



Institute of Actuaries of Australia

5th Financial Services Forum

Renovating the Financial System

2010

13 and 14 May 2010 – SYDNEY

Our New 'Old' Problem – Pricing Longevity Risk in Australia

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(& Gavin Jones)**

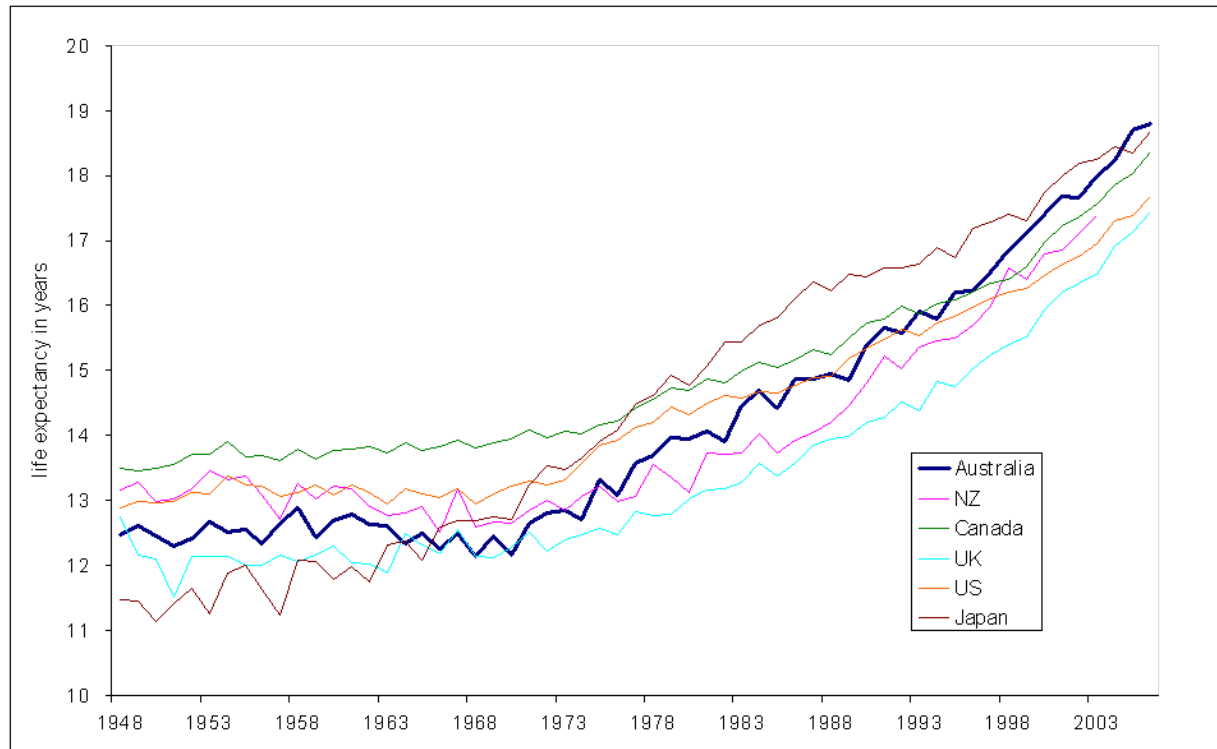
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Agenda

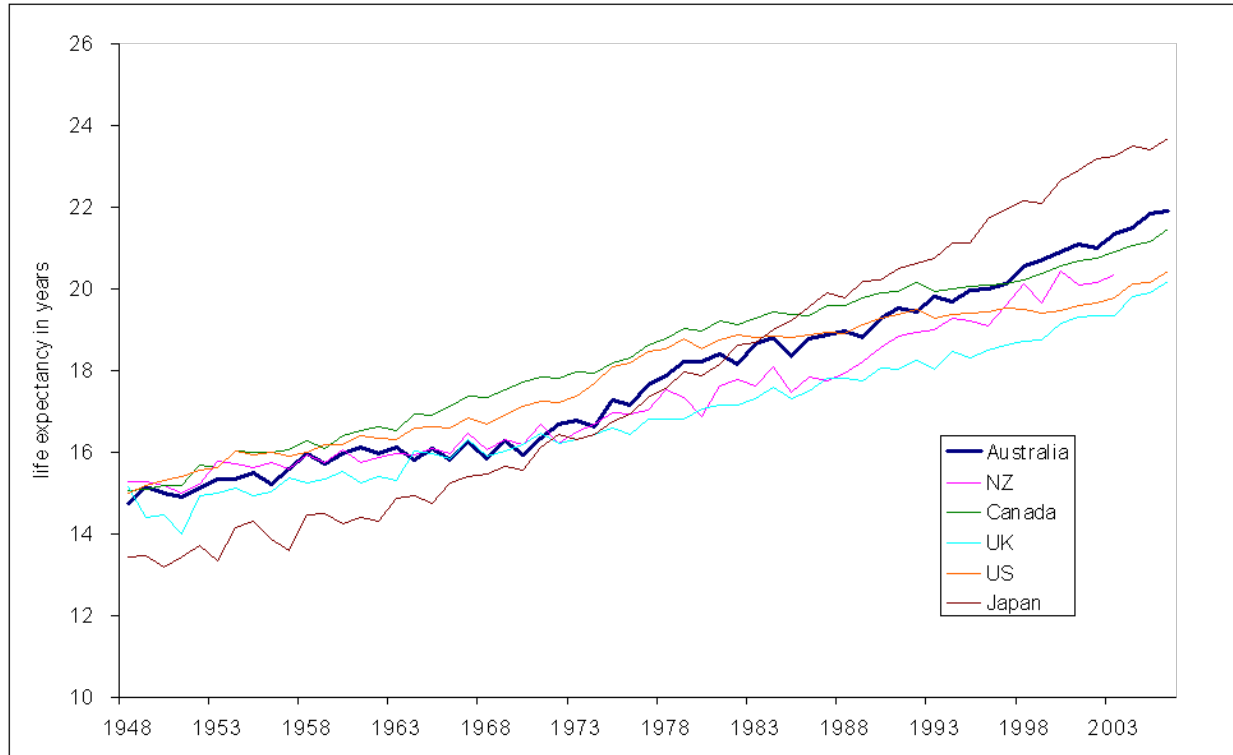
- Current mortality levels
 - Population
 - Sub groups (UK, US and Aust)
- Future mortality modelling
 - Forecasting methods
 - Historical improvements and extrapolation models
 - Model, parameter and statistical variability

Male Period Life Expectancy at age 65



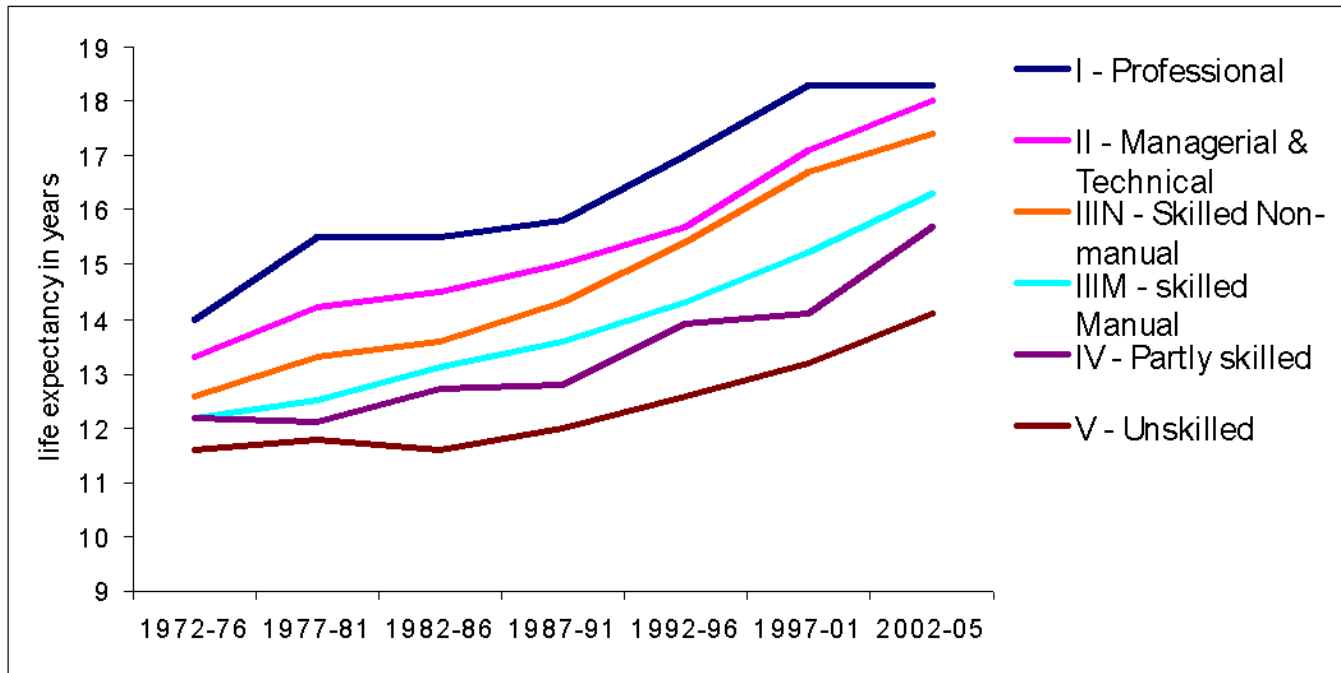
- Aust one of the fastest, increasing by 2.5 mths p.a.
- Since 1970s – reduction in smoking and medical advances in cardio-vascular diseases

Female Period Life Expectancy at age 65



- Slower growth than males, increasing by 1.9 mths p.a.
- Smoking and cardio-vascular diseases less relevant

UK Male Life Expectancy at 65



- ONS Longitudinal Study
- Gap of 4 yrs+ => 10% annuity cost
- Widening gaps

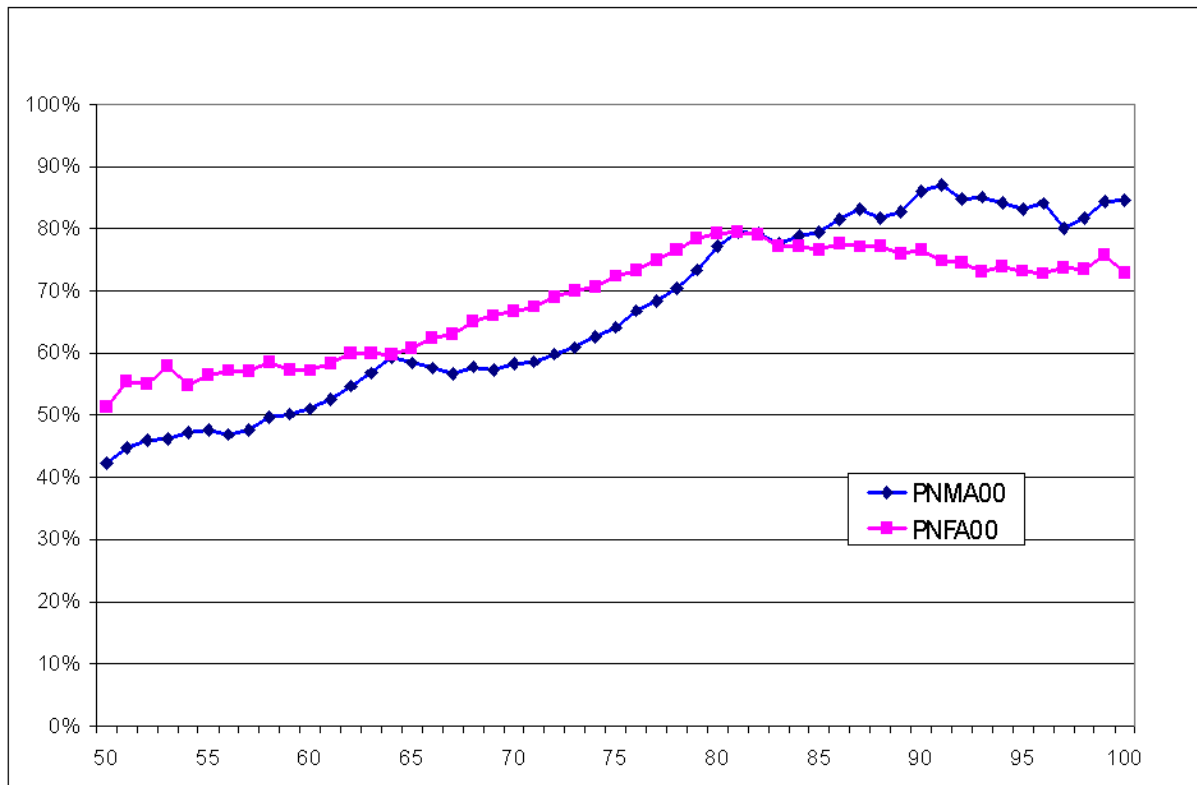
UK Annuities by Postcode



The screenshot shows a Microsoft Internet Explorer browser window displaying a BBC News article. The address bar shows the URL: <http://news.bbc.co.uk/2/hi/business/8441314.stm>. The page title is "BBC News - How to avoid the annuities postcode trap - Microsoft Internet Explorer provided by Swiss Re". The article title is "How to avoid the annuities postcode trap" under the "Money Talk" section by Billy Burrows and Burrows & Cummins. The article text states: "Many people living in the more affluent parts of the country are being disadvantaged by annuity pricing based on postcodes. An annuity is a policy, bought with the proceeds of your pension fund savings, which pays you an annual income in retirement until you die. Most of the top providers are now pricing annuities". There is a small image of an elderly couple looking at a newspaper titled "STOCK MARKETS". The browser's taskbar at the bottom shows the Start button and several open applications including Internet Explorer, Microsoft Word, and Microsoft Excel.

- ONS life expectancies by local authority
 - LE at 65 from 13.8 yrs to 23.1 yrs
- Annuities vary by 4%+ due to postcode

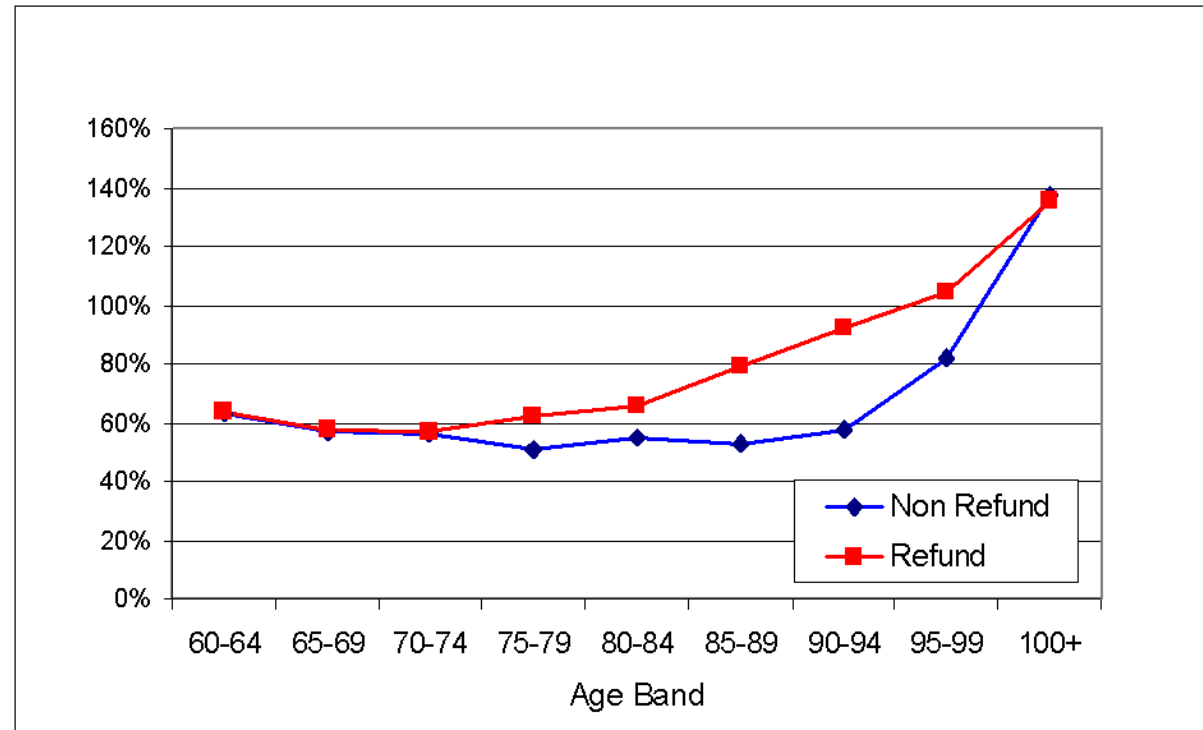
UK Annuitant Mortality vs. Population



- At younger ages – employment and self select
- Lighter mortality than the Self Administered Pension Schemes (SAPS)

US Male Annuitant Mortality vs. Popn

- A voluntary market
- Pivot tables provided in SOA study
- Self-select evident
- Females similar





Australia Experience

- Public sector scheme pensioners 2005-07
 - shape similar to UK annuitants
- Immediate annuitants 1998-99
 - flatter shape

Current Mortality - Summary

- Aust post retirement life expectancy growing rapidly
- Socio-economic class strong predictor of longevity
 - postcode and benefit amount
- Other factors - Annuity buying behaviour, employment status etc
- Widening gaps

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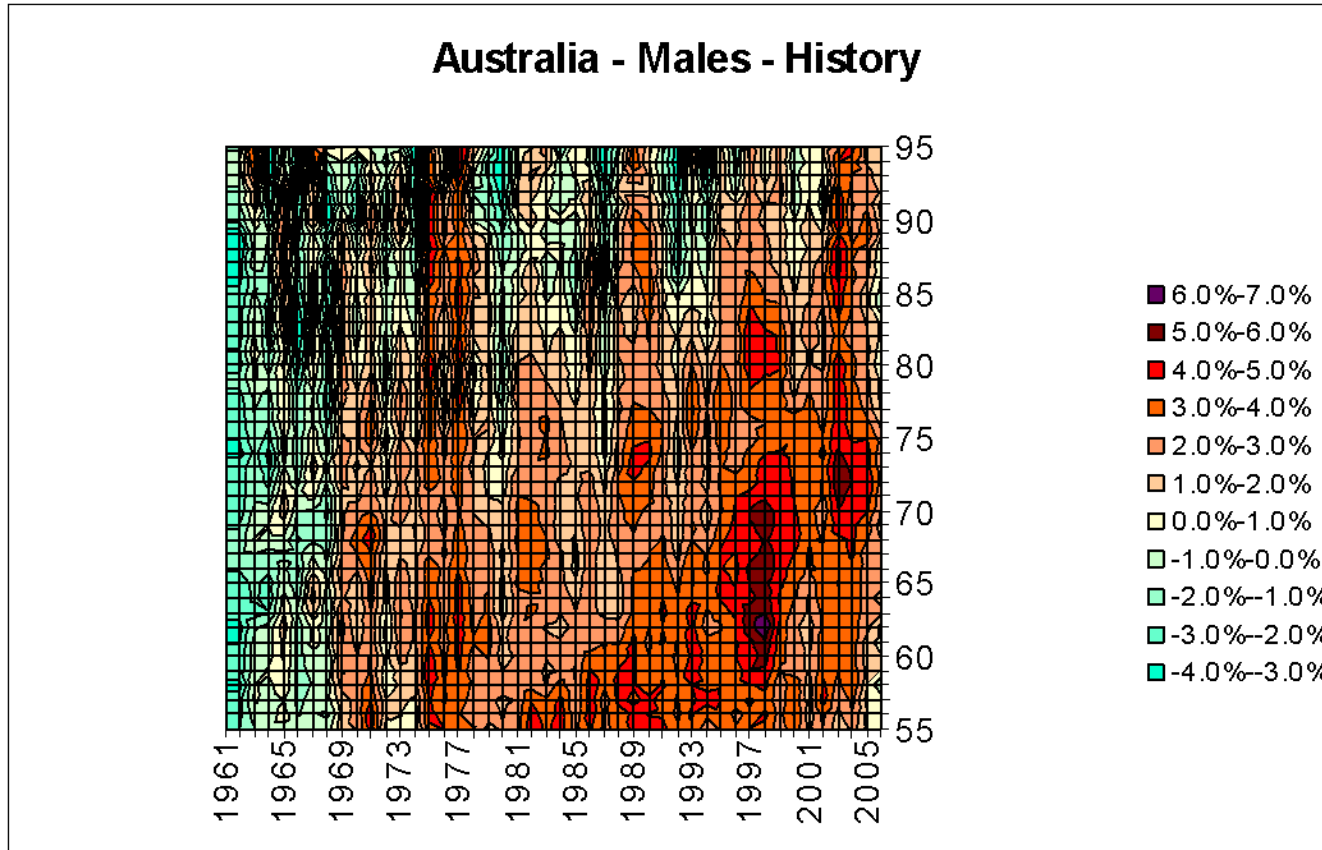




Future Mortality Modelling

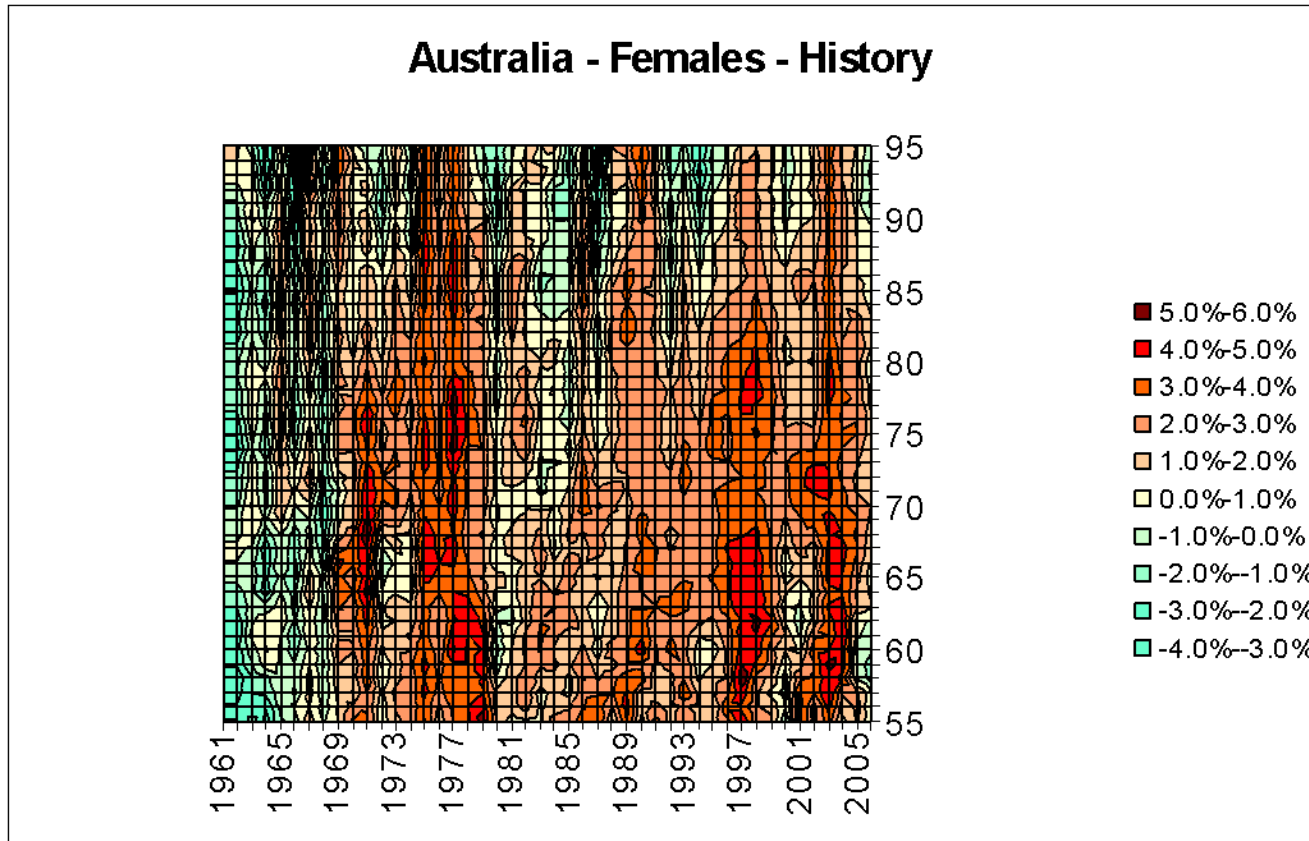
- **Extrapolation**
 - time series and other statistical models
- **Explanatory / Process-Based**
 - extrapolation by cause and cause-elimination
- **Expert Opinion / Expectation**
 - genetics and biological processes

Historical Improvements - Male



- Clear period (vertical) and cohort (diagonal) effects

Historical Improvements - Female



- Improvements generally lower, cohort effect weaker

Mortality Models

- Lee-Carter

$$\log \mu_{x,t} = a_x + b_x p_t + \epsilon_{x,t}$$

Age effects $a_x b_x$

Period effects $p_t r_t$

Cohort effects c_{t-x}

Random error $\epsilon_{x,t}$

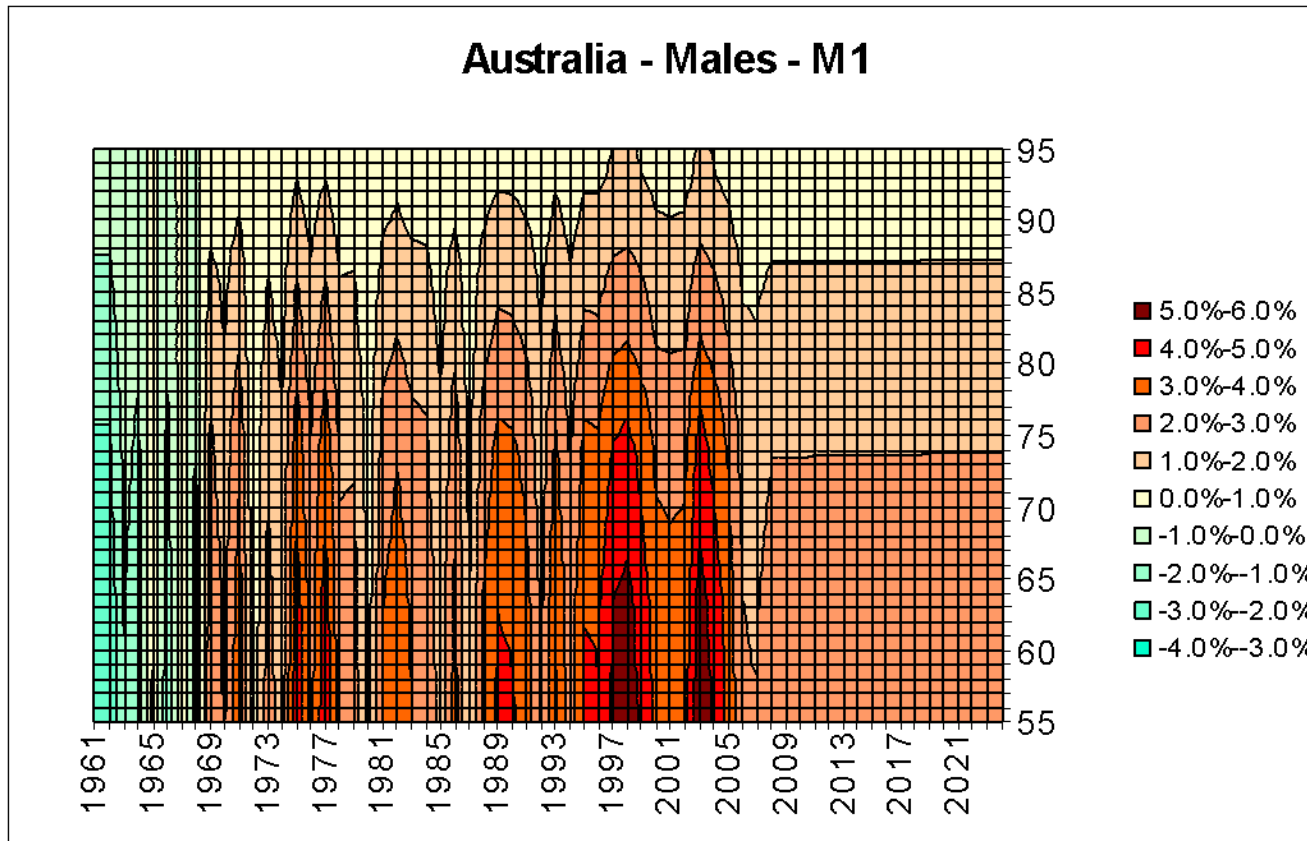
- Currie Age-Period-Cohort

$$\log \mu_{x,t} = a_x + p_t + c_{t-x} + \epsilon_{x,t}$$

- Cairns-Blake-Dowd (CBD) with Cohort

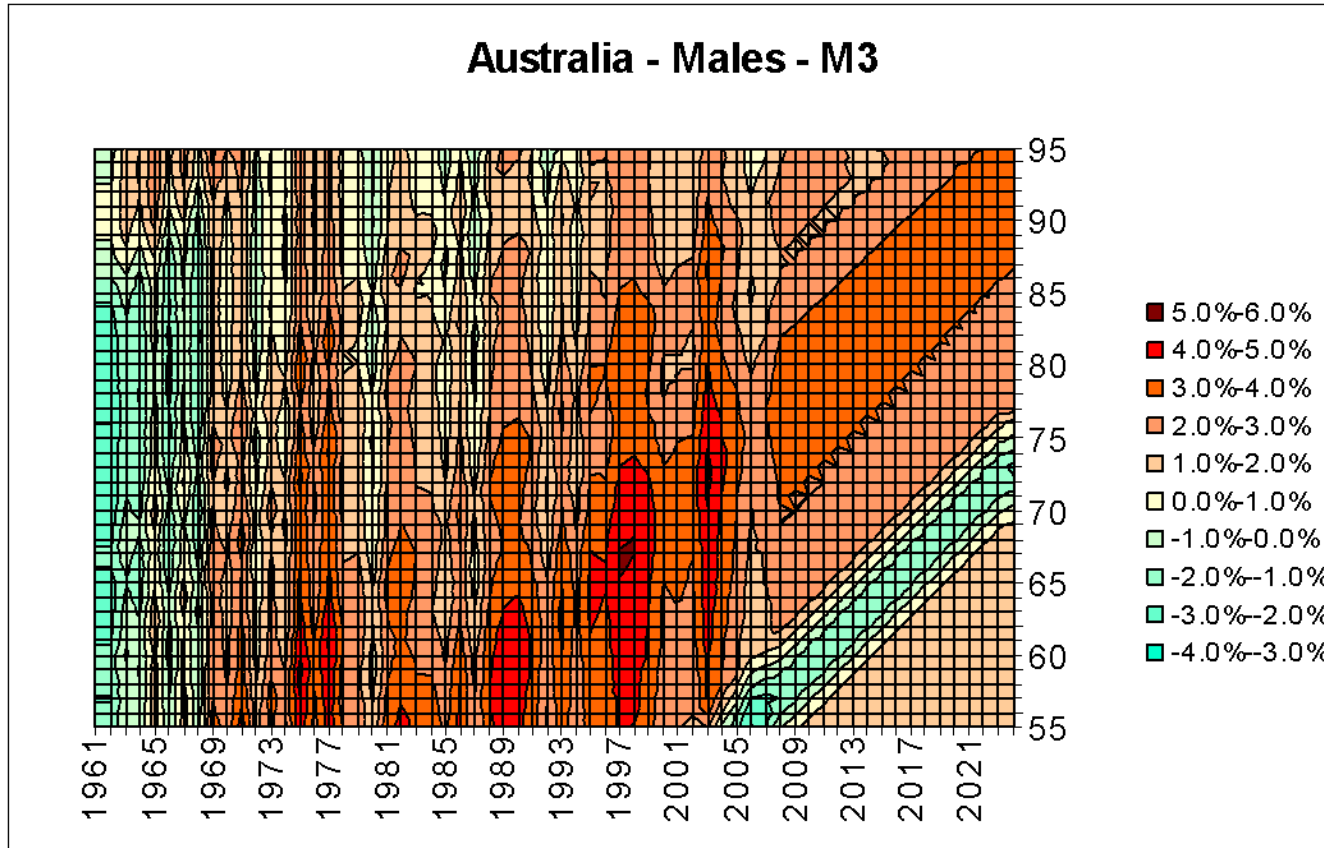
$$\text{logit } q_{x,t} = p_t + r_t (x - \bar{x}) + c_{t-x} + \epsilon_{x,t}$$

Lee-Carter Model (M1)



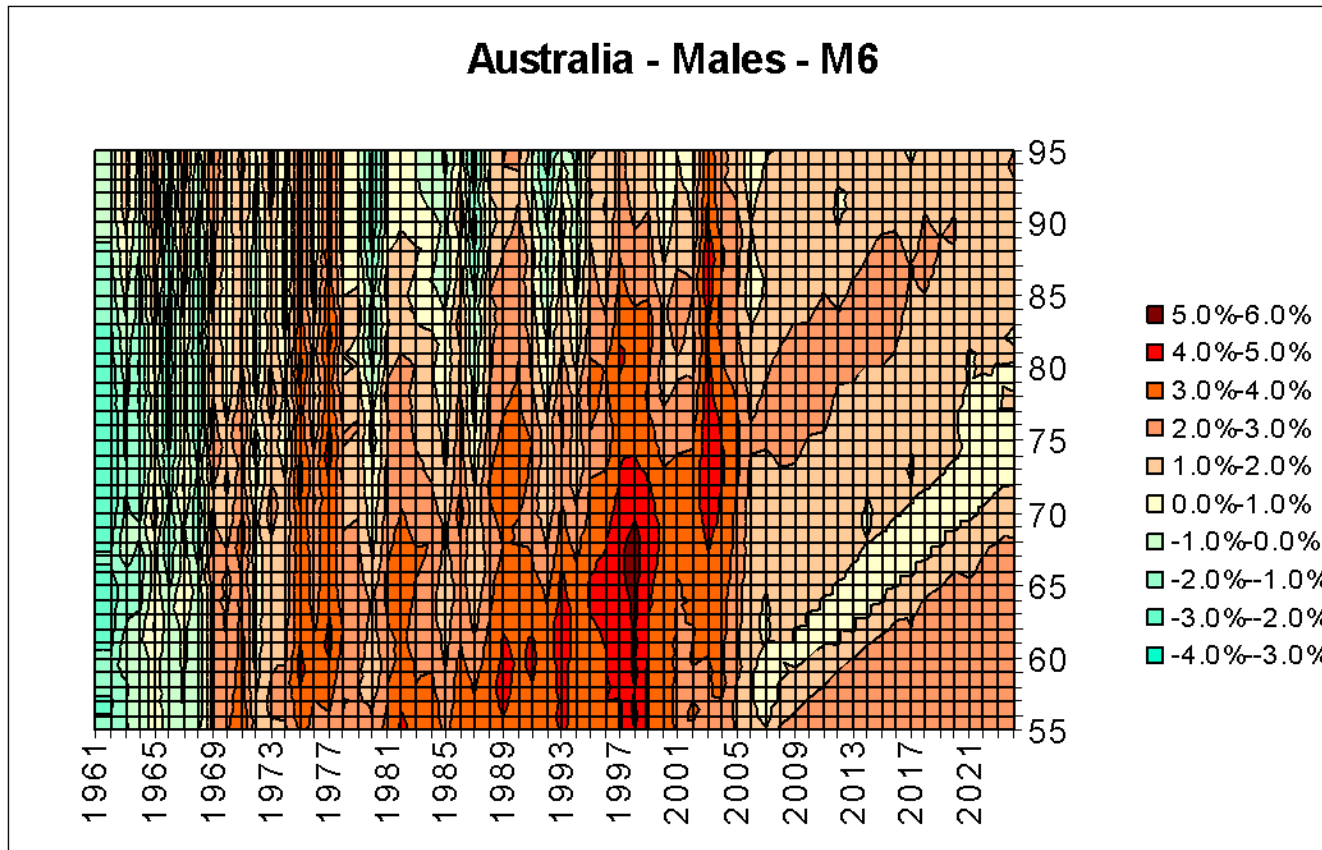
- No cohorts, improvements vary by attained age only

Currie APC Model (M3)



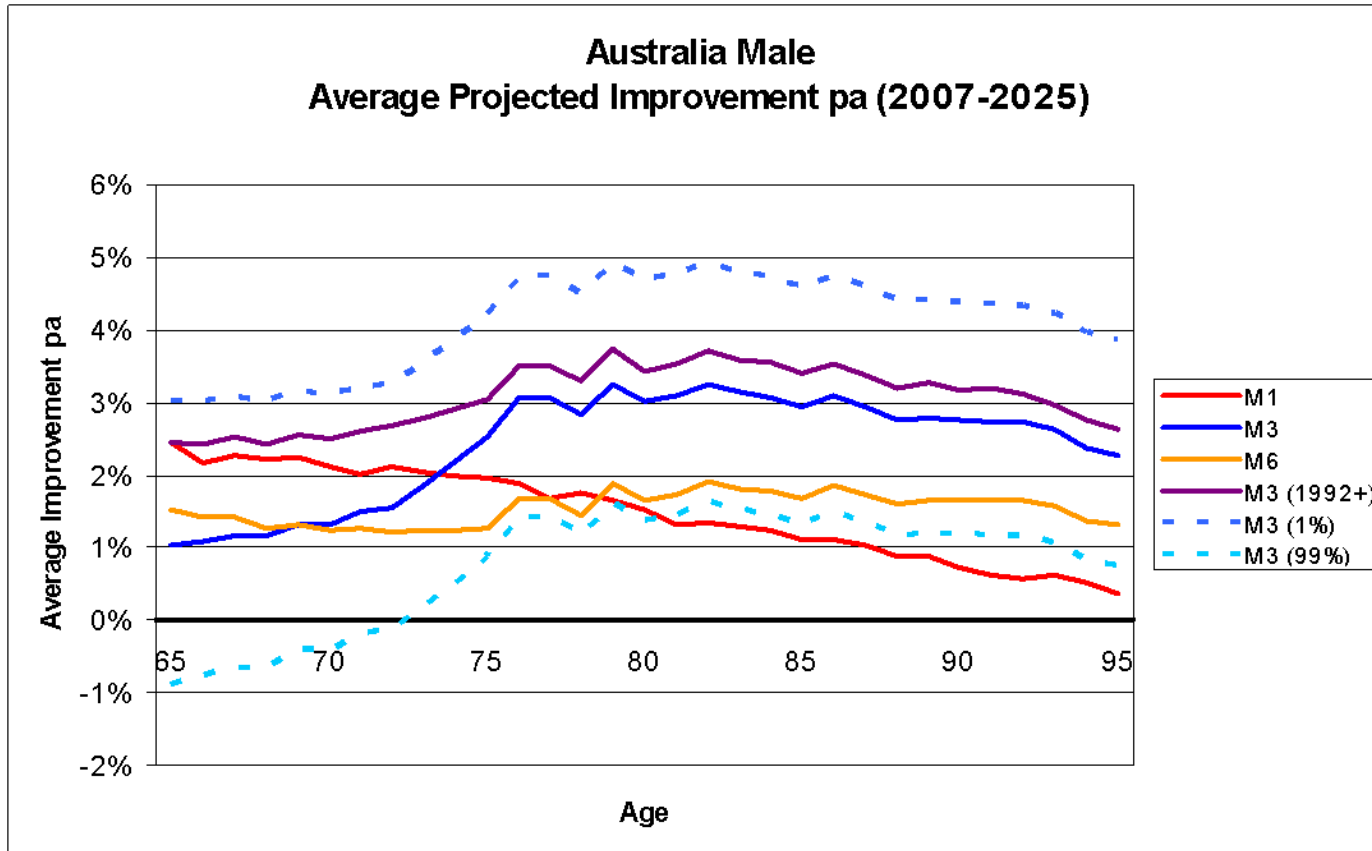
- Strong, dominant, persisting cohort effect

CBD with Cohort Model (M6)



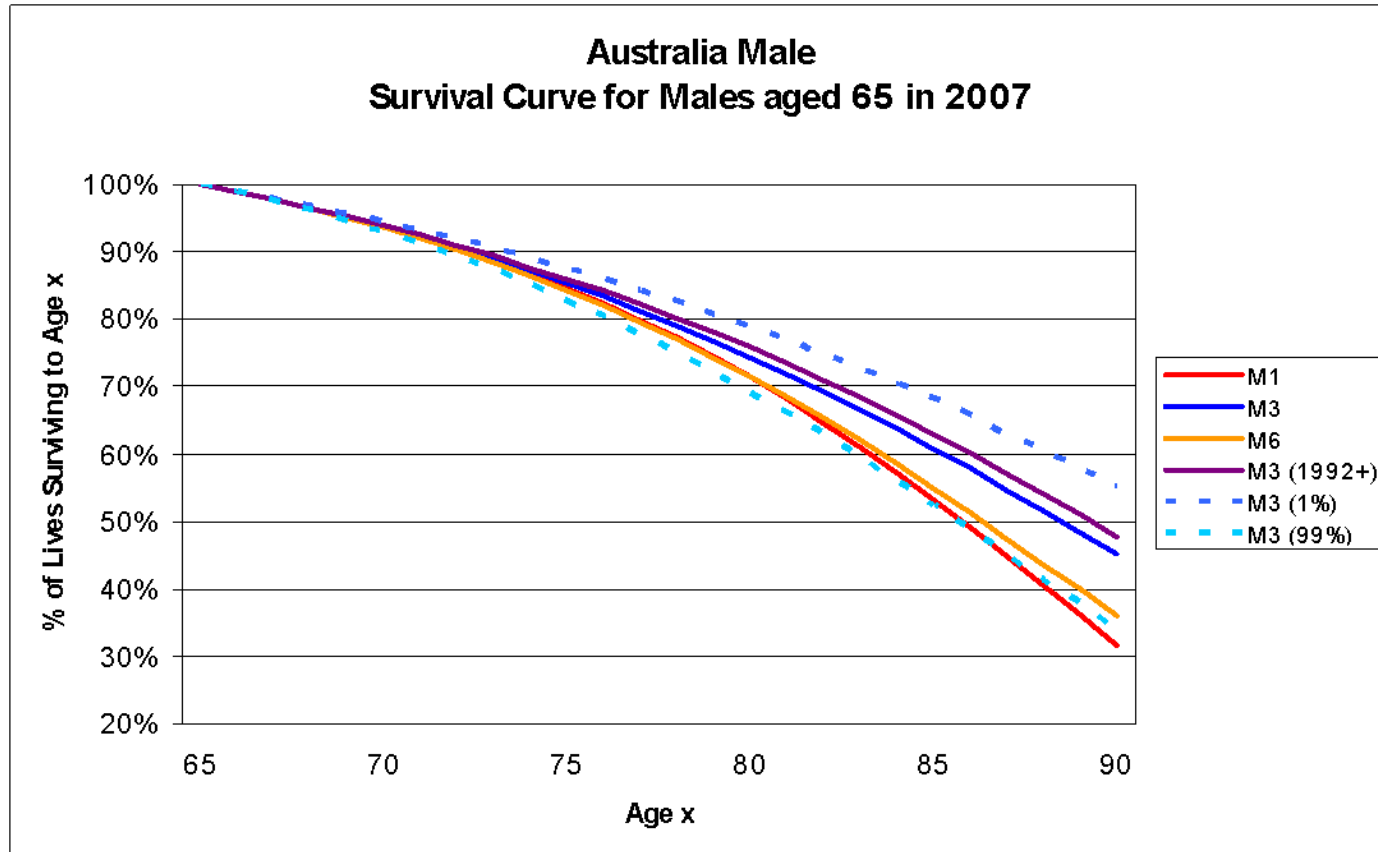
- Weaker cohort effect, diminishing over time

Model, Parameter, Statistical Variability



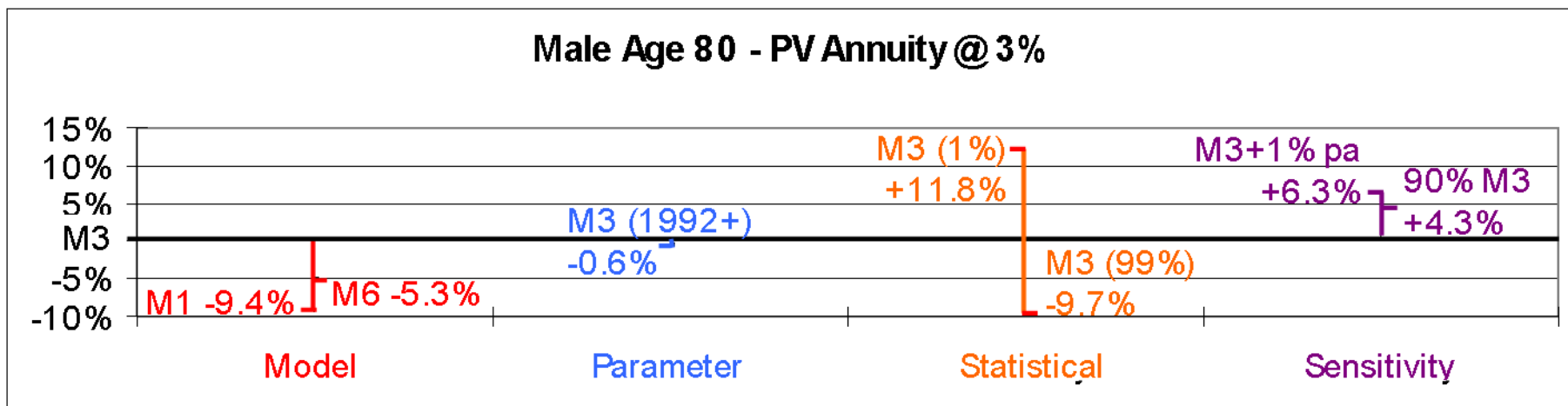
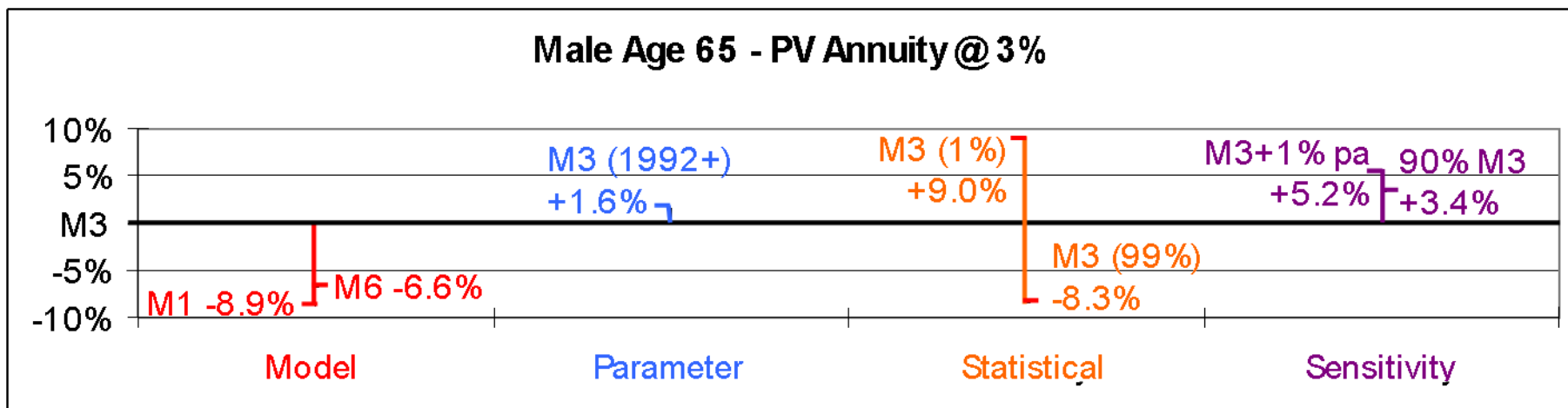
- Relative strength of modelled period / cohort effects reflected in varying mortality improvement by age

Model, Parameter, Statistical Variability



- Variation between models can exceed statistical variability within model

Model, Parameter, Statistical Variability





Future Mortality - Summary

- Use a combination of extrapolation, explanation, expert opinion
- Strong evidence of cohort effect for 1925-35 males, weaker for females
- Similarly plausible models can give very different answers
- Important to understand the possible range of outcomes

Conclusions

- Large differences in mortality between sub-segments of the population
- Large differences in projected future mortality depending on model chosen, period of fit and statistical volatility
- No single “correct” approach for longevity pricing - quantify uncertainty based on a range of plausible outcomes