



Conversion and Retention Modeling

CAS RPM Seminar

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March 2010



Agenda



- What is price elasticity?
- Why is it important?
- What affects elasticity?
- What are some of the issues?
- Summary



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What is Price Elasticity?



Price elasticity defined

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



$$\text{Elasticity} = \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}}$$

$$= \frac{D_1/D_0 - D_2/D_0}{P_1/P_0 - P_2/P_0}$$

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What is Price Elasticity?



Elasticity curves will vary by risk

- Requires modeling to understand the effect of different premium changes on different market segments

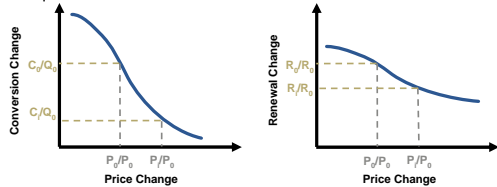


What is Price Elasticity?



New versus renewal business

- Significant differences in elasticity shape
- Requires different treatment



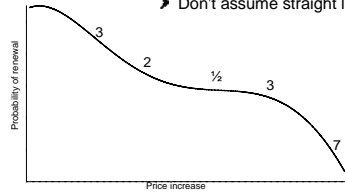
- New business elasticity high (1.5 to 5+), relatively low conversion rate (C/Q)
- Renewal elasticity low (<0.5), high expected renewal rates

What is Price Elasticity?



Price elasticity varies by price for a given risk

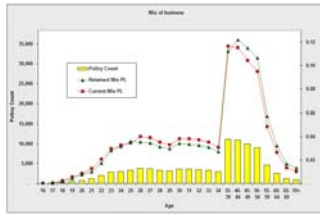
- Does "Policyholder X has elasticity Y"?
- Don't assume straight lines



Why is Elasticity Modeling Important?



- ▶ Forecasting "real" impact of a rate change
- ▶ Studying retention or conversion
- ▶ Identifying "at risk" customers
- ▶ Allocating expenses
- ▶ Price Optimization techniques require high-quality elasticity models

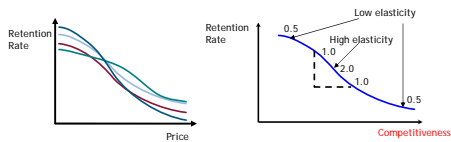


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What is our Task?



- ▶ Build demand models that reflect decision processes
 - ▶ Predicts demand across a wide range of price and change values
 - ▶ Discriminates sufficiently between different customer segments



- ▶ Exhibits appropriate "smoothness" by elasticity factors
- ▶ Easy to explain & maintain

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Differences from Risk Modeling?



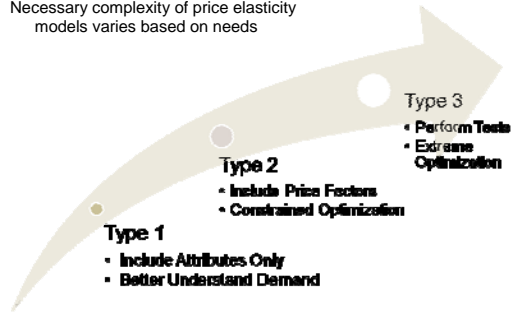
	Risk Models	Elasticity Models
Response	Number of Claims Loss Dollars	Accept/Reject
Observations	100K+	40K+
Time Horizon	3-5 Years	Shorter Time Horizon
Segmentation	Frequency/Severity by Cause of Loss	Lifestyle, Distribution Channel, etc.
Factors	UW & Rating	UW & Rating Plus many more...

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Categories of Elasticity Models



Necessary complexity of price elasticity models varies based on needs



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What Affects Price Elasticity?



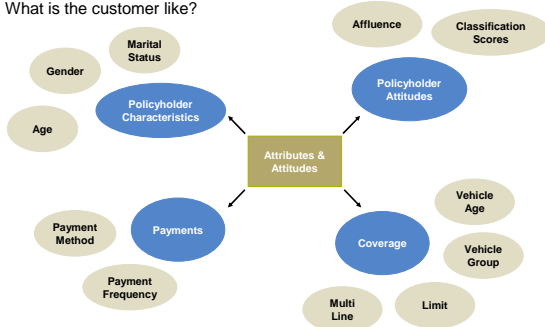
- Attributes & Attitudes** What is the customer like?
- Influences** What you have done to the customer?
- Environmental** What are the external influences?
- Status Changes & Triggers** What has changed and when?

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What Affects Price Elasticity?



What is the customer like?

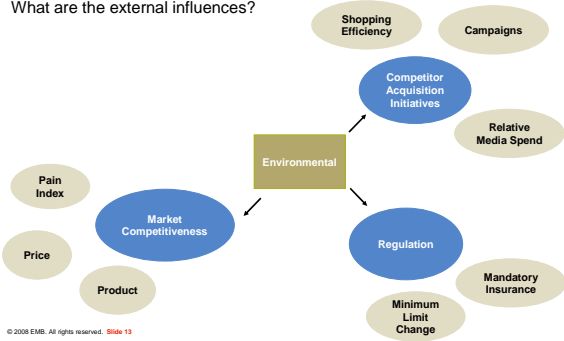


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What Affects Price Elasticity?



What are the external influences?

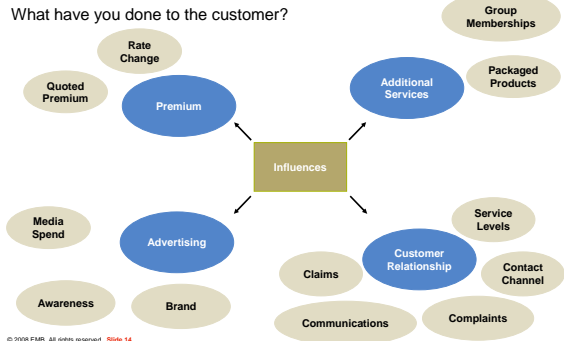


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What Affects Price Elasticity?



What have you done to the customer?

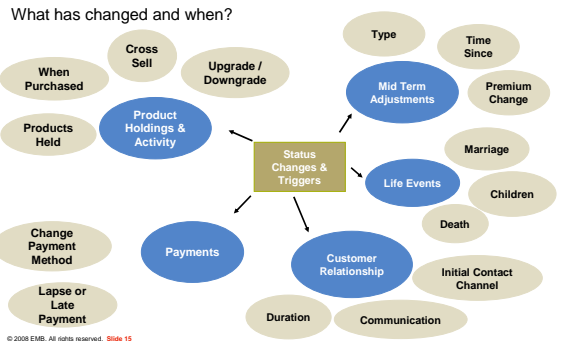


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What Affects Price Elasticity?



What has changed and when?

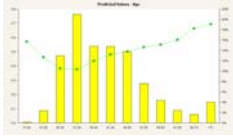


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Example of Effect of Customer Attributes

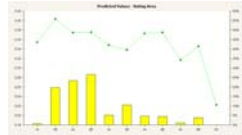


Customer experience and expectation is a significant influence on elasticity



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

- Retention varies by geographic region

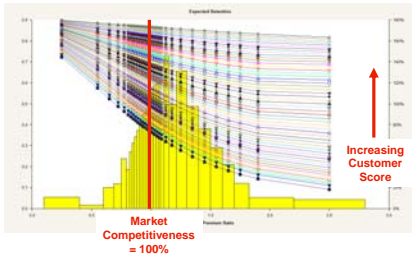


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Example of Effect of an Environmental Factor



Competitor actions will significantly affect elasticity

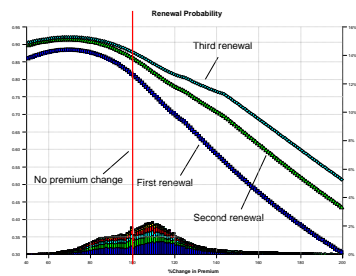


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Example of Effect of Company Action



Effect of price change on renewal customers varies by customer profile

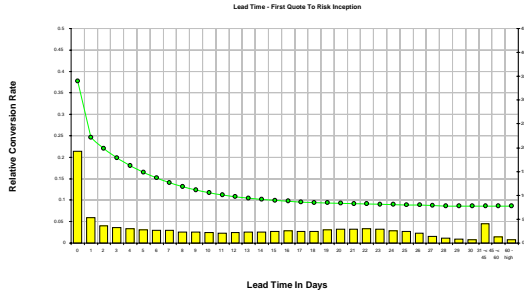


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Example of Effect of Potential Triggers



Conversion rate decreases when insured has time to shop



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Are There Any Challenges?



Data issues

Price testing

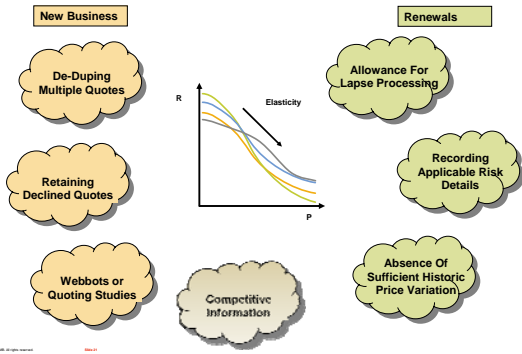
Accuracy of estimates

- Negative elasticity
- Validation



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What are Common Practical Data Issues?



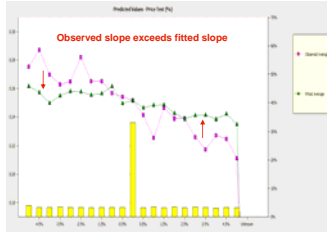
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What about Price Testing?



Tendency of models to underestimate elasticities when price tests are not included, but cannot fully "test" in US marketplace

- ▶ Test within framework of range of actuarial estimates
- ▶ Judgementally adjust the predicted elasticities based on knowledge from where allowed
- ▶ Constrain adjustments to changes where model performs well

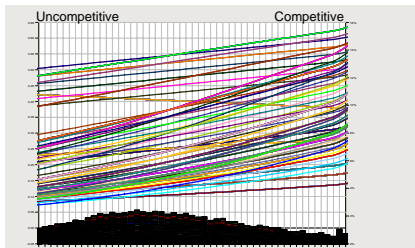


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What about Negative Elasticities?



Some concern about prediction of negative elasticities

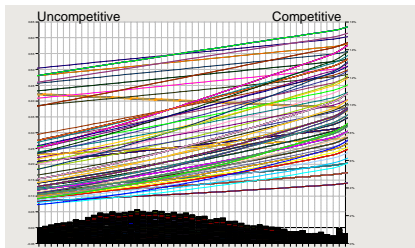


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What about Negative Elasticities?



Some concern about prediction of negative elasticities



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Are there Strategies to Overcome This?



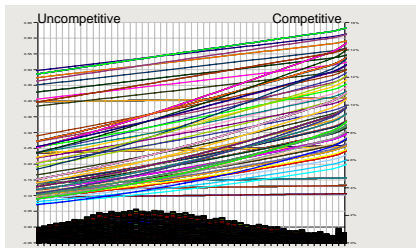
Some use generalized non linear models (GNLMs)

$$y = \frac{1}{1 + \exp(-X\beta + \Delta P e^{z_x})} + error$$

Additional term forces predicted elasticity to be positive

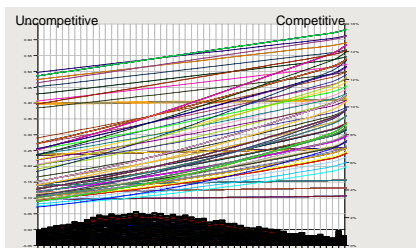
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Do Generalised Non-linear Models Solve the Issue?



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Do Generalised Non-linear Models Solve the Issue?



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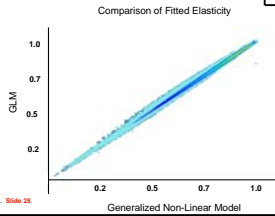
When is this an Issue?



Overcoming erroneous negative elasticity

- ▶ Generalized non linear models (GNLMs)
- ▶ Segmented GLMs
- ▶ "Smart" interactions
- ▶ Visual inspection/judgment

Number of price interactions	% records with negative elasticity*
0	0%
1	0.04%
2	0.3%
3	0.8%
4	1.5%



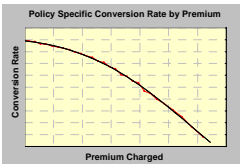
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Can We Validate the Models?

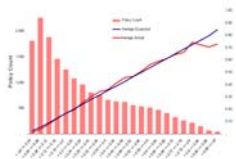


Validation

- ▶ Models need to pass out of sample or out of time test



New Business - Out Of Time Validation



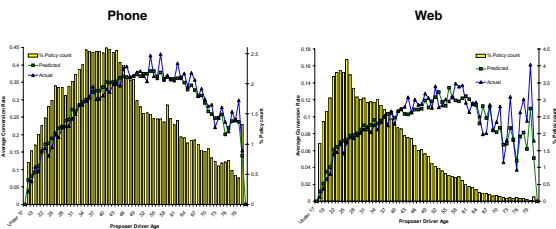
- ▶ Models need to produce appropriate conversion/renewal rate for each customer when price is varied

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Should We Continue Validation?



Imperative to continue to monitor the model performance over time to see if recalibration is needed



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Summary



$$\text{Elasticity} = \frac{\% \text{ Change in Demand}}{\% \text{ Change in Price}}$$

Elasticity models have important business applications, including optimization

Many factors impact customer demand

As with anything, there are issues to resolve



