

Technical (yet practical) reserving tools for a cyclical market

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Agenda

- Challenges for reserving actuaries
- The underwriting and reserving cycles
- Impact of Solvency II on reserving
- What actuaries need to do now
 - Understanding the business
 - Understanding the data
 - Premium rate recording
 - Improving your toolkit for reserving in the soft market

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Challenges for reserving actuaries – the market's view

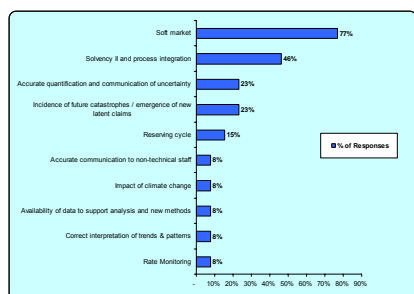
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The soft market - where are we now?

- “On the back of a good performance in 2007 we need to sound a note of caution for 2008 because of softening market conditions and because of the financial turmoil we've seen” - **Richard Ward, Lloyd's Chief Executive**.
- “There was no shortage of events in 2007, but the fact that frequency trumped severity led to balance sheet strength. Excluding a major shock, we anticipate soft market conditions to prevail in most reinsurance markets for a number of years.” – **Sean Mooney, Chief Economist at Guy Carpenter**

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What do you see as the greatest challenges for reserving actuaries over the next few years?



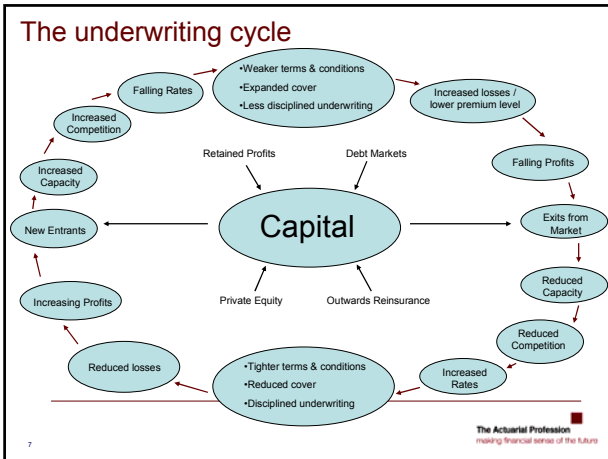
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The underwriting and reserving cycles

“The market cycle and investment market volatility make 2008 a challenging year” – Best's

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The underwriting cycle



The reserving cycle

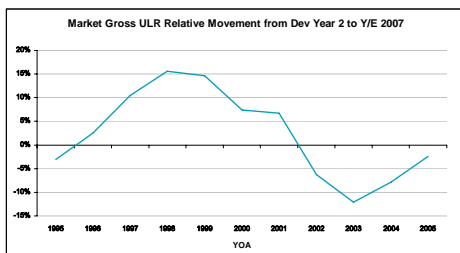
- **What is the reserving cycle?**
 - Distinct from the underwriting cycle...
...but has a strong relationship with it
 - Clear cycle of over and under reserving
 - Visible across underwriting classes
 - More pronounced for funded business than accident year
 - More pronounced for longer tailed business
- **Why does the reserving cycle occur?**
 - Inappropriate use of historic trends and patterns due to the impact of the underwriting cycle
 - Inappropriate use of rating indices due to the impact of the underwriting cycle
 - Poor understanding of the business
 - Booked reserves differ from actuarial best estimate
 - Actuaries or management may deliberately choose to move away from best estimate figures at different stages of the cycle
 - Denial of the reserving cycle – or its full extent

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Reserving Cycles – they exist

We can track the movement in ULRs set at 24 months to the current position:

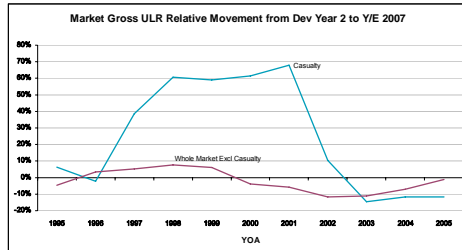


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Reserving Cycles – dominated by casualty

The movement on casualty is more extreme:

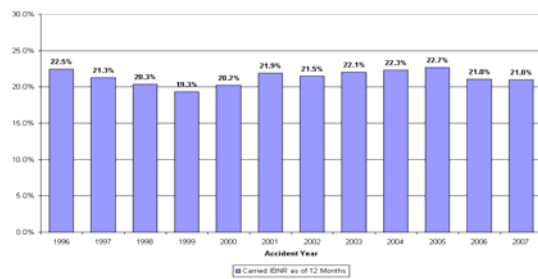


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Reserving Cycles – another view

Carried IBNR as of 12 Months Relative to Earned Premium
Industrywide All Lines of Business

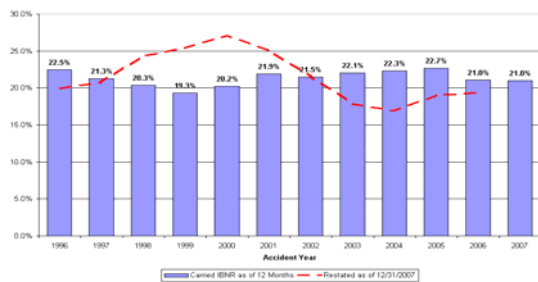


Source: Munich Re

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Reserving Cycles – another view

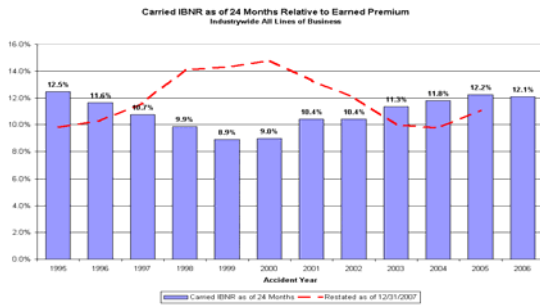
Carried IBNR as of 12 Months Relative to Earned Premium
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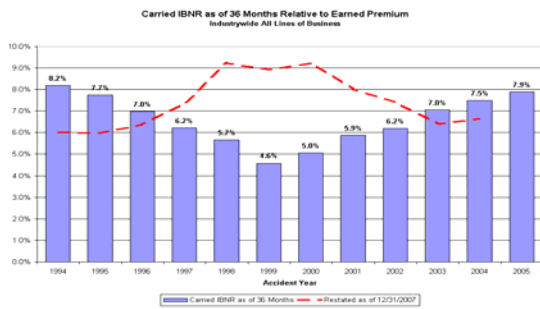
Reserving Cycles – another view



Source: Munich Re

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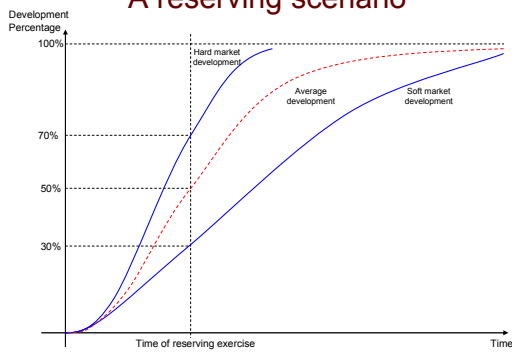
Reserving Cycles – another view



Source: Munich Re

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A reserving scenario



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The impact of Solvency II on reserving

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Solvency II – Impact on reserving

- Reserving lies within Pillar 1, Implementation, of the Solvency II framework and is a key element of Solvency II.
- The draft Solvency II Directive describes the calculation of technical provisions. It states that "they will be calculated as the sum of a best estimate and a risk margin".
- It also contains sections detailing:
 - the actuarial function
 - general governance requirements
 - risk management procedures
 - internal control systems
 - disclosure requirements.

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Solvency II – Issues to consider

Disclosure

- Pillar 3 of the Solvency II framework focuses on disclosure. In particular, enhancing disclosure requirements in order to increase market transparency.
- At present, the requirements are unspecified. Pillar 3 could potentially force the disclosure of regulatory returns (including best estimate reserves) to the public.

Company results

- Consequently, if best estimate reserves are available to the public, there will be less scope for insurance companies to manipulate the results they report.
- It would be more difficult for companies to smooth their results over time using technical provisions.
- Could result in more pressure on those involved in reserving to come up with "best estimates" that match the companies' objectives.
 - **Justifying your reserving toolkit is appropriate for soft market reserving**

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Solvency II – Issues to consider

Discounting

- Reserves will be discounted.
- In particular, Article 76.2 states that the best estimate shall take account of the time value of money, using the relevant risk-free interest rate term structure.

Testing best estimates

- How will actuaries prove that a given value for technical provisions is a best estimate?
- How will best estimates be tested / challenged by regulators?

Understanding current estimates

- Key to the process will be understanding what percentile your current reserves are set at.

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Understanding the business

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Understanding the business

- **Why is it important?**
 - validate appropriateness of statistical methods
 - gain confidence of underwriting colleagues
 - recommendation of GRIT
 - improve pricing methods
- **Important to understand changes in historical mix of business**
 - RAD vs LOD vs CMD
 - Changes in underlying exposure
 - Inception date profile
 - Geographical mix
 - Concentration of account
 - Currency profile
 - Loss profile
 - Changes in personnel
- **External consultants used to build 'Underwriting Bibles' to**
 - facilitate understanding of business
 - document changes in business mix
 - useful guide for new staff
 - quick reference for internal and external actuarial staff

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Understanding the data

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Understanding the data

- Reserving well through the soft market is also dependant upon having a good understanding of your data
- Key Deloitte reserving survey points:
 - Understanding the impact of various claims initiatives on development patterns was a concern mentioned by several participants
 - Understanding any changes in claims reserving philosophy
 - Numerous companies mentioned an aspiration to improve the speed of data processing, but data quality is the main focus of regulators.
 - Impact this has on reserving/ capital
 - Ability to be able to do "deep data dives"
 - Rationale for reasons for movements in data
 - Possibility for considering individual transaction level reserving in the future

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Premium rate recording

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Premium rate recording

- A key challenge of reserving in a soft market is around the derivation of Expected Loss Ratios for current year reserving
- Historical concerns over approach to premium rate recording
 - Over dependence on underwriting staff
 - Failure to adequately break down rate movements
 - Inadequate allowance for T&C changes
 - Lack of consistency (both internal and external)
 - Inadequate allowance for new business

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Where are we now?

- More focus on premium rate monitoring from regulators
 - Lloyd's Market Bulletin (May 2004)
 - Lloyd's rate monitoring packs
- Increased market attention
- From the survey, a key area of focus for a lot of insurers

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Deloitte Reserving Process Survey 2008

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Survey output – part 1

- Most companies now have a model to track premium strength
 - Move towards explicit consideration of premium drivers
 - Risk by risk analysis
- Increased actuarial pricing
 - Improving existing models, standardisation and reduction in number
 - Move towards integrating pricing models directly into rate monitoring
- Move towards building in allowance for new business premium rates

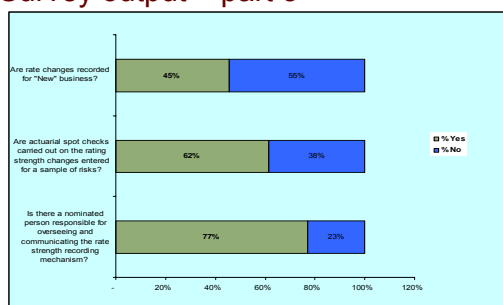
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Survey output – part 2

- Comparison of actual price/ technical price/ modelled price
- More companies ensuring there is a nominated person responsible for the rate monitoring system
- More actuarial input into process
- Production of good management information
- Allowing for increased propensity to claim subject to economic climate still an issue

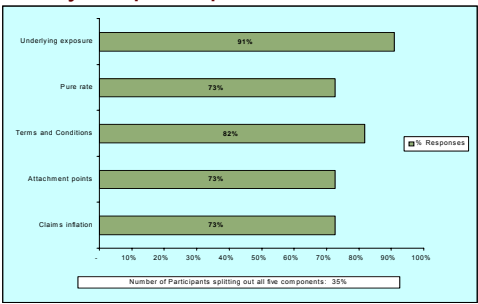
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Survey output – part 3



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Survey output – part 4

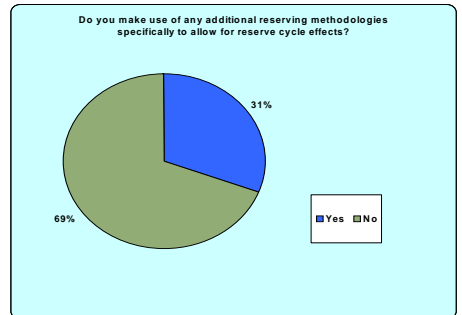


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Toolkit for reserving in the soft market

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Deloitte Reserving Process Survey - 2008



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Method 1: Using diagnostics

Advantages

- Explicitly shows changes in business
- Easy to explain to non-actuaries
- Standard methods can still be used

Disadvantages

- Data may not be available
- Adjustments are necessarily subjective
- Effect of changes of business may not be apparent

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Method 2: Hard and soft patterns

Overview of method

Within a class of business, recognising the different cumulative paid or incurred development patterns:

- for hard market years
- for soft market years

Steps to building the model

1. Identify which years are classed as hard and soft
2. Fit a basic chain ladder models separately to both hard and soft years
3. For recent years estimate where you are in the cycle then blend between the two patterns

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Method 3: Benchmarking

▪ Soft market can lead to:

- Businesses writing new classes of business
- Underwriters accepting non standard risks to achieve income targets
- Underwriters accepting different mixes of business within each reserving class

▪ Benchmarking

- Can provide an additional estimate for more recent years
- Can act as a reasonableness check

▪ Key is to:

- understand the underlying business being benchmarked
- understand the business underlying the benchmark

▪ Sources

- Association of British Insurers
- Rating Agencies
- Lloyd's
- External consultants

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Method 4: The Wright method

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A model to test for and accommodate reserving cycles

- Paper prepared for CAS CLRS call paper program
- Develops the curve-fitting idea put forward in GRIT report
- Curves are fitted simultaneously to paid and incurred run-off data so a single ultimate is produced for each origin year
- Has produced further evidence that reserving cycles exist
- Is a practical tool for
 - testing for existence of cyclical run-off patterns
 - helping identify possible causes
 - producing improved reserve estimates

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Curves fitted to cumulative paid and incurred simultaneously

- Allows bias in case estimates to be modelled
- Produces single ultimate for each origin year

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Principles of curve fitting to cumulative paid development

- The cumulative paid run-off pattern is the cumulative distribution function (cdf) of delay between start of origin year and time of payment, $F_P(d)$ say
- For each \$1 ultimately paid, the expected amount paid by time d is \$ $F_P(d)$
- If U is the ultimate, the expected amount paid by time d is $U \cdot F_P(d)$
- So in principle, we could try fitting any mathematical family of cdfs (eg Log-Normal, Gamma, Weibull) to cumulative paid run-off patterns
- To allow for cyclical effects, the parameters of the chosen distribution family can be linked to a premium rate index Q_j . For example: $a_j = \exp\{\alpha_0 + \alpha_1 \cdot (Q_j - 1)\}$
- The parameters α_0, α_1 can then be estimated by least squares

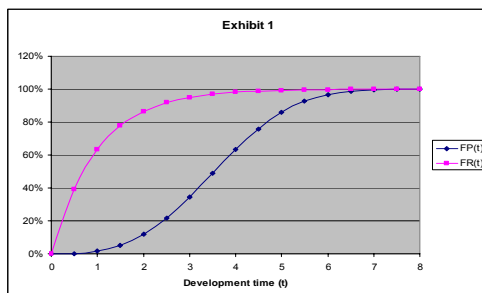
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Principles of curve fitting to cumulative incurred

- Cumulative incurred often decreases so cannot be modelled directly using cdfs
- Decreases occur if case estimates are higher (on average) than actual payments
- Suitable family of curves for cumulative incurred can be derived by considering probability distributions of reporting delays and payment delays
- When claim is reported, suppose case reserve is (on average) b times amount ultimately paid. The parameter b is the "case-estimate bias-factor".

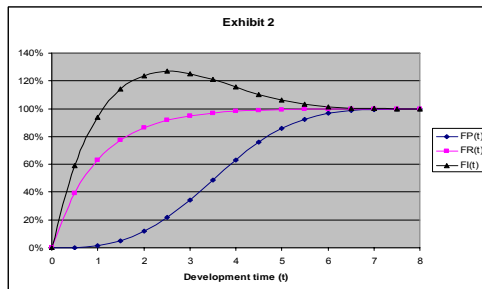
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Cumulative distribution functions for payment and reporting delays



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Cumulative incurred: $F_P(t) + b \cdot \{F_R(t) - F_P(t)\}$
(example with $b = 1.5$)



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Principles of curve fitting to cumulative incurred

- For each \$1 ultimately paid, the expected amount paid by time d is $\$ F_P(d)$
- With no bias in case estimates: for each \$1 ultimately paid, the expected amount incurred by time d would be $\$ F_R(d)$ (where $F_R(d)$ is cdf of reporting delays)
- Outstanding is incurred minus paid, so for each \$1 of ultimate, expected amount os would be $\$ \{F_R(d) - F_P(d)\}$. With bias, this becomes $\$ b \cdot \{F_R(d) - F_P(d)\}$
- Incurred equals paid plus outstanding, so for each \$1 of ultimate, expected
- incurred at time d is $\$ F_P(d) + b \cdot \{F_R(d) - F_P(d)\} = \$ b \cdot F_R(d) + (1-b) \cdot F_P(d)$

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Principles of curve fitting to cumulative incurred

- For each \$1 of ultimate, expected incurred at time d is $\$ b \cdot F_R(d) + (1-b) \cdot F_P(d)$
- If ultimate is U , expected incurred at time d is $U \cdot \{b \cdot F_R(d) + (1-b) \cdot F_P(d)\}$
- This can be fitted to actual cumulative incurred by least squares to estimate the parameters of the cdfs $F_P(d)$ and $F_R(d)$, the parameter b , and the ultimate U .
- The cumulative paid curve $U \cdot F_P(d)$ can be fitted simultaneously to the cumulative paid data by minimising the total sum of squared residuals of paid and incurred.
- The case-estimate bias-factor can be linked to the underwriting cycle (in the same way as other parameters of $F_P(d)$ and $F_R(d)$) through an equation of the form: $b_i = \exp\{\beta_0 + \beta_1 \cdot (Q_i - 1)\}$
- It is the parameters β_0 and β_1 that are determined from the data by least squares

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Suitable parametric distributions

- In principle, any parametric cdfs could be used for $F_P(t)$ and $F_R(t)$.
- Since every claim must be reported before it is paid, we must have: $F_R(t) \geq F_P(t)$.
- Weibull, Burr and Inverse Burr distributions have the advantages that they
 - are relatively simple mathematically
 - are flexible (mode can be zero or greater than zero)
 - seem to provide good fits to actual run-off data

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Least squares estimation

- Parameters of run-off curves are determined as those values that minimise the residual sum of squares (RSS) of cumulative run-off data
- $RSS = \sum (\text{actual} - \text{expected})^2$
- "expected" is
 - $U.F_P(d)$ for cumulative paid
 - $U.\{b.F_R(d) + (1-b).F_P(d)\}$ for cumulative incurred
- Because $F_P(d)$ features in both paid and incurred expected values, RSS is minimised simultaneously for paid and incurred
- This also produces a single set of estimated ultimates U_j from both paid and incurred

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Relative influence of paid and incurred data

- Combined (paid and incurred) residual sum of squares is:
 - $RSS = RSS_P + w_i.RSS_i$
- w_i is a "weight" that determines the relative influence of incurred and paid data
- Appropriate value for w_i can be found empirically: it is the value such that mean weighted squared residual is the same for both paid and incurred
- For example, if mean squared residual (unweighted) is higher for incurred than paid, then selected curves provide worse fit to incurred than to paid, so incurred data should be given less weight

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Testing statistical significance of cycle effects

- Cycle effects are included in the model through equations such as:
 - $a_i = \exp\{\alpha_0 + \alpha_1 \cdot (Q_i - 1)\}$ (where a is a parameter of chosen cdf)
 - $b_j = \exp\{\beta_0 + \beta_1 \cdot (Q_j - 1)\}$ (where b is case-estimate bias-factor)
- Q_i is a premium rate index normalised to have a mean value of 1
- $\alpha_0, \alpha_1, \beta_0, \beta_1$ are the parameters estimated by least squares
- Cycle effects are present if parameter α_1 or β_1 is statistically significant
- Statistical significance is determined using F-tests

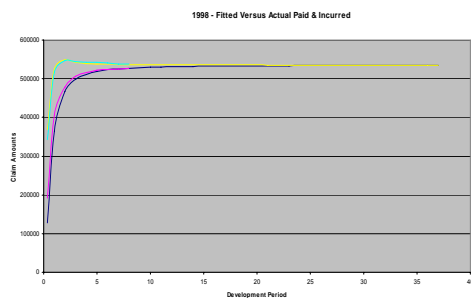
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Use of premium or other exposure data

- Fitting curves to cumulative paid and incurred data does not in general give reliable estimates for the latest origin years (as in CL method)
- Reliability can be greatly improved by also making use of premium or other exposure information (as in BF method)
- Extended residual sum of squares: $RSS = RSS_p + w_i \cdot RSS_i + w_x \cdot RSS_x$
- $RSS_x = \sum (\text{actual} - \text{expected})^2 / (\text{relative variance})$
- Actual exposure = Prem_i / Q_i (where Q_i is normalized to have mean 1)
- Expected exposure = $U_i / (\text{expected ultimate loss ratio})$
- Expected ultimate loss ratio = $\rho_0 + \rho_1 \cdot j + \rho_2 \cdot Q_i$

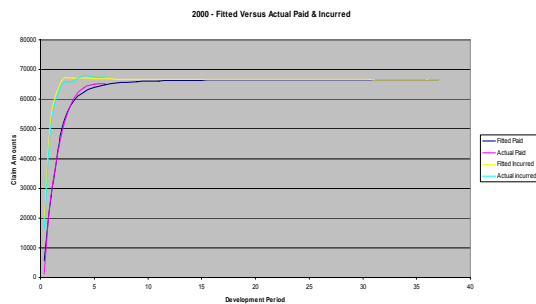
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Example of curves fitted to actual paid & incurred data



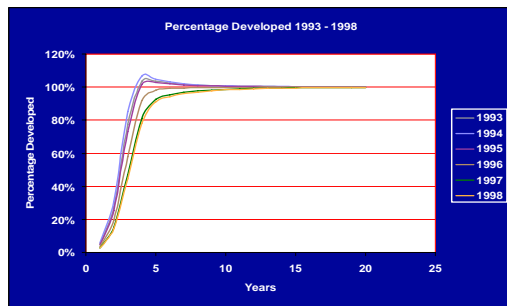
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Example of curves fitted to actual paid & incurred data



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Example of curve fits to incurred development



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Summary

- Softening market conditions and financial turmoil – new challenges for reserving actuaries
- Reserving and Underwriting cycles – need to manage the route through the cycle
- Solvency II – new definition of technical provisions

What is in your reserving toolkit?

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Questions?

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