# eλrnix

Price Optimization

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2	420.00 41 200	1 0 Broker	53.59 0
3	368.91 04 East	1 O Broker	146.09
4	360.15 46 North	1 1 Broker	153.59
5	573.48 49 North	0 0 Broker	146.09
6	40 Moro	0 0.61010	126.0

Price Optimization-Practical Challenges

Presented by:

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October 6, 2008

San Diego

**Price Optimization** 

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6	349.67	40 100ru		0. Brond	126.03
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What is an insurance CEO's number one concern?

From Dow Jones:

Insurance executives say insurance pricing weakness is the biggest risk their industry faces in the next few years.



**Company View** 

Customer View

#### **Price Optimization**

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4	368.15	46 North	1 Broker	106.96
5	501,74	49 North	1 D.Broken	153.59
1 6	573.48	40 North	0 D.Broke	140.0
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# Many concepts are overlapping...

- Lifetime value
- Demand modeling
- Competitive analysis
- Retention modeling
- Scenario modeling
- Price Optimization
- Others?

Unlike other predictive modeling projects, you must "push" more to the end user (the underwriter, the product manager, the pricing actuary) Price Optimization

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2 420.00	63 South	0 Broker 155.07
4 366.1	46 North	1 1 Broker 106.90
6 573	48 49 North	0 0 Broker 146.09
7 349	AT East	O Broken

## The Renewal Dilemma

- •The more tenure, the better the loss ratio
- •But switching can be hard, tenure = value
- Most companies will ignore renewals or not give the full actuarial discount – is that the optimal treatment?



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3 368.91 03 East 1 0 Broker	146.09 0
4 368.15 46 North 1 Broker	106.90
5 501.7 48 49 North 0 0 Broker	146.09
6 5/3 40 North 0 0 Broke	126.03
7 47 East 0 0 Eron	146.0

## Demand Modeling

- Given a quote, will we convert?
- Start getting the data now (the ether of the renewal offer)
- Different for new business and renewals
- A key variable is the amount of rate change as well as the tenure of the policy

# **Ε**Å**R**NIX I



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# GLMs can be used to model demand

Logistic regression analyzes binomially distributed data of the form

$$Y_i \sim B(p_i, n_i), \text{ for } i = 1, ..., m,$$

where the numbers of Bernoulli trials *ni* are known and the probabilities of success *pi* are unknown. An example of this distribution is the fraction of flowers (*pi*) that germinate after *ni* are planted.

# **EARNIX** Price Optimization

#### Demand models (Continued)

The model is then that for each trial (value of *i*) there is a set of explanatory/independent variables that might inform the final probability. These explanatory variables can be thought of as being in a *k* vector *Xi* and the model then takes the form

$$p_i = \mathbf{E}\left(\left.\frac{Y_i}{n_i}\right| X_i\right)$$



#### Demand Models (Continued)

The logits of the unknown binomial probabilities (*i.e.*, the logarithms of the odds) are modeled as a linear function of the *Xi*.

$$\operatorname{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \beta_1 x_{1,i} + \dots + \beta_k x_{k,i}.$$

Note: there are other ways to analyze demand, but make sure you are doing it in a statistically significant manner.





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2 420.00 41 200th 1	o Broker	53.59 0
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4 300.74 46 North 1	1 Broker	153.59
5 573.48 49 North 0	0 Broker	146.09
7 349.67 40 East 0	O Broken	120.07

#### Effect of Previous Claim on Renewal Demand



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#### CAS Predictive Modeling Seminar

San Diego





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6	349.67	40 North	0 0 610101	126.09
7	343.0	47 East	0 0 Broke	146.0

#### Effect of Premium Increase on Renewal Demand



CAS Predictive Modeling Seminar





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#### Effect of Tenure on Renewal Demand



CAS Predictive Modeling Seminar



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Next step is optimization

The "Objective Function"

## Given an objective of X subject to the condition Y what is the price I should charge?

Price Optimization	

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#### Xs and Ys

#### **Optimization is not blind profit maximization!**

- Possible Objectives (X)
- More profit
- More volume
- More retention

#### Possible Constraints (Y)

- Rate Change
- Actuarial Indications
- Volume
- Retention
- Profit

#### Price Optimization

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1	420.00	41 South	1 O Broker	153.59 0
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5	573.48	49 North	0 0 broker	146.09
6	249.6	7 40 100101	0 0,610	126.07
	1	47 E804		146.0

#### Lifetime Value

- Lifetime value is the present value of a piece of business today to the company
- Easy to explain, but hard to implement
- Example: a 25 year old single male buys a liability only policy
- Will he eventually get full coverage?
- Will he eventually get married (and stay with the company)?
- Will he buy a homeowner's policy from us?
- Will he buy life insurance?

Price Optimization	1      319.57      35.600      1        2      420.00      41      South      1        3      368.91      63      South      1        4      368.15      44      East      1        4      368.15      44      East      1        5      501.74      46      North      1        6      573.46      49      North      1        6      549.67      40      North      0
	7 349.07 7 349.07 47 East

## Optimization

- •Once you have defined the objective function, you must find the optimal points
- •Use calculus to find the minimum/maximums
- Because of the complexity of the objective function and the constraints, this is a difficult problem to solve.

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## Monitoring

- One of the benefits of an optimization type analysis are detailed predictions of the amount and type of renewals and new business.
- Deviations can be sign of a "model breakdown" competitors changing rates, changes in underlying demand.
- Can be a tool for not only what to charge but when to change rates.

1 319.57	41 South	1 0 Agen	46.09 0
2 420.00	63 South	1 0 Broker	146.09 0
4 368.15	46 North	1 1 Broker	106.96
6 573.4	8 49 North	0 0 Broker	146.09
7 349.0	47 East	0 Broken	100.0

#### Arguments against optimization

- 1.We are getting away from expected costs.
- •European companies are monitoring this issue, they haven't seen major problems.
- Hard market would likely see focus return to costs.

#### Arguments against optimization

2. "I want to maximize PIF and take no policies below the cost of capital, therefore I don't want to under price (capital destruction) and I don't want to overprice (I won't sell as many policies)." **Price Optimization** 

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4 368.15 44 North	1 1/Broket 106.96 0
6 573.48 49 North	0 0 Broker 146.09
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#### Arguments against optimization

Answer: Focus on Marginal ROE

- •Determine the amount of expenses fixed over the policy term.
- •Throw these OUT!

•If fixed expenses are 10% of last year's premium, and you need to price to a 4% underwriting profit, you can now price a policy to -6% underwriting profit and still make your return on capital.

#### Price Optimization

2 420.00 41 2000 2 368.91 63 South 1 0 Broker 153.59 0 3 368.91 64 East 1 0 Broker 146.09 3 368.15 44 East 1 0 Broker 146.09
3 368.91 04 East 1 0 Broker 146.09
263.19
4 501 74 46 North 1 1 Broker 153.59
5 5011 49 North 0 0 Broker 146.0
6 349.67 40 Moron 0 0 600m 125.0

## **Regulatory Issues**

Regulation – Open Issues

- Optimization began in Europe and Israel
  where there is little rate regulation.
- •Easier to implement in commercial lines.
- •Might be possible to optimize a regulated line if you have related products (example: worker's comp)
- •Personal lines implementation will vary by state.

#### Price Optimization

1 319.57 38 Los	0 Ageta 146.09 0
2 420.00 41 1 2 219 91 63 South 1	0 Broker 153,59 0
3 368.15 44 East 1	O Broker 106.96
5 501.74 46 North 1	0 Broker 153.59
6 573.48 40 North	0. Broker 146.0
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#### **Regulatory Issues**

**Regulation – Open Issues** 

# Most companies don't currently file actuarially indicated rates for every cell

- Ignored Classification Issues (Renewals versus New Business)
- Credibility
- Competitive Issues
- Stability



Price Optimization

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What is optimization?

Optimization is a tool to assist rating judgment to balance these factors as well as actuarial considerations, it's just formalizing what we currently do.

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2	368.91 63 500 368.91 63 500	th 1 0	Broker 1	46.09 0
1	368.15 46 No 501.74 46 No	ath 1	Broker	153.59
6	573.48 49 W	orth 0	0 Broker	146.09

#### Price optimization in the travel industry

Differences:

- Demand can be more elastic in travel than insurance due to ease of substitution. This will vary by consumer and (in the case of airlines) the specific route.
- High variable costs in the insurance industry means that one less policy causes significantly less costs.
- Supply is highly constrained in the short term for travel, especially hotels. (Check New York hotel rates)

# **EÁRNIX** Price Optimization

## **Final Thoughts**

- People like optimized prices Optimization makes some prices more affordable. This could lower uninsured rates since marginal customers are the most elastic.
- Entrenched in Europe
- Still early in the process for the US early adapters may make a lot of money (See "Credit Scoring" circa 1990)
- Regulatory impact unclear