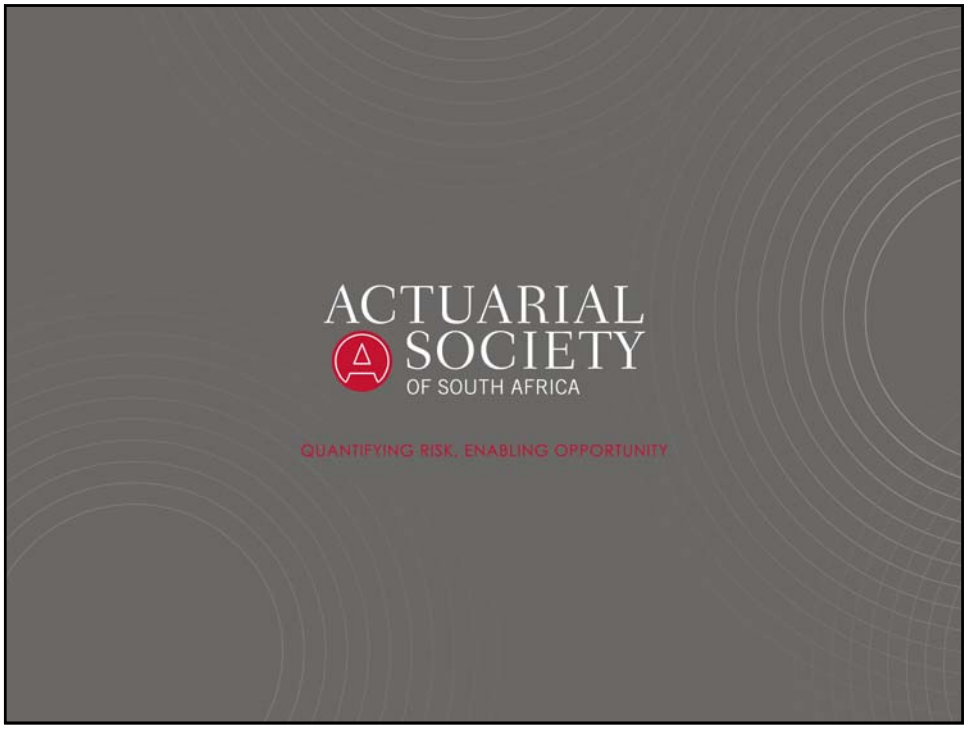

Demand modelling and optimisation

A presentation by James Tanser
of Towers Watson

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Agenda

- What is optimisation?
- What ingredients are needed?
- Demand and elasticity modelling
- The journey to optimisation
- Conclusion

WHAT IS OPTIMISATION?

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What is optimisation?

- Traditional approach to pricing is "cost-plus": Premium equals
  - Risk cost
  - Plus loadings for fixed and variable expenses, profit, commission etc
  - Profit typically fixed proportion of risk
- Optimised pricing is any deviation from "cost-plus" where:
  - You use information on things other than the insured risk (eg behaviour)
  - The premium is adjusted away from the cost-plus price
  - The purpose of the movement is to achieve some business goal
  - Profit not fixed proportion of risk

Adjusting prices away from a cost-plus basis to better achieve business objectives

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Manual versus mathematical optimisation

Manual optimisation	Mathematical optimisation
• Based on good understanding of risk from GLM and simple model behaviour (e.g., one- or two-way analysis) • Used to construct model of business • Test alternate premium structures	• Based on high-quality GLMs of risk and behaviour • Complex model of business capturing all significant effects • Explicit business aims and constraints • Rigorous mathematical algorithm produces best price to achieve these aims

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Manual optimisation

- Can be implemented quickly once good risk models are in place
- Can deliver significant business insights
- Model of business will evolve over time as additional models (e.g., of behaviour) become available
- Small, incremental improvements to profitability reliably achieved
- Forms foundation for later mathematical optimisation

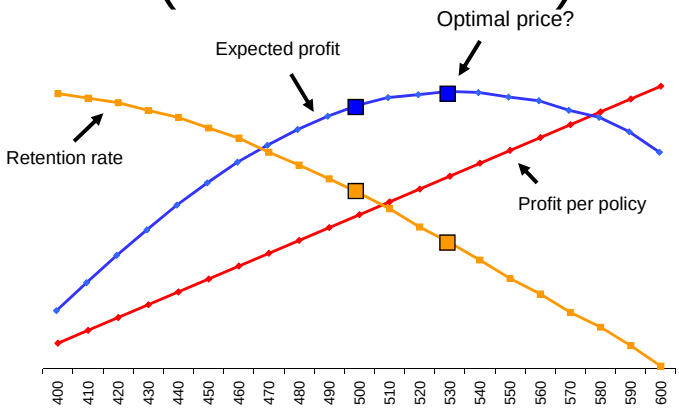
What is mathematical optimisation?

Use customer level knowledge of:
- Risk costs
- Expenses
- Competitive positioning
- Price elasticity
- Buying behaviour
- Retention behaviour
- 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

Results for one policy (Unconstrained)



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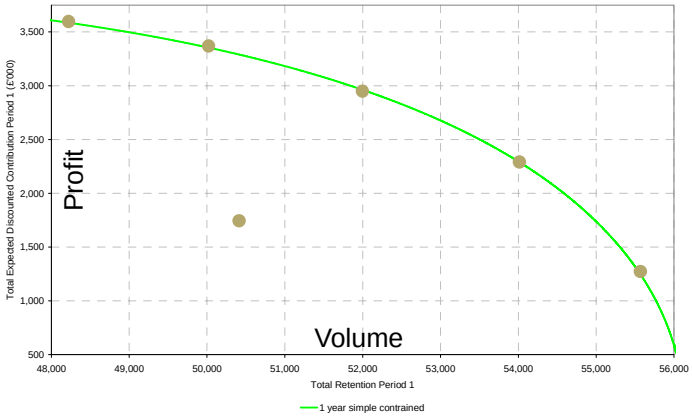
One year efficient frontier



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More complex in practice…

- Limits on policy premiums acceptable
- Time horizon
- Life Time Value
- Policy add-ons
- Marketing promises

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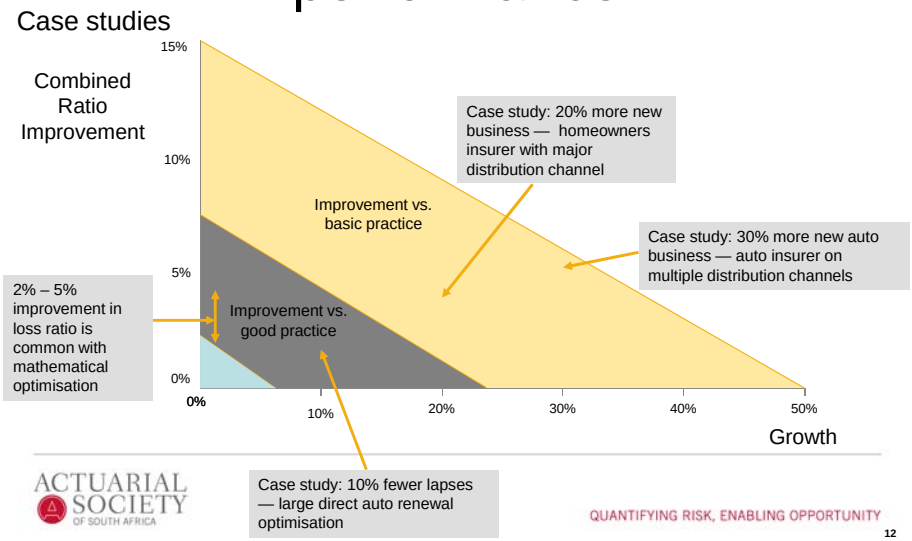
The impact of good pricing on performance



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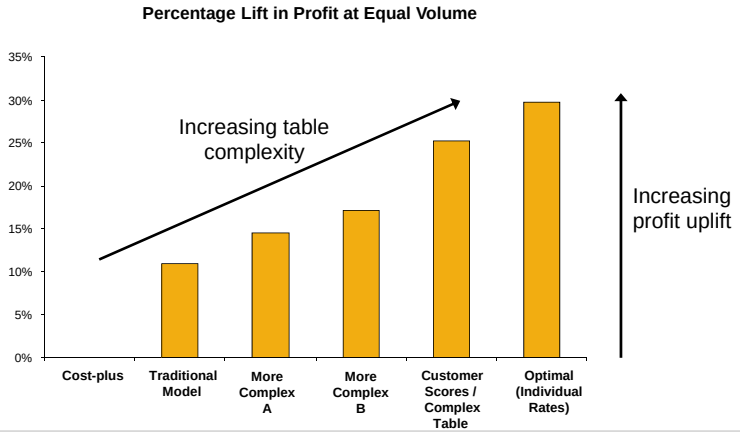
Implementation options

- Individual
  - Each policy gets unique price
  - Can update rapidly following market changes
  - Relatively straightforward for renewals
  - More challenging for new business
- Rate book
  - New rating structure derived to target goals
  - Simple to implement using existing processes
  - Benefits smaller than individual optimisation
  - Harder to react to rapidly changing market

Motor renewal example



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WHAT INGREDIENTS ARE NEEDED?

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What ingredients are needed?

- Data
- Models
- Assumptions
- Targets & Limits
- Software
- … and a really good cook!

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Data

- Policy & claims data
  - Accurate and appropriate
- Customer behaviour data
  - Renewal
  - New business
  - Other products
- External data
  - Geography
  - Credit
  - Vehicle

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Models

- Risk models
- Lapse rates
- Conversion rates
- Up sell rates
- Cross sell rates

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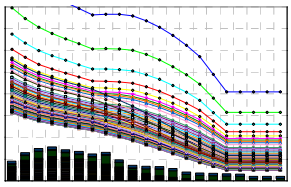
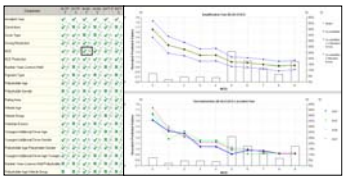
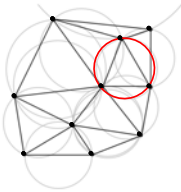
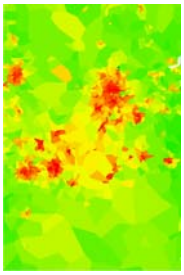
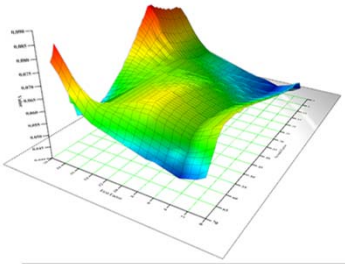


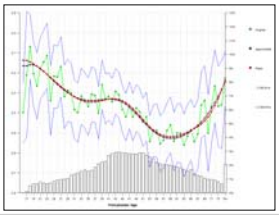
Models











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Assumptions, targets and limits

- Expenses, split into fixed, variable, per claim
- Competitor prices (useful if available)
- Quotations

- Management goals
  - Profit or volume?

- Minimum & maximum price change
- Minimum premium

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Software

- Data manipulation
  - Create new fields
  - Join data
  - Analyse and clean data
- Analyse using GLM tool
  - Must cope with large data sets
  - Needs to fit models quickly
  - Ideally include advanced discovery tools
- Perform optimisation
  - Should allow bespoke model creation
  - Needs to cope with policy features
  - Must provide useful Management Information
- Implementation
  - Use existing policy administration systems or replace?
  - Bolt-on software can provide simple solution

What makes a good cook?

- This is a lot of work which takes time and resources
- Substantial front end investment, but yields big rewards
- You need
  - Leadership
  - Vision
  - Control of budgets
- This implies the project overseen by the senior management
  - Not just a technical exercise in an ivory tower

DEMAND AND ELASTICITY MODELLING

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Demand and elasticity modelling

- Lapse and conversion rates are key to optimisation
- However, models of demand are not sufficient in themselves
- We want to understand the change in the demand following a price change – this is price elasticity
- A model of demand is not automatically a model of elasticity

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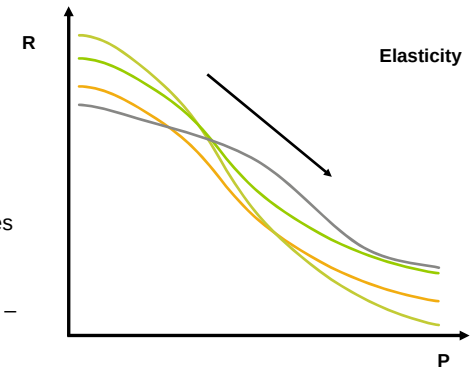
Demand modelling

- Use GLM with all available information
  - This gives the demand
- Could include premium in the model
  - Gradient of line is elasticity
- In practice this is problematic
  - Correlated with other variables
  - Correlated with segmental competitiveness
  - Hard to derive good elasticity – can have wrong sign



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Definition of elasticity

- Standard definition is:
  - Percentage change in demand / Percentage change in price
- This is challenging to model directly using a logistic GLM
- Common to use “price sensitivity”:
  - Change in GLM linear predictor / Percentage change in price
- This is simple to model and has several nice properties

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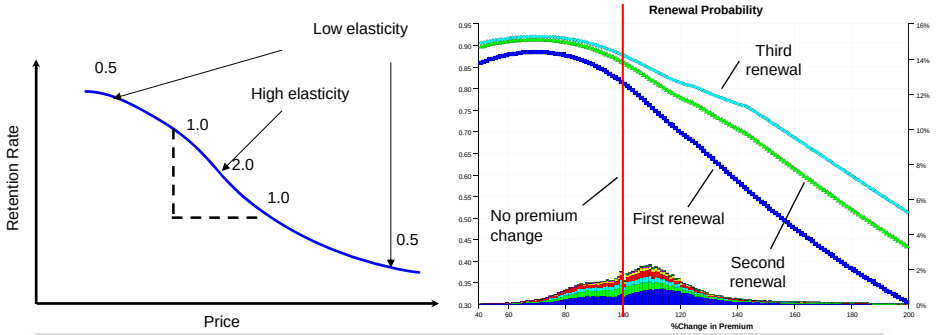
Elasticity

- Elasticity is not constant



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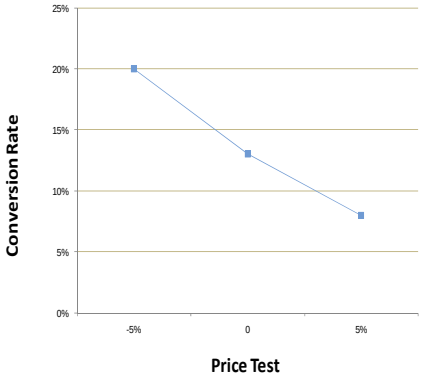
Elasticity (sensitivity) modelling

- Include a price test in the model in addition to premium and other rating factors
  - Premium should be before the price test
- Gradient of resulting slope is price sensitivity
- Ideally price test should be random



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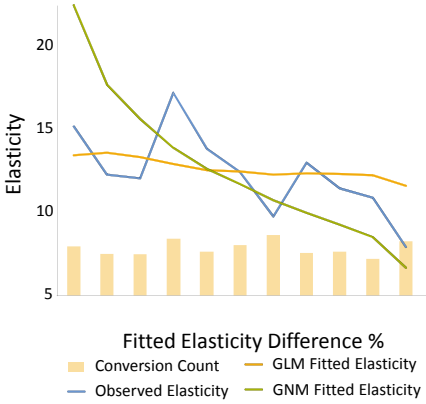
Alternate method

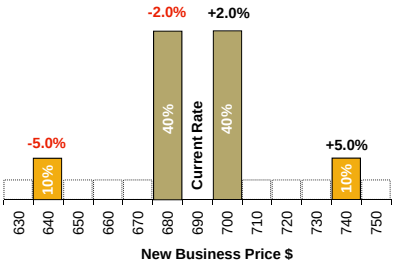
- Generalised non-linear models
- Corrects for some perceived weaknesses of GLM approach
- Overall method is no better

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



Randomised price trials

- Typically use some pseudo random proxy to ensure consistency
  - Function of postcode typical
- Can use just two values
  - +/-5%
  - No need to include 0%
- Ideally every customer is included in the trial
- Historic price changes can be used in unoptimised environment only



Best practice modelling

- Use recent, relevant data
- Competitor prices or market index can be useful
- Price sensitivity can vary between segments – consider interactions
- Regularly refresh the models

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THE JOURNEY TO OPTIMISATION

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The journey to optimisation

- Optimisation is hard to do right, but can deliver large rewards
- A step by step approach will ensure that the full potential is realised
- Each step should deliver insights and improved performance
- Process can build in reference samples to demonstrate value realised

Steps along the way

Foundation	Entry	Expert
• Analytics software • External data • Improved risk models • Policy level projection software • Basic customer impact & portfolio projection	• Basic demand models • Flexible customer facing IT systems • Detailed expense analysis • Enhanced what-if portfolio projection (manual optimisation)	• Randomised price trials • Elasticity models • Optimisation pilot • BAU optimisation • Allowance for up-sell and cross-sell • LTV measures used to guide customer interactions

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Value case: Foundation level

Foundation

- Analytics software
- External data
- Improved risk models
- Policy level projection software
- Basic customer impact & portfolio projection

- Business as usual for most companies
- External data arms race common feature of developed markets
- Advanced interaction search techniques can add significant value
- The cost of getting this wrong is significant anti-selection

Value case: Entry level

Entry

- Basic demand models
- Flexible customer facing IT systems
- Detailed expense analysis
- Enhanced what-if portfolio projection (manual optimisation)

- Improved customer facing systems allows premiums to be updated daily, and creates platform for later enhancements
- Basic model of potential outcomes enables better decision making
- Overall can result in significant loss ratio reduction

Value case: Expert level

Expert

- Randomised price trials
- Elasticity models
- Optimisation pilot
- BAU optimisation
- Allowance for up-sell and cross-sell
- LTV measures used to guide customer interactions

- Pilot optimisation on subset of book can clearly quantify benefits
- Further enhancements increase customer lifetime value across the book
- 2% to 5% loss ratio improvements possible at constant volume
  - Higher volumes possible in return for smaller LR improvements

CONCLUSION

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Conclusion

- Optimisation is being used in many world markets to deliver improved performance
- High quality models of customer behaviour are key to this process
- There is considerable value in even partial solutions
- First movers have a significant advantage, and will be able to improve their portfolio at the expense of the rest of the market
- Continuous improvement needed to maintain that position

Lessons from literature

- "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"
  - The Red Queen, Alice Through the Looking-Glass by Lewis Carroll

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