



# Predictive Modeling Seminar

Demand Modeling

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## Agenda



- What is elasticity?
- Why is it important?
- What affects elasticity?
- How to model elasticity?
- Summary

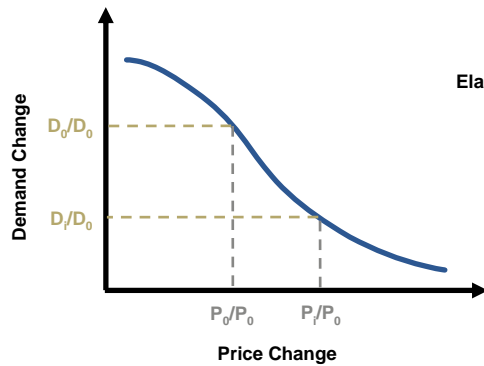




## What is elasticity?

### Elasticity defined

- Rate of response in quantity demanded given a specified change in price



$$\begin{aligned} \text{Elasticity} &= \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}} \\ &= \frac{D_0/D_0 - D_1/D_0}{P_0/P_0 - P_1/P_0} \end{aligned}$$

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## What is elasticity?

### Values or percents

- *Is elasticity determined with percentage change in price or dollar change?*

$$\begin{aligned} \text{Elasticity} &= \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}} && \text{vs.} && \frac{\% \text{ Change in Demand}}{\text{Change in Price}} \\ &= \frac{D_0/D_0 - D_1/D_0}{P_0/P_0 - P_1/P_0} && && \frac{D_0/D_0 - D_1/D_0}{P_0 - P_1} \end{aligned}$$

- Consumers may have a dollar threshold of price change tolerance

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## What is elasticity?

Values or percents

- *Is elasticity determined with percentage change in demand or change in policies sold?*

$$\begin{aligned} \text{Elasticity} &= \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}} & \text{vs.} & \frac{\text{Change in Demand}}{\% \text{ Change in Price}} \\ &= \frac{D_0/D_0 - D_i/D_0}{P_0/P_0 - P_i/P_0} & & \frac{D_0 - D_i}{P_0/P_0 - P_i/P_0} \end{aligned}$$

- Percentage change eliminates effects such as increases in advertising or additional agency appointments.
  - Used for aggregate analysis of elasticity
- Change in demand used in elasticity models at the policy level

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## What is elasticity?

A simple calculation

- Elastic Insurance decreases base rates by 5% and observes that weekly conversion (sales/quotes) increases from 25% to 28%.
  - The increase in demand is  
 $(0.28 - 0.25)/0.25 = 0.12$
  - Elasticity =  $0.12 / -0.05 = -2.4$ 
    - Usually expressed as 2.4 elastic
    - Common to ignore the fact that elasticity is negative

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## What is elasticity?



### New versus renewal business

- Significant differences in elasticity shape thus requires different treatment



- New business elasticity high (1.5 to 5+), relatively low conversion rate (C/Q)



- Renewal elasticity low (<0.5), high expected renewal rates

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## Why is it important?



- Forecasting sales
- Studying retention
- Understanding competitor actions
- Selecting new rates
- Optimizing profit

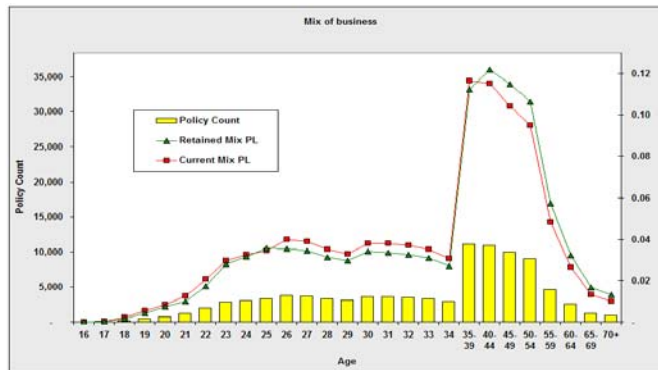
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## Why is it important?



### Effect of rate change

- Renewal impact of rate changes alter the mix of business



- Traditionally pricing forecasts would ignore this effect

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## What affects elasticity?



Attributes & Attitudes

What is the customer like?

Influences

What you have done to the customer?

Environmental

What are the external influences?

Status Changes & Triggers

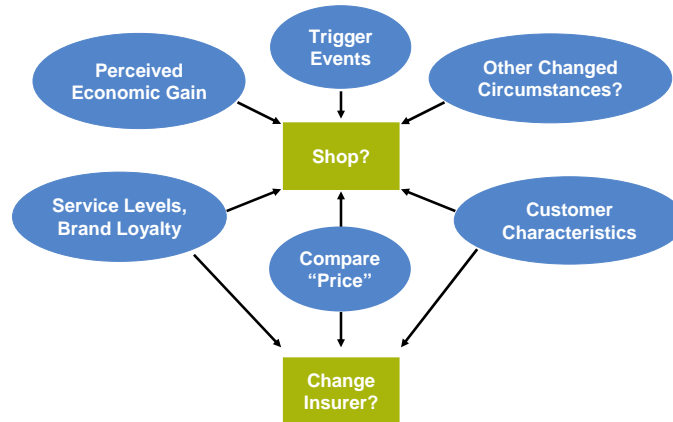
What has changed and when?

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## How to model elasticity?



Good models reflect the underlying process



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## How to model elasticity?



- Model construction
  - Strategies
  - Price testing
- Price factors
  - Price change
  - Competitive position
- Non-price factors
  - Analyze
  - Consider applicability

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## How to model elasticity?



### Strategies

#### Classification and Regression Trees

- Interpolate missing data
- Identify initial main effects
- Identify key segments for models
- Identify complex interactions

#### Generalized Linear Models

- Parameterizes model structure
- Complex interaction strategies
- Issues
  - Possible "negative" elasticity

#### Generalized Non Linear Models

- Interacts price factors with all non price factors
- Non linear element forces positive elasticity
- Issues
  - Tendency to overfit
  - Ignores real "negative" elasticity

- Modeling requires flexibility in choosing the right strategy for the right data set

## How to model elasticity?



### Price testing

- *Rates are regulated so there is no way to test elasticity*
- Historical rate changes provide a great deal of information
- Observe the effect of separating rates for a formerly homogeneous group

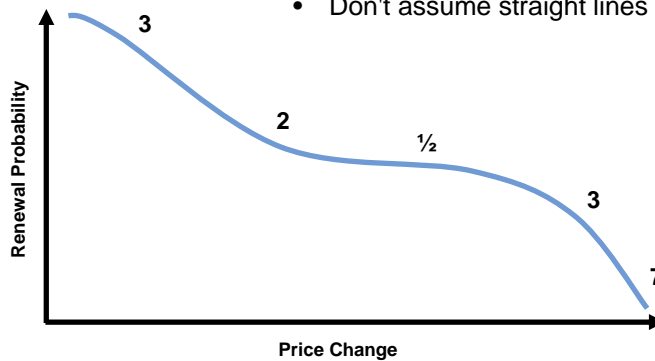


## How to model elasticity?



### Price factors

- "Policyholder X has elasticity Y" ✗
- Don't assume straight lines



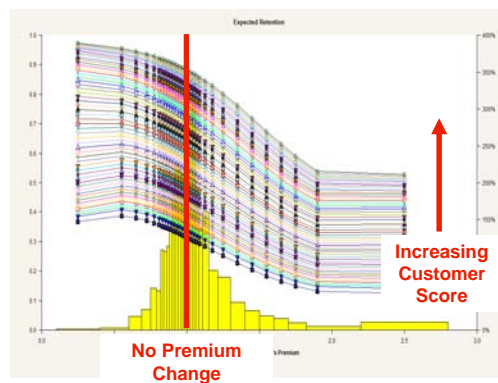
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## How to model elasticity?



### Price factors

- Effect of price change varies by customer profile requires different implementation strategies
- Could you optimize with two small changes?
- Is capping renewals profitable?
- Should all rate effects be capped?
- Could you sell rate capping?



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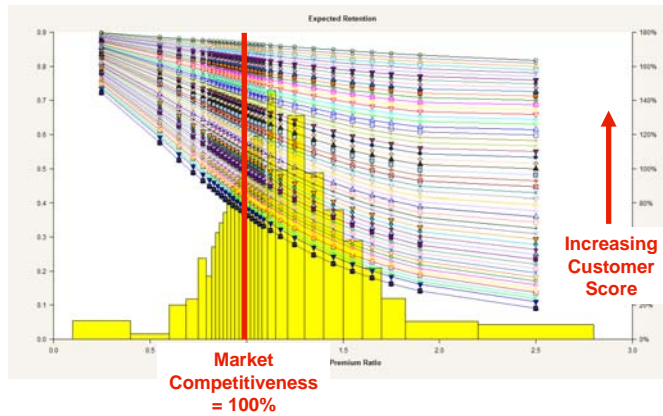




## How to model elasticity?

### Price factors

- Competitor actions will significantly affect elasticity



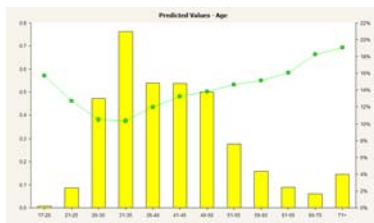
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## How to model elasticity?

### Non-price factors

- Customer experience and expectation is a significant influence on elasticity.



- Retention varies by geographic region

- Retention varies by named insured's age
- Young adults more likely to shop



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## Summary



*Elasticity models represent the next evolution in setting rates*

- Develop rate to retain existing business
- Develop rates to capture new business
- Systematically links pricing and marketing for a unified message
- Price optimization



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