Key themes in technical pricing

- Process and control
- Understanding difference between expectations and reality
- Selecting the right tools for the job
  - Parsimonious modelling
Integrated business processes

- Rate monitoring
- Allocating cost of capital
  - Line of business
  - Policy
- Communication
  - Reserving
  - Underwriting
  - Capital modelling
Processes and controls

- Managing operational risk is an important aspect of the business
- Rigorous controls are the norm for claims
- Pricing is key source of profit
- How do you protect your business against:
  - Charging the wrong price
  - Accusations of unfairness in pricing
  - Errors in key calculations
  - Loss of key staff
Processes and controls

- Need to have:
  - Clear and persistent records of analysis
  - Documentation of decisions
  - Standard methods to allow task sharing

- These should be:
  - Automatic and embedded within systems
  - Universal: Actuaries, Underwriters, Claims Managers
  - Regularly reviewed to check compliance
  - Not too onerous
Technical pricing overview
Clean

- Insurance data notoriously poor
- Common issues:
  - Duplicate data
  - Overlapping exposure
  - Miss-matching claims
  - Zero claims / nuisance claims (eg £1)
  - ...
- External data
  - Watch for non-matches
Clean

- Need to record steps and make it repeatable
  - Makes updates easier
- Don’t forget the sense checks:
  - Number of records
  - Total exposure, premium, claims
- Missing values
  - Ignore or correct?
  - Interpolation?
Clean
Common issues

- Character fields containing only numbers
- Equality mappings with rounding errors
  - 0.99999999 vs 1
- Concatenation and spaces
- Unexpected loss ratios
  - Earned or Unearned premium
  - Annual or Monthly premium
  - Current, Office or Actual premium
  - Mid-term cancellations/adjustments
  - Different as at dates for claims
  - Different mix of business
Technical pricing overview

- Final Premium
- Raw Data
- Pricing Data
- Analyse
- Refine
- Theoretical Model
- Commerical Model
- Adjust
- Proposed Premium
- Project
- Monitor
Analyse

- Oneways and twoways still useful
- Understand outliers (distribution graphs)
- Iterate models
  - Start with simple variables
  - Add interactions
  - Consider grouping and splines
  - Take care not to over fit
Analyse
Type of modelling

- Pick suitable tools for the job
  - More than 1000 claims?
    - Use GLM
  - More than 50 claims?
    - Consider statistical methods on own data
  - Less than 50 claims?
    - Use benchmarks

- Can use mix of methods
  - Credibility can be used to blend results
Analyse
Model form

- Poisson / Gamma GLM
  - Standard for frequency / severity
  - Multiplicative model well suited to premiums
  - Best choice for mass market pricing

- Tweedie GLM
  - Useful for high level analysis
  - Can miss detail
  - Take care in interpretation
Analyse
Model form

- Probability models
  - Binomial error recommended
  - Choice of link functions
    - Logit
    - Probit
    - Log
    - All useful in different situations
Analyse
GLM or GAM

- GLMs useful in most cases
- GAMs have some nice extensions for continuous variables
- Use of splines sits in GAM world
  - Regression splines easily fitted using GLMs
- In general, GAMs are more processor hungry, often by an order of magnitude
Technical pricing overview

- Proposed Premium
- Commercial Model
- Theoretical Model
- Refine Model
- Analyse
- Clean
- Raw Data
- Monitor
- Final Premium
- Project
Refine

- Theoretical models useful and interesting
  - Eg: Can use in projections later
- Commercial models reflect the reality of what can be done
  - Still best model of data, just from a smaller set of variables
  - May include some restrictions where necessary
Refine
Continuous variables

- Best treated as regression splines
- Easy to use, easy to understand
Refine Splines

- Take care with missing values
  - Use indicator flag to avoid distortion
- Verify actual shape of curve, especially at edges
- Common issues:
  - Knot placement
  - Overfitting to noise
  - Inappropriate extrapolation
Inappropriate extrapolation

Retention analysis

Change in premium vs. Probability

Probability Model

The Actuarial Profession
making financial sense of the future
Refine Seasonality

- Relevant for monthly projections and very short term products (e.g., travel)
- Also useful for models of claims
  - Reserving
  - Initial claims estimate
- Can model using circular splines
  - Add underlying trend factor to deal with inflation
Seasonality plus trend

Seasonal Data

Example seasonality - Spline, trend year
Refine
Check the model’s fit

- Ideally keep hold out sample
  - 80/20 or 60/40
  - No hard rule

- Check the model for:
  - How well does it predict
  - How well does it separate
  - Improvement over existing models
Refine
Model validation
Refine
Lift curves

Claim frequency vs. Exposure (years)

- Model 1
- Model 2
Refine
Loss ratio impact
Technical pricing overview

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Adjust

- Modelling process delivers relativities
  - Smooth if necessary
- Base level may not reflect reality
  - Slicing
  - Weighting
  - Where clause
  - Gamma typically within +/-10% (usually less than 5%)
Absolute rates

- **What premium income is required?**
- **For claims consider**
  - IBNR / IBNER
  - inflation
  - trends
  - large claims
  - abnormal effects
- **Then add on expense / commission /profit loadings etc**
Adjust

- Update intercept to hit target income on assumed portfolio
- Take care with maturing portfolios
- Remember that discounts and offers change both premium and risk profile
Technical pricing overview
Project

- Try to understand what will happen following a change in premium
- Many actions have unexpected consequences
  - Try to anticipate some of these!
Project
Range of projection complexity

Simple

- Compare current and proposed rates
- Adjust a small number of parameters to balance changes
- Use policy and claims data only

Complex

- Use projection using customer behaviour models to understand outcome
- Calculate optimised moderators to limit portfolio impact
- Perform price optimisation

Combine results from multiple sources
Project

Simple impact graph

Example job

Age of driver

0
1000
2000
3000
4000
5000
6000
7000

0.450 -
0.500
0.600 -
0.650
0.750
0.800
0.850
0.900
0.950
1.000
1.050 -
1.100
1.150
1.200 -
1.250
1.300 -
1.350 -
1.400
1.450
1.500 -
1.550
1.600 -
1.650
1.700
1.750
1.800 -
1.850
1.900 -
1.950
2.000 -
2.050
2.100 -
2.150
2.200 -
2.250
2.300 -
2.350
2.400 -
2.450

Ratio: Risk Premium / Current tariff

Count of records

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
110%
120%
130%
140%
150%
160%
170%
180%

Loss ratio

17-21 22-24 25-29 30-34 35-39 40-49 50-59 60-69 70+
Claims / Earnedprem
Project

- Projection will give some indication of likely impact of premium
- Final selected premium will be customised to meet specific targets
- No plan ever survives contact with the enemy
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Monitor

- Monitor actual outcome against projection
  - Volumes
  - Average premiums
  - Loss ratios

- Take care with IBNR / IBNER
  - Can get caught by late developing claims
  - Important to stand back and take longer term view
Monitor

- Work to improve data quality and capture new data
- Can short circuit process:
  - Mini-price changes
  - Quick analyses
- Return to start to do regular re-rating
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Technical pricing overview
Best practice

- Document each step
  - Reproducible
  - Checkable
  - Auditable

- Use common software, templates and methods

- Check and peer review of work

- Use suitable methods & experiment with new ones
Questions
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