The Actuarial Profession
making financial sense of the future

Momentum: Workshop D4
Phil Ellis & Rob Murray, LCP

Actuarial Modelling: not as good as it should be?

4 December 2012

Session Agenda

- Warm-up act: Phil Ellis
  - Intentionally provocative title
    - *But who knows, you might even agree in 20 minutes time!*
  - Various angles on the "problem"
    - *Will talk GI and mainly reserving, but can generalise*
- Headliner: Rob Murray
  - A different approach to reserving
  - With a case study
- Debate from the floor

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Try 1: A ("the") big actuarial idea

- Projecting the uncertain future is hard
- But actuaries are the boys and girls for the job
- We choose a "basis" then do calculations
- **The result depends on the basis**
- But we use the result for decisions (pension funding rate, GI profit, etc)

- In GI the part of the basis is played by the reserving method plus adjustments
  - and the future new business and financial assumptions where relevant

- Rough analogies(?)
  - Blindfold investigation of an elephant
  - Anamorphic art(!)

2

"Anamorphic Art" *by Ole Martin Lund Bo - 1*

3

"Anamorphic Art" - 2

4

"Anamorphic Art" - 3

5

"Anamorphic Art" - 4

`6`

Arguably …

- GI actuaries don't think about this enough
    - Less so than Pension and Life actuaries
- We might always do the same thing
    - e.g. "Chain Ladder plus Bornhuetter-Ferguson"!?
    - When different tools may bring better perspectives

- "The reserving cycle" discussion can help prompt thought
- We should better consider previous models' performance
    - "Validation", "Back-testing", "P&L attribution", …

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Try 2: How surprising can the world be?

- Do our models make adequate allowance for surprises?
  - Really?
- Ask Fukushima post the Tohoku earthquake
- Or Arab Governments after the spring uprisings
- Or Christchurch post the second quake
- Or New Orleans post Hurricane Katrina
- Or New York post 9/11
- Or Fred Goodwin post the crash (!)
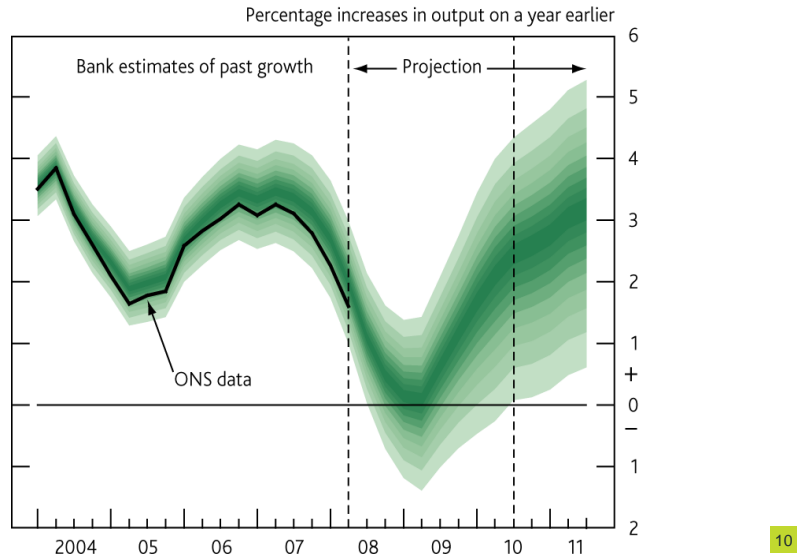
Consider this example from the Bank of England

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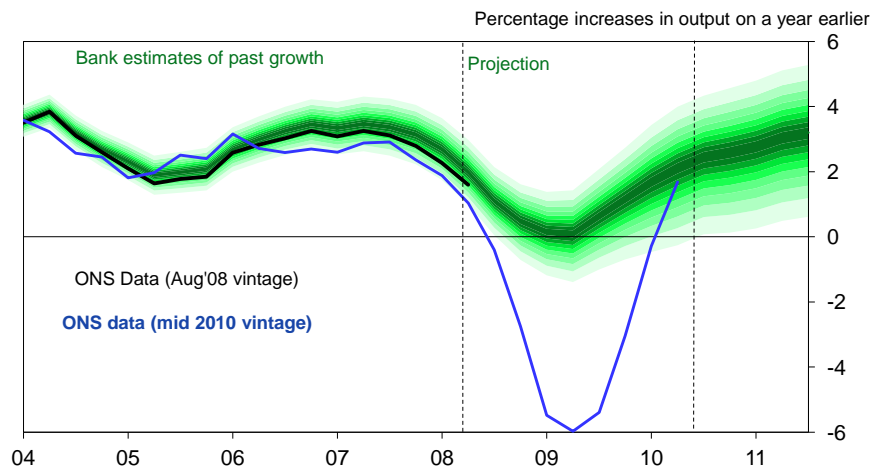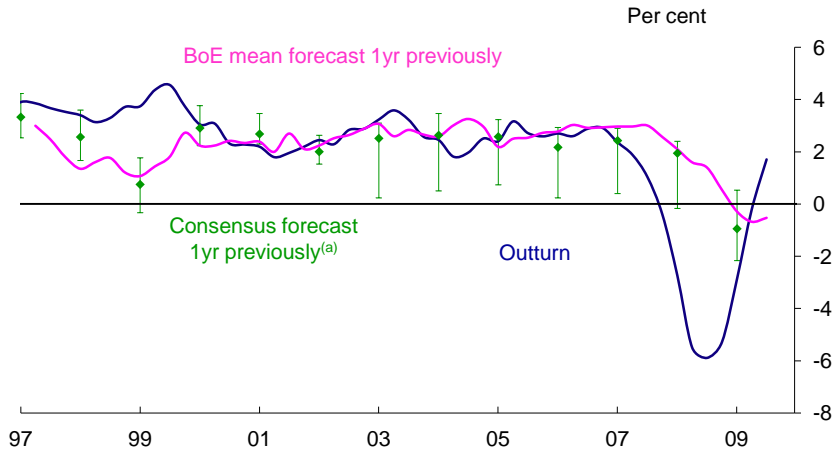## Bank of England, GDP projection Aug 2007

Percentage increase in output on a year earlier

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Bank of England, GDP projection Aug 2008

Percentage increases in output on a year earlier

Bank estimates of past growth — Projection

ONS data
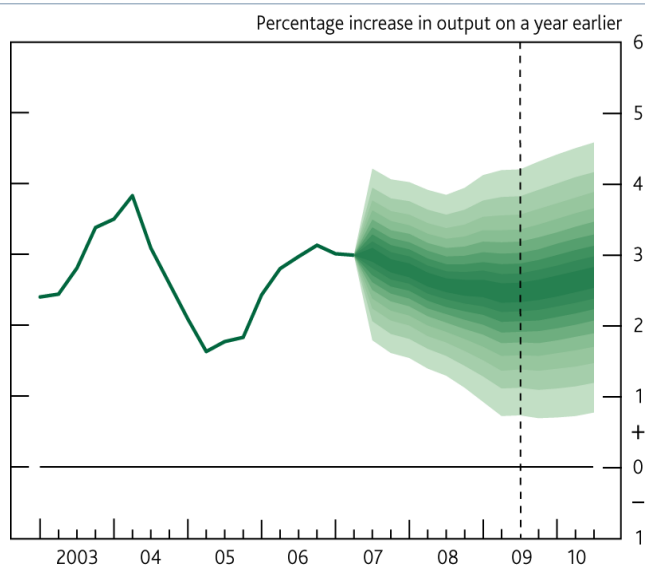
Bank of England, GDP projection Aug 2008 compared to out-turn (@ mid 2010)

Percentage increases in output on a year earlier

Bank estimates of past growth Projection

ONS Data (Aug'08 vintage)

ONS data (mid 2010 vintage)

A different view of the same data series

Per cent

BoE mean forecast 1yr previously

Consensus forecast
1yr previously[a]

Outturn

6
4
2
0
-2
-4
-6
-8

97   99   01   03   05   07   09

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Try 3: (Perspectives …) Reserving is:

- Pattern spotting
  - Any mildly intelligent monkey could do it

    AND

- Intellectually stimulating & demanding
  - Very hard to do as well as is possible

NB: I avoided "get right" since this would need careful definition

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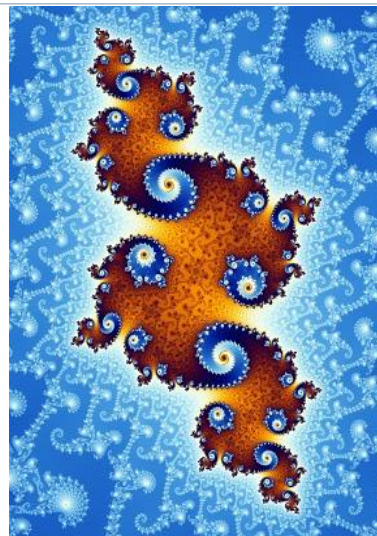
Professional Guidance may be unhelpful?!

- Focus: methods/assumptions/replicability
  - Tends towards using fixed, standard machinery

- I'd rather get the right answer
  - Even if methods could be "flaky" (i.e. heavily JUDGEMENT BASED)

- Arguably current standards consider:
  - Only PROCESS
  - Not QUALITY OF RESULT

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Huge class differences (especially in EC3)

- The JOY of the GI, especially the London market is variety
  - Heisenberg would have loved it
- Many classes have <u>intrinsic</u> degree of un-knowable-ness
      (unless we collect LOTS more data & do LOTS with it)
- And often we have far from "perfect" data

So:

- Pick the best tools for the job
- Use your considerable & expensive skills and judgement
- And enjoy the ride!

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Too Simplistic or Too Complex?

- The Basic Chain Ladder, plus
- Bornhuetter - Ferguson
- Are <u>NOT</u> the only games in town

But excessive complexity *can* also lead to issues:

- Many subdivisions of data
- Taking away outliers
- "As-iffing" historical data to reflect the current situation
- Building individual scenarios
  - e.g. to assess reinsurance impacts

Some actuaries can miss the wood for the twigs!

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Nice smooth models: "Central 3 from 5 factors"

A talk at my only US reserving conference ~ 1995:

- Do development factor models
- At each development stage, pick the central 60% of ratios & discard the rest
- Result is lovely smooth model
- But answers will be biased on the low side(!)
  - Reason: Life is skew "good's nice but bad's often awful"
- This is a lovely way to get smooth and pretty models
- But doesn't help get "the right" level of reserves
  - The problem is just passed into the "biasing adjustment"

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What do the best GI actuaries do?

A good GI actuary has a range of tools in their toolbox

Different problems succumb to different approaches

They:

- know their data and the mechanisms that produce it
- have many different ideas & approaches available to them
- use judgement appropriately (so justify humungous salaries)
- understand the uncertainties
- and communicate this to actuarial and other "consumers"

IF you think not all GI actuaries do all this

Then logically you agree with the assertion in my title!

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Try 4: Tails of Reserve Ranges

- How likely bootstrap gives the right tails out at extreme levels?
  - Really?!

Issues include:

- What is the incentive to do this "right"?
- Sensitivity to a few individual ratios
- Always the wrong number of large losses
  - None is not enough, several is probably too many
- Underlying exposures where "lucky" throughout our experience?
- 1 in 200 is around 1 in 8 "actuarial generations"
  - assuming a "leading role" from ages 30 to 55, say

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Reserve Ranges: Issues and Approach

- Assessment of reserves is inexact and judgemental science
- Suppose we seek proper best-estimate plus a view of variability
- Idea: interrogate historical triangle to lift out signal and noise
  - Signal allows us to project immature cohorts to ultimate
  - Noise can give an indication of reserving uncertainty
- Bootstrap method aims to do this
  - Methodology identifies observed noise around best-fit model
- In practice:
  - Judgements, especially with dependencies on a few points
  - Arguably history won't include all that could happen

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Potential problems – Reserve Ranges

Strong signal, limited noise
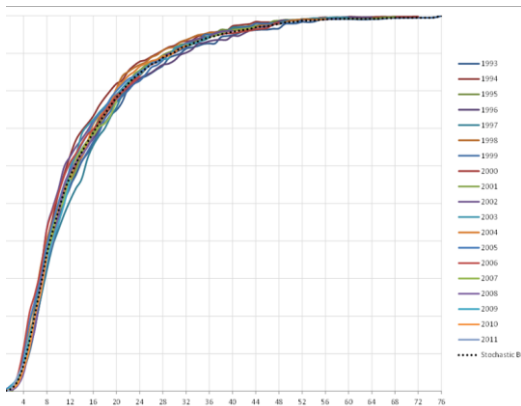
In this example:

- Projected ultimates "obvious"
- Uncertainty appears very small

- Modelled 99.5th percentile will be close to the mean

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Potential problems – Reserve Ranges

Weaker signal, much more noise
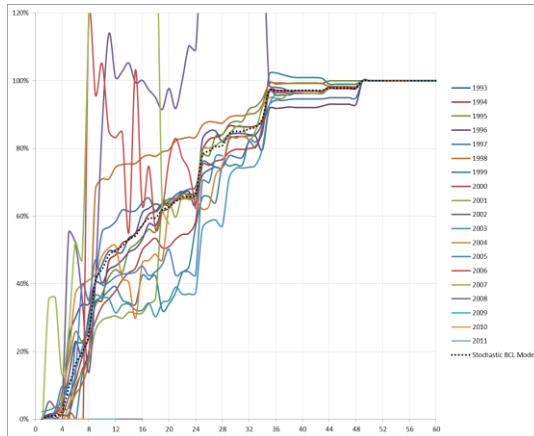
For this different class:

- Less certain about the most likely outcome
- Much more aware of the volatility

- Modelled 99.5th percentile far from the mean

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Illustrative Bootstrap output and use

Signal gives central projection, Noise guides variability
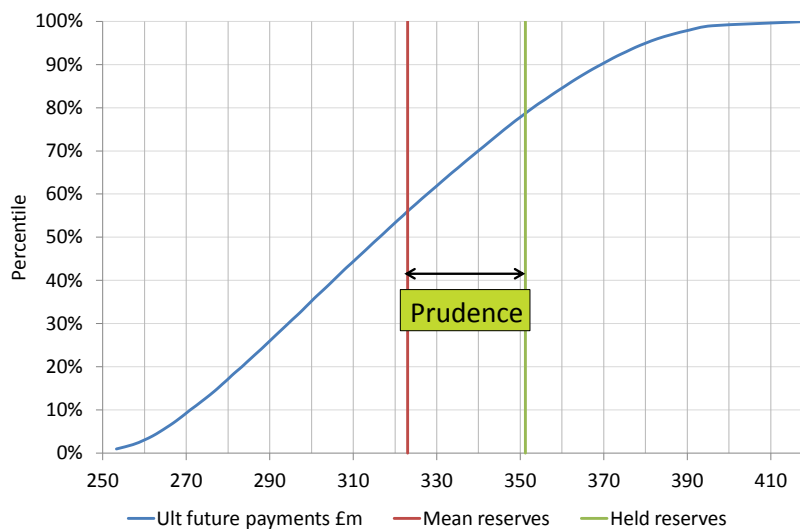
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Illustrative Bootstrap output and use

Specify 1:200 reserve risk?!

Are we really sure up here?!

Prudence
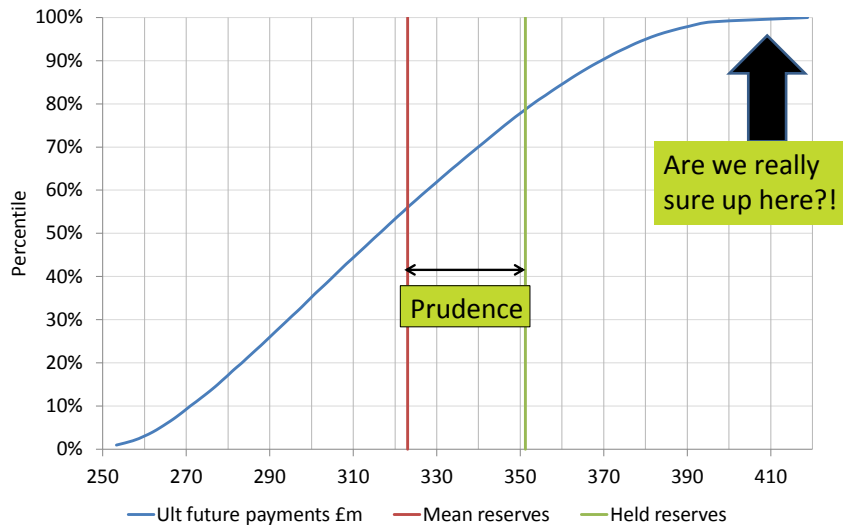
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Final Thoughts: Nassim Nicholas Taleb, Behavioural Finance, Modesty

- NNT stirred actuaries ~5 years ago
  – Books pretty badly written(!)
  – But some important themes

- Behavioural Finance is getting lots of economists excited
  – eg "Superfreakonomics"

- Hubris is not appealing even for actuaries
- Modesty is more appropriate

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An alternative to development factor modelling

4 December 2012

Session overview

1. Background
2. Introduce and explain a new (but simple) approach for deriving development models
3. Case study

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Background

- Traditional chain ladder modelling has some limitations:
  - Requires sufficient past data
  - Assumes 'one pattern fits all'
  - Fails to recognise changes in the underlying exposures, and processes for reporting and settlement
  - No direct links between various stages of the insurance claims process
    - But in reality payment patterns will depend on reporting patterns which will depend on exposure patterns etc.
  - Expert judgements made at relatively low levels
    - eg the removal of development factors)

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A new (but simple) approach

- Deconstruct the claims process into its component parts
- Build these parts back up into a working model
- Populate the model with assumptions or actual data where available

"The significant problems we face cannot be solved at the same level of thinking with which we created them"
- Albert Einstein

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Deconstructing the claims process

Time

| T0 | T1 | T2 | T3 |

Policies underwritten

Exposure to claim incidents

Claims incurred

Claims reported

Claims paid
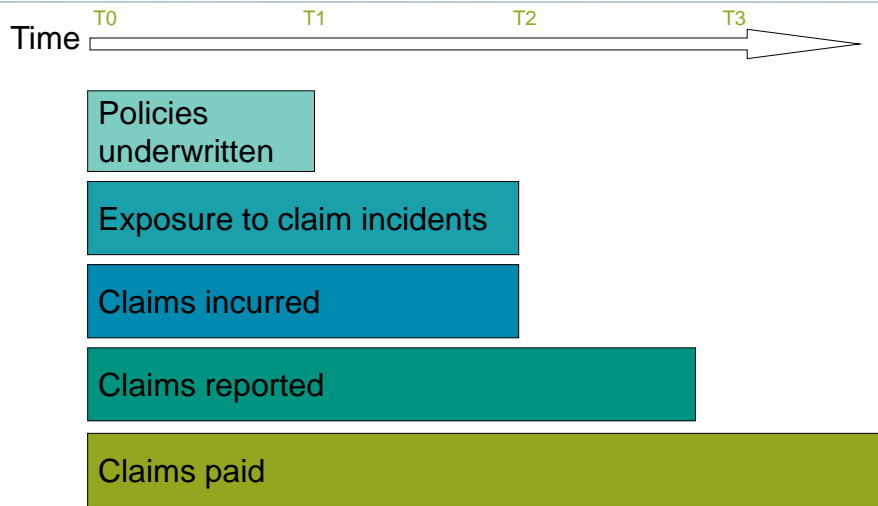
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Building the model - summary

Business written

Premium rates

Earnings patterns

Reporting delays

Settlement delays
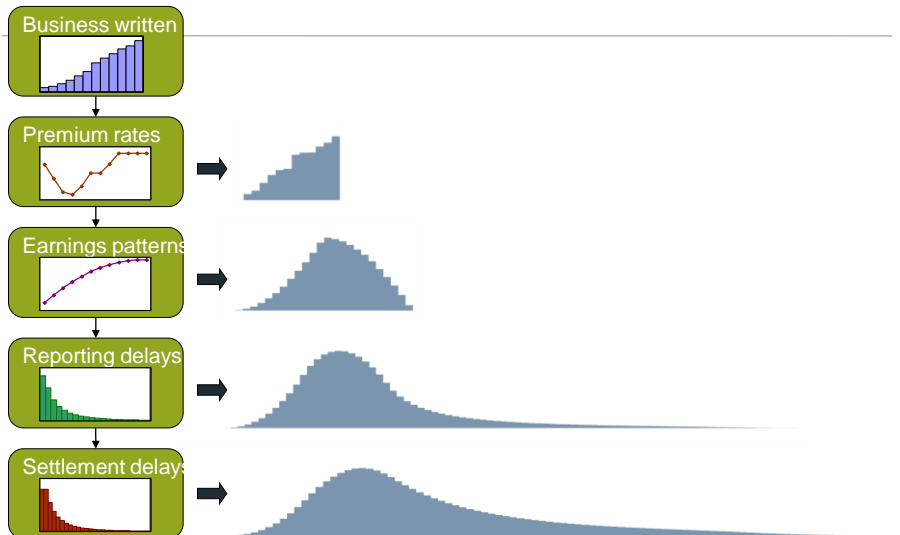
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Building the model: the detail (1)

• Analyse the written premiums:

Monthly Written Premiums
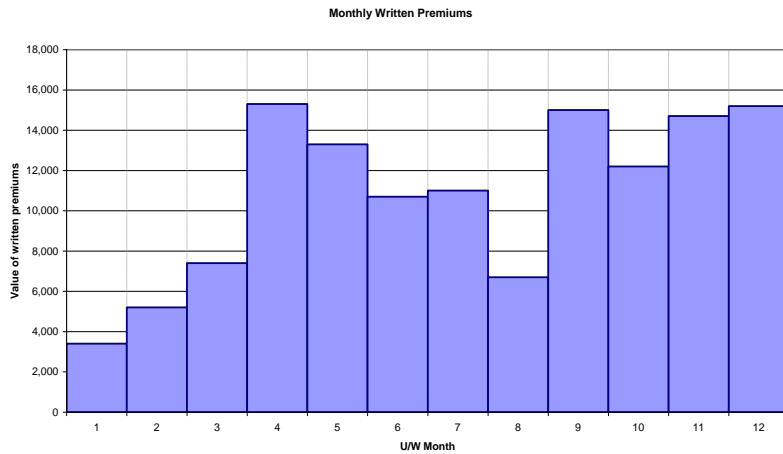
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Building the model: the detail (2)

• Allowing for premium rate changes, gives a written exposure profile:

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Building the model: the detail (3)

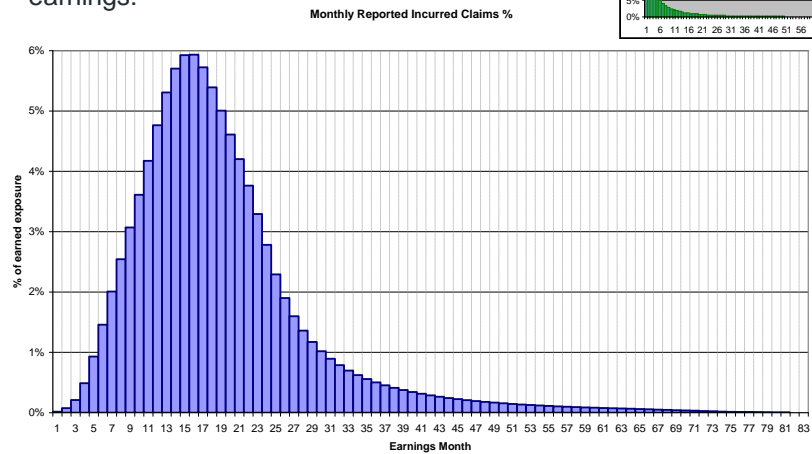| Earnings Pattern	Exposure Month	Month 1 Business	Month 2 Business	Month 3 Business	Month 4 Business	Month 5 Business	Month 6 Business	Month 7 Business	Month 8 Business	Month 9 Business	Month 10 Business	Month 11 Business	Month 12 Business	Total Business	Cumulative Total
	Total	2.39%	4.34%	7.54%	16.23%	12.38%	8.30%	8.53%	4.68%	9.36%	7.61%	9.17%	9.48%	100.00%	
4.17%	1	0.10%												0.10%	0.10%
8.33%	2	0.20%	0.18%											0.38%	0.48%
8.33%	3	0.20%	0.36%	0.31%										0.87%	1.35%
8.33%	4	0.20%	0.36%	0.63%	0.68%									1.86%	3.22%
8.33%	5	0.20%	0.36%	0.63%	1.35%	0.52%								3.06%	6.28%
8.33%	6	0.20%	0.36%	0.63%	1.35%	1.03%	0.35%							3.92%	10.19%
8.33%	7	0.20%	0.36%	0.63%	1.35%	1.03%	0.69%	0.36%						4.62%	14.81%
8.33%	8	0.20%	0.36%	0.63%	1.35%	1.03%	0.69%	0.71%	0.20%					5.17%	19.98%
8.33%	9	0.20%	0.36%	0.63%	1.35%	1.03%	0.69%	0.71%	0.39%	0.39%				5.76%	25.74%
8.33%	10	0.20%	0.36%	0.63%	1.35%	1.03%	0.69%	0.71%	0.39%	0.78%	0.32%			6.46%	32.20%
8.33%	11	0.20%	0.36%	0.63%	1.35%	1.03%	0.69%	0.71%	0.39%	0.78%	0.63%	0.38%		7.16%	39.36%
8.33%	12	0.20%	0.36%	0.63%	1.35%	1.03%	0.69%	0.71%	0.39%	0.78%	0.63%	0.76%	0.40%	7.94%	47.30%
4.17%	13	0.10%	0.36%	0.63%	1.35%	1.03%	0.69%	0.71%	0.39%	0.78%	0.63%	0.76%	0.79%	8.23%	55.53%
	14		0.18%	0.63%	1.35%	1.03%	0.69%	0.71%	0.39%	0.78%	0.63%	0.76%	0.79%	7.95%	63.49%
	15			0.31%	1.35%	1.03%	0.69%	0.71%	0.39%	0.78%	0.63%	0.76%	0.79%	7.46%	70.95%
	16				0.68%	1.03%	0.69%	0.71%	0.39%	0.78%	0.63%	0.76%	0.79%	6.47%	77.41%
	17					0.52%	0.69%	0.71%	0.39%	0.78%	0.63%	0.76%	0.79%	5.28%	82.69%
	18						0.35%	0.71%	0.39%	0.78%	0.63%	0.76%	0.79%	4.41%	87.11%
	19							0.36%	0.39%	0.78%	0.63%	0.76%	0.79%	3.71%	90.82%
	20								0.20%	0.78%	0.63%	0.76%	0.79%	3.16%	93.98%
	21									0.39%	0.63%	0.76%	0.79%	2.58%	96.56%
	22										0.32%	0.76%	0.79%	1.87%	98.43%
	23											0.38%	0.79%	1.17%	99.60%
	24												0.40%	0.40%	100.00%

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Building the model: the detail (4)

- Spread each month's written exposure over the policy term using the selected earnings pattern:

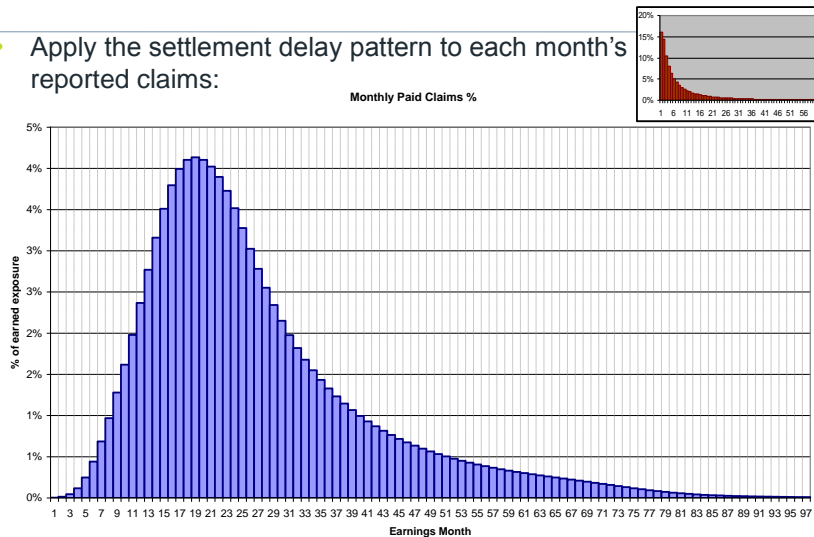Monthly Earned Exposure % = Monthly Incurred Claims %
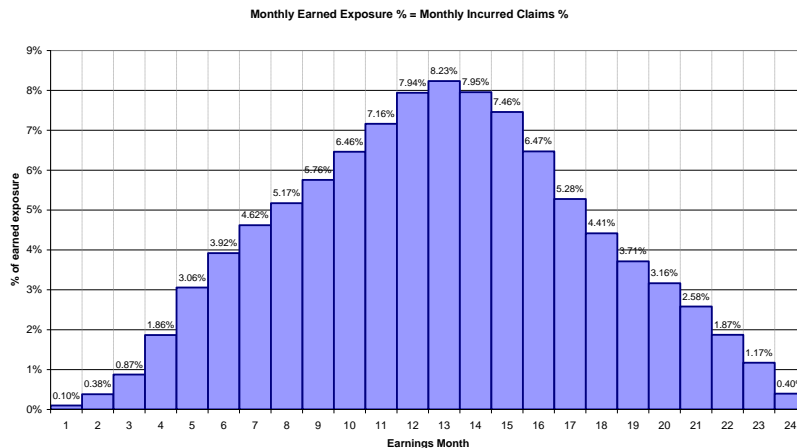
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Building the model: the detail (5)

- Apply the reporting delay pattern to each month's earnings:
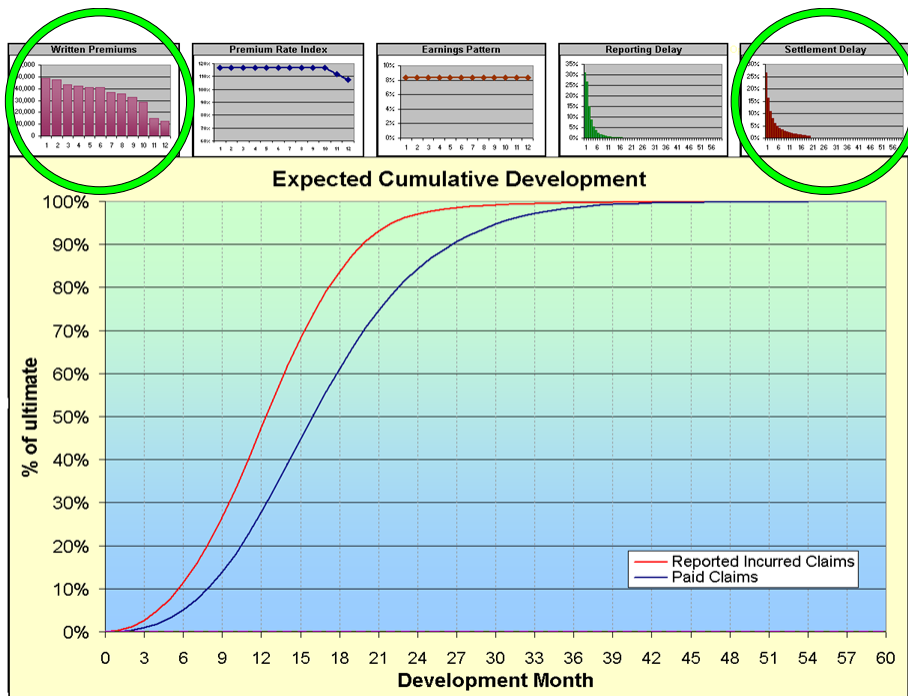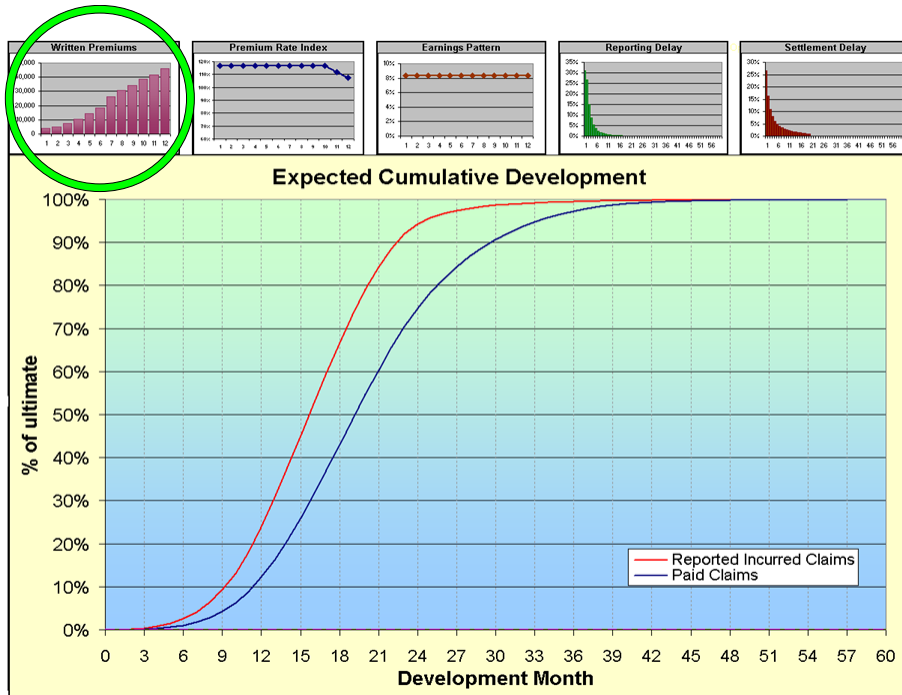
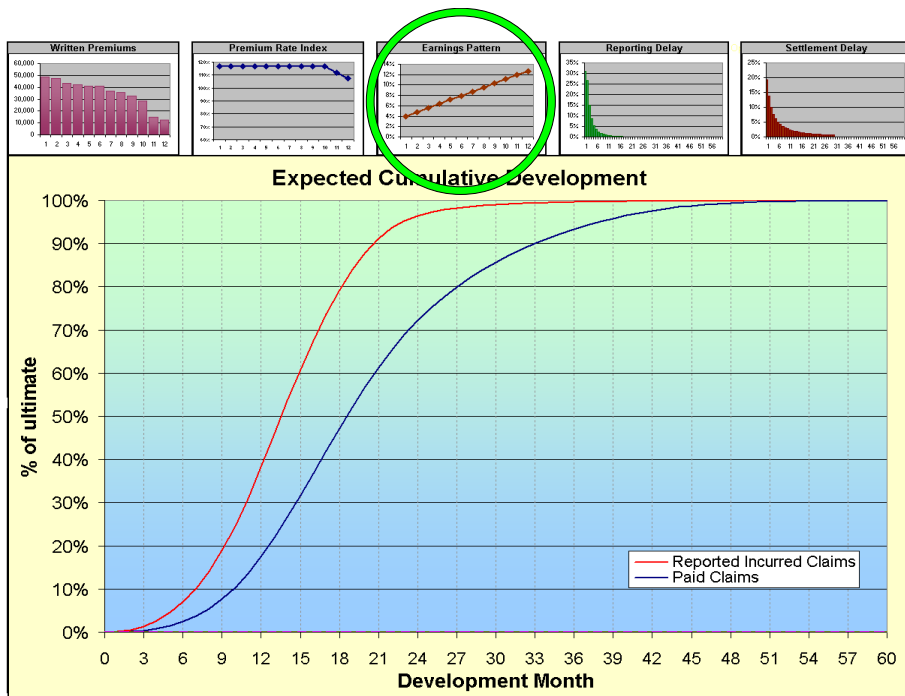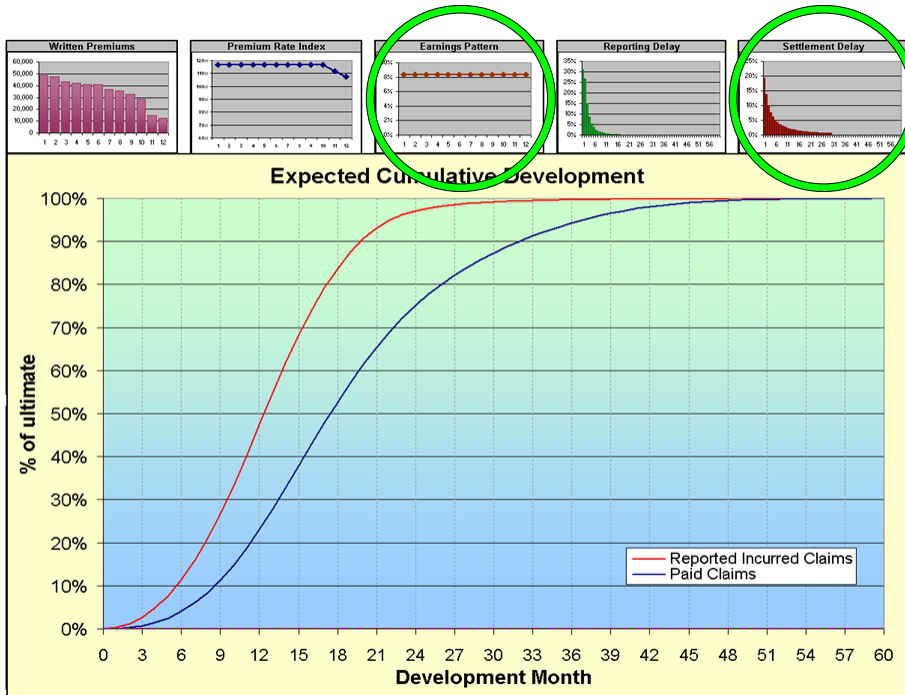Monthly Reported Incurred Claims %

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Building the model: the detail (6)

- Apply the settlement delay pattern to each month's reported claims:
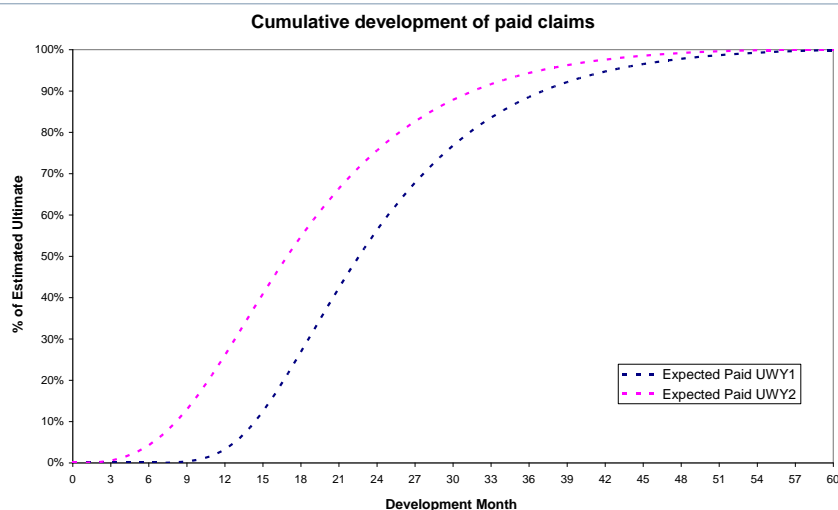
Monthly Paid Claims %

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Real life case study – the problem

- Produce estimates of ultimate claims and expected cash-flows for a new GAP account
- Multi-year policies
- Earnings patterns are distinctly non-uniform
- Forecasts required on an underwriting year basis
  – Business began partway through a financial year
  – and ended partway through the following year

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Real life case study: our prediction

Cumulative development of paid claims

Legend:
- Expected Paid UWY1
- Expected Paid UWY2

X-axis: Development Month (0 to 60)
Y-axis: % of Estimated Ultimate (0% to 100%)

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Real life case study: actual experience

Cumulative development of paid claims
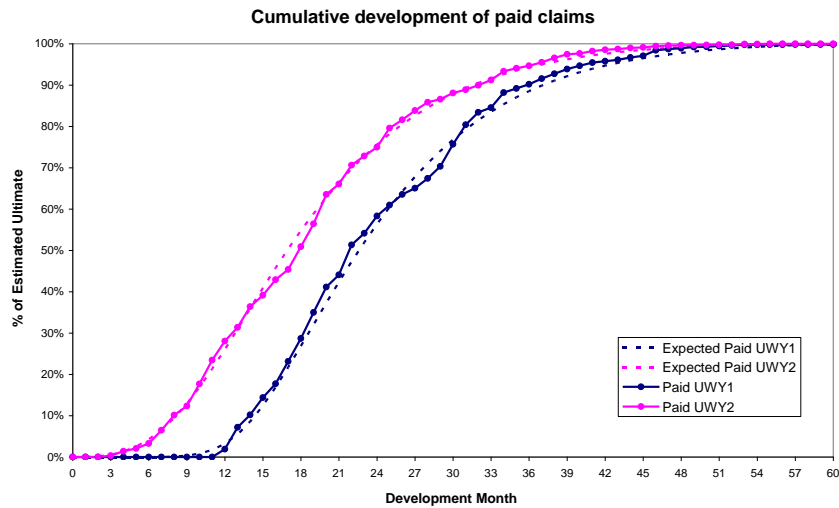
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Real life case study: actual experience
Looking at the business as a whole

Cumulative development of paid claims
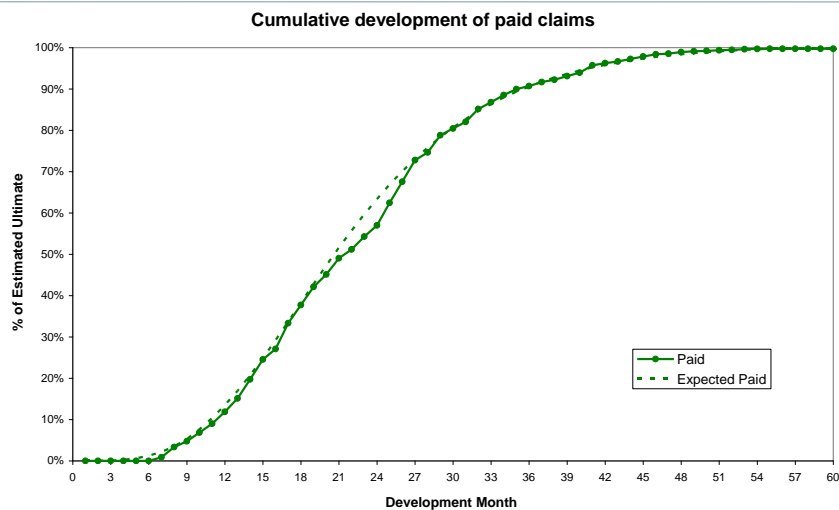
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Some of the benefits…

- Projections can be made with little or no claims data
- Early warning management tools can be constructed
- Enables management to act or react faster
- Different years do not have to follow the same pattern
- Can allow for changes in exposure/reporting/settlement
- Insights into the business
  - how the business is earned
  - claims reporting and settlement processes
- Easy to produce models on different bases
  - eg underwriting year or accident year

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Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenters.

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