Sophisticated Price Optimization Methods

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Session PM-7

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Contents

- Introduction to optimized pricing
- Case study
- Conclusion
The next frontier in pricing management

To set **optimized prices** we need......

- **Cost models** which predict the net claims and other costs for different types of customers
- **Competitive Market Analysis** which provides a thorough understanding of the market place in which a company is operating
- **Customer price elasticity models** which reflect market competition and customer behaviour so as to predict the volume of new business and renewal acceptances at various prices for different types of customers
- **Optimization techniques** which integrate these models to predict the profit/volume impact of price changes, and to identify the best price changes for a given financial objective and constraints
Why Price Optimization?

- The personal lines insurance industry is highly competitive and maintaining underwriting profits will continue to prove a challenge for the industry.

- Opportunities for improving profitability though efficiency and cost reduction are becoming more difficult.

- Pricing management presents the best opportunity for a company to improve its profitability – optimizing prices is the next step.
Progressive: growing volume while maintaining profitability through price segmentation

- Predictive modeling gained more attention in the US around 2000 due to Progressive success:
  - In 10 years moved from 43rd to 3rd largest Motor insurer in the US
  - Share price quadrupled

Progressive Corp

![Graph showing total revenues from 1996 to 2008 with a peak in 2008.](chart.png)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Revenues (in $ Mill)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>4.6</td>
</tr>
<tr>
<td>1997</td>
<td>5.3</td>
</tr>
<tr>
<td>1998</td>
<td>6.1</td>
</tr>
<tr>
<td>1999</td>
<td>6.8</td>
</tr>
<tr>
<td>2000</td>
<td>7.5</td>
</tr>
<tr>
<td>2001</td>
<td>9.3</td>
</tr>
<tr>
<td>2002</td>
<td>11.9</td>
</tr>
<tr>
<td>2003</td>
<td>13.8</td>
</tr>
<tr>
<td>2004</td>
<td>14.3</td>
</tr>
<tr>
<td>2005</td>
<td>14.8</td>
</tr>
<tr>
<td>2006</td>
<td></td>
</tr>
</tbody>
</table>
Contents

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The Price Optimization equation

Profit models
- Price
- Claims plus other costs

Elasticity models
- Demand d
- Price

Competitor Prices

By integrating price elasticity models and profit (cost) models, **by customer segment and distribution channel**, we aim to set prices that optimize the trade-off between the contribution per policy and the volume of business expected to meet a given financial objective and business constraints.
# Optimization Project focused on better management of the renewal portfolio

## Context
- The company was providing quotes for renewal considering only profitability, past claims experience and previous premium.
- The market entered a price war.

## Objectives
- Improve the renewal process.
- Forecast the impact of different strategies on profitability and premium volume.
- Maximize retention and expected profit.

## Solutions Provided
- Claims cost per policy.
- Competitive market analysis for the specific profile of the portfolio.
- Elasticity of demand study.
- Forecast tool to estimate renewal rate for a given pricing strategy.
- Provide directions for discounts granted to agents.
- Optimized prices subject to the objectives and restrictions of the company.
- Evaluate different pricing strategies.

## Steps
- An analysis of claims (GLM model) and expenses was previously performed.
- The steps were the following:
  1. Agree to objectives and constraints
  2. Gap analysis
  3. Competitive Market Analysis
  4. Renewal analysis
  5. Measure and model customer price elasticity
  6. Optimization
  7. Implementation

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Case study is based on a European company - rate regulations are different in the US
Agree to objectives and constraints

- Initial project workshop to further understand the company’s strategy and financial objectives for the Price Optimization process.
- Establish:
  - Maximization/minimization function: Maximize Expected Profits
  - Time horizon (One year)
  - Business constraints:
    - Global (Target retention rate: 85.0%)
    - Individual (Base on individual policy profiles):
      - Number of claims in the previous years (0, 1, 2, >2)
      - Non claims discount (<55%; => 55%)
      - Tenure (< 4 years; >= 4 years)
      - Historical loss ratio (<55%; >= 55%)
Gap analysis

Step 2

- Understand how much of the information and analysis is already available through previous work
- Use existing company pure pricing models based on expected cost of claims as an input to the Optimization process. This is a fundamental part of the process and one which will have a significant impact on profitability
- Understand the current rating structure and what enhancements and additional flexibility might be required to meet the objectives
**Competitive Market Analysis (CMA)**

- CMA is a fundamental part of an insurance company’s pricing management processes and a key input into the process of Price Optimization:
  - Understand the positioning of the company’s rates in the market at any point in time
  - Help identify segments where the company’s prices are relatively cheap/expensive relative to the market
  - Understand the intensity of competition in each segment
  - Understand the scope for price changes and what impact such changes would have on market positioning
  - Key input into later steps

**Step 3**
Renewal analysis

What is it?
- The renewal rate is defined as a customer (who has been offered renewal) staying with the company 12 weeks after expiring date

How is it used?
- Assess how variable the renewal rate is across the portfolio and identify segments of the business that have higher/lower than average rates
- Combine with the CMA to assess how good a predictor the competitiveness measure is of retention - by customer segment and over time
- Provide initial insight into customer elasticity e.g. what happened to retention rates when previous price changes were implemented?
- Assess how retention rate varies as a function of price change at renewal

Data used for the statistical estimation of customer renewal demand:
- All car policies renewed between May 2007 and July 2007.
### Price Variation vs. Competitiveness position

#### Step 4

**Illustrative example**

<table>
<thead>
<tr>
<th>Competitiveness Position</th>
<th>% Variation Price of Client</th>
<th>ELR: Expected Loss Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (Higher than 10%)</td>
<td>Negative (Lower than 0 %)</td>
<td>19% Portfolio 85% Retention 38% ELR</td>
</tr>
<tr>
<td></td>
<td>Moderate (0 – 5%)</td>
<td>36% Portfolio 85% Retention 36% ELR</td>
</tr>
<tr>
<td>High (Lower than 10%)</td>
<td>High (Higher than 5%)</td>
<td>45% Portfolio 85% Retention 61% ELR</td>
</tr>
</tbody>
</table>

**Marginal Distribution**

- 50% Portfolio 86% Retention 41% ELR
- 39% Portfolio 83% Retention 40% ELR
- 11% Portfolio 80% Retention 176% ELR
- 15% Portfolio 85% Retention 41% ELR
- 4% Portfolio 86% Retention 31% ELR
- 5% Portfolio 61% Retention 251% ELR
- 10% Portfolio 82% Retention 41% ELR
- 20% Portfolio 83% Retention 25% ELR
- 1% Portfolio 80% Retention 201% ELR
- 15% Portfolio 85% Retention 45% ELR
- 25% Portfolio 90% Retention 45% ELR
- 15% Portfolio 80% Retention 126% ELR
- 5% Portfolio 80% Retention 61% ELR

**Price Variation**

- High (Higher than 5%)
- Moderate (0 – 5%)
- Negative (Lower than 0 %)

**ELR**

- Expected Loss Ratio
Customer price elasticity
Summary of models

Step 5

GLM
Final Models

Model to predict the renewal rate
Model to predict the need for an agency-determined discount
Model to predict the amount of agency-determined discount
Model to predict a change in coverage by the policyholder
Model to predict the benefit of the change in coverage

Note: in Europe, agencies are given discretionary “budgets” to offer discounts to insureds – sometimes referred to as “commercial discounts”
## Customer price elasticity
### Possible explanatory variables

<table>
<thead>
<tr>
<th>Policy characteristics</th>
<th>Risk characteristics (Driver)</th>
<th>Risk characteristics (Vehicle)</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Premium change</td>
<td>Years without claims</td>
<td>Type of vehicle</td>
<td>Payment type</td>
</tr>
<tr>
<td>Renewal month</td>
<td>Driver’s age</td>
<td>Age of vehicle</td>
<td>Payment term</td>
</tr>
<tr>
<td>Discounts</td>
<td>Driver’s gender</td>
<td>Usage</td>
<td>Distribution channel</td>
</tr>
<tr>
<td>Coverage</td>
<td>Driver’s license age</td>
<td>Value</td>
<td>Cross sell</td>
</tr>
<tr>
<td>Actual premium</td>
<td>Driver’s occupation</td>
<td>.....</td>
<td>Amount of agency-determined discounts</td>
</tr>
<tr>
<td>Absolute change in premium</td>
<td>Additional driver presence</td>
<td>.....</td>
<td>Broker classification</td>
</tr>
<tr>
<td>Amount of difference with market</td>
<td>Additional driver’s age</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Percent of difference with market</td>
<td>Additional driver’s licence age</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Number years policy held</td>
<td>.....</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Number years client in company</td>
<td>.....</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Bonus/malus TPL</td>
<td>.....</td>
<td>.....</td>
<td>.....</td>
</tr>
</tbody>
</table>

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# Customer price elasticity
## Base profile

<table>
<thead>
<tr>
<th>Variables</th>
<th>Base Profile</th>
<th>Relativities Range</th>
<th>Explaining Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross sell</td>
<td>ONLY MOTOR 400-600 €</td>
<td>0.40 - 1.00</td>
<td>31.0%</td>
</tr>
<tr>
<td>Premium offered</td>
<td></td>
<td>0.35 - 2.15</td>
<td>20.8%</td>
</tr>
<tr>
<td>Product</td>
<td>THIRD PARTY + WINDSCREEN</td>
<td>0.50 - 1.20</td>
<td>9.3%</td>
</tr>
<tr>
<td>% change premium</td>
<td></td>
<td>0.40 - 1.60</td>
<td>8.4%</td>
</tr>
<tr>
<td>Payment type</td>
<td>BANK ACCOUNT</td>
<td>1.00 - 1.80</td>
<td>6.8%</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>&lt; -5% MARKET</td>
<td>1.00 - 1.75</td>
<td>6.3%</td>
</tr>
<tr>
<td>Distribution channels</td>
<td>BROKER</td>
<td>0.80 - 2.10</td>
<td>4.1%</td>
</tr>
<tr>
<td>Province</td>
<td>Zone 2</td>
<td>0.70 - 1.30</td>
<td>3.4%</td>
</tr>
<tr>
<td>Num. years policy held</td>
<td>3-4</td>
<td>0.75 - 1.15</td>
<td>2.4%</td>
</tr>
<tr>
<td>Commercial classification of broker</td>
<td>2</td>
<td>0.80 - 1.35</td>
<td>2.3%</td>
</tr>
<tr>
<td>Years without claims</td>
<td>5</td>
<td>0.80 - 1.25</td>
<td>2.2%</td>
</tr>
<tr>
<td>Sex – Age</td>
<td>H40-54</td>
<td>0.70 - 1.25</td>
<td>1.3%</td>
</tr>
<tr>
<td>Age of driver license</td>
<td>&gt;20</td>
<td>1.00 - 1.50</td>
<td>0.9%</td>
</tr>
<tr>
<td>Type of Vehicle</td>
<td>Automobiles</td>
<td>0.85 - 1.45</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

**Illustrative example**

**Step 5**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Relativities Range</th>
<th>Explaining Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Xb=Lineal Predictor</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Lapse probability=</td>
<td></td>
<td>13.4%</td>
</tr>
<tr>
<td>Xb/(1+(Xb))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewal probability=</td>
<td></td>
<td>86.6%</td>
</tr>
<tr>
<td>1-Xb/(1+(Xb))</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Customer price elasticity
Results – Elasticity curve

Illustrative example

Step 5

% PREMIUM CHANGE

Lapse rate

Policies
Probability
Lower C.I.
Upper C.I.

PREMIUM OFFERED

Policies
Probability
Lower C.I.
Upper C.I.
This step involves combining the cost models (claims and expenses) and the customer price elasticity models derived in previous steps in order to determine the optimal profit loading by customer type.

The optimal price will be the one that satisfies the company’s objectives and constraints maximising profitability subject to a certain volume of business.

**Illustrative example**

The graph shows the Expected Profit Efficient Frontier with two curves: 
- **EF with restrictions**
- **EF without restrictions**

- **Expected profit (Million €)**
- **Retention (%)**

- **Point of interest**:
  - Orange dot: Company Strategy
  - Blue square: Optimal Strategy
Step 6

Comparison of company and optimized pricing schemes

Price Strategy Comparison
## Optimization

### Step 6

**Illustrative example**

<table>
<thead>
<tr>
<th>Distribution of premium changes</th>
<th>Average Premium Change</th>
<th>Retention Rate</th>
<th>Expected Profit (million)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optimal</strong></td>
<td>-4%</td>
<td>85%</td>
<td>13.8</td>
</tr>
<tr>
<td>-4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-4% - 0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0% - 2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2% - 6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;=6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Company</strong></td>
<td>-4%</td>
<td>85%</td>
<td>11.2</td>
</tr>
<tr>
<td>-4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-4% - 0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0% - 2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2% - 6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;=6%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Implementation

- Optimized rates can be implemented in different ways:
  
  a) An algorithm that calculates the optimised price per individual customer based on their particular rating attributes. The algorithm can be built into the rating structure and operate in real-time
  
  b) A set of optimized premium rates that would fit into a tabular rating structure
  
- Given the IT investment, lead time, and other operational considerations that need to be made for option (a), our current recommended approach for the company is (b)
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Price Optimization: The next challenge

The insurance industry is highly competitive and maintaining underwriting profits will continue to prove a challenge for everyone, whereas improving profitability though efficiency and cost reduction are more difficult, pricing management presents the best opportunity for a company to improve its profitability and **OPTIMIZING PRICES** is the next step.
Conclusions

- **Advanced statistical techniques** will be necessary for **managing a portfolio**:
  - Selecting profitable customers, leaving unprofitable ones to competition
  - Implementing gradually to reduce market disruption
  - Maintaining benefits over time
  - Providing a solid basis to monitor the portfolio

- It is possible to **grow market share** without **compromising profitability**

- **Stay ahead of competition!**