Price Optimization for the U.S. Market: Techniques and Implementation Strategies

CAS Ratemaking and Product Management Seminar

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March 20, 2012

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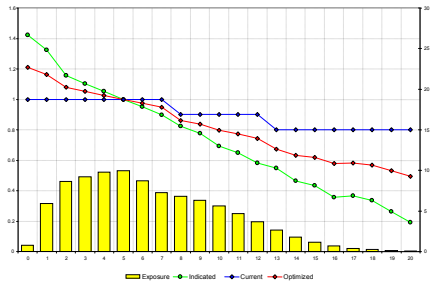
Agenda

- What is price optimization?
- Key aspects
  - inputs
  - algorithm
  - implementation
- Business benefits and wider implications

What is price optimization?



What is price optimization?

Use customer level knowledge of:
- Risk costs
- Expenses
- Competitive positioning
- Price elasticity
- Buying behavior
- Retention behavior
- Existing product-holdings
- Likelihood to purchase additional products
- Marketing activities

→

… to improve portfolio performance
- Immediate volume and/or profit uplift
- Sustained long-term improvement
- Aligned with strategy

←

… with hygiene factors
- Parameterization process efficiency
- Risk management, control and audit
- Minimal systems impact

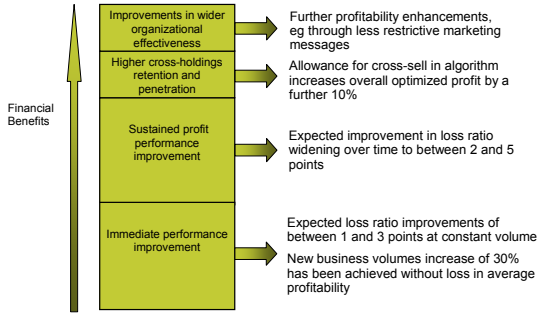
Price optimization

- Pricing performance scorecard for the insurance industry?

Task	Ability
Aggregate loss costs	
Granular loss costs	
Price competitive position	
Regulatory challenges	
Policyholder reaction to price	
Bringing it all together	

Ready
Somewhat ready
Not ready

Financial benefits



Further profitability enhancements, eg through less restrictive marketing messages

Allowance for cross-sell in algorithm increases overall optimized profit by a further 10%

Expected improvement in loss ratio widening over time to between 2 and 5 points

Expected loss ratio improvements of between 1 and 3 points at constant volume

New business volumes increase of 30% has been achieved without loss in average profitability

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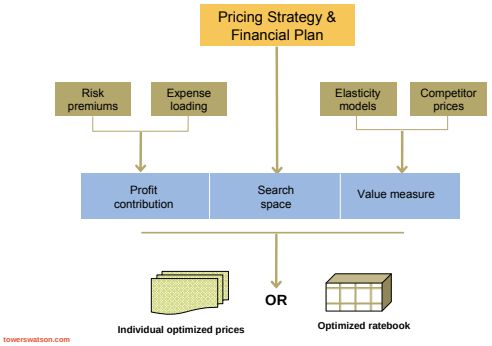
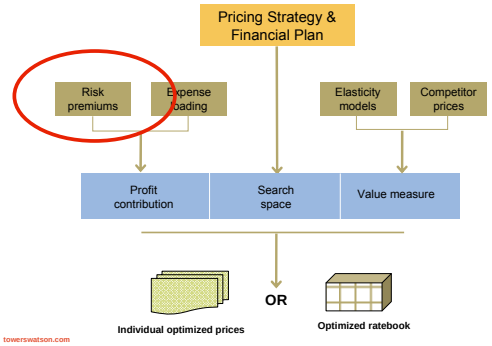
Price optimization



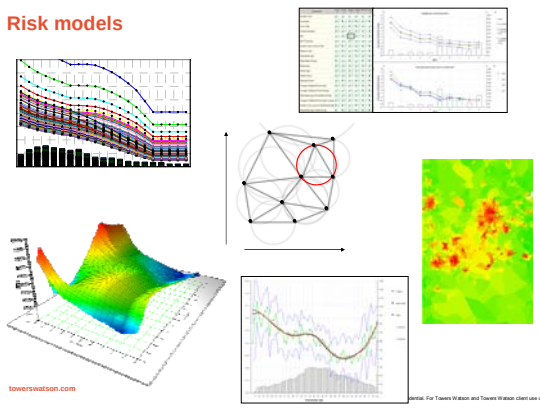
Price optimization

Inputs	Sound inputs are critical
Optimization Algorithm	Important to have practical optimization approach which pays due regard to long term value
Outputs	Practical and phased implementation

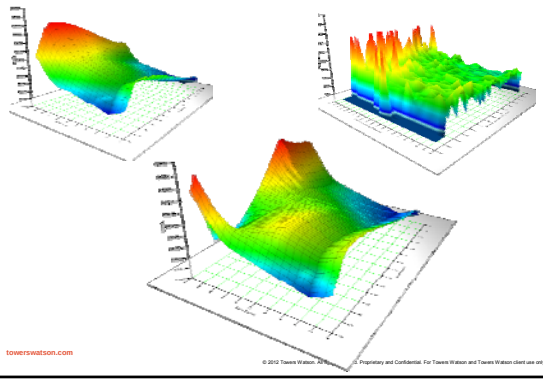
Price optimization



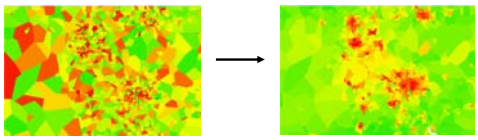
Risk models



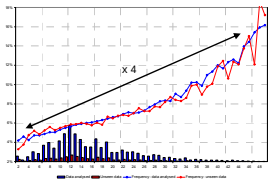
Interactions



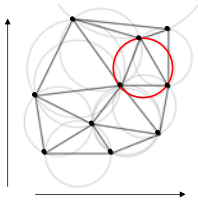
Spatial smoothing

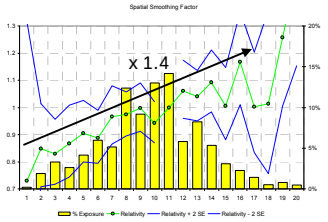


Unsmoothed Smoothed



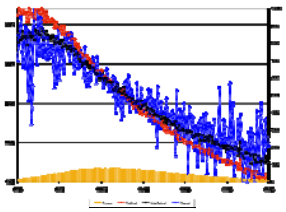
Analogous vehicle groupings techniques



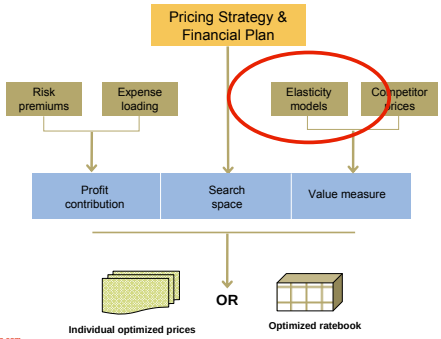


"Case Deleted Deviance"

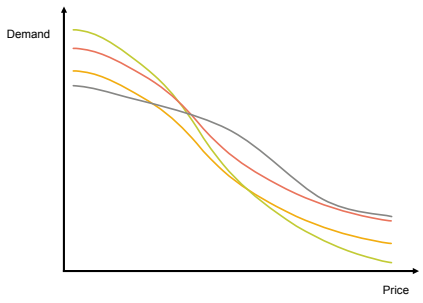
- Tony Lovick & Peter Lee
- Sessional Meeting of the Institute and Faculty of Actuaries 28 March 2011
- www.actuaries.org.uk



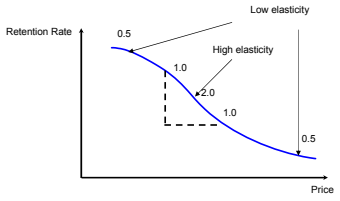
Price optimization



Price demand elasticity

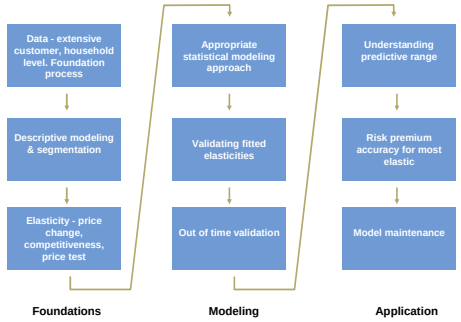


Elasticity



- There are different definitions of elasticity
- Common definition is % change in demand for % change in price
- Price elasticity varies by price:
  - "Policyholder X has elasticity Y" ✖
  - Be wary of assuming straight lines (even in linear predictor space)

Elasticity modeling - a rigorous approach



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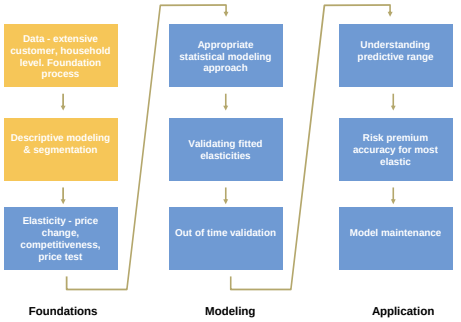

Customer characteristics

(Contents not available in handout)

Company triggered changes

(Contents not available in handout)

External influences

(Contents not available in handout)

Customer triggered changes

(Contents not available in handout)

An alternative view of elasticity drivers
Return to basic economic theory

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Brand

(Contents not available in handout)

Behavioural analysis and customer profiling

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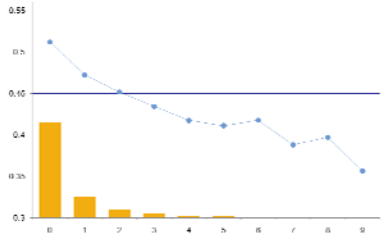
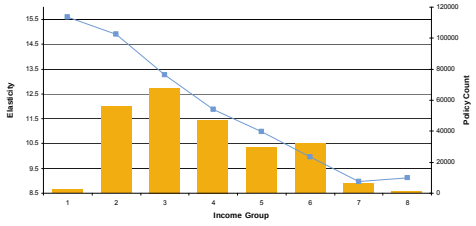
Behavioural factors

Auto retention rate by number of homeowners quotes

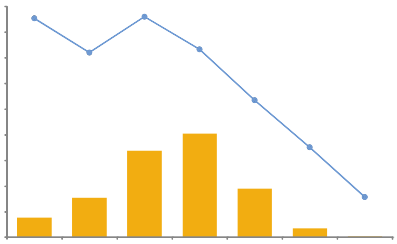


Affluence

Elasticity Variation by Affluence



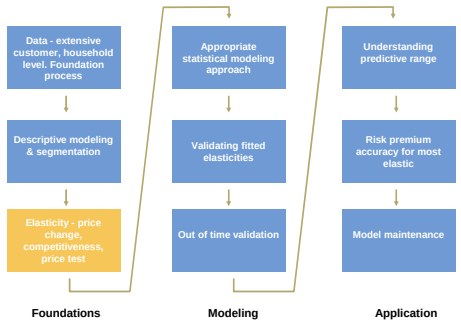
More unusual factors



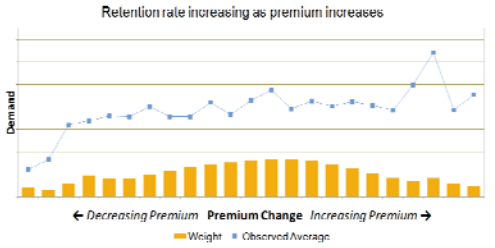
Add-on propensity

(Contents not available in handout)

Elasticity modeling - a rigorous approach

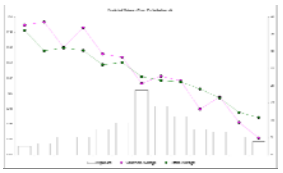


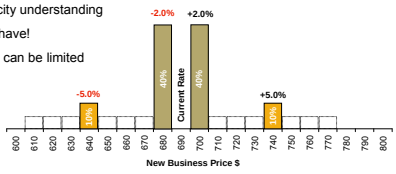
Risks



Price trials

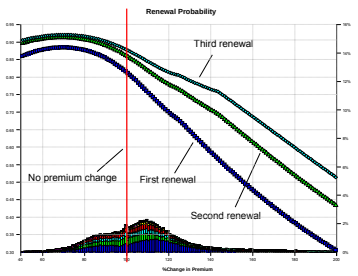
- In deregulated markets, ideally vary random sample of quotes on an ongoing basis
- In regulated markets, other standard rate changes need to act as a proxy
- Best to decorrelate from other factors as much as possible
- Geographical or vehicle reclassification can yield valuable elasticity understanding
- But, you have what you have!
- If range is limited, scope can be limited





Elasticity modelling without price tests

- It is possible to capture some elasticity variation just from undesigned historic price changes



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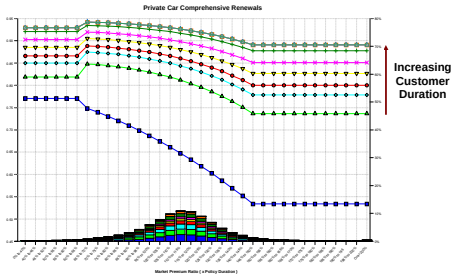
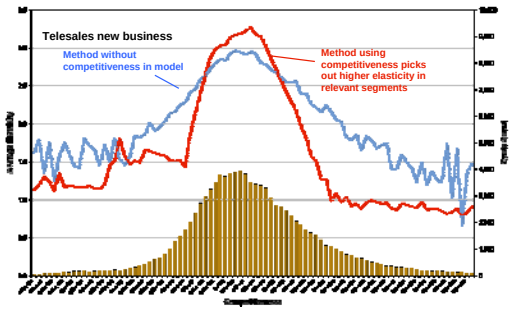
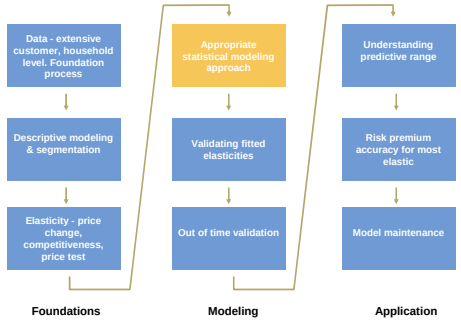


Competitiveness measures

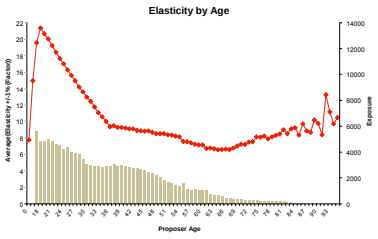


Elasticity modeling - a rigorous approach



Modeling elasticity vs demand

- Y-variate still "did they buy, yes/no"
- Focus on price related explanatory variables different
- Can re-express as elasticity by wobbling price explanatory variables after fitting model

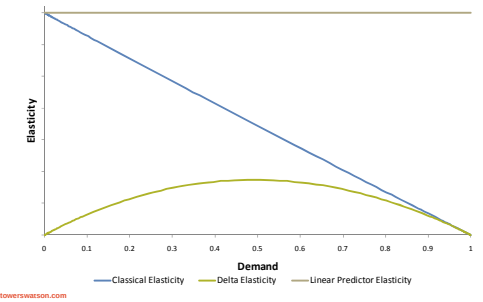


What do we mean by "price elasticity"?

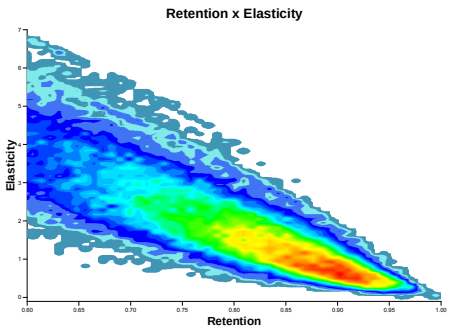
- Most people define elasticity as ….
  - **Percentage change in demand / percentage change in price**
  - "Classical elasticity"
  - Definition found in economics textbooks
- But sometimes …
  - **Percentage point change in demand / percentage change in price**
  - "Delta elasticity"
- or …
  - **Absolute change in linear predictor / percentage change in price**
  - "Linear predictor elasticity"
  - Doesn't vary with demand

What does logit imply about elasticity?

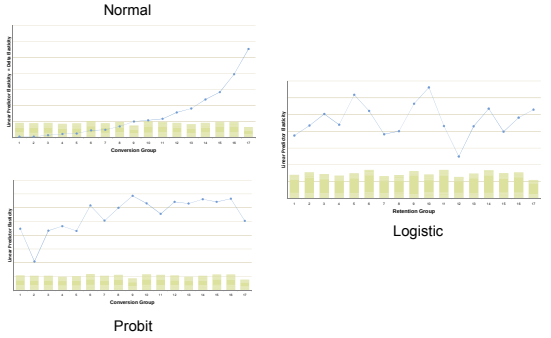
- If there are ***no interactions with price change factors***



Classical elasticity and lapse rate – example XY plot



The case for logistic GLMs



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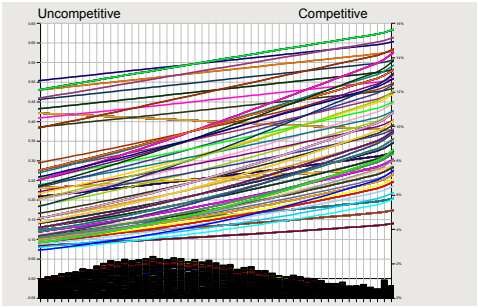
Potential issues for GLM with interactions



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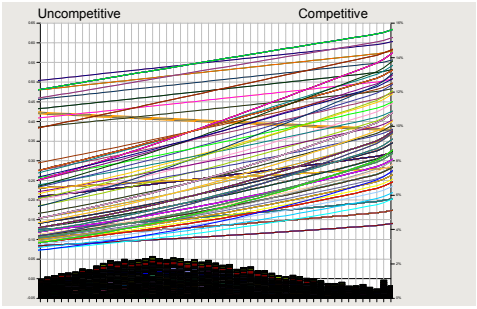
Potential issues for GLM with interactions



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Generalized non-linear models

- Many forms, one of which is:

$$y = \frac{1}{1+\exp(-X\beta + \underbrace{\Delta P e^{Z\chi}}_{\text{Term forces elasticity to be positive}})} + error$$

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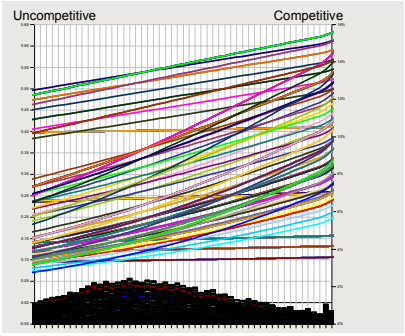
Generalized non-linear models



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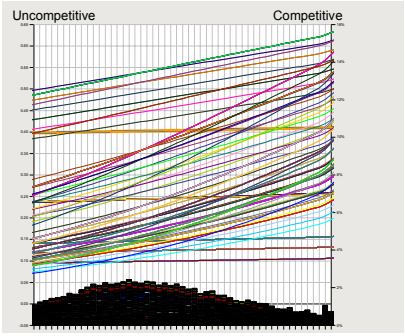
Generalized non-linear models



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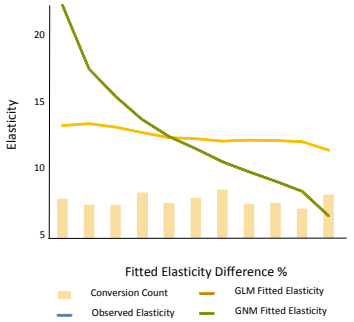
New business – linear vs. non-linear



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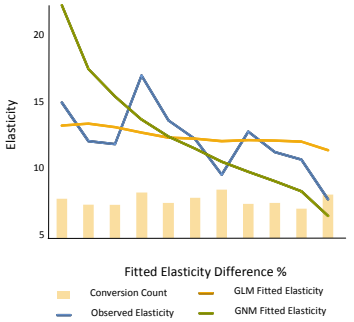
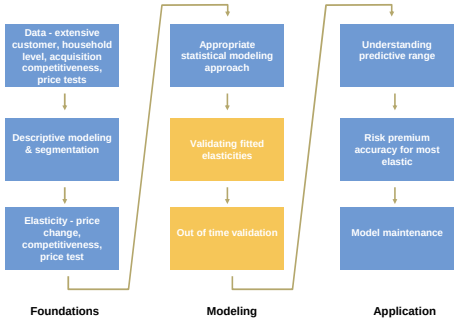
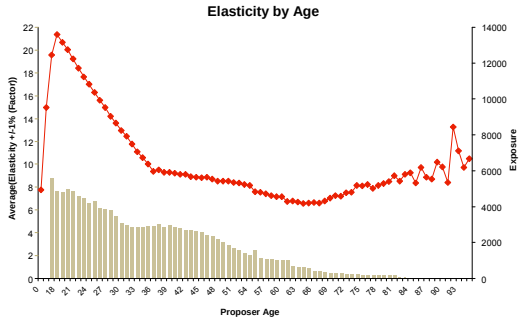


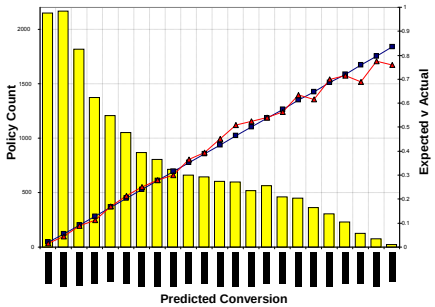
Elasticity modeling - a rigorous approach



Checking modeled elasticity



New business - out of time validation



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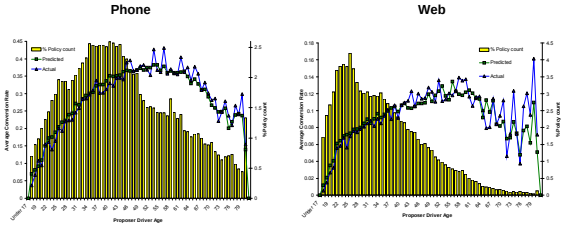
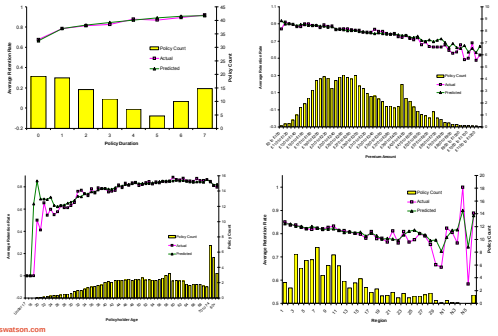


Renewals - out of time validation



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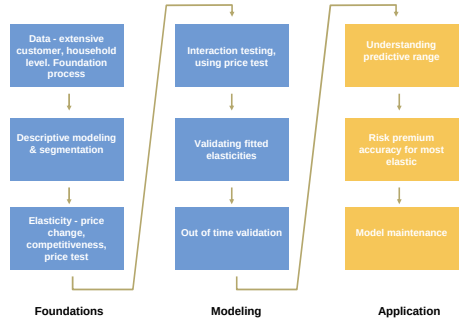

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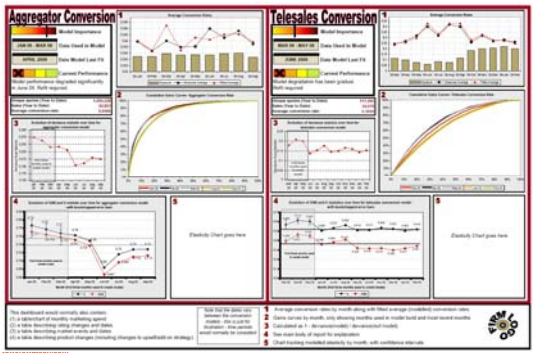
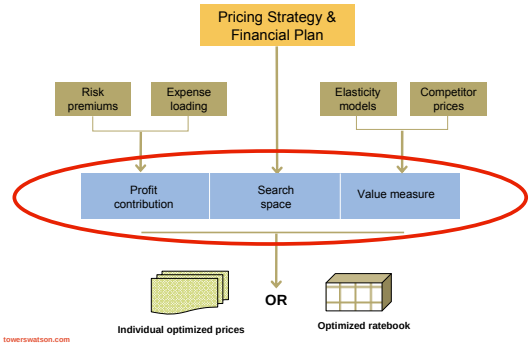
Monitoring



Price optimization



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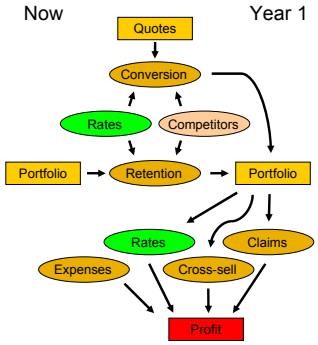
Projection



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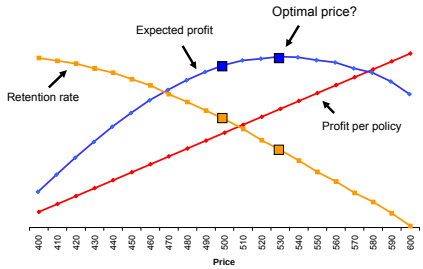
Results for one policy



Premium for policy in question

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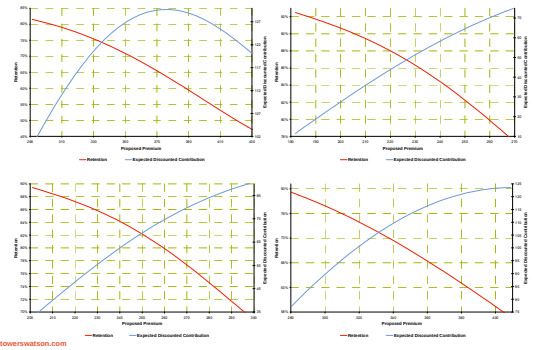
Results for four policies



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Balancing profit and volume

- Can optimize
  - profit for a particular volume, or
  - volume for a particular profit

  over a defined time horizon
- Try different options to understand different balances available
- Generates efficient frontier which aids understanding of target selection

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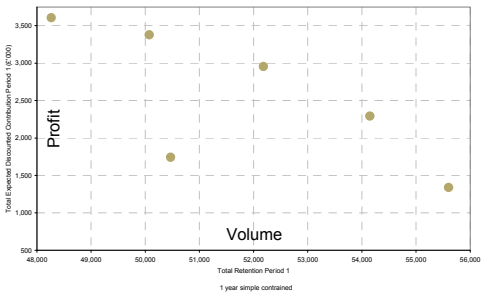
One year efficient frontier



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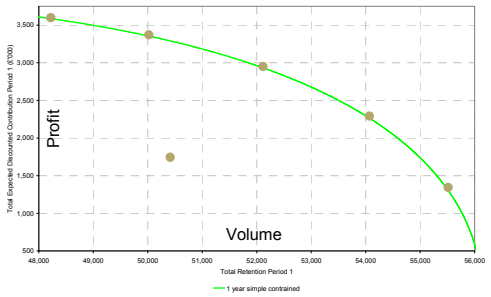
One year efficient frontier



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Time horizons

Advantages

More certain short-term profitability

Protects long-standing customers

Time Horizon

Short → Long

Disadvantages

"Milks" the most inelastic customers leads to a reducing quality portfolio

Profits anticipated in future years may be "illusory" (predicting future market prices?)

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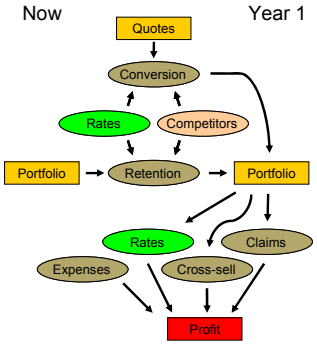
Projection



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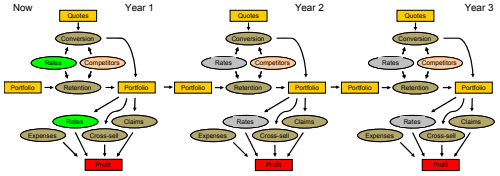
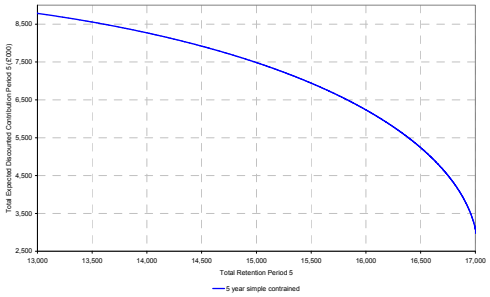
Projection

Projection

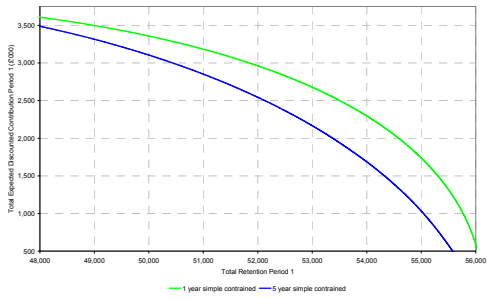


Projection

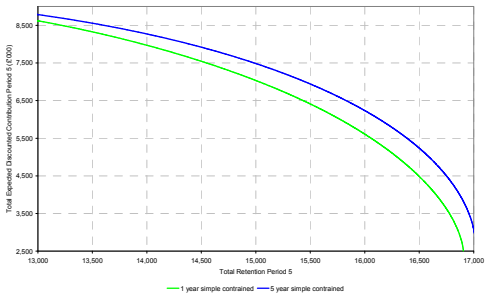
Five year efficient frontier



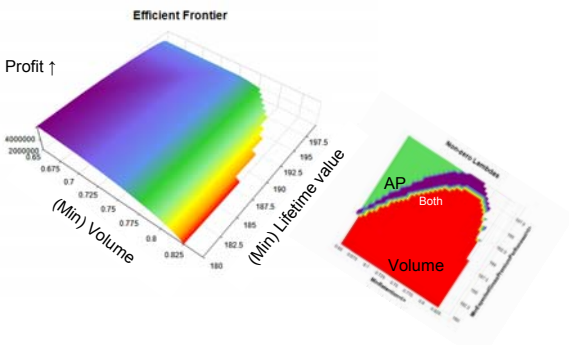
One year efficient frontier



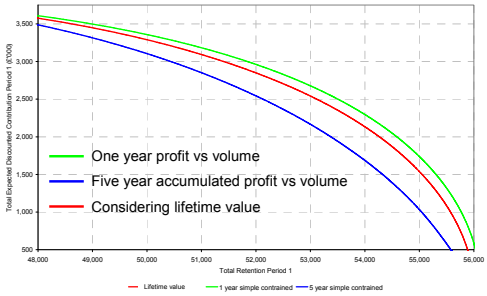
Five year efficient frontier



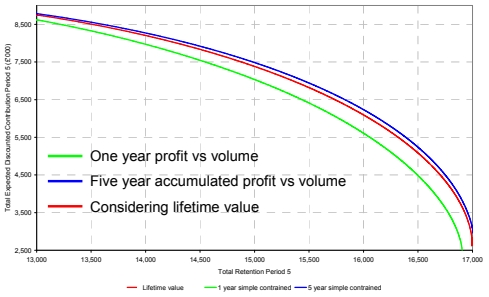
Multidimensional Optimisation



One year efficient frontier

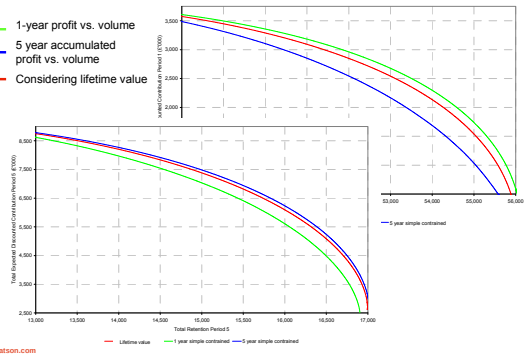


Five year efficient frontier



Almost the best of both worlds

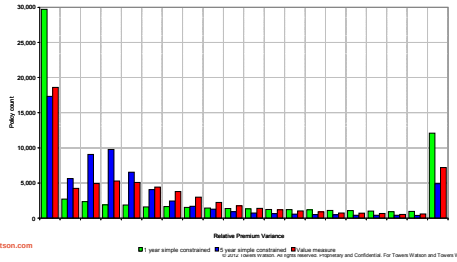
1-year profit vs. volume
5 year accumulated profit vs. volume
Considering lifetime value



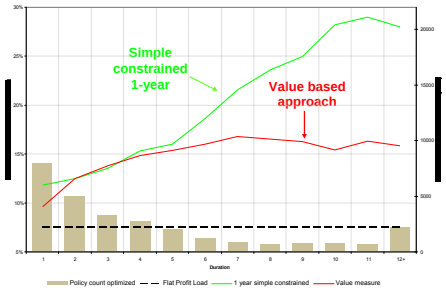
Value based approach - premium variances

Value based approach avoids concentration of profit loads at extreme values which…

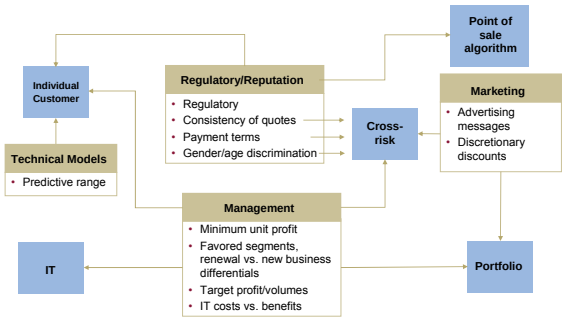
- Extracts large profits from a small customer group
- Maximizes degree of price differentiation
- Relies on predictive accuracy of models at their extremes



Value based approach - premium variances by tenure



Constraints

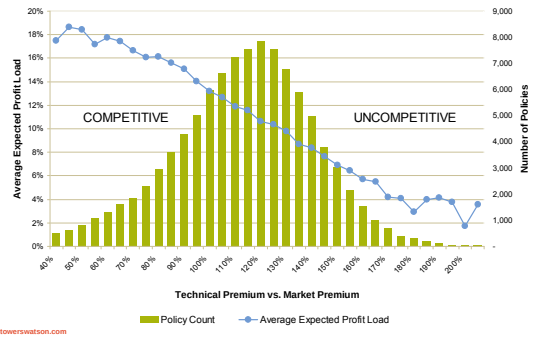


Example profitability constraint

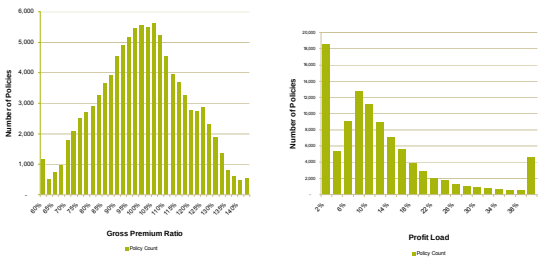
(Contents not available in handout)

- Constraining profit loads inhibits ability to drive profit uplift(!)
- This is the "natural" dimension of uplift for an inelastic portfolio
- Constraint cedes a large percentage (65%) of potential profit uplift measured at constant retention
- Cedes around 58% of potential retention rate uplift, at constant profit load uplift

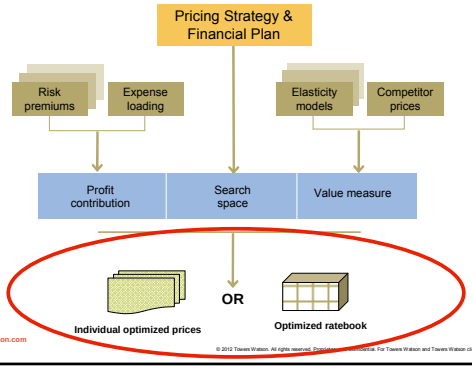
Example diagnostics



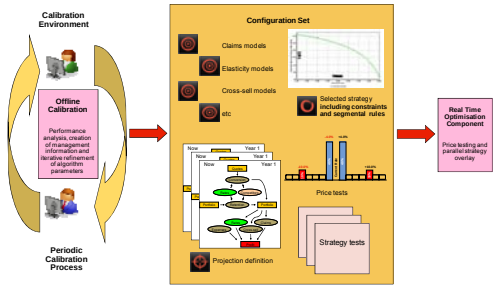
Example diagnostics



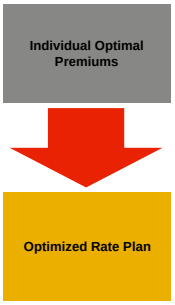
Price optimization



Implementation - Real Time Optimisation



Optimization Process



- Maximum performance lift
- Not feasible for pricing
- Useful for other decisions

- Optimal within rate plan constraint
- Simple to complex
- Easier to communicate and manage

Implementation

Individual optimized Prices

Policy no.	Premium
PEL009759458	327
UQJ408808153	555
KZH964999642	261
DDU700866747	349
VUQ391058119	334
YUM718736198	331
GBQ270981530	279
CSR303293030	188
XTB008693907	175
TJJ330632016	319
MFD704472553	349
ZVI955030095	277
ZJY528736252	372
VRF026498810	647
BIN297260627	555
SXT608697514	203
JAE716278042	163
XUS991829954	633
IVN822320056	641
FOD690200573	232
DCI071346826	325
SEL511154881	538

- Starting point is individually optimized rates

Implementation

Individual optimized Prices

Policy no.	Premium
PEL009759458	327
UQJ408808153	555
KZH964999642	261
DDU700866747	349
VUQ391058119	334
YUM718736198	331
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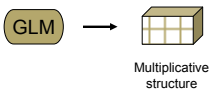
Can fit GLM to results to yield multiplicative structure using standard rating factors



Implementation

Individual optimized Prices

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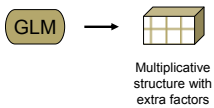
JAE716278042	163
XUS991829954	633
IVN822320056	641
FOD690200573	232
DCI071346826	325
SEL511154881	538

Can fit GLM to results to yield multiplicative structure using standard rating factors **plus alternative factors**



Implementation

Individual optimized Prices

Policy no.	Premium
PEL009759458	327
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VUQ391058119	334
YUM718736198	331
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JAE716278042	163
XUS991829954	633
IVN822320056	641
FOD690200573	232
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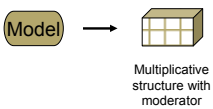
Can use moderators (caps and floors) in conjunction with multiplicative structure



Implementation

Individual optimized Prices

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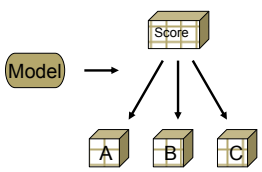
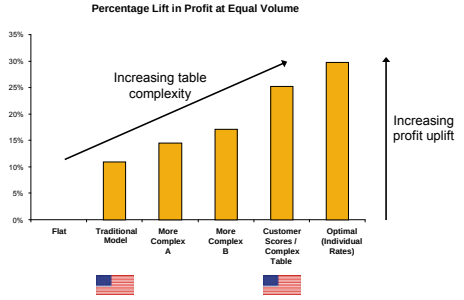
FOD690200573	232
DCI071346826	325
SEL511154881	538

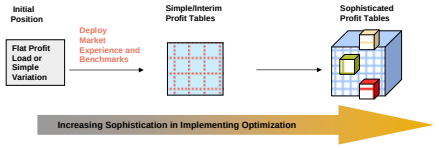
Can create scoring algorithm similar to tiering approach



Profit uplift comparison
Real example (UK motor renewals optimization)



Optimized Prices — Implementation Alternatives



Simple/Interim Tables

- Least onerous IT implementation
- Refreshed rarely
- Low uplift attainable
- Trades on blunt intrinsic demand characteristics

Sophisticated Tables

- Can be more onerous IT implementation
- Client rating engine capabilities are key
- Requires more frequent re-parameterization
- Varying uplift attainable
- Reflects changing demand characteristics

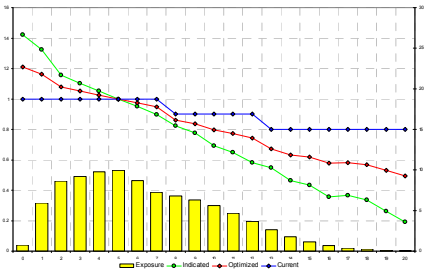
Why not optimize the ratebook directly?

- Methods exist which allow direct optimization of ratebook form
- Does not improve of approach of modeling individually optimized rates
- Does not show loss of potential lift
- Modeling individually optimized rates indicates when new factors/scores should be considered

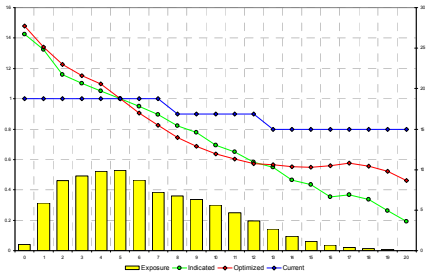
US regulatory constraints

- "Rates shall not be excessive, inadequate, or unfairly discriminatory"
- "A rate is not unfairly discriminatory because it is based in part upon the establishment or modification of classifications of risks based upon:
  - (1) the size of the risk
  - (2) the expense or difficulty in management of the risk,
- …
- Reasonable range
- Reduction in complaints

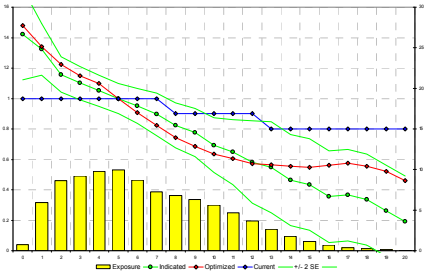
Regulatory constraints



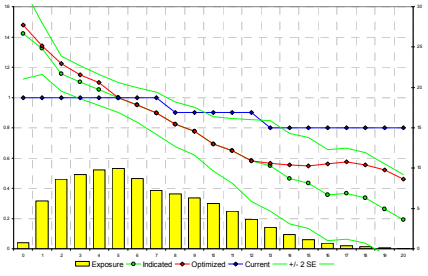
Regulatory constraints



Regulatory constraints



Regulatory constraints



Integrated pricing process

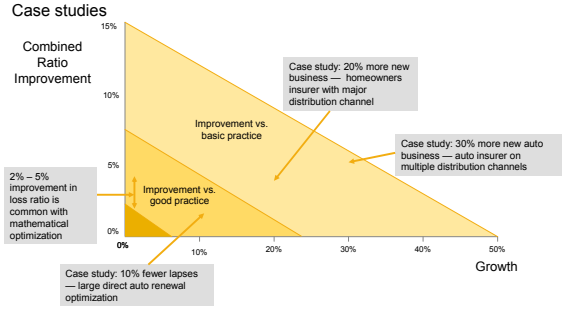
(Contents not available in handout)

Agenda

- What is price optimization?
- Key aspects
  - inputs
  - algorithm
  - implementation
- Business benefits and wider implications

The impact of good pricing on performance

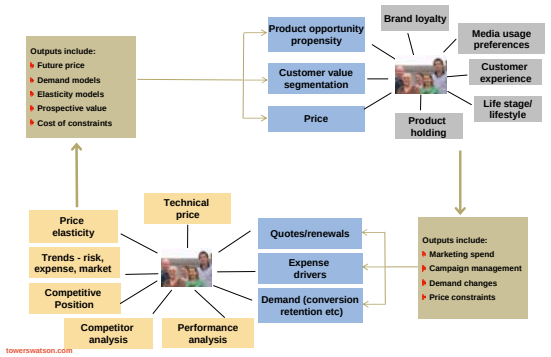
Case studies



Other examples

- Company A improved its private auto new business predicted **loss ratio** by **3%** at constant conversion rate
- Company B had **20%** increase in auto **new business** at constant profitability
- Company C improved **loss ratio** of direct auto business by **1½%** at constant volume, against a control group. Numerous additional benefits cited by company
- Company D optimised its pricing of telesales direct new business: improving predicted **loss ratio** by around **2%**, whilst increasing actual converted business **volumes** by around **6%**
- Distributor E increased its **commission income** by more than **£10 million** per annum
- Distributor F improved its aggregator-sourced private car **conversion** rate by a more than **10%**, at constant unit profitability per sale

The links with marketing



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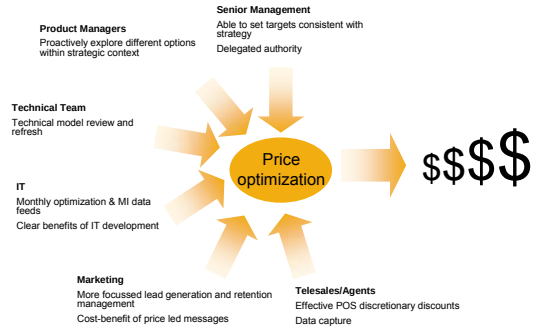
Optimization - bringing the business together



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Price Optimization for the U.S. Market: Techniques and Implementation Strategies

CAS Ratemaking and Product Management Seminar

Duncan Anderson
Alex Laurie

March 20, 2012

TOWERS WATSON