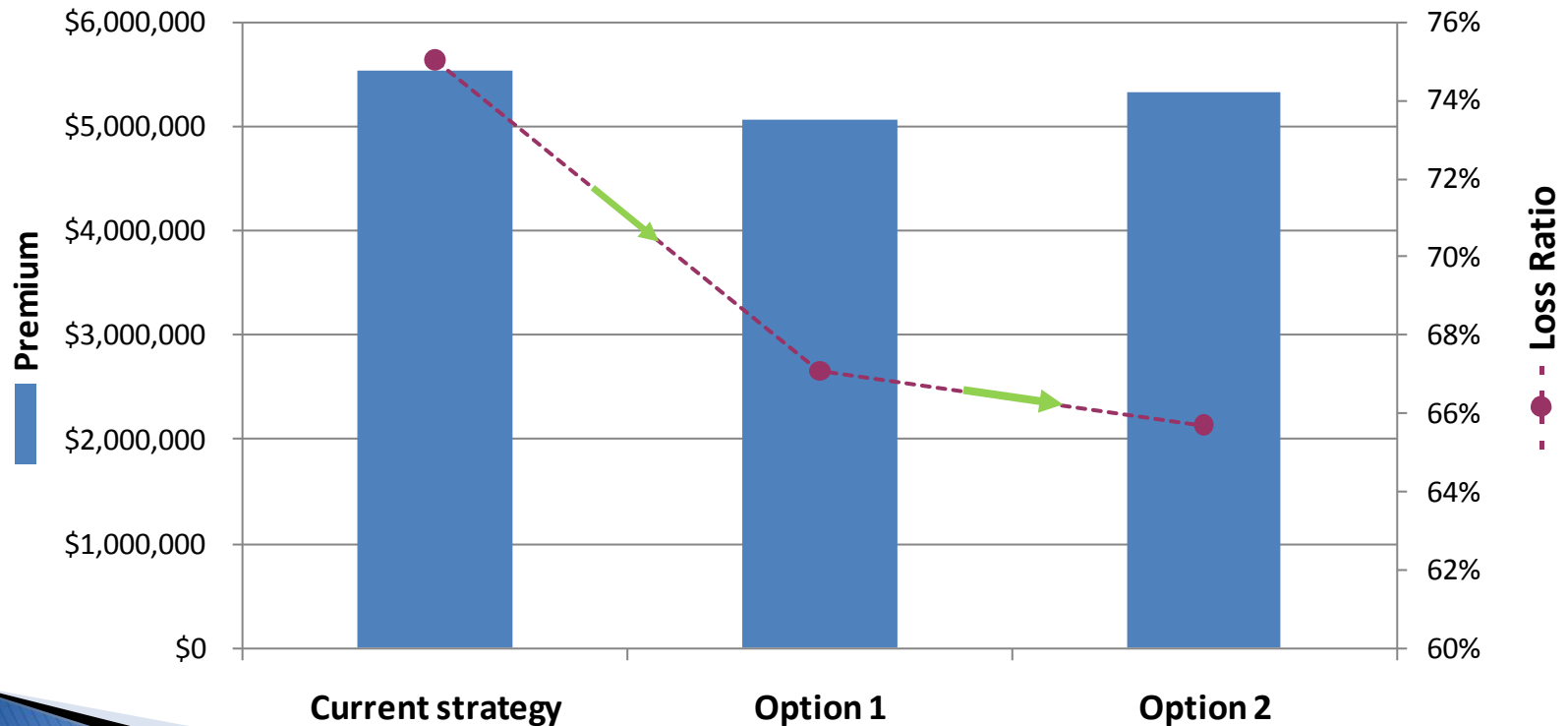Will the model work?

Will it be better?

How will you implement this?

»» Will benefits justify costs?

Should you implement this?

Quantify potential benefit

- Implementation options from collaboration:
  - Option 1: Decline the worst 10% of premium (bin 10)
  - Option 2: In addition, target bins 1 and 2 for growth

Identify all costs

▸ Decide if cost is reasonable given

  ◦ systems constraints

  ◦ market constraints

  ◦ cultural/underwriting constraints

  ◦ legal constraints

5 QUESTIONS

Will the model work?

Will it be better?

How will you implement this?

Will benefits justify costs?

>> Should you implement this?

At your finger tips

1. **Lift analysis**   Verify that the model works on your own data

2. **Performance comparison**   Benchmark your historical performance vs. model's ability to score policies

3. **Score report**   Provide information to assess execution risk

4. **Cost-benefit analyses**   Quantify the potential benefit using an implementation strategy selected by you
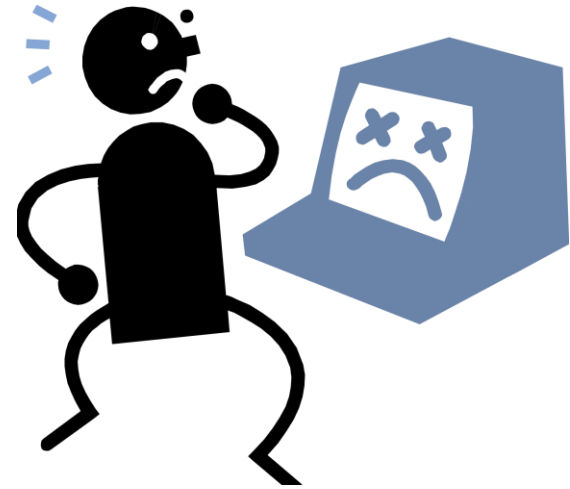
Allow rapid resolution of "Go/No Go" decision

MANAGING EXTREMES Willis Re | VALEN technologies

Models: They're Only Human
(Things that can go ~~wront~~ wrong)

Common Pitfalls That Reduce Value

- Business problem and usage
  - Extrapolation

- Construction
  - Lack of usage clarity

- Scoring:
  - Implementation defects

Example 1: Bold Usage Extrapolations

▸ Carrier had declined, non-renewed under 26 yrs old, more than 2 at-fault accidents
  ◦ Started a non-standard auto program scored with a model to help price policies
  ◦ The modeler selected variable transformations to fit the observed data

Probability of an at-fault BI/PD claim occurrence of $100,000 or more
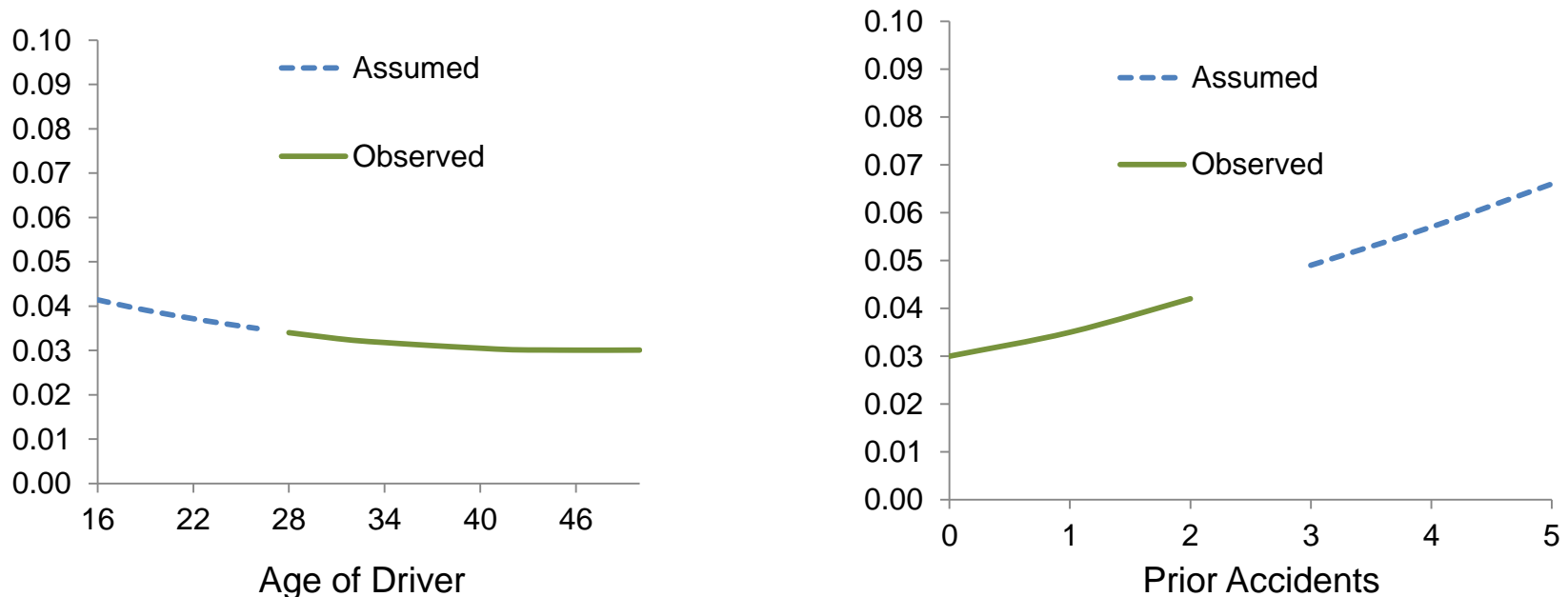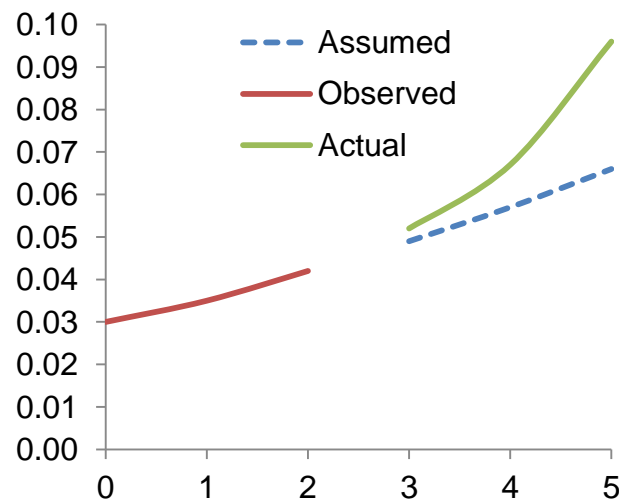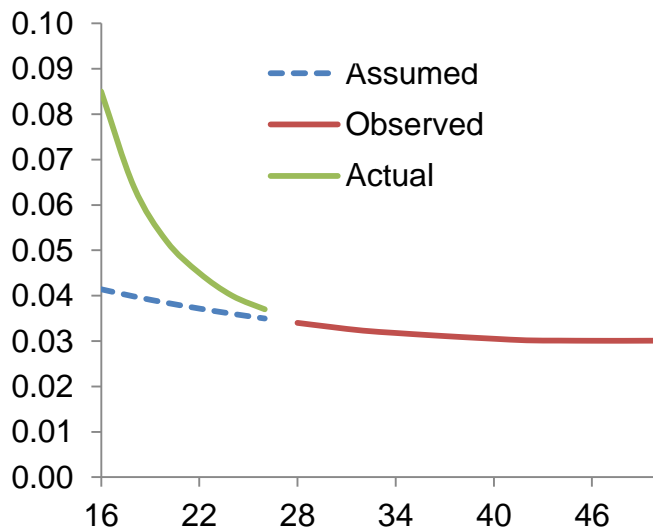

Model prediction for a 16 year old driver with 5 prior accidents: 5.5% chance of a $100k+ claim

Example 1: Bold Usage Extrapolations

- Things that can go wrong?
  - Extrapolation region is not statistically estimable
  - The business manager is too far removed from the statistical procedure
  - Modeling judgment, like all judgment, is subject to error

Probability of an at-fault BI/PD claim occurrence of $100,000 or more

Model prediction for a 16 year old driver with 5 prior accidents: 5.5% 9% chance of a $100k+ claim

Example 1: Bold Usage Extrapolations

▶ **Best Practices**

- ◦ Recognize samples almost always have "blind-spots" related to past treatment

- ◦ Formally compare the sample to the future population to be scored

- ◦ Have an "extrapolation choices considered and made" section in model documentation

- ◦ Run tests or find more appropriate data to model

- ◦ Usage conservatism, assumption stress-testing

Example 2: Target Definition Inconsistency with Business Use

▸ Carrier built a loss ratio prediction model
  ◦ Model dependent variable: Loss ratio of policy in its prospective term
  ◦ Underwriters were shown the prediction of 60%

Things that can go wrong

For What Usage?
- Schedule Rating price adjustment
- Compare "target" loss ratio of 65%

What definition of loss ratio?
- Losses at ultimate?
- Capped?
- LAE included?
- Premium definition?

▸ Best Practices
  ◦ Modeler and end-user solve together
  ◦ Write requirements in plain English, with examples
  ◦ Demonstrate the math
  ◦ Explicitly document "potential common mistakes"
  ◦ Peer review

Example 3: Inadvertent scoring variable definition change in production

▶ A predictor variable in an underwriting model was a policy's "past 3 year loss ratio"

- ◦ Original production coding format: XXX.X
  - • 72.3% was coded as 72.3

- ◦ **Potential Error?**
  - • Reformatted during a later production release: X.XXX
    - • 72.3% was coded as 0.723, without altering the model equation
    - • Essentially, all policies treated as having no prior losses

▶ Remedy
- ◦ Automated operational monitoring and notification
  - • Metrics such as population the PSI (population stability index), which can be coded to detect unexpected variable distribution shifts
  - • Pay close attention to distributions of nulls and zeroes and highly repeated values

Predictive Modeling Application

Loss Ratio Relativity

A WC Risk Selection and Pricing Model

▸ Current State

  ◦ Policy price = Manual Rate for the Class X Experience Mod X Schedule Mod

    • (plus adjustments such as prem discount, etc)

  ◦ Model Output: Predicted Discretionary Price

    • Underwriter's assessment of the policy's (future) risk

    • Market pricing considerations

    • +/- 25% (some states +/-40%)

Discretionary Pricing is a Mental Model

▶ Each underwriter has a "mental" predictive model
  ◦ How explicit and specific are the mental predictions?

▶ How well do discretionary price selections correlate with the future loss ratio performance of policies?

Empirical Indications: Case Study 1
Rule/judgment-based price selection versus model

▸ For this carrier, historical discretionary price selections have a moderate degree of correlation with the future loss performance of the policies
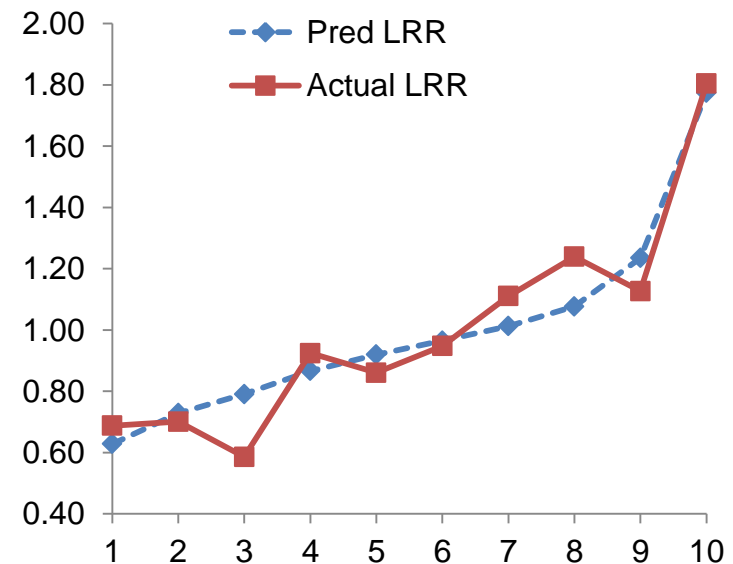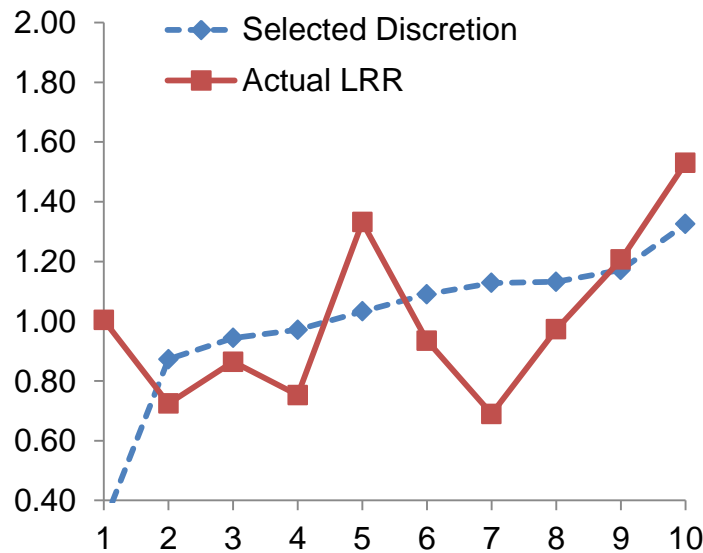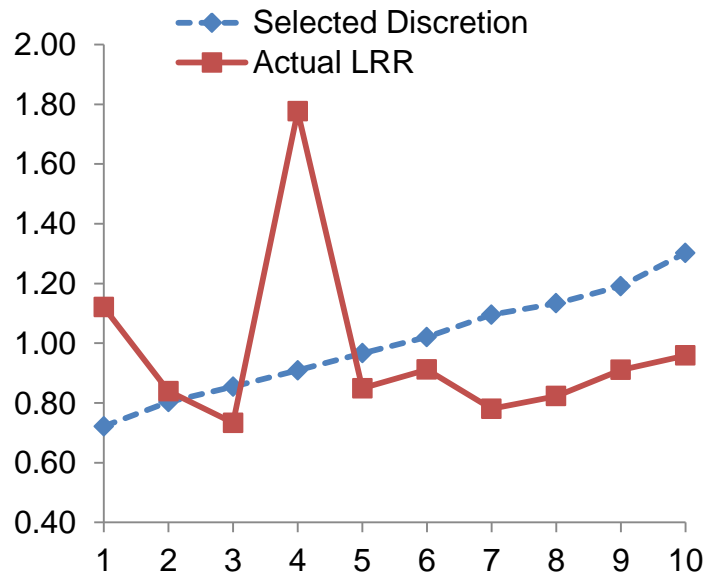

▸ "Discretion" is defined as rule/judgment based assignment to company plus judgmental selection of schedule mod
▸ Loss ratio premium is pure premium after application of experience mod
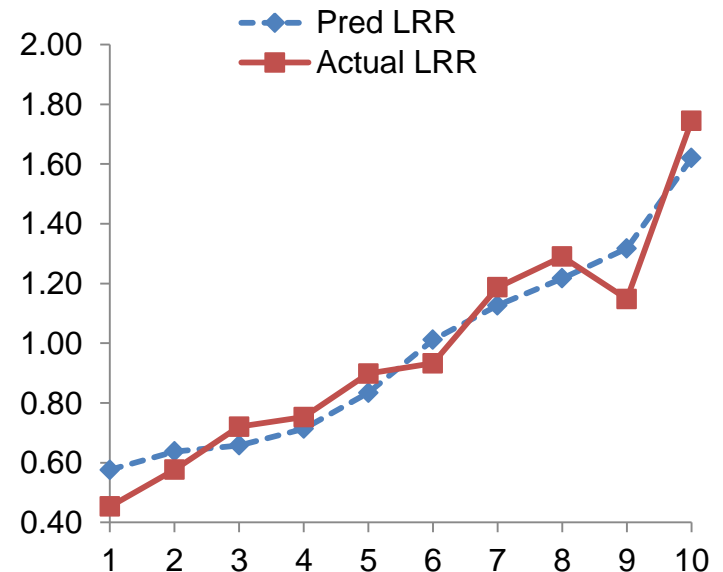
Empirical Indications: Case Study 2
Rule/judgment-based price selection versus model

▸ For this carrier, historical discretionary price selections have no correlation with the future loss performance of the policies

Rule/Judgment-based Price Selections
Loss Ratio Relativity

Model-based Price Indications
Loss Ratio Relativity

▸ "Discretion" is defined as rule/judgment based assignment to company plus judgmental selection of schedule mod

▸ Loss ratio premium is pure premium after application of experience mod

Predictive Models Add Value to Judgmental Underwriting and Pricing Decisions

▸ Underwriters empowered with better information

▸ More accurate risk selection and pricing decisions

▸ Consistent decisions

▸ Increased profitability, lower loss ratio

Objective, Measurable Improvement Through Model Implementation → **Better Reinsurance Placements**
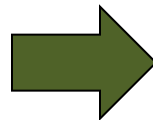
Emerging Application of Predictive Modeling for Reinsurance

Homeowners Profitability is Challenging

All Carriers Combined Ratios
A.M. Best and Insurance Information Institute

■ Homeowers   ■ All Lines

Combined Ratio
HO All Years: 113.2%
All Lines All Years: 102.3%

- 2008: 116.8% / 101.0%
- 2009: 105.7% / (0.0%)
- 2010: 106.7% / 100.8%
- 2011: 123.7% / 108.2%
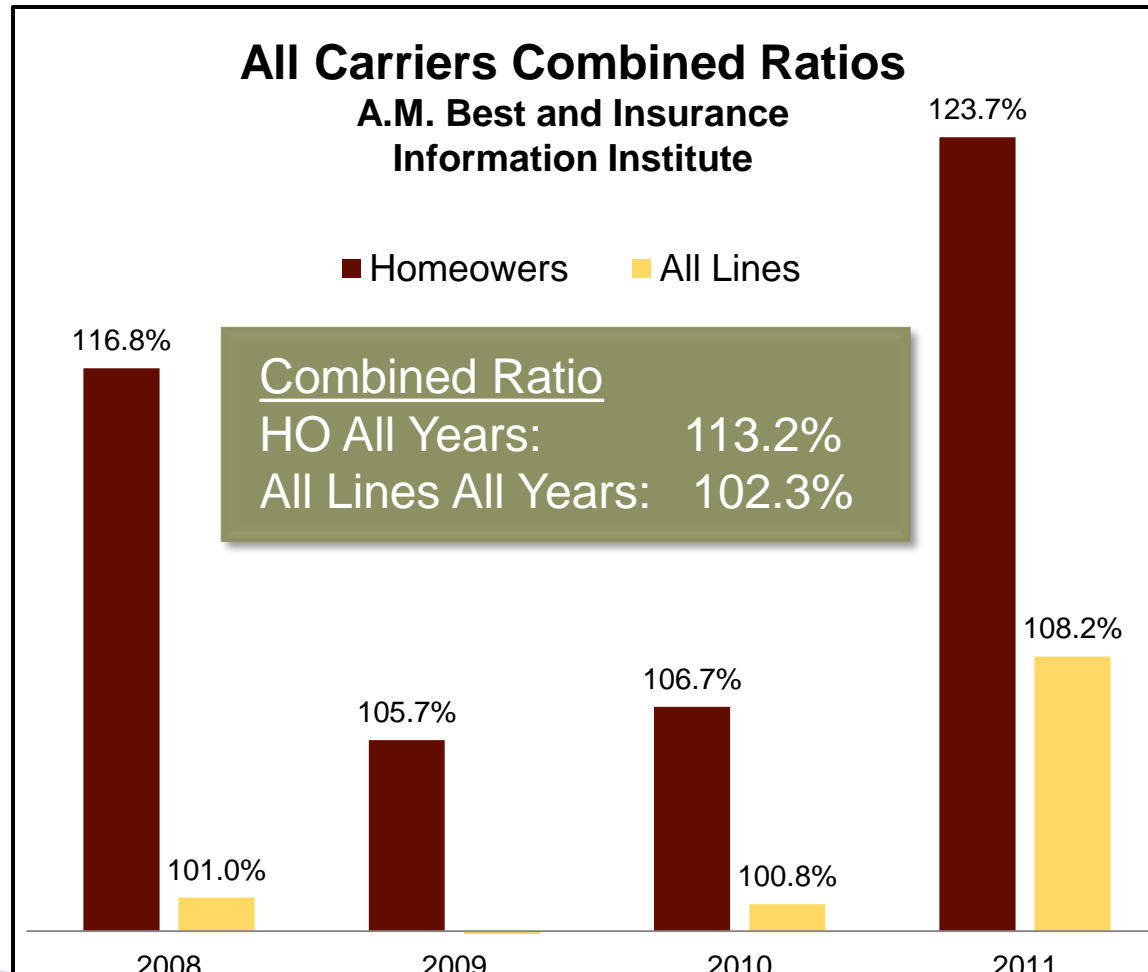
Ways to Improve Profitability

- Cat risk management, reinsurance

- Rating

- Forms/coverages

- Claims management

- Service/retention

- Underwriting activities
  - Loss avoidance
  - ITV deficiencies

Know what you insure
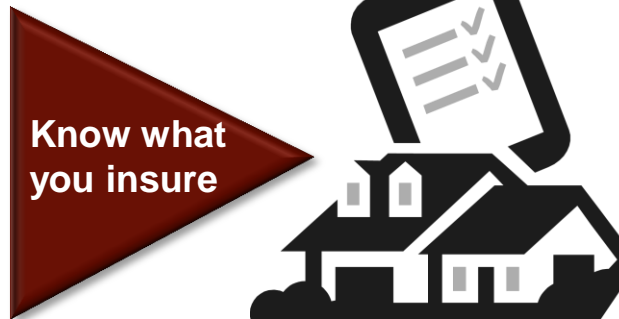
Inspection Strategy

▶ Inspection Assignment
  ◦ Which properties?
  ◦ What type of inspection?

▶ Inspection Goals
  ◦ Find properties that merit underwriting action
  ◦ Achieve high return on inspection spends

▶ Current state
  ◦ Traditional business rules determine properties for inspection

Traditional Inspection Assignment Rules Produce Fewer Underwriting Actions Than Desired

▸ Over-inspect new policies
▸ Under-inspect renewals
▸ Sub-optimal inspection types selected

	Submission Information	**Inspection finding: nothing to remedy**
New Policies		

	Original Inspection Findings	**Things change but aren't discovered**
Renewal Policies		

35

Predict Inspection Outcomes

▸ Direct inspections toward properties that merit underwriting action

▸ Modeling Solution
  ◦ Predict inspection outcomes before inspections are ordered:
    • Presence of property conditions or liability hazards
    • Presence of ITV deficiency over a threshold of interest
      • Example: ITV deficient by 10% or more

Proven Model: Top 5 Carrier Case Study

40

**Discovery rate
with underwriting
rules**

68

**Discovery rate
with Valen model**
70% increase

6

6 : 1 ROI

PropertyRight: Predictive Modeling for Homeowners Underwriting

Predict Inspection Outcomes
Presence of conditions or liability hazards
Presence of ITV deficiency

Increase Actionable Inspections

Increase Underwriting Effectiveness
Loss avoidance / mitigation
ITV increases

Profitability Improvement
Lower Losses
Increased Premium
Improved Inspection ROI
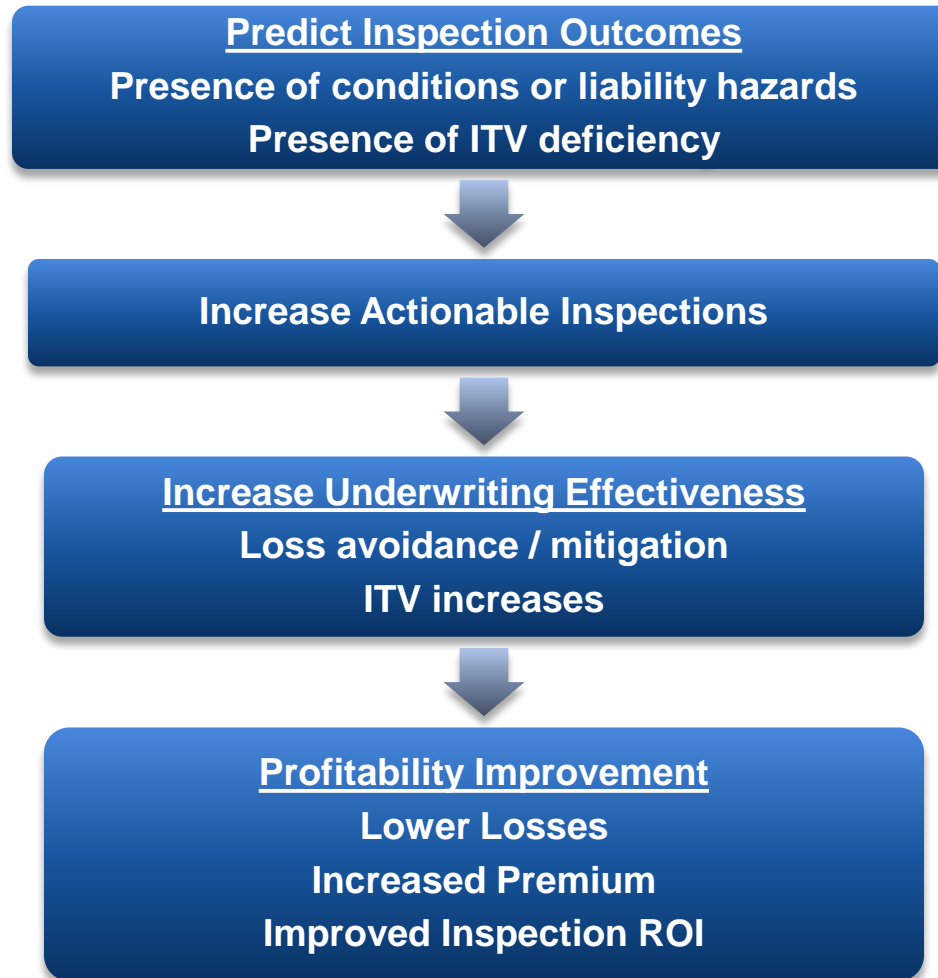
ITV deficiency predictions are useful for benchmark comparisons

		Carrier A		Carrier B		Carrier C
(1)	Mean Cov A (Deck Page)	$	295,205	$	433,155	$	203,657
(2)	Policies		1,000		1,000		1,000
(3)	Total $ Cov A	$	295,205,394	$	433,155,309	$	203,657,138
(4)	$ Underinsurance	$	(56,790,656)	$	(103,413,458)	$	(33,113,302)
(5)	% of Total Cov A $ Underinsurance		-19.2%		-23.9%		-16.3%
(6)	% policies 10% or more underinsured		60%		81%		61%
(7)	% policies 30% or more underinsured		36%		36%		17%

Insured to Value (ITV) Distribution by Carrier
Example: 12% of Carrier B's policies have ITV's from 72% to 75%

Thank You
Q&A