Actuarial

Data Analytics / Predictive Modeling

March 23, 2015

Matthew Morton, LTCG
Dan McCoach, Pricewaterhouse Coopers
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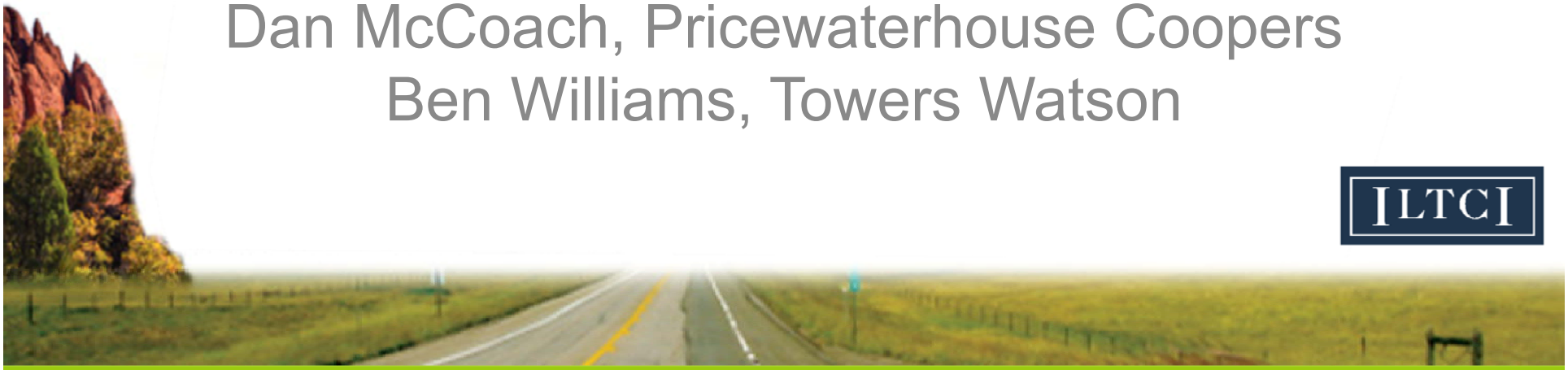

ILTCI

15th Annual Intercompany Long Term Care Insurance Conference

Agenda

- Introductions
- LTC Dashboard: Data Analytics
- Predictive Modeling

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Data Analytics

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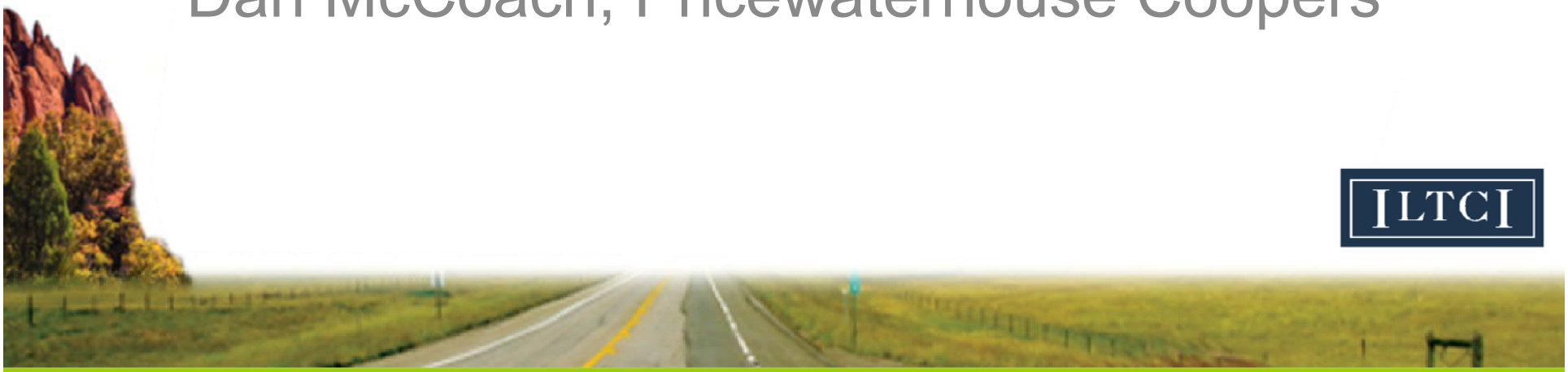

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Data Analytics

- Who is watching
- What to measure
- How frequently
- When to act on changes
- How PM can help identify outliers
- How PM can measure deviations
- Metrics that can be measured.

Who is watching?

- Senior Management
- Stakeholders
- Investors
- Regulators

What should be measured?

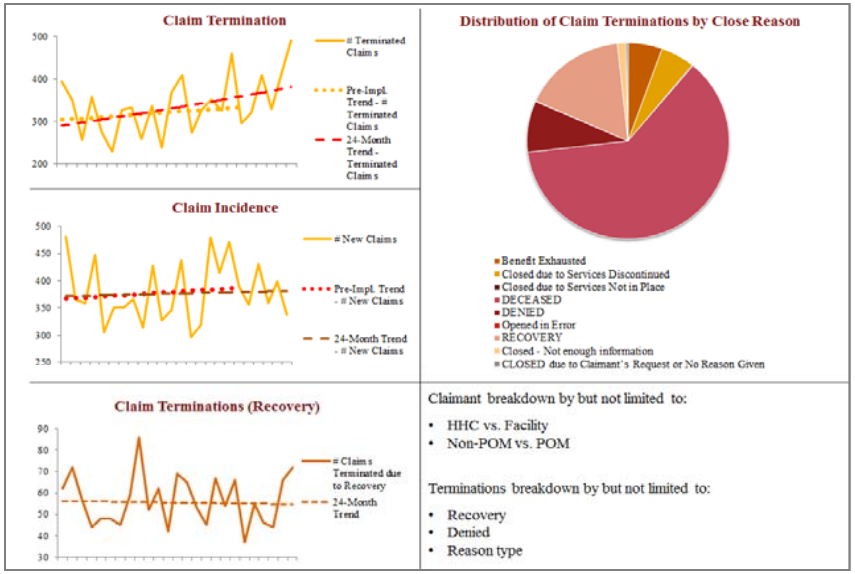
- Broadly speaking LTC carriers should monitor:

1. Operational performance in the following areas:
   - Administration
   - Claims, specifically:
     - Risk profiling
     - Morbidity monitoring

2. Financial performance:
   - The drivers of corporate reporting, such as Source of Earnings (SoE)
   - Rate activity
   - Reserve analysis
   - Expenses
   - Underwriting and sales
   - Investment performance

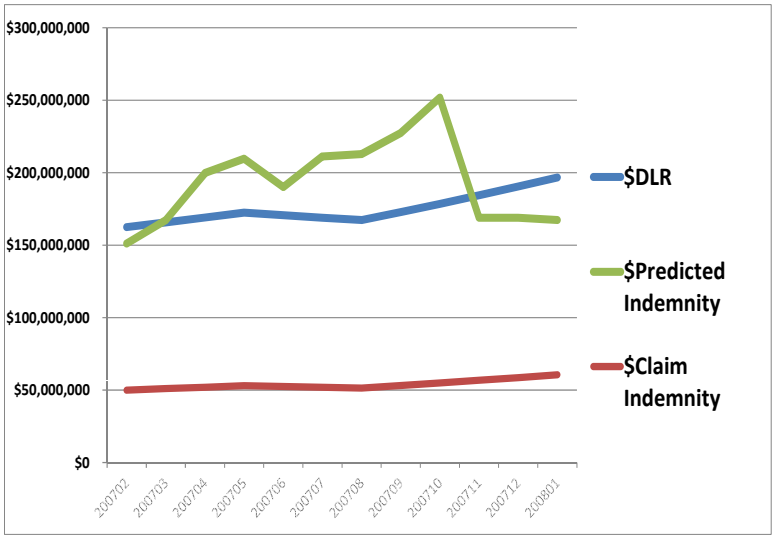
What should be measured – Operational

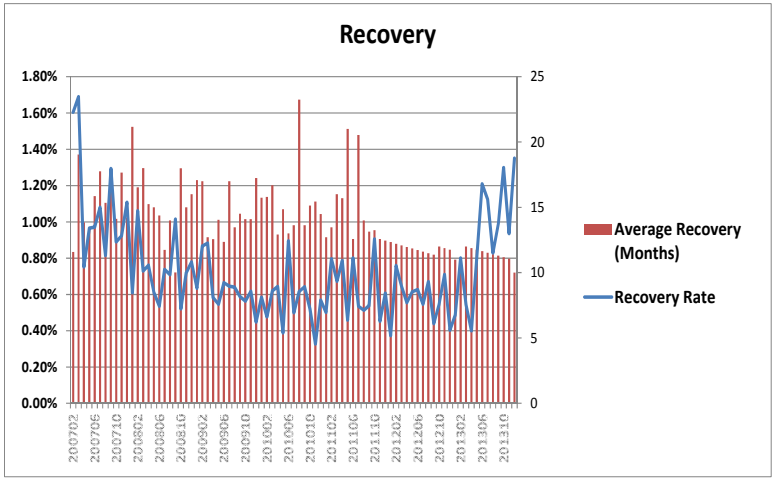
- Carriers should build capabilities to address several questions:
  - How is actual vs. expected vs. predicted developing and are the variations short or long term trends?
    - Are they aberrations or something to worry about?
  - Of the components of morbidity that are changing, what can be controlled?
    - And are our operational claims procedures structured to efficiently and effectively deal with those differences?
    - Can we supply evidence of the efficacy of those controls?



What should be measured – Operational

- Carriers should build capabilities to address several questions:
  - How is predicted indemnity tracking to booked DLR and Indicated Claim Indemnity?
  - Are claim terminations higher or lower than expected? What types of terminations are occurring?
  - How are paid claims performing compared to expected for the period? And what is the reason for variance?
    - Utilization, lower claim terminations, increased incidence, or a combination of these reasons?
  - Did the claim results vary by product feature? For example, claims with an inflation benefit or "non pot of money"*

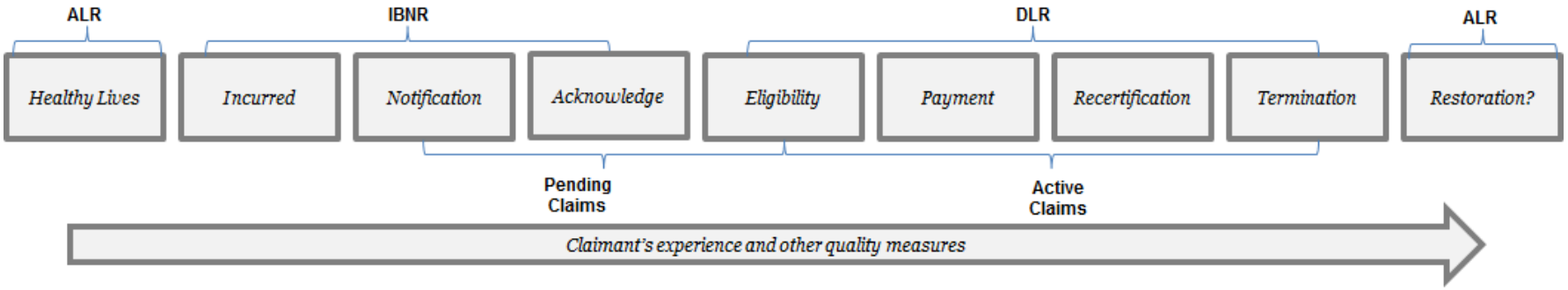




* Pot of Money benefit feature encourages conservation of benefit over time

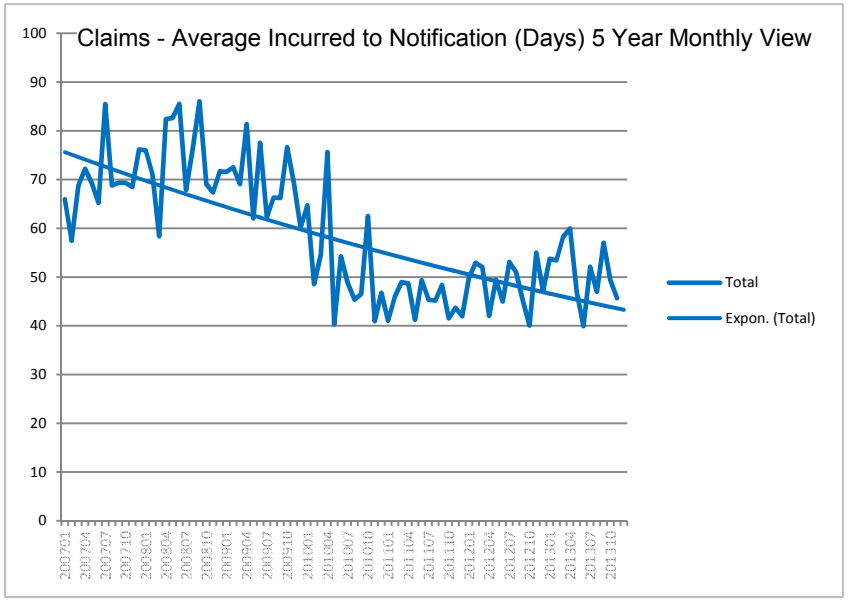
What should be measured – Operational

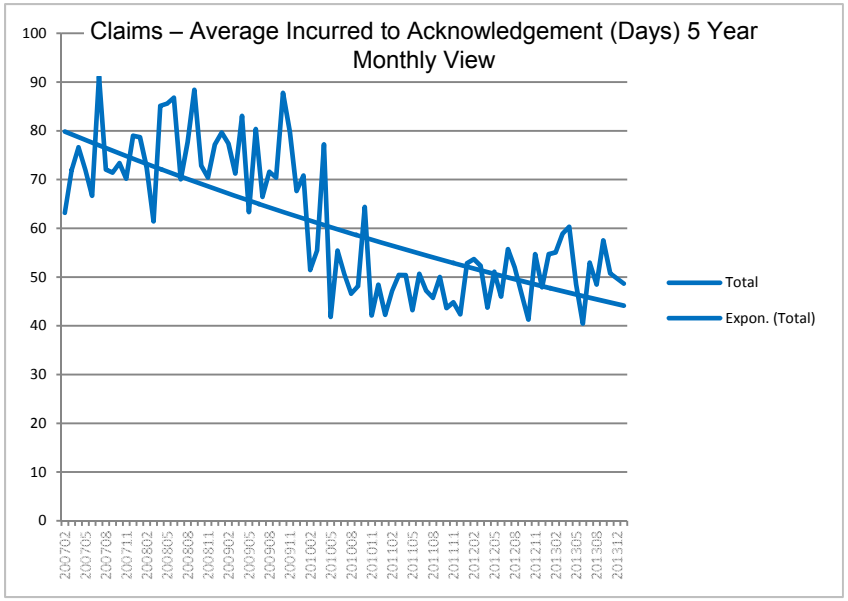
- What has the largest impacts on “LAE”, Quality, Customer Service, etc.?
  - Resources
  - Controls
  - Process efficiency (timeliness, accuracy)
  - Quality
  - Service

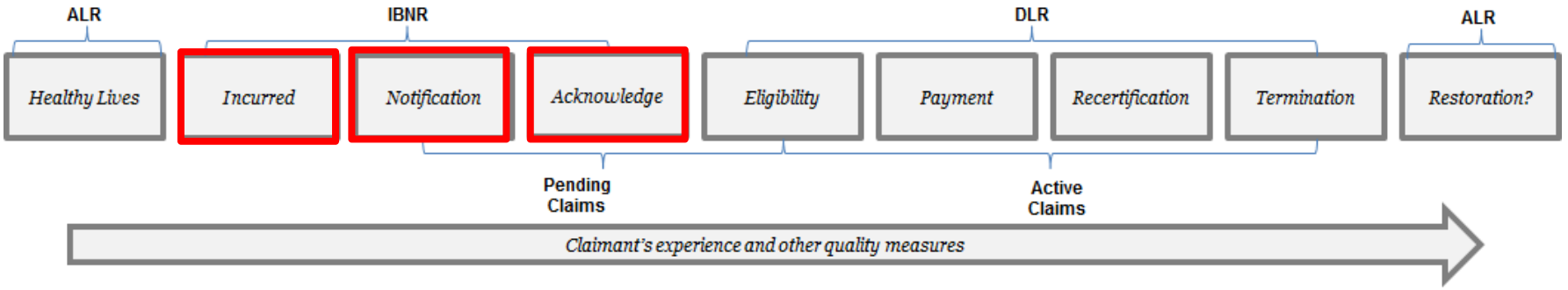


Explicitly define the process, the dates and linkages to reserving.
Then express the formulas defining the periods…

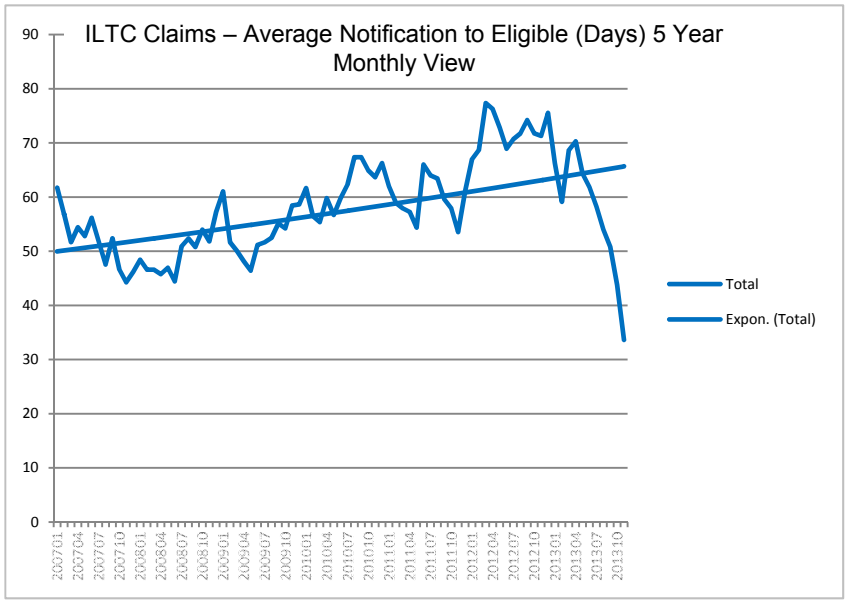
What should be measured – "External Lag"

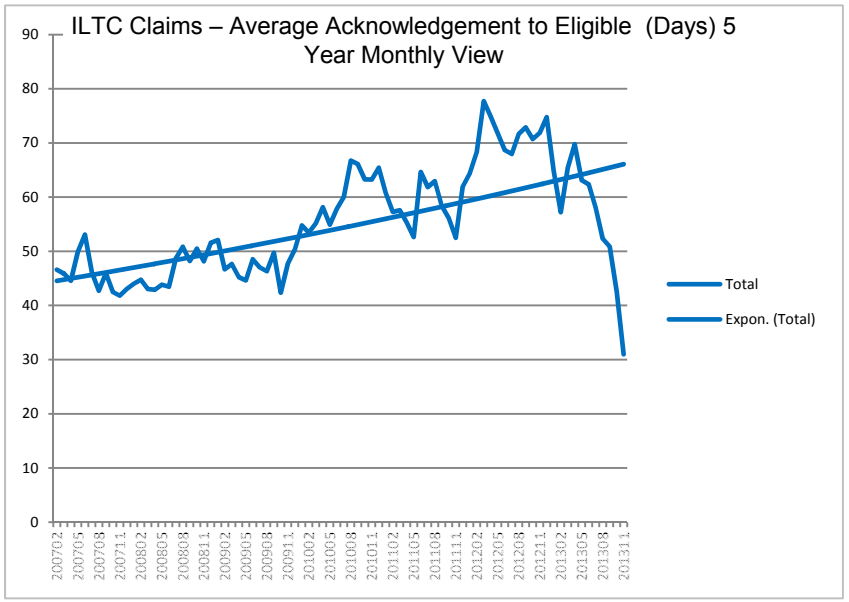


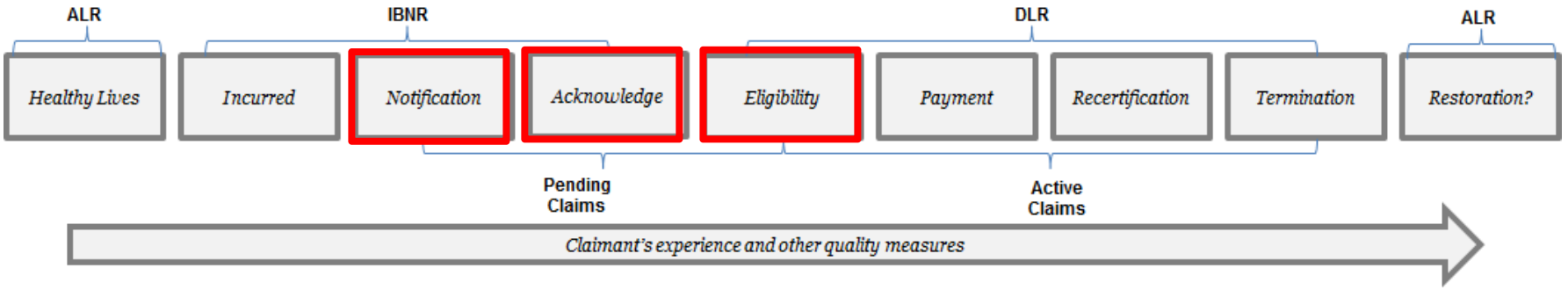




What should be measured – Process Completion Times







Summary

This is easy…right?

- Start with a consistent definition of measured terms combining both operational and financial measures
- Try to establish a "joint" working committee with finance, actuarial and operations representatives – define a governance process
- Remediate operational systems to capture the elements required
- Develop a single repository with views that join and integrate actuarial/financial and operational requirements

The dimensions provide context for the primary events

Product features:
- *Benefit Trigger Options*
- *Underwriting Type/Status*
- *Issue Age / Attained Age*
- *Gender*
- …

- *Pending*
- *ICOS*
- *Utilization and Salvage*
- *Transitions*

	"Active" (lives) Events	"Disabled" (lives) Events
Operational View	Movement Analysis: + New Entrants + Recoveries - Incidence (new claims) - Lapses - Death	Policies On Claim Counts / Rates + New Claims - Death - Recovery - Benefit Exhaust
Financial View		

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Predictive Modeling

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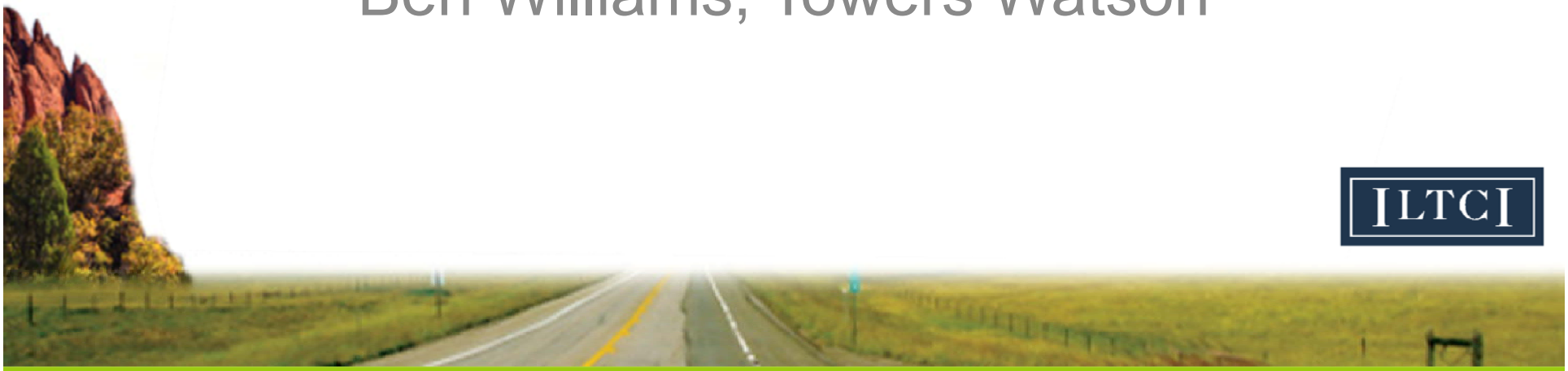

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Predictive Modeling: Agenda

- What is Predictive Modeling?
- What are advantages over Traditional Analysis?
- What are GLMs?
- Why are GLMs used in Insurance?
- Case Study: Incidence
- Limitations of Predictive Modeling
- Conclusions

What is Predictive Modeling?

- **Predictive Modeling** describes a statistical process that estimates the impact that a given set of independent variables (predictors) have in determining a specified dependent variable (response or target)
- **Predictors** could be attained age, gender, marital status, benefit period, underwriting class, duration, distribution channel, etc. Investors
- **Response/Target** could be claims incidence, probability that a claim is of a given type, probability of staying on claim

Classical/Traditional Analysis

- Is generally understood by actuaries and others
- Gives useful information
- Is good for pattern recognition
- Is quick and easy
- Useful for benchmarking experience

Limitations

But Classical/Traditional Analysis has weaknesses that can lead to inaccurate conclusions:

- Inability to remove random noise from the estimate
- No correction for distributional bias (doesn't determine true effect of each factor)
- Requires significant volumes of data to create reasonable results with any level of sophistication
- Limited insight into interactions between variables
- No statistical framework that provides information about the certainty of results or the appropriateness of the analysis (i.e. which factors drive experience)

Predictive Modeling overcomes these limitations

What are GLMs?

Generalized Linear Models (GLMs) are a flexible and sophisticated predictive modeling technique

Response = Signal + Noise

y = h(Combination of Predictors) + Error

Link function ($g=h^{-1}$) determines how factors are related

- Include variables that are predictive; exclude those that are not
- Simplify if full inclusion is not necessary
- Include combinations of predictors if necessary

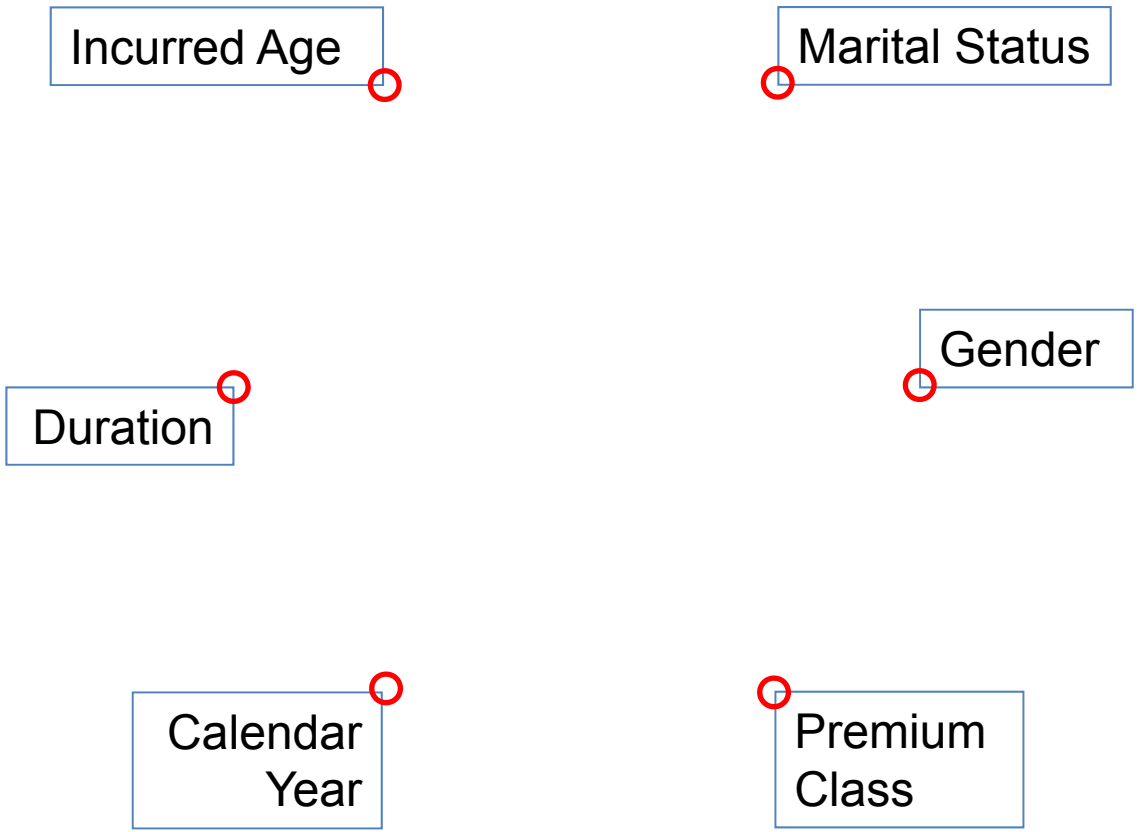
Reflects the variability of the underlying process and can be any distribution within a broad family (exponential distributions)

Why are GLMs used in Insurance?

- Their form makes them a natural choice for studying processes common in insurance
- They allow the blending of statistics and specialist knowledge in a transparent way
- GLMs have had widespread use in the P&C industry and are now being more widely adopted in Life, Annuity and LTC industries

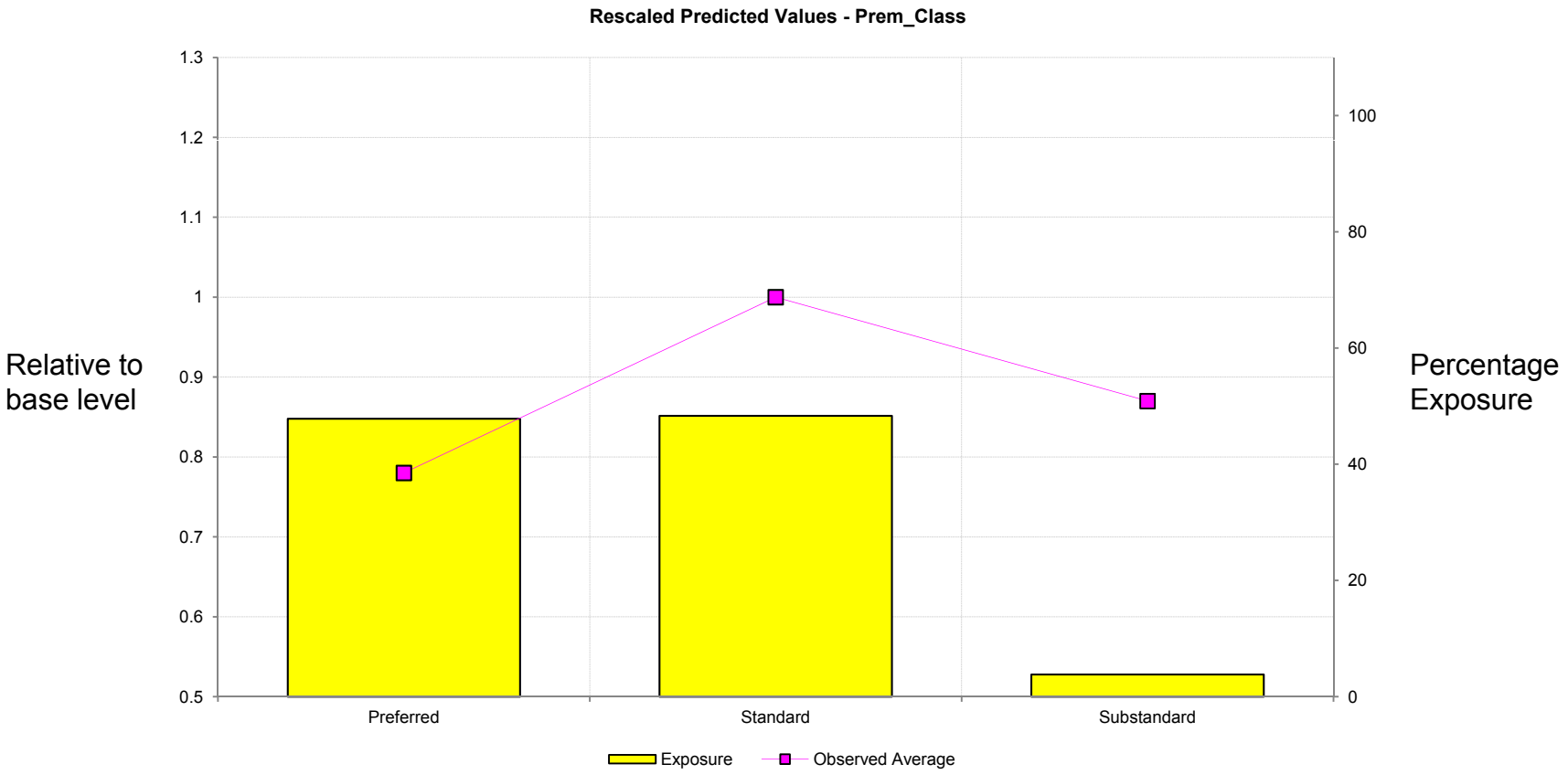
Case Study: Incidence

- We fitted a simple model to Industry incidence data



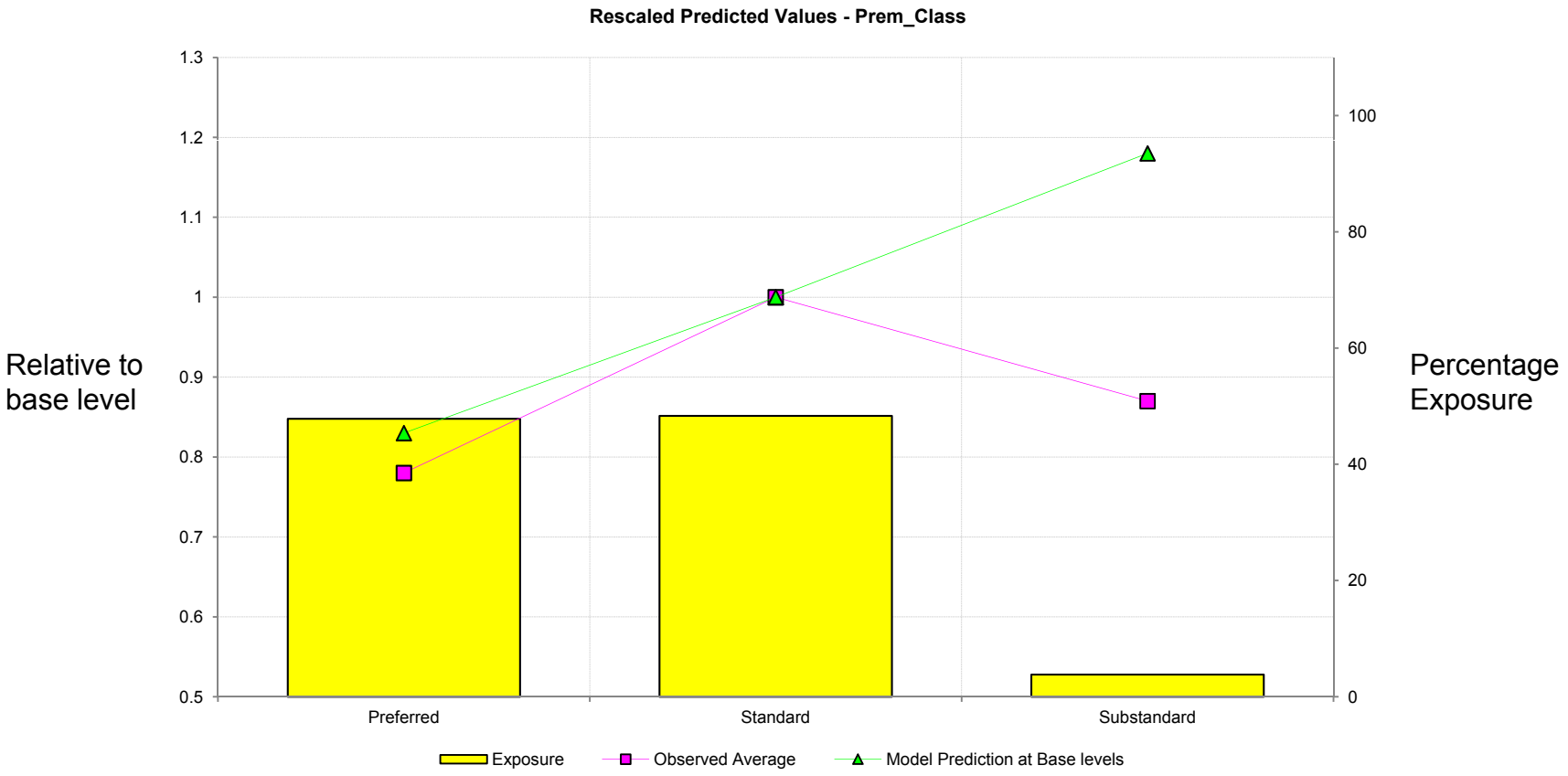
Case Study: Incidence

- Observed results (Substandard has lower incidence than Standard) are unintuitive



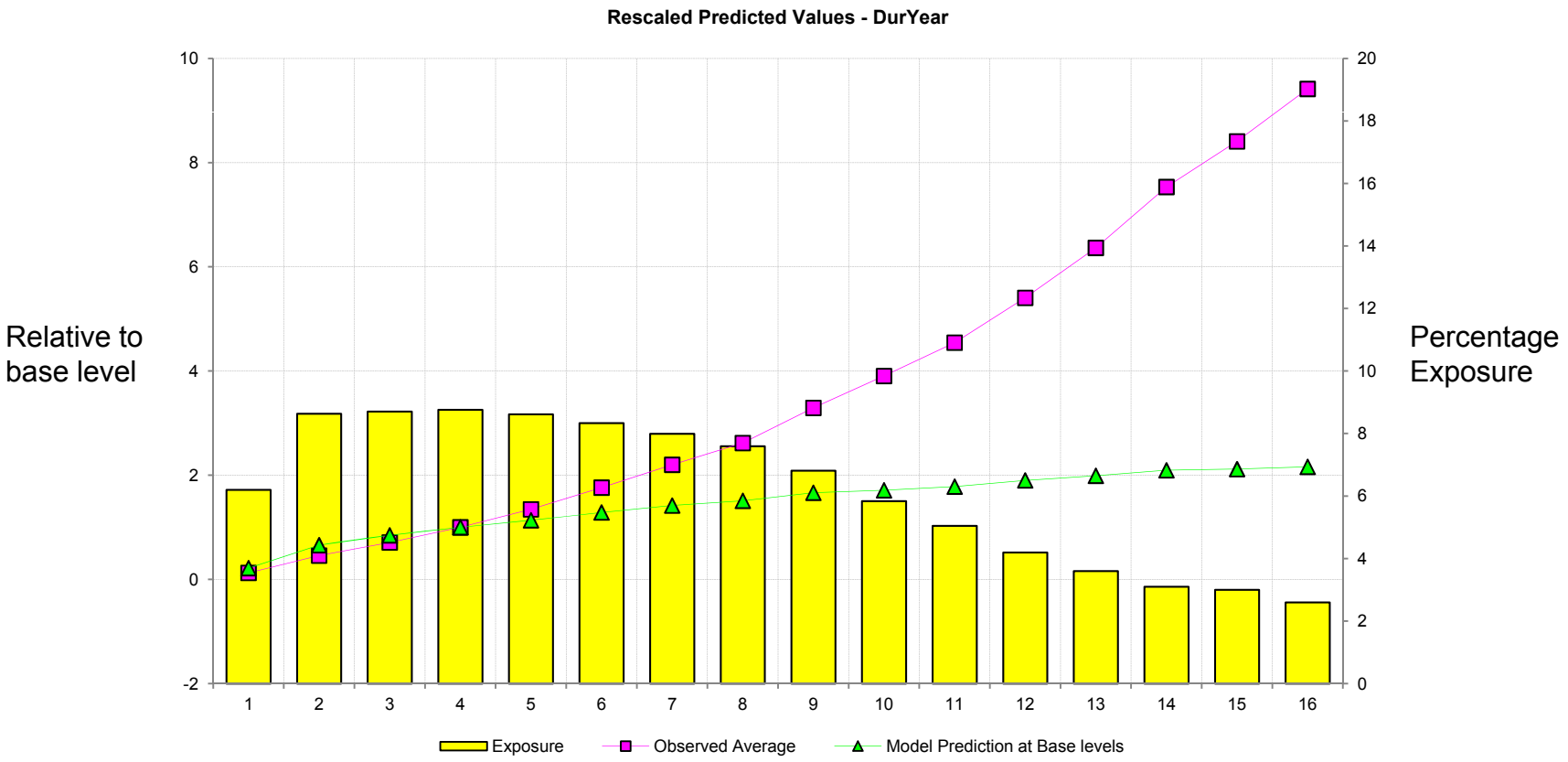
Case Study: Incidence

- Standardizing by other factors in the model leads to a more intuitive result



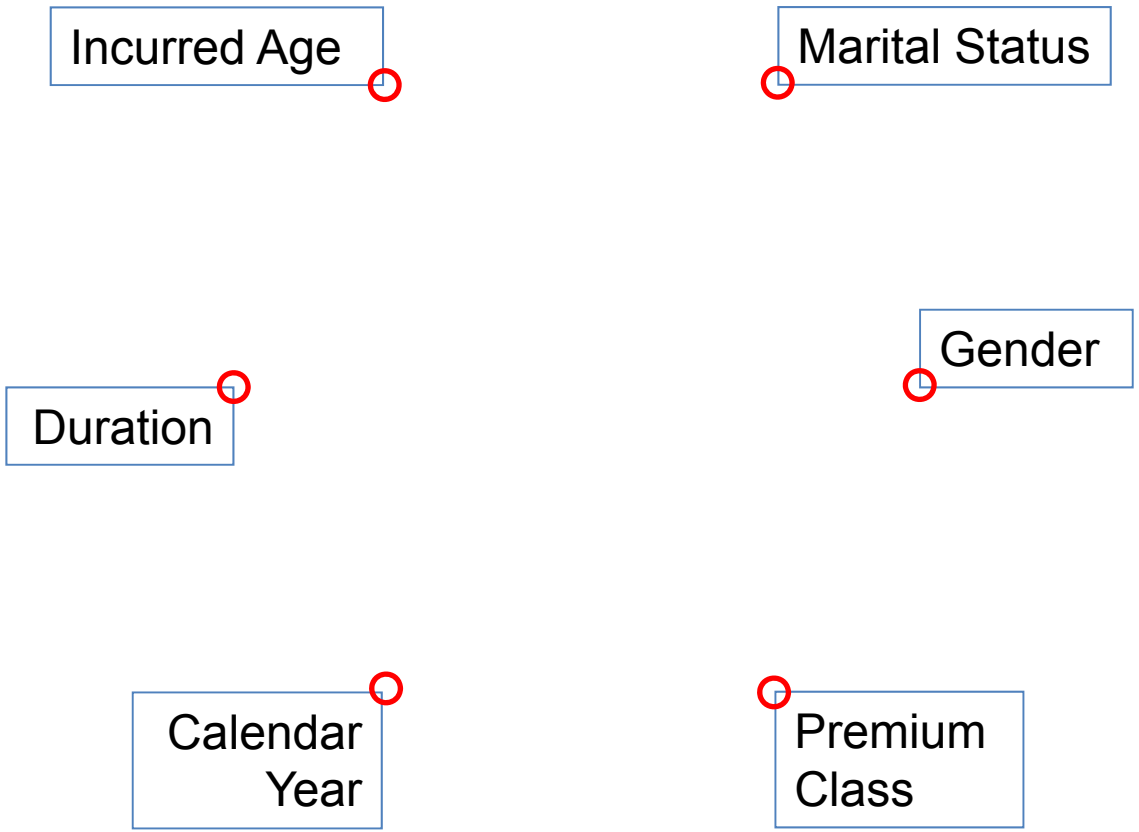
Case Study: Incidence

- Standardizing by other factors in the model shows that effect of duration is not as strong as indicated by observed results



Case Study: Incidence

- We also investigated some simple interactions



Case Study: Incidence

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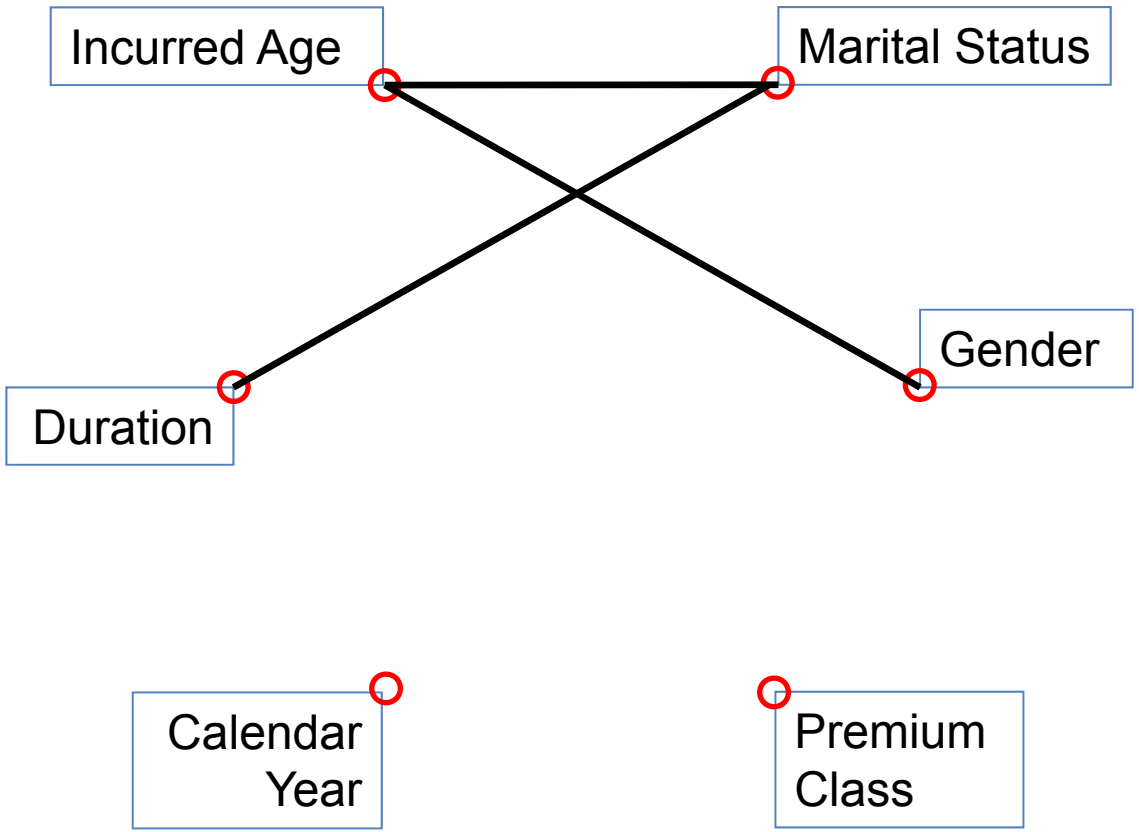
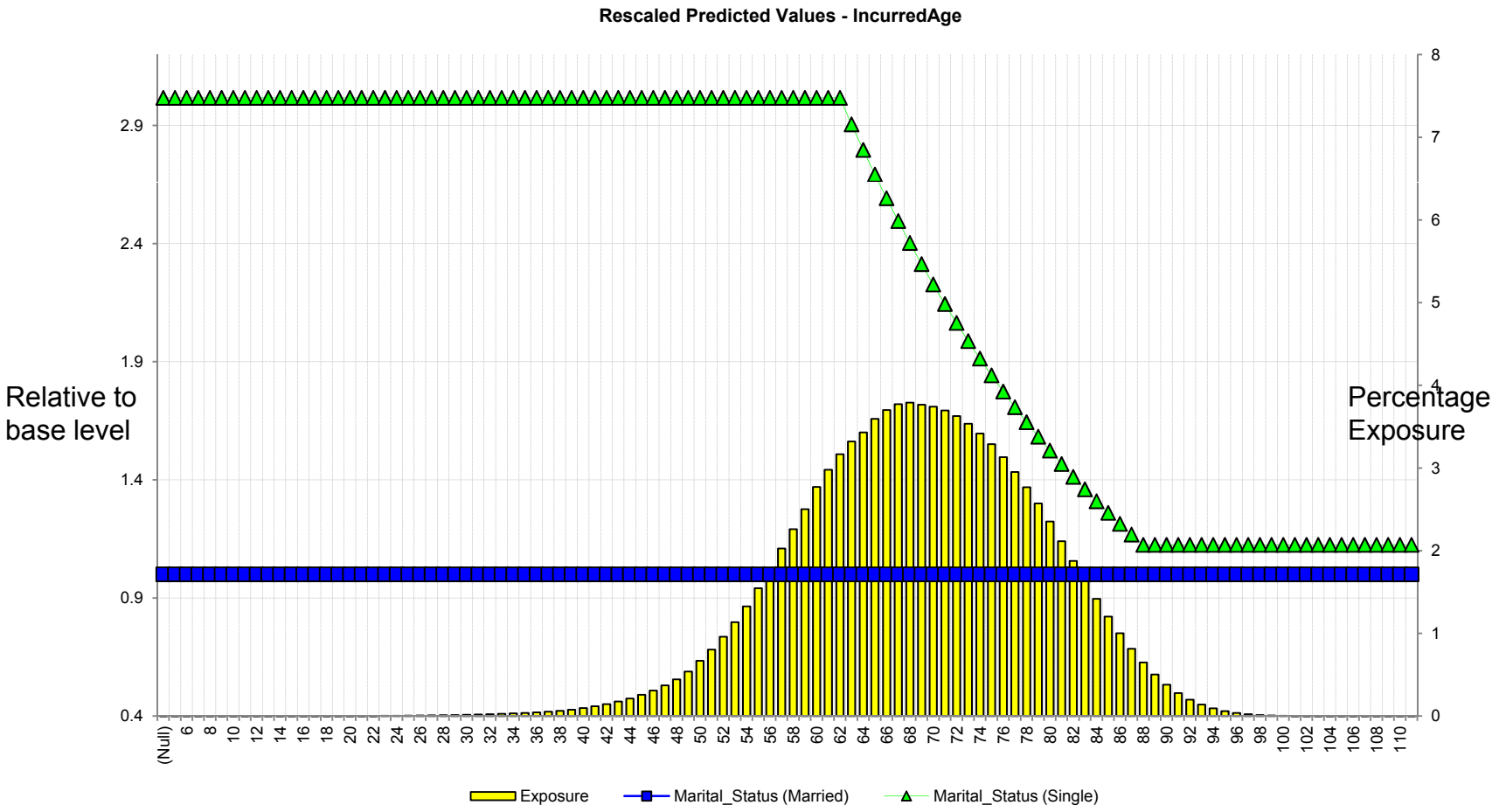


Case Study: Incidence

- Interaction between Incurred Age and Marital Status



Why are GLMs used in Insurance?

- Basic output is of tables and vectors
- These are multiplied together to give expected incidence for a given profile

Base		0.0018								
Gender * IncurredAge				**DurYear**		**Marital_Status**			**Prem_Class**	
		Gender		**DurYear**		**Marital_Status**			**Prem_Class**	
		Female	Male			Married	1.0000		Preferred	0.7800
IncurredAge	35-	0.2306	0.2560	1	0.2391	Single	1.3799		Standard	1.0000
	36	0.0022	0.2740	2	0.7034				Substandard	1.2050
	37	0.4799	0.0047	3	0.8754					
	38	0.4019	0.0040	4	1.0000					
	39	0.3335	0.3261	5	1.0973					
	40	0.0902	0.1340	6	1.1993					
	41	0.2187	0.1097	7	1.2748					
	42	0.1170	0.1801	8	1.3023					
	43	0.2816	0.0029	9	1.3835	Incidence:	=D2*E24*H20*K8*N9			
	44	0.1519	0.3636	10	1.3775					
	45	0.2467	0.2510	11	1.3779					
	46	0.1252	0.1255	12	1.4146					
	47	0.2470	0.0704	13	1.4276					
	48	0.1695	0.1180	14	1.4555					
	49	0.2775	0.2222	15	1.4211					
	50	0.2487	0.1840	16	1.4073					
	51	0.2750	0.1164	17	1.3820					
	52	0.2644	0.2192	18	1.3269					
	53	0.2700	0.1705	19	1.2720					
	54	0.3547	0.1437	20+	1.2688					
	55	0.3385	0.2185							
	56	0.3094	0.2321							
	57	0.3579	0.2915							

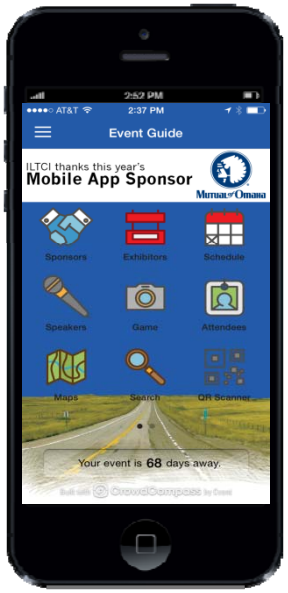
Limitations of Predictive Modeling

- Like Classical/Traditional analysis, Predictive Modeling does not foretell the future
- It looks for patterns in historical data, with the expectation that these patterns will repeat in the future
- Extrapolating those patterns into the future is just as problematic if the patterns come from Predictive Modeling, as if they come from Classical/Traditional Analysis

Conclusions

- Predictive Modeling offers advantages over Traditional Analyses in terms of understanding what factors are driving behavior, and how they drive it
- These advantages are applicable to LTC
- As always, judgment is required if results are to be extrapolated

Don’t forget to fill out the survey



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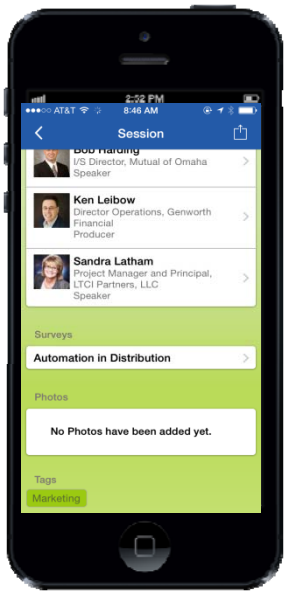
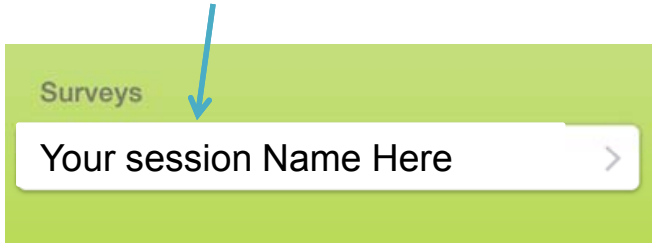
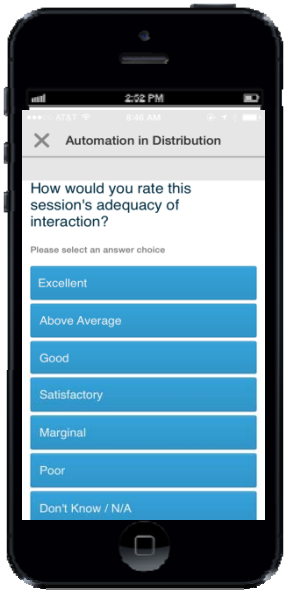
ANDROID APP ON Google play

Available on the App Store

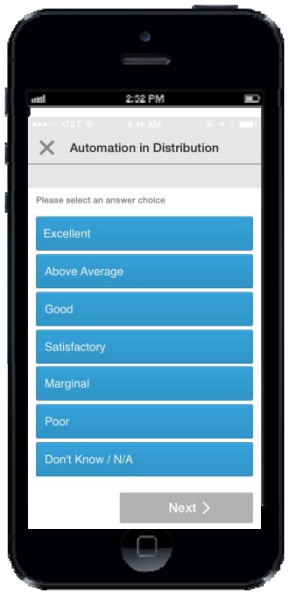
1. **Find the session**
2. **Scroll to the bottom**
3. **Tap on the session name below the survey**







Tap on the answer you wish to submit



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