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**Price Optimization for the U.S. Market:
Techniques and Implementation Strategies**
--Fundamentals and Challenges

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March, 2009

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Price Optimization in the US

What is Price Optimization for P&C?

- ... a process to modify the traditional actuarial cost-based pricing with customer demand data to optimize business metrics (e.g., profit, retention etc).
- ... a premium adjustment for a given rating system. i.e., built on top of an existing rating system.
- ... a tool to achieve business goals by balancing profitability and volume under certain constraints.

Price Optimization uses data to formalize current assumptions about demand

What is Price Optimization in the US?

The US market presents additional challenges for Price Optimization over many international markets.

- Regulatory restrictions may inhibit collection of data for comprehensive elasticity estimation.
- Personal Lines Price Optimization must be implemented through system of rating tables.
- Commercial Lines generally utilize subjective factors (credits/debits) in premium rating.

Price Optimization can be implemented in the US with careful planning

Optimization in Practice

Two major elements of Price Optimization

1

Underwriting Profit

(= Premium – Estimated Loss Cost – Allocated Expense)

- Reflect estimated marginal profitability per risk

2

Price Elasticity

- Incorporate competition and customer demand

Optimized
Prices

Adjusting premium triggers a change in both revenue and expected demand at the risk level.

...and the changes in demand will vary from risk to risk.

Elasticity Modeling in the US

Across the Pond...

- Insurers have more freedom setting rates in less regulated markets (e.g., UK, Spain).
 - Rates can be at the “individual level”, not using filed rating tables.
- Data collection for price sensitivity:
 - Controlled experiments can be conducted, varying prices for identical customers to obtain price sensitivity data (Krikler et. al. 2004).
- Implementation of “optimized” rates is less controversial.

Here in the US...

- Insurers cannot charge individual prices for individual customers.
- Stricter regulatory environment can slow adoption of optimized rate structures.
- Data collection for price elasticity is more difficult.

Price Optimization will be part of the future of ratemaking in the US

Data for Demand Modeling

New Business

- Quote data, agency or direct
- Conversion of quotes to policies
- Duplicate Quotes
- Multiple sets of rates
- Competitive rating

Renewal

- Renewal offers
- Policy renewal tracking
- Non-voluntary renewals
- Customer attributes at renewal
- Multiple rating structures

Logistic Regression

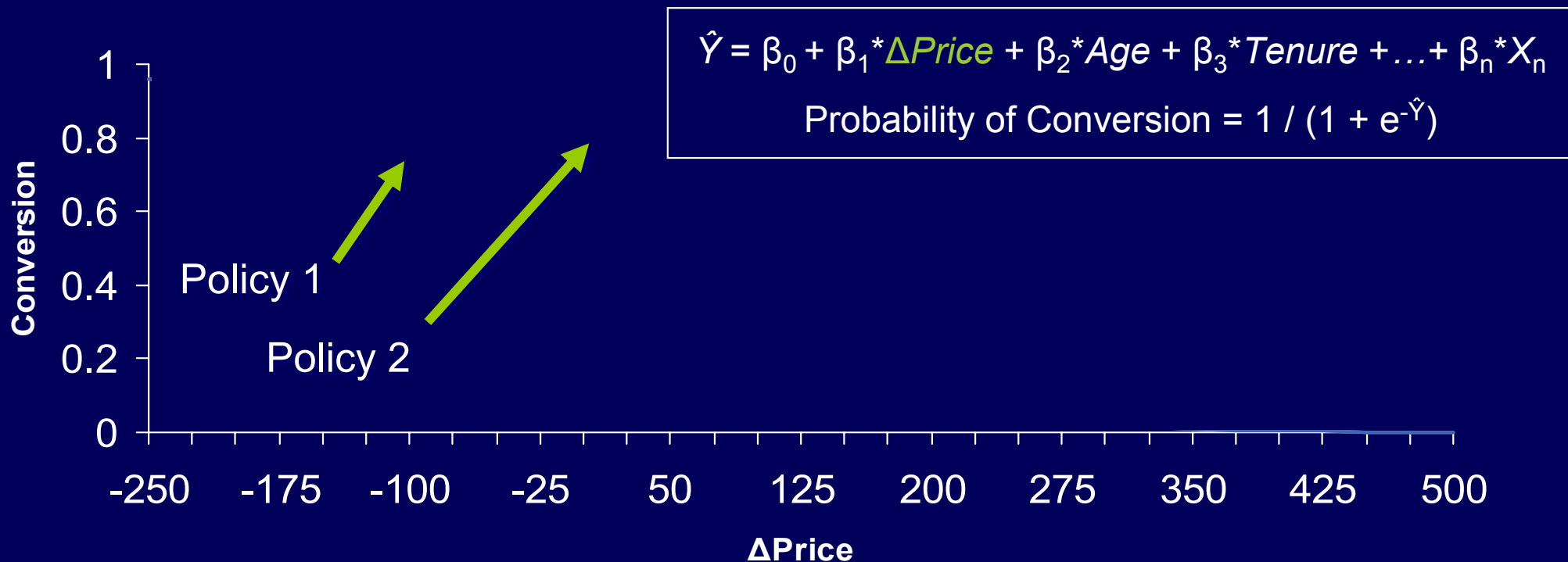
Logistic regression is one method for building a Demand Model

- Model for predicting binary dependent variables
- Generalized Linear Model
- Output is a probability score

$$\hat{Y} = \beta_0 + \beta_1 * \Delta Price + \beta_2 * Age + \beta_3 * Tenure + \dots + \beta_n * X_n$$

$$\text{Probability of Conversion} = 1 / (1 + e^{-\hat{Y}})$$

Individual Demand Curves

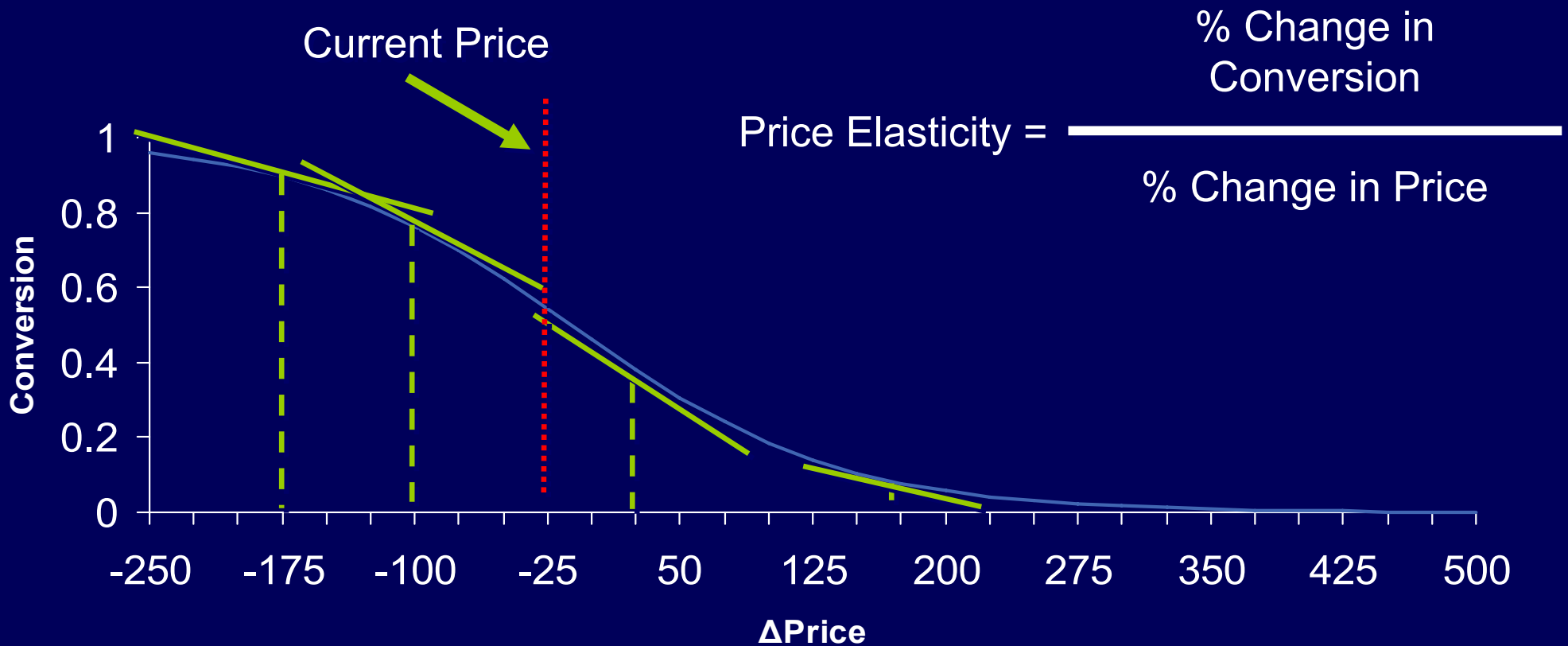


- Demand curves can be derived from the demand models.
- Each policy has an individualized demand curve, determined by the model and the individual policy characteristics.
- As price increases, probability of conversion decreases.

Challenges for Elasticity Modeling

Challenges in the US – Available Data

- Is there enough data to estimate price elasticity for a broad range of possible price scenarios?



Renewal Demand Challenges

Demand modeling is usually not as hard for renewals...

- Did the policy renew? What price was offered?
 - Often, this information is stored in data and ignored
- Detailed policy data is already well understood
 - Actuaries use risk characteristics for predictive modeling today (e.g., Prior losses, coverages, risk characteristics)
- Can changes in exposure be isolated?
 - Sensitivity to price changes for the same risk

Price Changes on Renewal

Data required for demand modeling is commonly discarded for risk modeling exercises

	Expiration	Renewal	Expiring Premium	Renewing Premium
Policy 1	1/15/2008	Yes	\$1,200	\$1,100
Policy 2	2/12/2008	Yes	\$1,000	\$950
Policy 3	3/30/2008	Yes	\$800	\$820
Policy 4	4/26/2008	No	\$1,500	???

...

Changing Exposure

Elasticity modeling is confounded by changes to premium that are related to exposure changes

	Expiring Premium	Renewing Premium	Price Change	Expiring Limit	Renewing Limit
Policy 1	\$1,200	\$1,100	+100	100,000	100,000
Policy 2	\$1,000	\$950	-50	100,000 	75,000
Policy 3	\$800	\$820	+20	50,000	50,000
Policy 4	\$1,500	\$2,000	+500	1M	1M
...					

New Business Demand Challenges

Data issues are a common barrier to demand modeling for New Business in the US

- Which quotes convert to policies and which do not?
 - Identifying information can be hard to find
- Can the quote be accurately reproduced?
 - More of an issue for Commercial Lines, where subjective rating elements come into play
- Can competitive rate information be obtained?
 - What kind of rates are available to this risk in the market?

Quote Databases

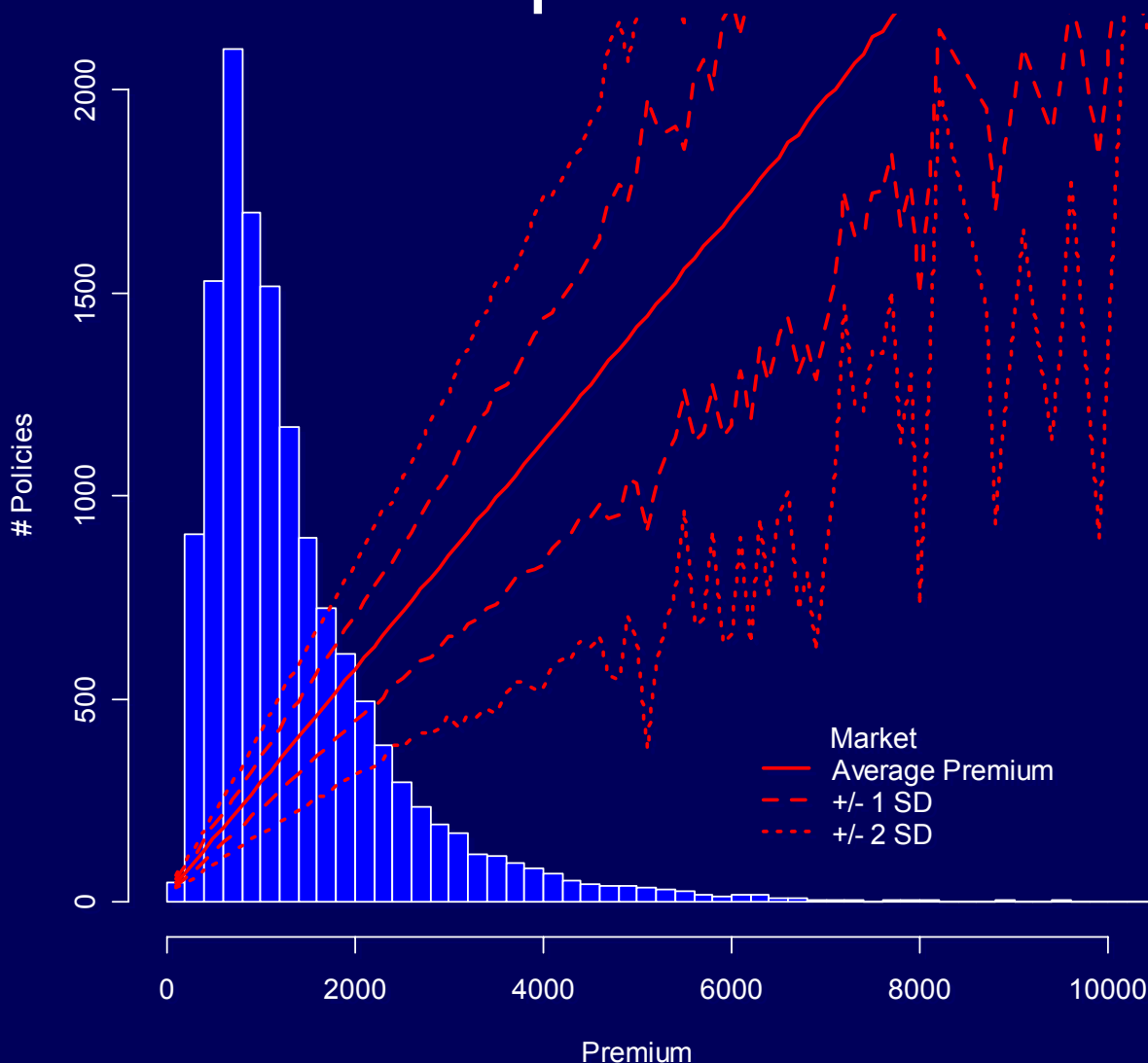
Quote data is often “dirty”, containing duplicate records, missing history or tied to current policies

	Previous Premium	Quoted Premium	Competitor Premium	Converted	Policy Number
Quote 1	??	\$1,800	\$1,900	Yes	A123
Quote 2	??	\$2,500	\$2,000	No	
Quote 3	??	\$1,500	\$1,600	Yes	A124
Quote 4	??	\$1,200	\$2,000	Yes	A125

...

Variation in Market Prices

Often the most difficult data to obtain is risk-level competitive information



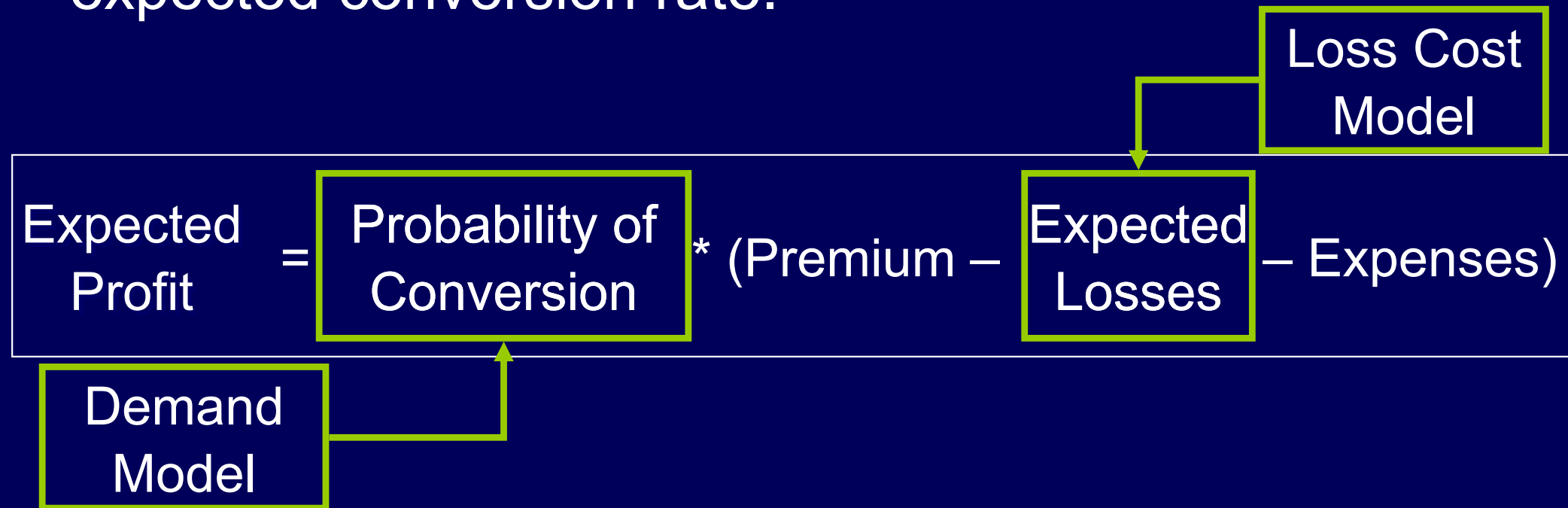
Questions:

- Who are the competitors?
- Can “good” quotes for each competitor be obtained?
- What is the variation in market rates?
- What are the effective dates of the rates?

Optimization

Example of an Objective Function

“Expected profit” – underwriting profit, multiplied by expected conversion rate.



- Premium recalculated using rating factors and “Extension of Exposure” technique.
- Optimize the objective function under business constraints (e.g., overall renewal rate, % change).

Business Drivers during Optimization

Key decision points during optimization

1

Target for optimization:

What business metrics will be maximized?

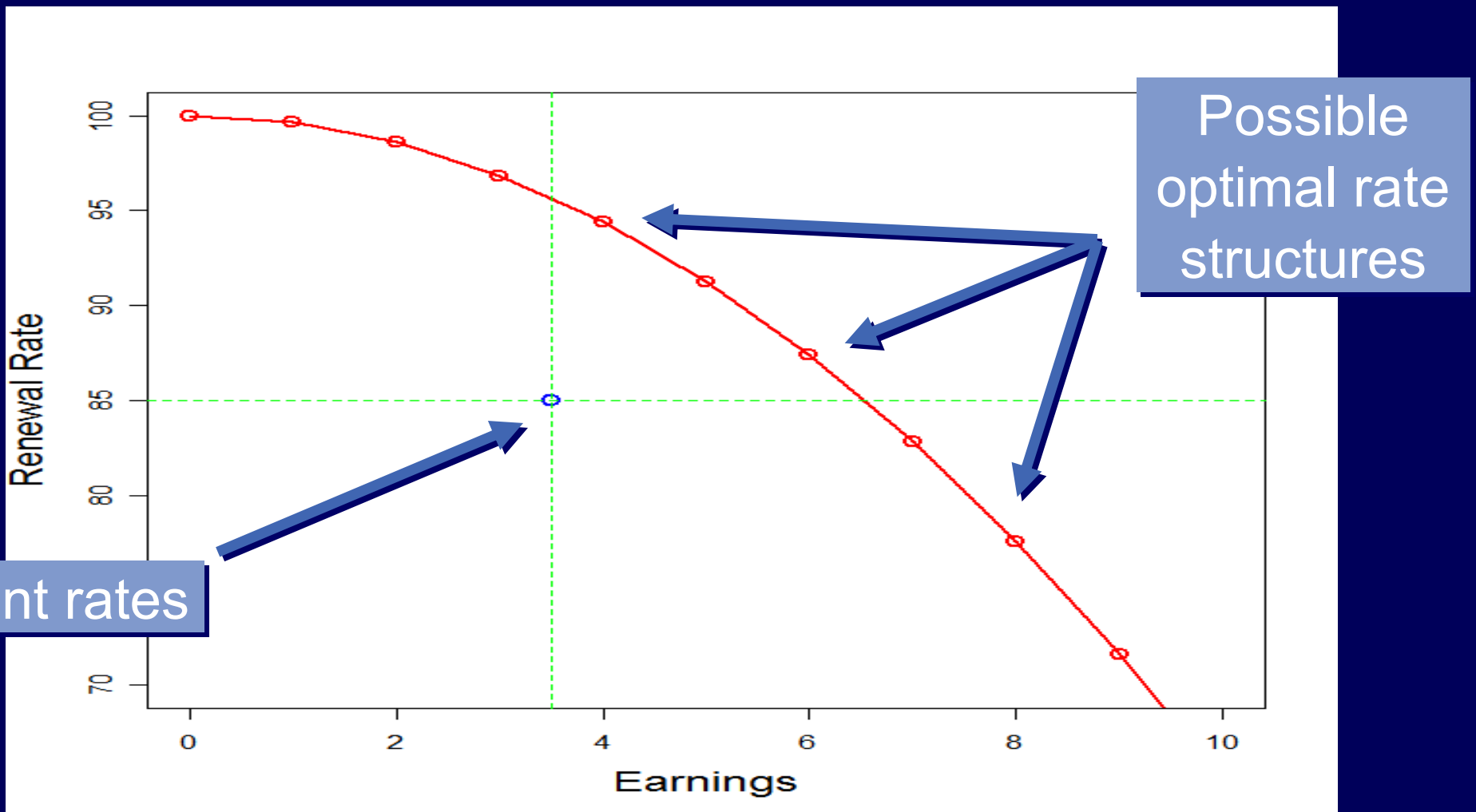
2

Constraints:

- Local (e.g., monotonicity of rating factors, change $< \pm 5\%$ etc)
- Global (e.g., aggregate premium increases by $\$X$, overall conversion rate = $Y\%$ etc)

Efficient Frontier

Where does a carrier's current rate structure stand, relative to optimization recommendations?



Implementing Optimization

Challenges for Implementation

Apart from technical modeling issues, implementation bears additional challenges

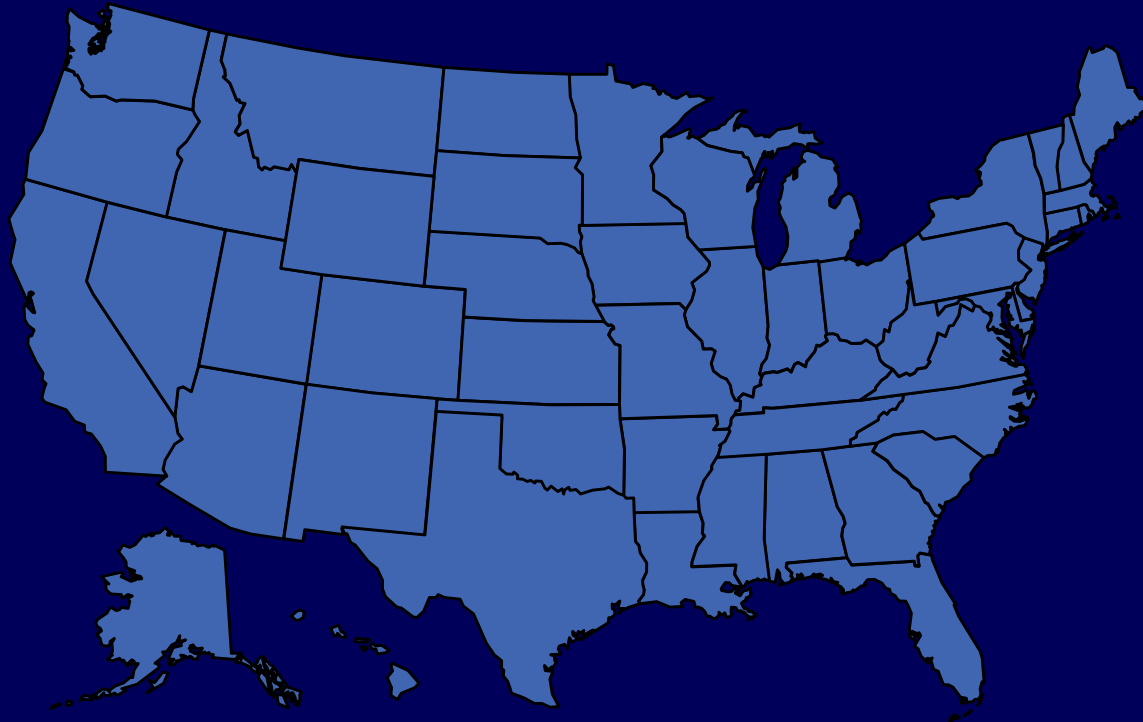
Regulatory Issues

- Regulatory environment
- Premium disruption
- Technical application

Business Process

- How is optimization integrated into the current rate change process?
- What is the business cycle for demand modeling?

Regulatory Constraints



Environments

More strict

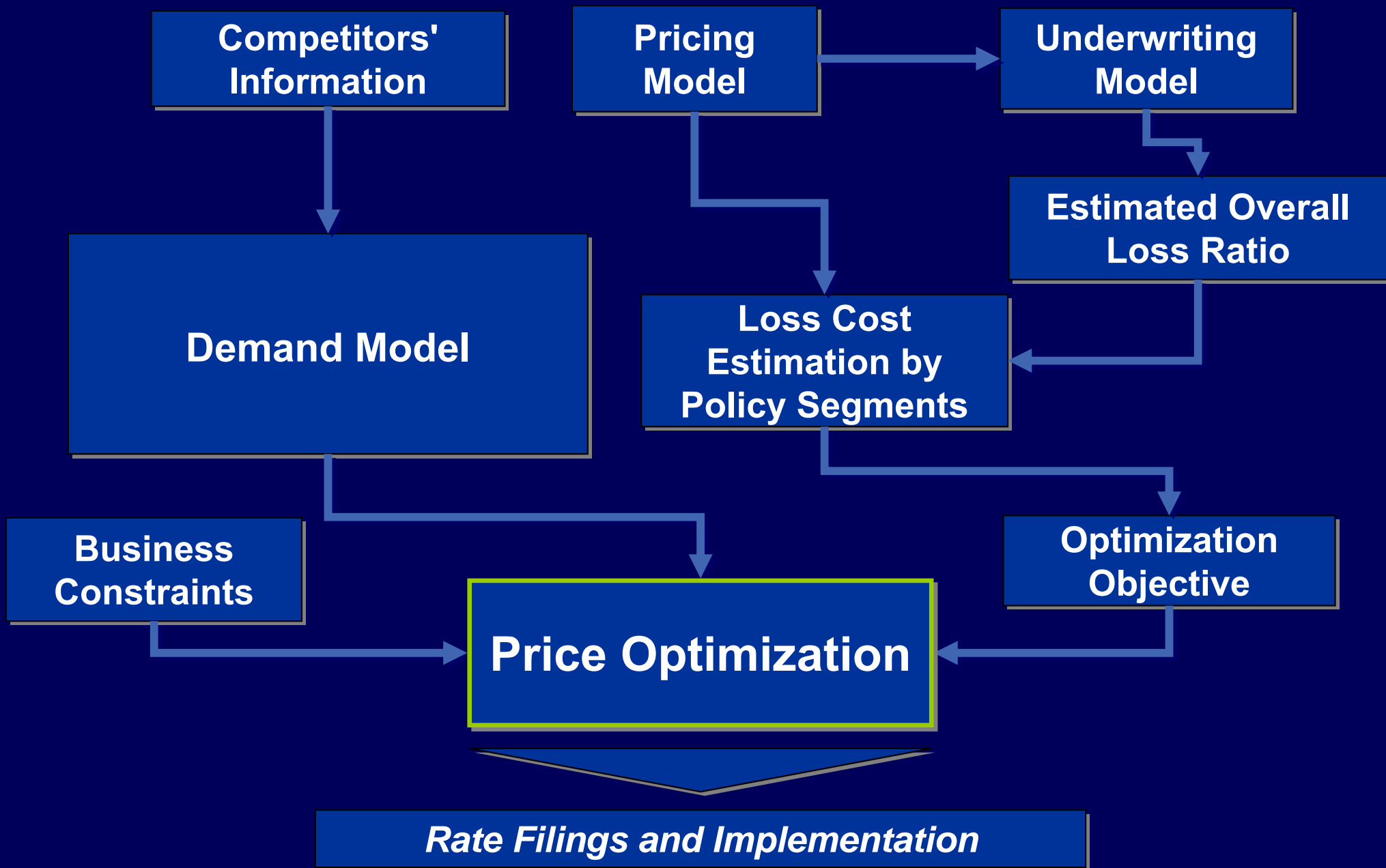
- Massachusetts – “Managed Competition”
- New Jersey – Territories

Less strict

- Texas – WC Non Subscribers
- Kentucky – Use and File

- Each state is a unique regulatory environment
- Requirements differ for individual Lines of Business

Supplementing the Pricing Process



Rating Factors and Tables

Optimization design rests heavily on implementation and complexity

	BI/CSL	PD	Comp.	Collision
Driver Class	X	X	X	X
Age / Points	X	X	X	X
Model Year			X	X
Symbol			X	X
Limit / Deductible	X	X	X	X

Summary

Summary

- Price Optimization is the formalization of incorporating demand into the ratemaking process.
- Demand modeling is affected by quality of available data.
- Challenges vary for New and Renewal
 - Renewal: Offered rates sometimes do not vary much
 - New Business: Difficult to obtain competitors rates
- Implementation issues are separate from modeling issues:
 - Integrating Demand Modeling with existing rate change process
 - Complex regulatory structures can slow adoption

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