Individual claim modelling of CTP data

Gráinne McGuire

Taylor Fry Consulting Actuaries

Contents

- Introduction
- Data
- Motivation – why model by injury severity
- Modelling
  - Injury severity
  - Legislative effects
  - Projection of claim sizes
- Discussion

Introduction

- A previous case study showed that traditional chain ladder models underperformed stochastic models of average claim size for an Australian CTP data set

- Generalised linear model used for size of individual finalised claims. Size depended on accident and calendar periods and operational time

- Data up to September 2003

- With three years additional experience does the model need revision?

Data

- Unit record claim data with
  - Date of accident, notification, finalisation
  - Injury codes and claim severity
  - Other claim characteristics

- Histories of
  - Claim status
  - Claim payments
  - Case estimates

Motivation – why model by injury severity

- Claims can have one of six injury severity levels:
  - 1 (least severe) to 5 (catastrophically injured) and 6 (fatality)
  - Claim sizes in each very different
- Claim frequency has been changing over time
  - Does not affect all severities equally
  - Higher claim frequency → more lower severity claims and vice versa

Motivation

- Change in claim size with changing frequency

Accident year ending 30 June	Proportion of claims in each severity							Overall Average size
	1	2	3	4	5	6	Other	
1997	72%	15%	7%	1.2%	0.6%	1.5%	2.6%	57,110
1998	73%	13%	6%	1.5%	0.4%	1.1%	4.0%	53,594
1999	75%	12%	6%	1.2%	0.4%	0.9%	4.3%	52,140
2000	74%	12%	6%	1.2%	0.4%	1.1%	5.1%	51,501
2001	75%	13%	6%	1.3%	0.5%	0.9%	2.6%	53,494
2002	75%	13%	6%	1.5%	0.4%	1.2%	2.0%	54,049
2003	77%	12%	7%	1.3%	0.4%	1.3%	1.7%	53,261
2004	75%	12%	8%	1.2%	0.6%	1.4%	1.2%	57,093
2005	71%	13%	10%	1.9%	0.6%	1.4%	1.3%	61,939
2006	71%	14%	10%	2.0%	0.6%	1.4%	1.3%	62,698
Average size of all finalised claims	32,187	69,167	161,647	339,372	906,672	110,734	19,966	

Modelling – injury severity

- The 2003 model was an EDF(2.3) model with terms involving operational time, finalisation quarter and accident quarter.

- The model is updated to
  - Incorporate injury severity
  - Include legislative effects

- Brief details given here – see paper for more information

Modelling – injury severity

- First step is to select suitable error distribution
    - Gamma is used here

- Legislation (2002) had major effect on claim sizes
    - Initially only model data up to start of legislation
    - Then compare actual values post legislation with predicted values (in absence of legislation)
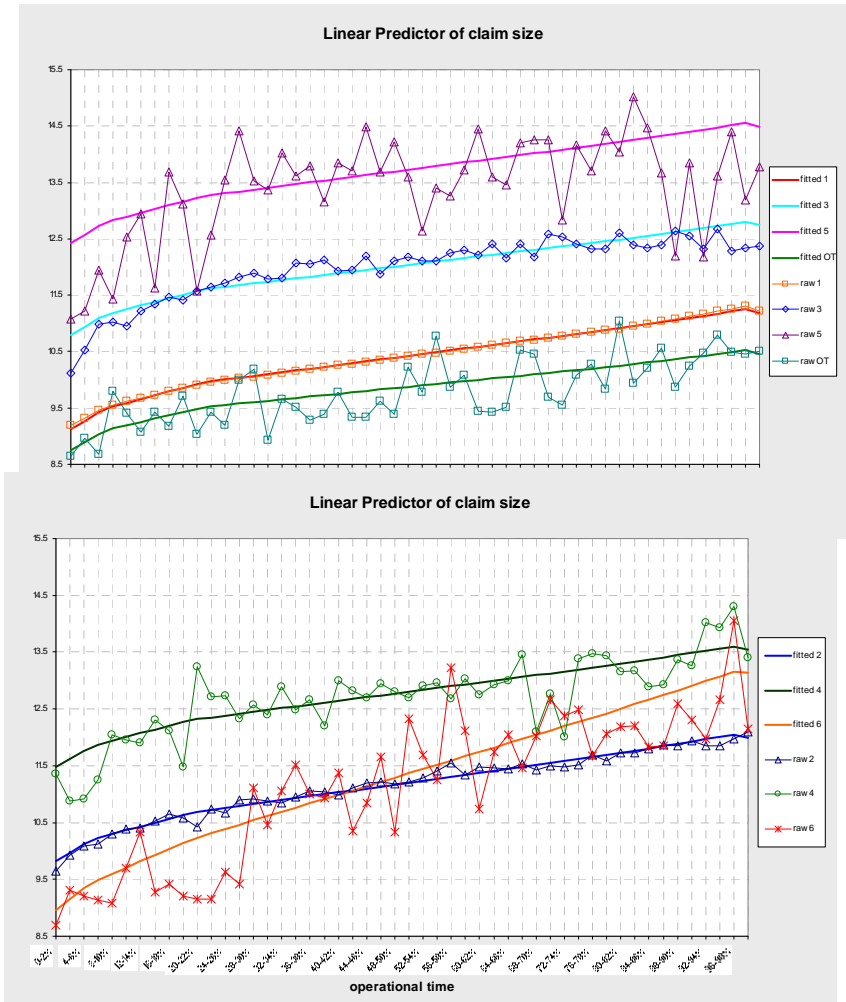
Modelling injury severity

- Fit an initial model with main (categorical) effects for
  - Severity
  - operational time
  - finalisation quarter
- Fit continuous shapes to operational time and finalisation quarter
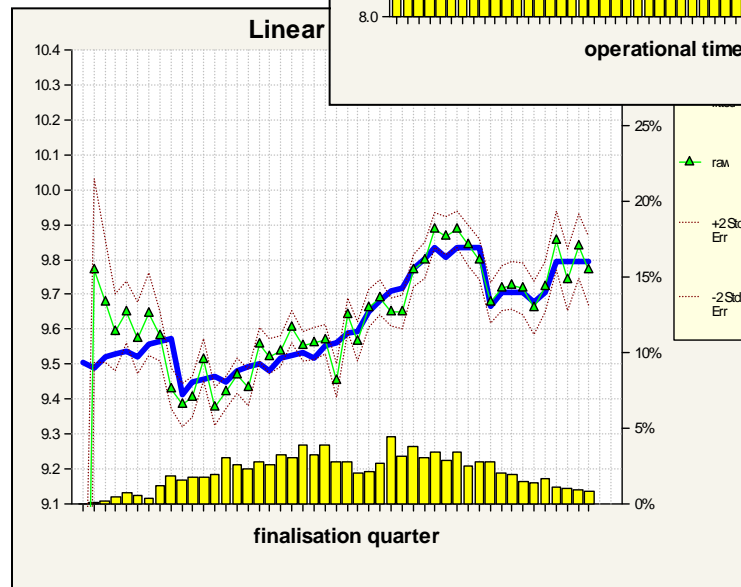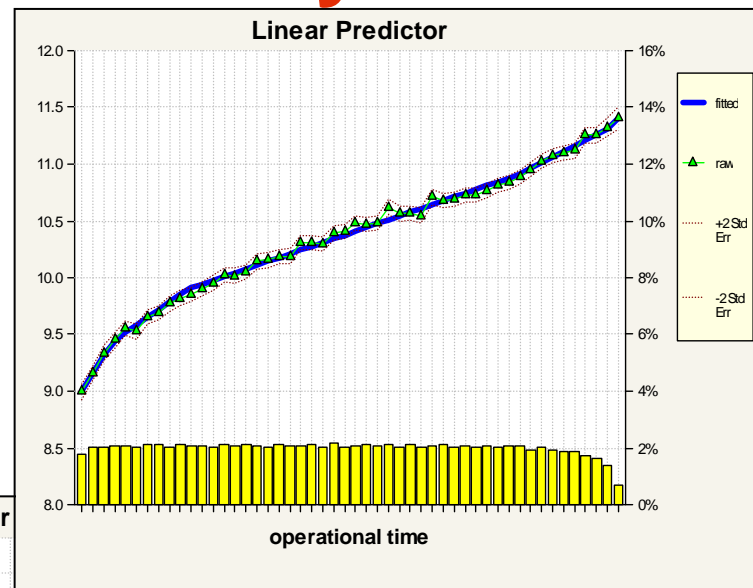
Modelling injury severity

- Now consider shape of operational time curve for each severity
  - Fit continuous time optime + severity + severity.categorical optime
  - Include suitable interactions between severity and cts optime terms to get a good fit

Linear Predictor of claim size

Linear Predictor of claim size

Modelling – injury severity

- Similar process may be used to examine:
  - different finalisation quarter effects for different operational times
    - Eg might expect higher levels of superimposed inflation for smaller claims
  - Interactions between severity and finalisation quarter effects

Modelling – legislation effect

- Consider only severity 1 here (see paper for other severities)

- Take pre-legislation model and look at actual/predicted [no legislation] values

Mar-03		85%	56%	93%	52%	43%	38%	48%	44%	51%	73%	83%	81%	82%
Jun-03			73%	41%	46%	35%	34%	49%	50%	76%	80%	78%	59%	
Sep-03		51%	76%	45%	59%	41%	54%	50%	69%	64%	92%	83%		
Dec-03		36%	75%	41%	45%	42%	59%	60%	92%	89%	90%			
Mar-04		109%	43%	39%	36%	40%	59%	92%	85%	123%				
Jun-04	26%		47%	35%	30%	50%	49%	78%	87%					
Sep-04		7%	46%	41%	34%	51%	66%	84%						
Dec-04		32%	117%	42%	46%	67%	77%							
Mar-05		51%	42%	46%	47%	61%								
Jun-05		19%	64%	48%	74%									
Sep-05		54%	44%	48%										
Dec-05		38%	94%											
Mar-06		43%												
Jun-06														

Modelling – legislative effect

- We see
  - A reduction in claim size
  - Wears off with increasing development quarter
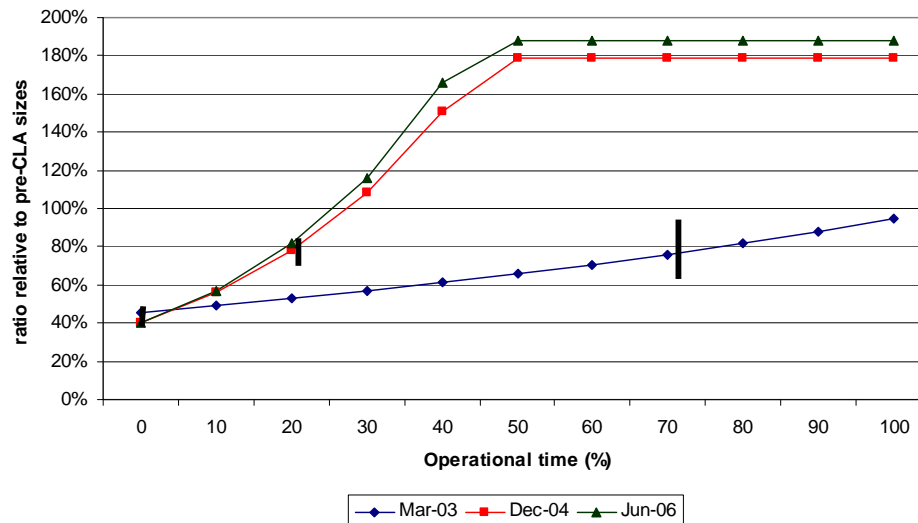 - Wears off with increasing accident quarter – a frequency effect?

Severity 1 frequency

Accident quarter
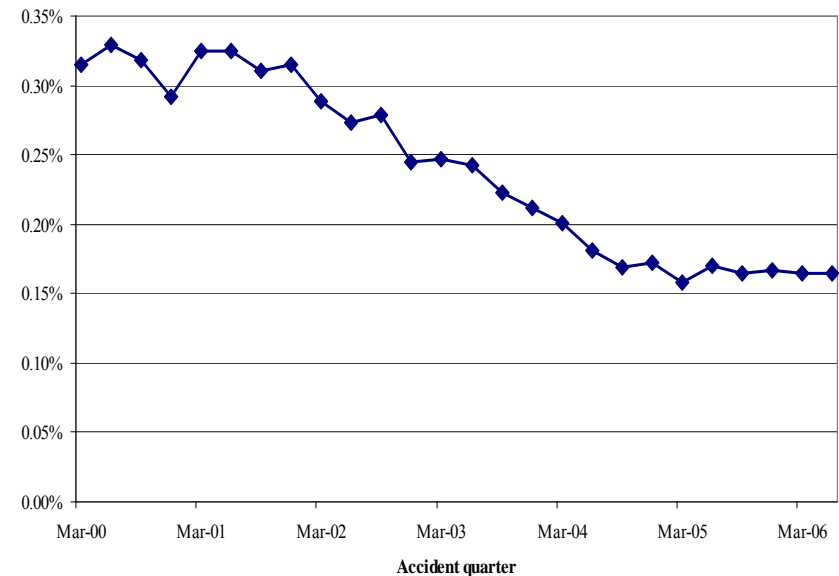
Modelling – legislative effect

- Model fits relativities of post-legislation experience to pre-legislation model

**Ratios relative to pre-legislation sizes limited to frequency differential**

Modelling - projection

- Post-legislation experience only 3.5 years

- How best to project claim size given immature experience?

- Suppose that the frequency reduction since 2002 has

  – been **entirely** due to legislation

  – knocked out the smaller claims only

  Pessimistic given long term trends – revisited later

Modelling - projection

- Simple example of the "frequency" effect
  - Smallest 30% (predicted) claims removed

- Real situation more complicated
 - Claims that are left may be reduced in size by legislation
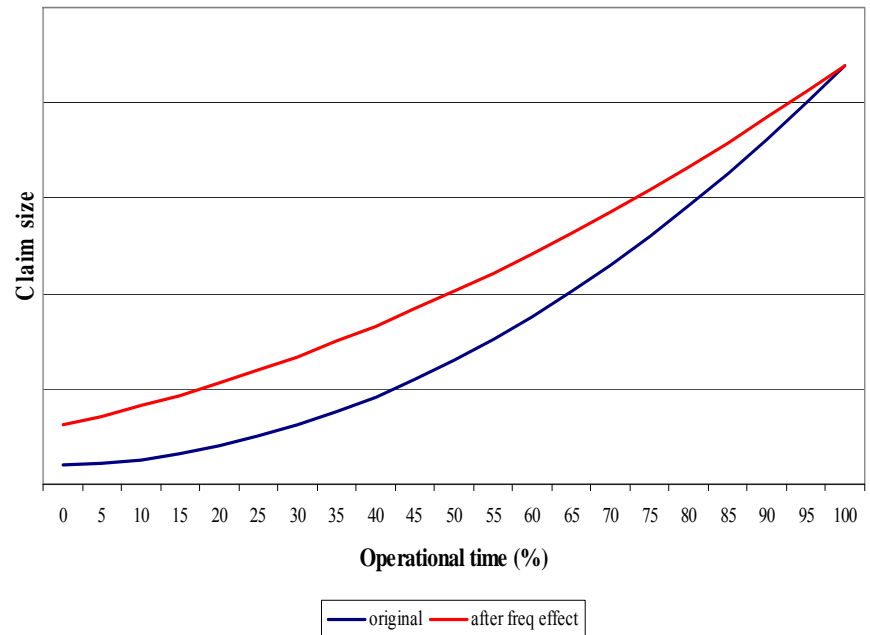
Modelling - projection

- Two submodels
  - Lower operational times (extrapolated from GLM)
  - Higher operational times (based on pre-legislation claim sizes, with operational time warped due to frequency effect)
- Merge these models

Projections for December 2004 accident quarter

Legend: pre-legislation · extrapolated legislation effect · pre-legislation stretched · estimated curve
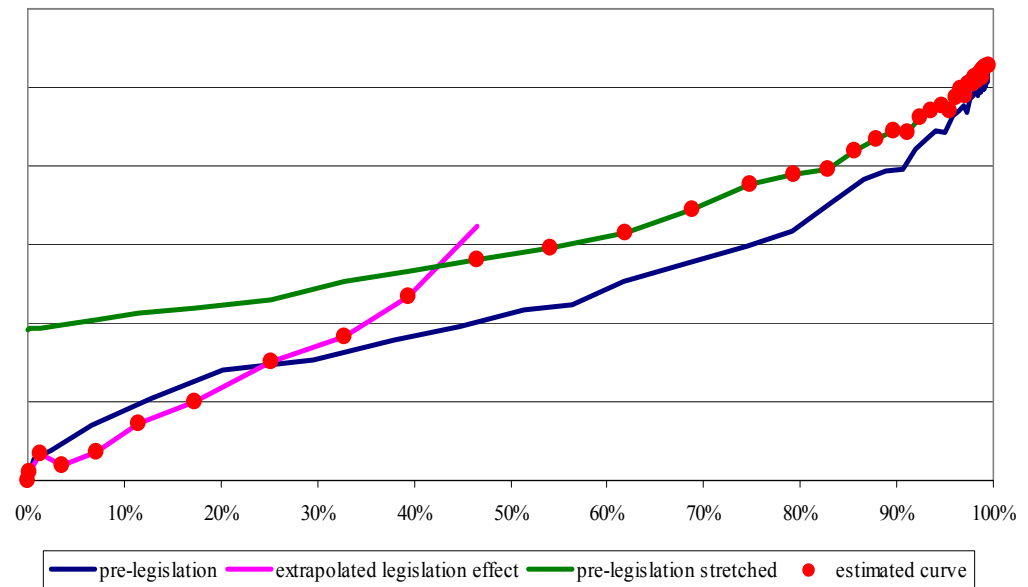
Modelling - projection

- Given long term frequency trends, severity 1 projection is likely to be pessimistic

- Apply judgemental reduction based on differential between long term downward trend and additional reductions since 2002

Discussion

Out of scope of paper

- Subsidiary models
  - Estimation of ultimate numbers in each severity
  - Estimation of transitions between severities
- Future superimposed inflation
- Use of other predictors
  - Employment status
  - Age etc

Discussion

- Aim is to reduce heterogeneity through use of severity

  – With >70% of claims potential for considerable heterogeneity to remain in Severity 1

  – Could split into less severe/more severe

    • Legal information

    • Injury codes, specific injury types (e.g. whiplash)

    • Level of general damages case estimates after 1 year

Discussion – where next

- Current model requires
  - 2 sub-models for predicting post legislation accident quarters
  - A judgemental assessment to offset pessimism introduced through assigning all frequency reductions to legislation
- Better to have one model for all
- Subject of current work