PRICE/DEMAND ELASTICITY
WORKSHOP

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Workshop
Price/Demand Elasticity

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Workshop: Price/Demand Elasticity

Summary

The aim of the workshop will be to discuss the development of a price demand elasticity model and the practical uses of such a model.

There will be presentation of the approach to, and results from a price/demand elasticity modelling investigation based upon an anonymous data pool of direct motor insurance quotation, conversion and renewal data.

After the presentation there will be an open discussion of the results and uses of such investigations. At time of writing, the results of the analysis are not yet available. However, in the following paragraphs we offer some background thoughts on:

1. How Price/Demand Elasticity Relates to Insurance

2. How to go About Measuring Price/Demand Elasticity

3. Applications of Price/Demand Elasticity Modelling

4. Other Considerations.

1. How Does Price Demand Elasticity Relate to Insurance?

A factor in whether or not a proposer accepts a personal lines quotation is premium rate offered.

The Price/Demand elasticity of a person is the significance of this factor. One way of expressing the Price/Demand elasticity measure of a customer is to express it in terms of a ratio of the change in level of quote acceptance (or renewal acceptance) to change in premium (in absolute terms or relative to a market price level).

Price/Demand Elasticity clearly impacts upon the following insurance functions:

1.1 Pricing
Actuaries and statisticians are involved in producing theoretical premiums to meet target profitability criteria. In the second stage of setting actual premiums charged, adjustments due to marketing and underwriting considerations mean that actual premiums may differ radically from theoretical. The working party believes that in practice, this two stage process could be significantly improved by drawing on results from price demand elasticity analysis. Extreme examples of the current market rating process include:

(i) Implementing theoretical premiums without due regard to market rates; or

(ii) Adjusting in-force premium rates according to "whim" and observational differences between theoretical and current rates; or

(iii) Following conversion/retention statistics too closely without due regard to the theoretical 'bottom lines' and hence profitability targets.

1.2 Marketing
Although the targets of marketing campaigns vary greatly, their fundamental purpose is to use an effective mix of media to attract *profitable* new business and/or retain *profitable* existing business. Marketing strategy should not work independently of pricing, as clearly marketing spend is wasted if it is used to sell to a highly price sensitive audience when one's premium rates are higher than the market.

1.3 Sales

Sales staff are often given some degree of price flexibility to close the sale. However, indiscriminate or badly targeted discounts can and do remove the profit (or contribution) margins built into the premiums. Knowledge of a customer's probable price demand elasticity and the margins built into the premium rate for that customer can be used to give guidance on the minimum acceptable premium for that customer.

1.4 Planning/Strategy

An insurance company's strategy would, over the long term, be expected to maintain or improve profitability per customer and enhance the company's market share (gain 'critical mass').

However:

- What is the time period over which results will be judged?

- Should this strategy be modified to take account of the insurance cycle? If so, how?

- What combination of pricing and marketing will deliver this performance?

Optimising a company's income and outgo relies upon maximising the combination of contribution per policy and portfolio size. To achieve this, the company will need to:

- Identify and concentrate on the most profitable market segments;

- Attract customers from those most profitable segments;

- Retain customers from those most profitable segments;

- Beware of adverse selection.

Understanding the customer's price elasticity is clearly key to achieving these goals.

2. How to go About Measuring Price Demand Elasticity.

2.1 Data Requirements
The data pool secured by the working party from 4 direct insurers is defined as follows:

New business quotations and renewal invitations in the UK for comprehensive private car insurance proposals received from male drivers aged between 25-65 with maximum or fully protected No Claims Discount during the second quarter of 1997.

The dataset, with one record per quotation, each containing the following fields:

Rating Factors:	Driver age
	Voluntary Driving Restriction
	Car Group
	Post Code
	Vehicle Age
	Voluntary Excess
	Premium Payment Frequency
	Any fault claims in previous year (Yes/No)
Plus,	Month in which quotation/renewal invitation is issued
	Premium Quoted (before any optional up-sells such as breakdown cover or legal expenses)

For new business:	A Binary Conversion indicator -	1 if policy incepted, 0 if quotation lapsed.
Or for renewals	A Binary Renewal indicator -	1 if policy renewed, 0 if lapsed.

Percentage increase in premium since last year

A market premium will be matched to each record by merging the dataset with a database of competitors' premiums for a large sample of "standard", all male risks obtained from a broker's motor insurance quotation program. It is not yet known how well the broker market's rates (excluding special scheme rates) compare with direct insurers' rates.

2.2. Proposed Analysis Methodology

The working party intend to use logistic regression to model probability of conversion (or renewal) using the GLIM software.

With the pooling of data from different companies, it is expected there will be some duplication of combinations of rating factors. This is more likely in the working party's data extract because a single mapping of post code to postal zoning system is used. However, as each insurer uses its own mapping of postcode to postal rating district the premium offered will vary for these otherwise identical risks.

The multivariate analysis of logistic regression will allow price/demand sensitivity to be measured whilst taking into account the potential effects of other explanatory variables such as driver age and other rating factors. As month of quotation was also recorded over the 3 months of data capture limited, observations on the effect of time may be possible.

The results from this modelling will produce a scoring algorithm to predict conversion and/or retention rates. The relative weights given to competitive price index parameter (premium quoted divided by competitive index/competitor's premium) in the model will be used as the coefficient of price elasticity.

2.3. Differences in Methodology for Practical Modelling

Extra potential rating factors could be added to the data specification. Also, a direct insurer can gather and use additional customer data for new business conversion modelling such as (i) the renewal premium offered by current insurer; (ii) the best quotation received so far by the proposer; (iii) the insurer/broker which provided the best quotation.

Many insurers either sell more than one branded product or use more than one set of premium rates - e.g. for different distribution channels (e.g. affinity group branded product and direct) or separate rates by sales team. Use of more than one set of insurers' rates can give a greater understanding of the effect of price variation upon conversion.

As described above, a direct insurer can, simply by posing the relevant questions to the customer, gather competitive information from new business quotations. However, at renewal, current competitive information for the customer is not available. Instead, it is necessary to gather a database of representative insurance quotations. This must be gathered from mystery shopping exercises as the vendors of broker quotation products do not wish to be seen to be helping the competitors to their clients.

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The time period for quotation data is particularly important. It needs to be sufficiently long to yield enough quotes (and successful conversions) to enable credible analysis whilst also being sufficiently short to be an accurate snap-shot of market rates at that point in time. Here the mystery shopping exercise design is significant as cost constraints may restrict the size and frequency of mystery shopping updates.

Once the first price/demand elasticity analysis is complete, the usefulness of the results can be compared to the cost factor of regular updates to the mystery shopping database. As some segments of the premium rate database may prove more volatile than others, updating of the database may be possible by sampling and extrapolation.

2.4. Making use of a Price/Demand Elasticity Model
The fitted GLM as described above measures conversion and/or renewal retention. The results of this would then be used to devise a strategy - be it pricing and/or marketing to optimise the profitability of the book of business. To do this a range of simulation scenarios would be built up in a further, probably spreadsheet based model.

Necessary augmentations to the basic retention/conversion GLM to undertake these profitability simulations would include:

- claims costs by rating factor;

- an assessment of expenses (ideally by rating factor) expressed as a flat amount, a percentage of the premium, or a combination of the two (expenses may also be split by actual or projected policy lifetime);

- an assessment of contribution from each policy. This could be a flat amount, a percentage of the premium or a more complicated approach based on a contribution per rating factor.

3. Applications of Price Demand Elasticity Modelling.
The results from such modelling work outlined in section 2.4 will give an insight into the profitability of the book of business. It is relatively simple to measure profitability of business over a one year time horizon. However, now that the acquisition of new business is relatively expensive for direct insurers, profitability should also be modelled as a "lifetime value".

3.1 What is "Lifetime Value"?

For an insurance company the "lifetime value" of a customer may be determined by taking the present value of the expected contribution to the company by the policyholder over the period of time the policyholder is with the company. For a single "averaged" customer profile, a simple deterministic or stochastic cash flow model that brings expected future premiums, expenses and claims to present value using an appropriate discount factor can be utilised with the added incorporation of future persistency rates.

For any given customer profile, his or her renewal rate will vary as will the customer's views and attitudes to renewal over time. For example, an unmarried 25 year old male living in an urban area with high expected price elasticity may very well "mature" into a married 55 year old male living in a suburban area with a very different price elasticity.

Future persistency also varies by how long a policyholder has been with a company. A customer who has been with the same insurer for 5 years is more likely to remain with that company the following year than a customer who has been with the insurer just one year.

Changes in premium - both relative to last year's premium and relative to the market - may modify or change a customer's price elasticity and thus persistency and projected lifetime value. For example, by charging the same premium as the previous year, the customer may feel that the premium represents good value for money. This may be a profitable strategy for a motor insurer because, generally risk declines with age, and the decline in risk cost may offset the increase in cost due to claims inflation. However, there may be a sudden increase in lapses if premiums charged are *significantly* higher than the market.

3.2 How does one use Lifetime Value?

Marketing
Probably the most important use of lifetime value could be identifying desirable classification groups for marketing. A firm could target those classes of business that provide the highest lifetime value per £ of marketing spend.

Pricing
Lifetime value can be used in making pricing decisions. If one assumes that loss costs and certain expenses are "fixed", but both persistency and certain other expenses vary by premium changes, then premium rates can be adjusted until a desired contribution outcome is achieved, i.e. the level of contribution per policy may be moderated according to a customer's price elasticity with the aim of spreading the initial marketing and expense costs over future years through higher retention.

Company Valuation

If enough data is available to determine an accurate price elasticity measure and expected loss/expense costs, then the lifetime values of customers can be added up to determine a book of business' net worth. This is of particular interest for company or "book" sales and purchases where the acquisitor would compare his current premium rates with those of the book of business which is being acquired. Knowledge of the book's price elasticity profile would give an indication of what might happen at the first renewal according to various renewal pricing strategies (with the view to moving towards 'house' premium rates) and the likely lifetime profits stream that such a purchase could provide.

3.3 How Does One Measure Lifetime Value?

As previously stated, a simple cash flow model can be used in combination with expected future persistency. A format of presentation taken largely from Feldblum (Further Reading reference 2) for such a model is given overleaf:

Lifetime Value - Simple Rating Structure with Underwriting Cycle

(a) Class: A (age 25, unmarried, male)

(b) Company's Planned Competitive Position: (Broadly close to market)

| Year | Premiums | Expenses | | Claims | Retention Rate | | Dis-count Factor | Present Value of Profit | Under-writing Cycle |
		1st Yr	other		In Year	To date			
(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
1	500	(100)	(50)	(400)	N/A	100%	1.000	(50)	0.0%
2	548	0	(53)	(407)	70%	70%	0.893	55	9.5%
3	530	0	(55)	(415)	71%	50%	0.797	24	5.9%
4	471	0	(58)	(421)	72%	36%	0.712	(2)	-5.9%
5	453	0	(61)	(428)	73%	26%	0.636	(6)	-9.5%
6	500	0	(64)	(434)	74%	19%	0.567	0	0.0%
7	548	0	(67)	(440)	75%	14%	0.507	3	9.5%
8	530	0	(70)	(445)	76%	11%	0.452	1	5.9%
9	471	0	(74)	(449)	77%	8%	0.404	(2)	-5.9%
10	453	0	(78)	(453)	78%	7%	0.361	(2)	-9.5%
11	500	0	(81)	(456)	79%	5%	0.322	(1)	0.0%
12	548	0	(86)	(458)	80%	4%	0.287	0	9.5%
13	530	0	(90)	(460)	81%	3%	0.257	(0)	5.9%
14	471	0	(94)	(460)	82%	3%	0.229	(1)	-5.9%
15	453	0	(99)	(459)	83%	3%	0.205	(1)	-9.5%
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Notes:

(d) Assumes premium rate follow the underwriting cycle in column (l) with no 'inflation increases'.

(e) First year expenses set at 20% of first year premium.

(f) Other expenses initially 10% of first year premium, thereafter increasing with inflation at 5% p.a.

(g) Assumes initial loss cost of £400. Thereafter 5% p.a. claims inflation mitigated by improvements in loss propensity due to increase in age of policyholder of 3 percentage points per year.

(h) Dependant on (a), (b), and changes in (d).

(j) Assumes 12% cost of capital.

(k) Sum of (d) through (g), multiplied by (i) then (j)

The present value of profits from the cash-flow model is extremely sensitive to assumptions about persistency and how it changes over time. As discussed before, persistency and how it changes over time is, in turn, dependent on (1) the type of customer, (2) length of time with the insurer, (3) the insurer's competitive position, (4) magnitude of rate changes imposed, and how all four change over time.

The above model just considers one line of business (e.g. private car insurance). For simplicity, the potential value of cross selling has been ignored. However, this may have a significant value, particularly as cross selling saves on the significant marketing costs associated with the acquisition of direct business.

3.4 How Does One Optimise Lifetime Value?

Unlike section 3.3, optimising the lifetime value of a book or cohort of business is not as simple as measuring it. However, one can define the 'optimal' strategy as the combination of pricing and marketing strategies that attracts and retains the most profitable business.

4 Other Considerations/Problems

4.1 Moderating a Price Elastic Customer's Elasticity

Can an insurer moderate a new customer's price elasticity? At the new business stage, price was one of the main factors in winning the business. Thereafter, it is only when the customer makes a claim, a policy amendment or is invited to renew the policy that the customer is reminded of an insurer's "excellent service". Thus, at renewal, many customers will not know how good or bad an insurer's service is. How then can such customers decide to renew because of good service rather than shop around?

Some insurers have tried sending their customers 'club' type newsletters/magazines with details of special offers, competitions etc. Do such techniques aid retention?

Some insurers re-solicit customers who haven't yet renewed (or have moved to another insurer), sometimes with renewal incentives (e.g. "accept now over the telephone and receive a 5% discount."). Do such techniques retain more customers than they lose? For those customers who do renew, would they have renewed anyway?

4.2 Attracting Inelastic Customers

An interesting problem exists when trying to apply the results of price/demand elasticity and the concepts of lifetime value. For instance, suppose married 50 year old males are determined to be desirable policyholders due to both their (1) low loss propensity and (2) price inelastic tendencies. How does the insurer attract more of this niche as new business? The company may try to :

(a) offer a rate low enough to lure them away from other companies. As they are price inelastic the discount must be fairly substantial or guaranteed in order to attract these inelastic customers. Are such discounted rates profitable?; or

(b) advertise on quality of service and strength of brand. But is the brand strong enough to attract sufficient volumes of the targeted customers?; or

(c) identify the profile of 'inelastic customers' before they become 'inelastic' i.e. when they are younger. However at younger ages they are more likely to leave for (slightly) lower priced competition. How do you profitably retain such business until such time as become less price elastic?

4.3 Moral Issues

Finally, there are some moral issues concerning the use of price/demand elasticity modelling results. If an insurance provider takes advantage of a customer's 'nature' by manipulating the price according to the price the customer is prepared to pay, then it may load premiums at renewal for those customers which are identified as "price inelastic". Identification of 'inelastic' customers could be achieved by segmentation according to customer details (e.g. age) or distribution channel. Recently banks and building societies have received bad press for 'closing savings account brands' to new customers and paying lower interest rates on these accounts than their 'new business' saving accounts. Do insurers employ such tactics? Should insurers employ such tactics?

Pricing according to the level of risk is the accepted principle in insurance. However, at what level is it morally acceptable to vary price according to how much the customer is prepared to pay?

Further Reading:

(1) Sutter, R L (1998) "The Impact of Price Changes on Costs" - Casualty Actuarial Society 1998 Discussion Paper Program - Dynamic Analysis of Pricing Decisions

(2) Feldblum, S (1996) "Personal Automobile Premiums: An Asset Share Pricing Approach for Property-Casualty Insurance" - Proceedings of the Casualty Actuarial Society 1996

(3) Taylor, G C (1986) "Underwriting strategy in a competitive insurance environment" - Insurance:Mathematics and Economics 5 (1986) 59-77

(4) Taylor, G C (1987) "Underwriting strategy in a competitive insurance environment" - Insurance:Mathematics and Economics 6 (1987) 275-287