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## A11: Uncertainty in longevity assumptions

Jonathan Hughes

Head of Strategic Development, RGA UK

Sacha Dhamani

Demographic Risk Actuary, Partnership Assurance



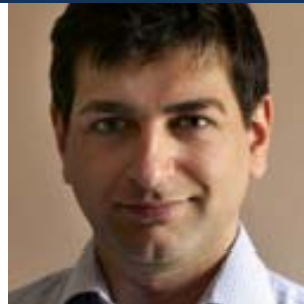
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### Who we are

Jonathan Hughes, RGA



Sacha Dhamani, Partnership

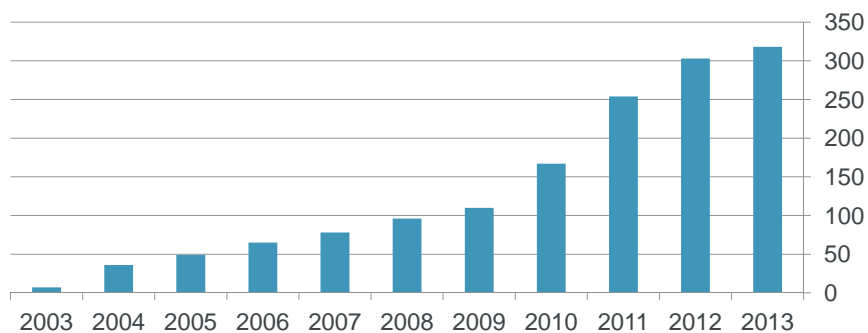


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## A well-trodden path

Cumulative number of documents on this topic since 2003:



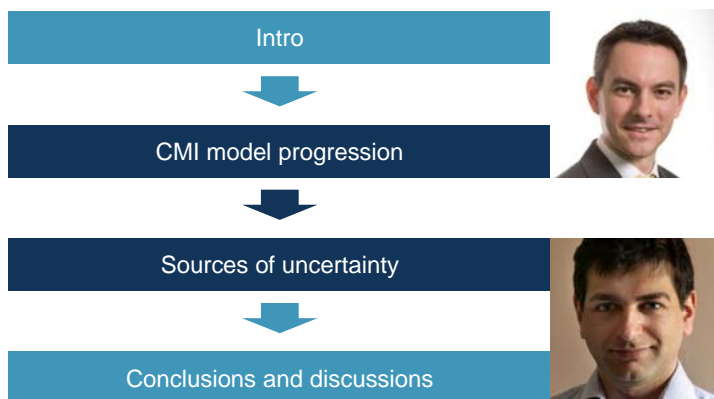
Source: [Search in IFoA online document library](#) for "uncertainty in longevity assumptions" in the Life Insurance practice area



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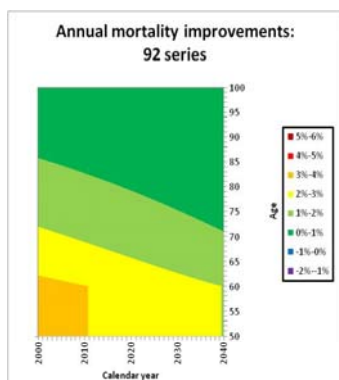
## Agenda



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## Trends in our trend assumptions



92 series

- Age
- Calendar year

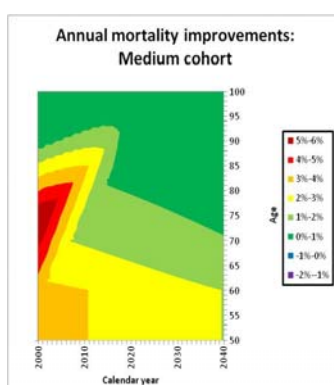
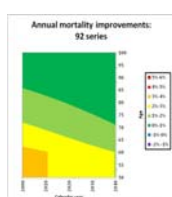


Source: Own summary of mortality improvements from [CMI library of mortality projections](#)

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## Trends in our trend assumptions



Interim adjustments

- Age
- Calendar year
- Cohort effect

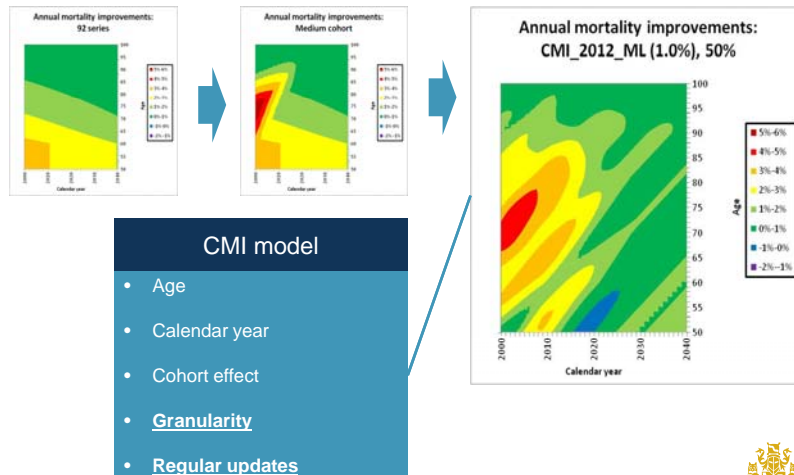


Source: Own summary of mortality improvements from [CMI library of mortality projections](#)

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## Trends in our trend assumptions



Source: Own summary of mortality improvements from [CMI library of mortality projections](#)

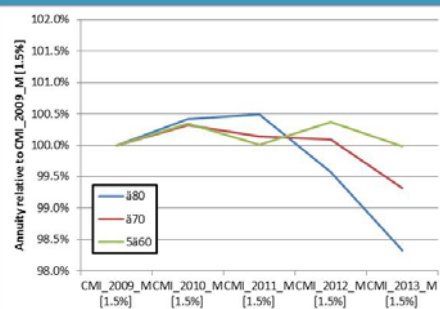


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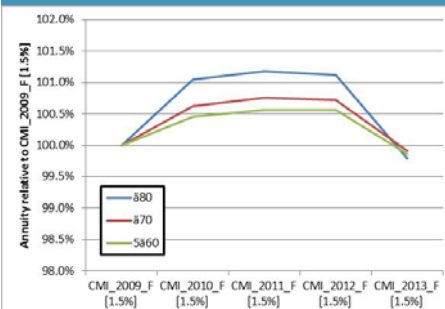
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## CMI model behaviour 2009 to 2013

Male annuities relative to CMI\_2009



Female annuities relative to CMI\_2009



Source: Own summary of CMI models over time. Methodology as described in Appendix C of WP63.

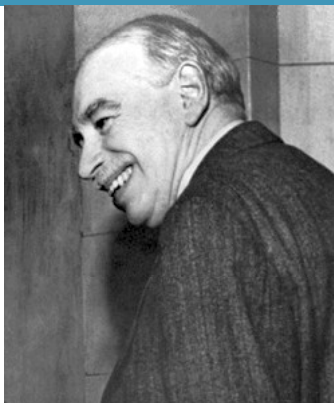


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## CMI model behaviour 2009 to 2013

Have the facts changed?



John Maynard Keynes



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## CMI model behaviour 2011 to 2012

Change in population estimate following 2011 Census results

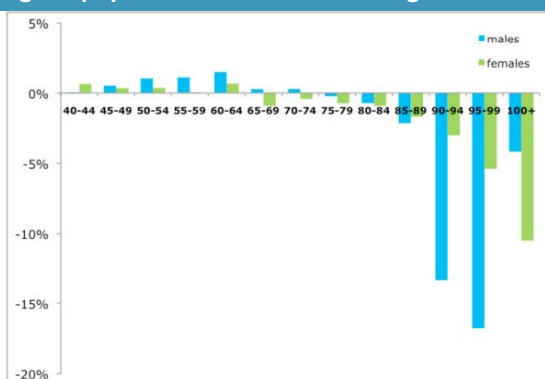


Figure 1. Increase in England & Wales population estimate (as a %) following publication of the 2011 Census results, by age group & gender

Source: [The Actuary](#) (Richard Willems, 28 Nov 2012)



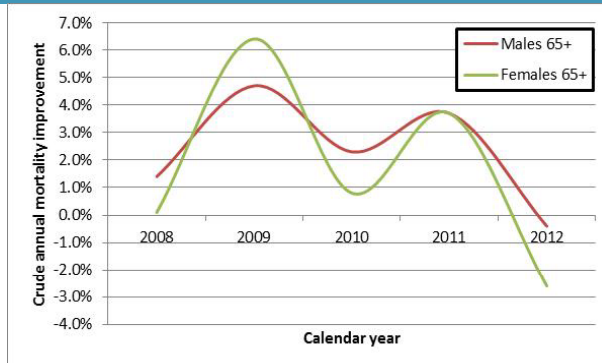
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## CMI model behaviour 2012 to 2013

### Crude annual mortality improvement by calendar year



Source: Illustration of table from CMI WP69



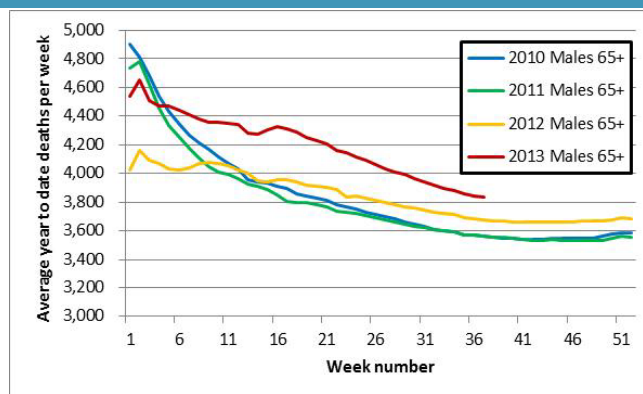
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## CMI model behaviour 2013 to 2014?

### Average year to date deaths per week



Source: RGA analysis of ONS weekly deaths data



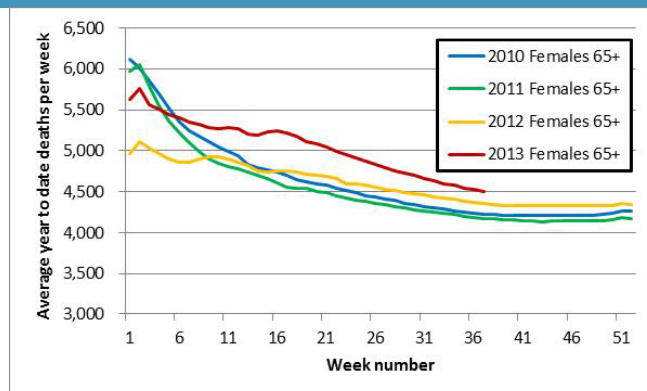
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## CMI model behaviour 2013 to 2014?

Average year to date deaths per week



Source: RGA analysis of ONS weekly deaths data

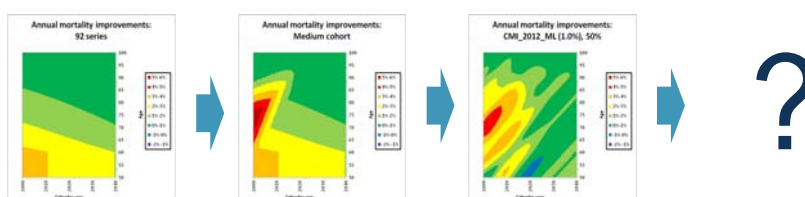


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## What next?



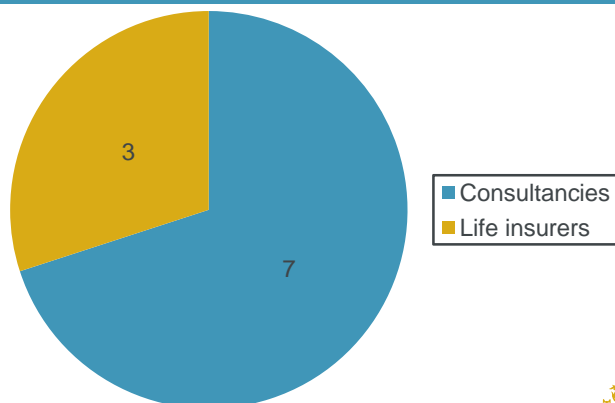
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## Consultation feedback

### Responses to consultation paper



Source: Illustration of CMI WP 69



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## Consultation feedback

+	~	-
Projections library	Spreadsheet size	Transparency of initial rates derivation
Common currency	E&W data rather than UK	Transparency of age/period and cohort split
Initial => long-term rate		Convergence parameters
Minimal core parameters		
Annual updates		

Source: Summary of CMI WP 69



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## Where will effort be most rewarded?

- The Committee are working on potential improvements and will consult before adopting material changes
- But even if the model is “perfected”, it will not address:
  - **Probabilities:** in its current form, it is fundamentally and intentionally deterministic, not stochastic
  - **Specific portfolios:** every users’ portfolio will be different to the reference population

So what could go wrong when applying this model to your portfolio?



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## Risk in Applying Trend Assumptions to Specific Portfolios

erprise  
 Sponsorship  
 Thought leadership  
 Progress  
 Community  
 Seasonal Meetings  
 Education  
 Working parties  
 Volunteering  
 Research  
 Shaping the future  
 Networking  
 Professional support  
 Enterprise and risk  
 Learned society  
 Opportunity  
 International profile  
 Journals  
 Support

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## Introduction

- Changes in Behaviour
- Model Risk
- Basis risk
- Conceptual Validity in Trend Assumptions



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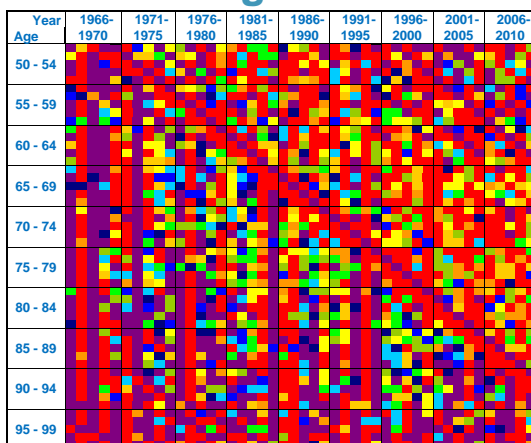
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## Change in Behaviour



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## Past Changes in Behaviour



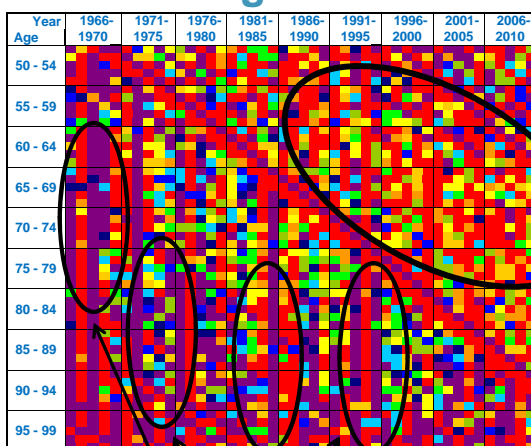
Own Calculation based on ONS Data



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## Past Changes in Behaviour



Cohort Effect

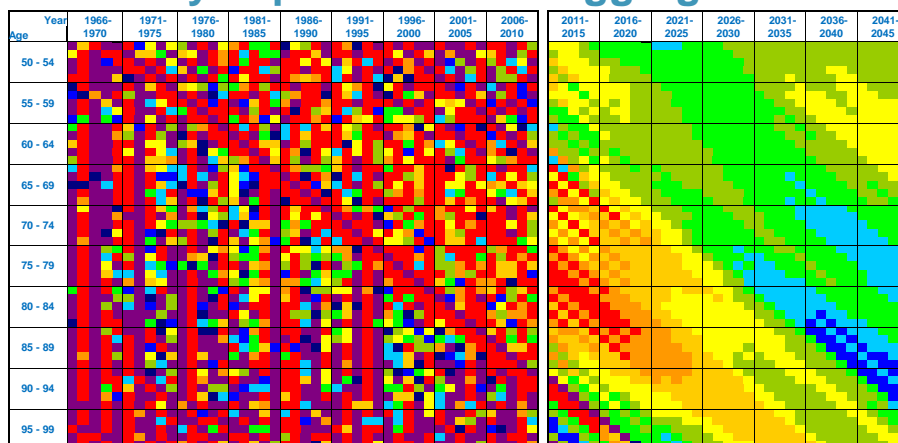
Period Volatility



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## Mortality Improvements - Aggregate



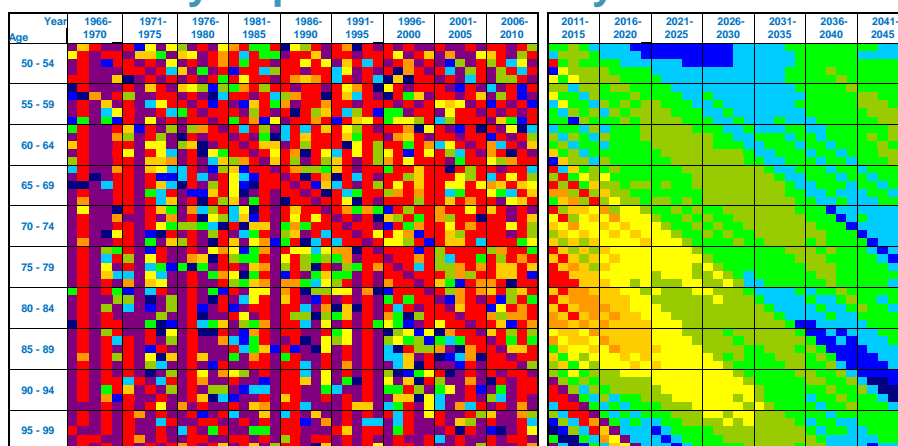
Own Calculation based on ONS Data



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## Mortality Improvements – By Cause



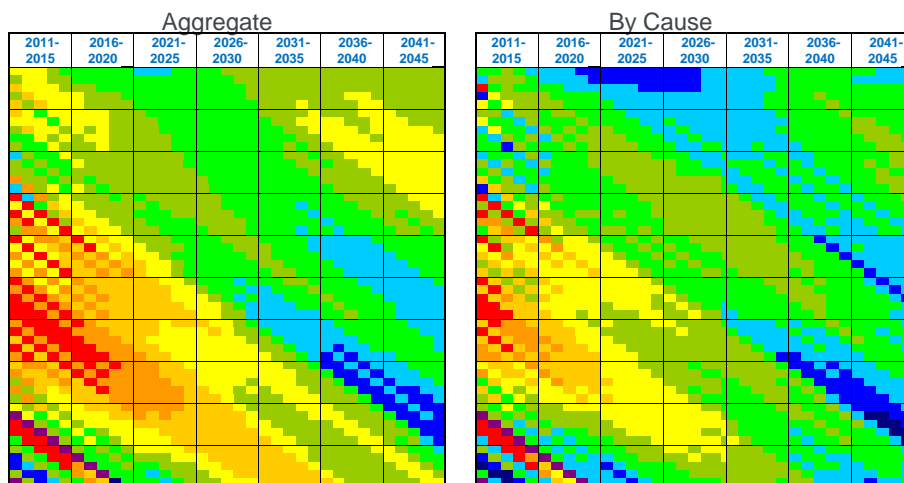
Own Calculation based on ONS Data



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## Mortality Improvements



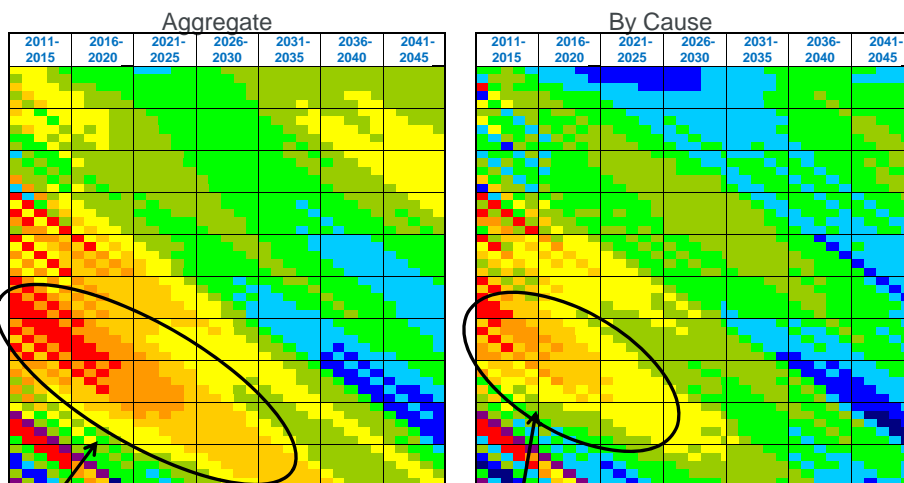
Own Calculation based on ONS Data



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## Mortality Improvements



Long duration of  
cohort effect

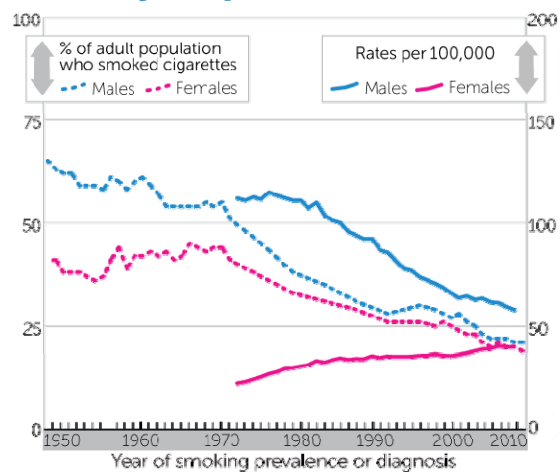
Short duration of  
cohort effect



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## Mortality Improvements - Drivers



Richard Doll  
1912-2005

Prepared by Cancer Research UK, using ONS data



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## Future Changes in Behaviour

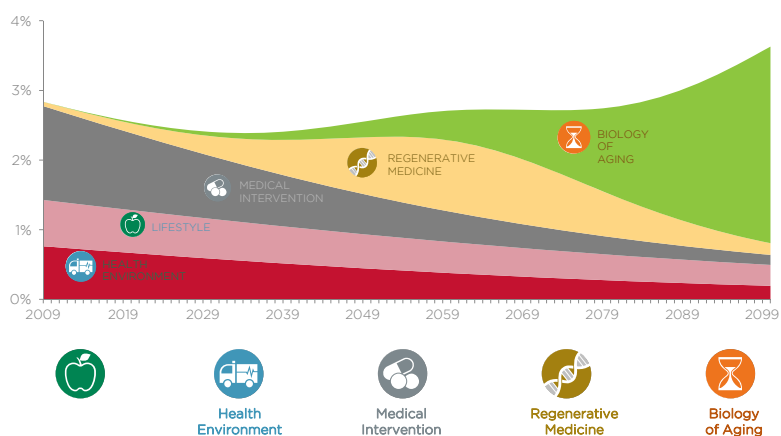


Chart kindly provided by RMS



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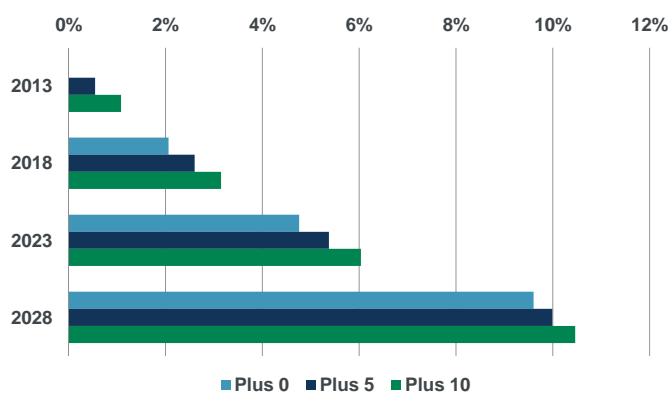
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## Model Risk



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### Model Risk – CMI Model



% Difference in Male Life Expectancy at aged 60



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## Model Risk – Wider Issues

- Mortality Rates or Improvement Rates
- Model Drivers – Age, Period, Cohort
- Deployment of “Model Power”
- Aggregate or Dis-aggregated
- Balance between Extrapolation and Prediction



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## Basis Risk

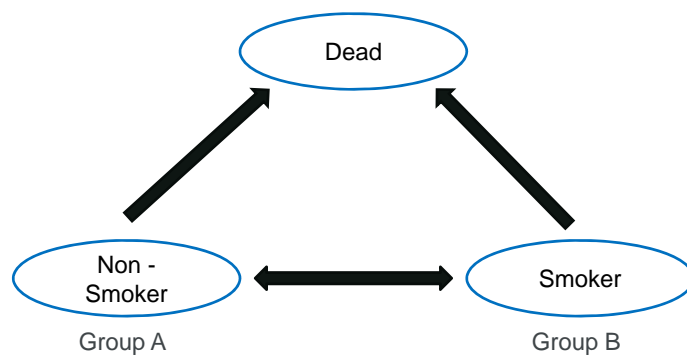


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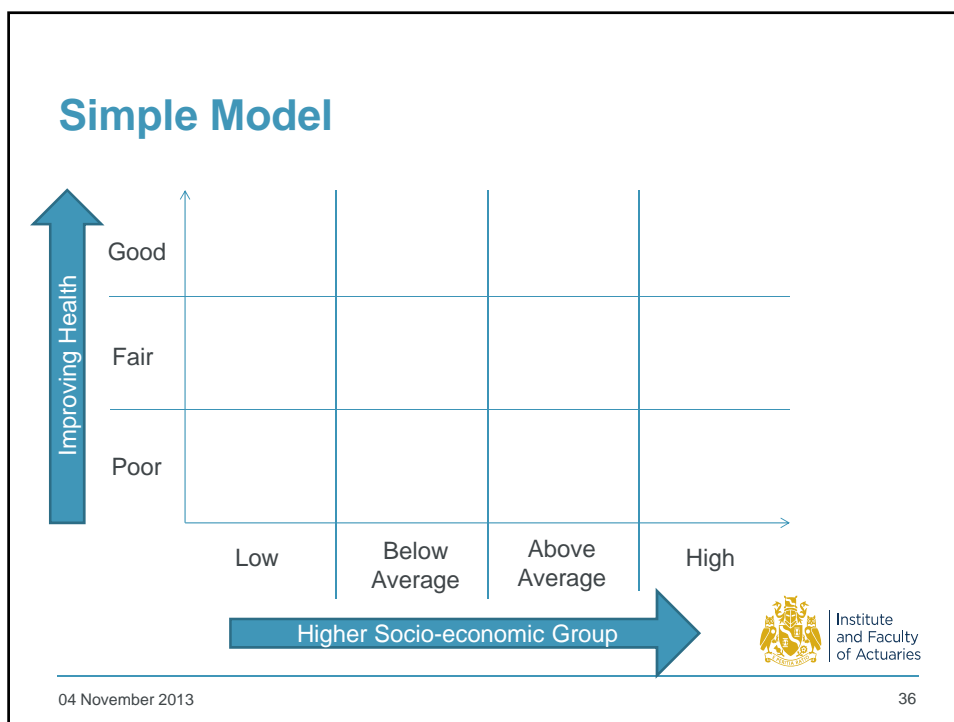
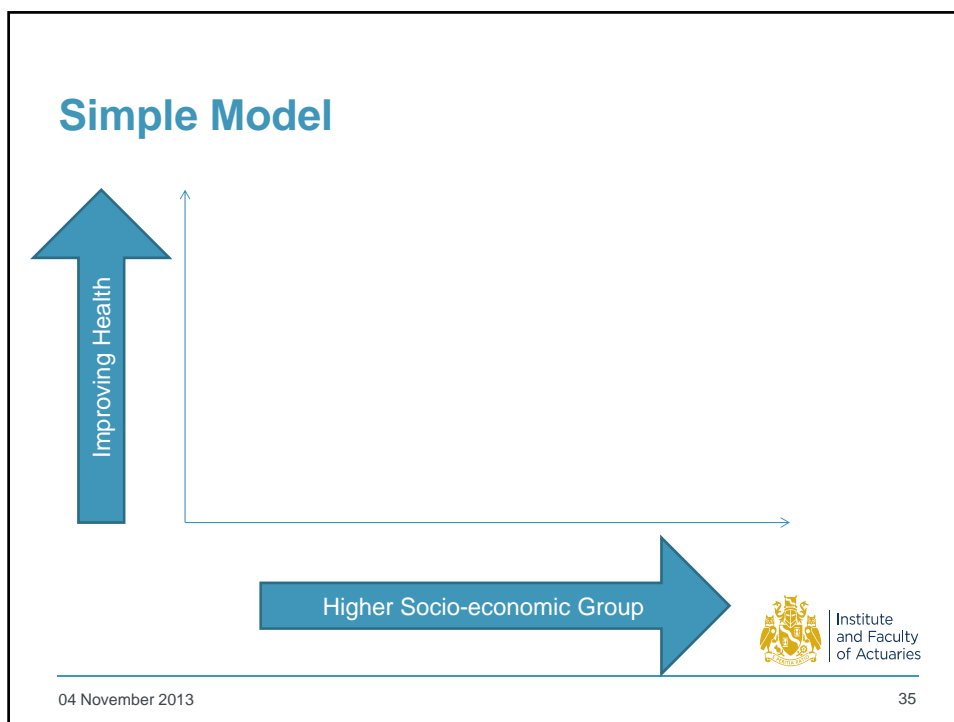
## Smokoria

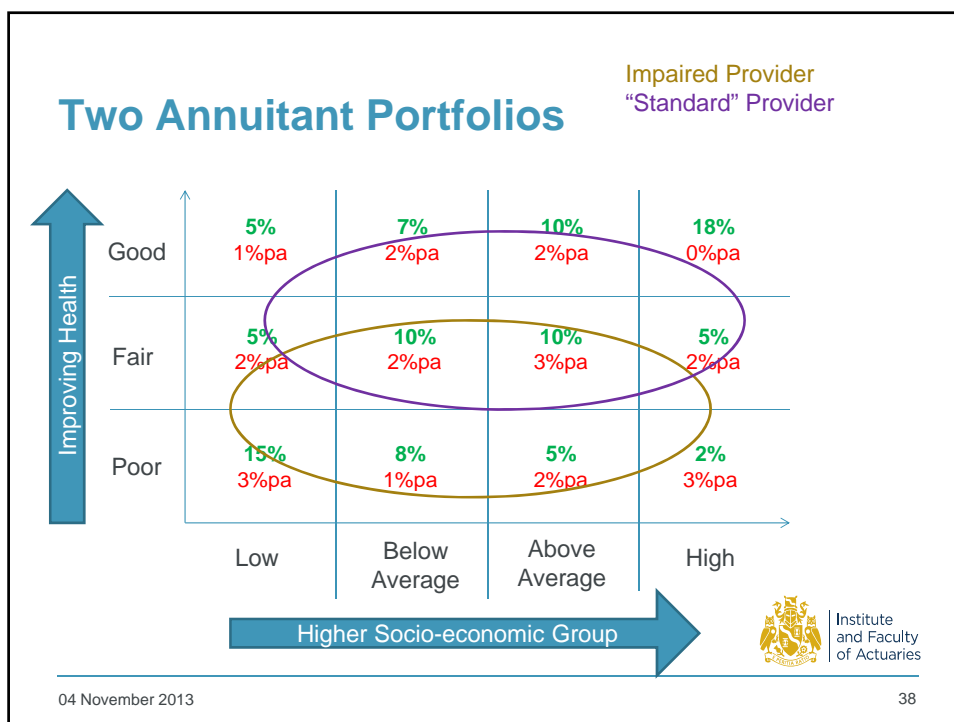
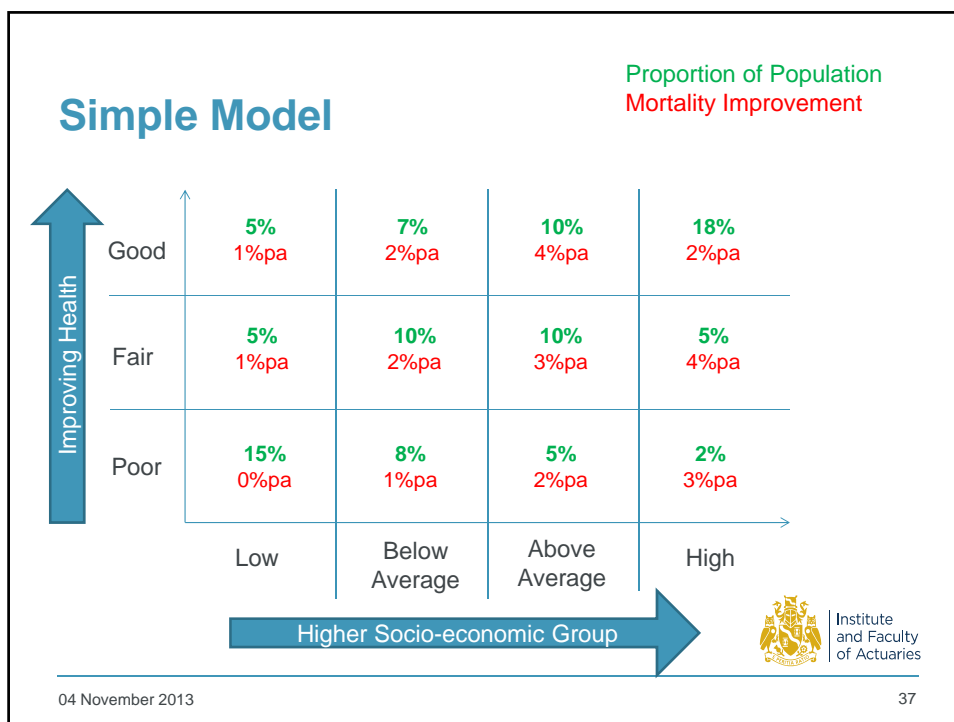


## Two Smokoria Life Companies

Both using population data to derive trend projection

Scenario	Description	Smok'em Life	Non-Smok'em Life
1	Same Improvement Rates	Trend Correct	Trend correct
2	Non Smoker Mortality Improvement	Overestimate of Trend	Underestimate of Trend
3	Smoker Mortality Improvement	Underestimate of Trend	Overestimate of Trend
4	Smokers becoming Non-Smokers	Overestimate of Trend	Overestimate of Trend





## Two Annuitant Portfolios

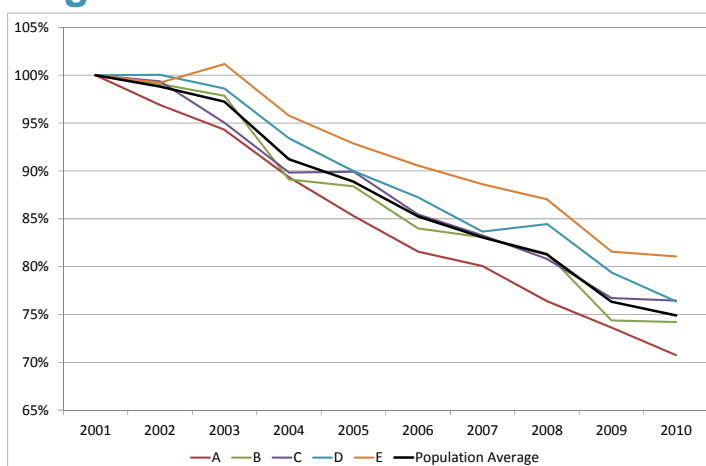
Portfolio	Description	Average Improvement
Population	Mix as per population	1.78%
Enhanced Annuity Provider	0% Good Health 33% Fair Health 67% Poor Health	2.31%
"Standard" Annuity Provider	67% Good Health 33% Fair Health 0% Poor Health	1.35%



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## Divergence in Trend



Own Calculation based on ONS Data



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## Conceptual Validity in Trend Assumptions



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## What is Mortality Improvement?



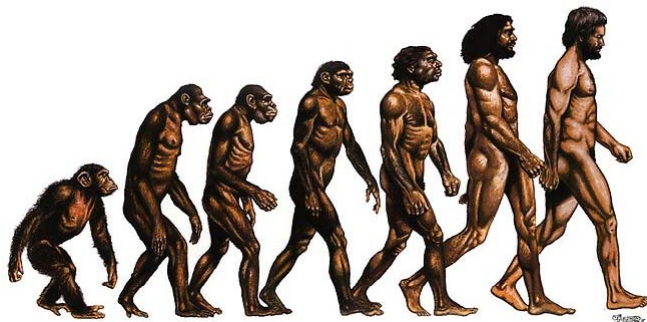
Is his mortality improving?



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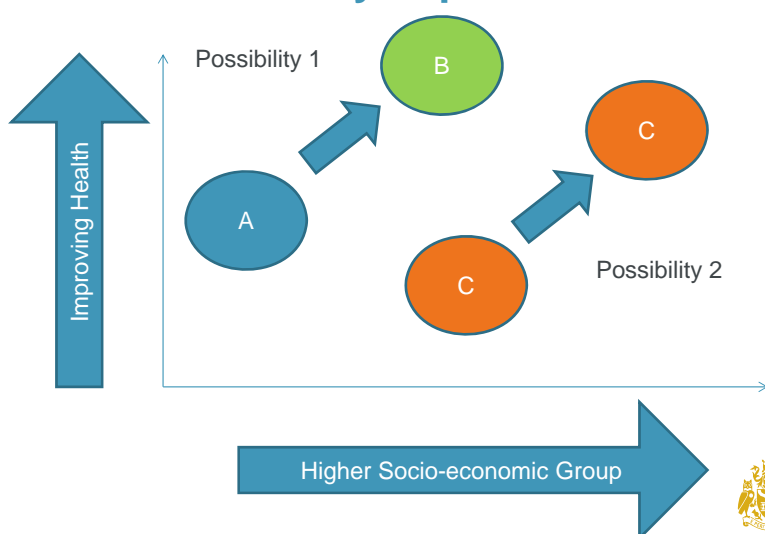
## What is Mortality Improvement?



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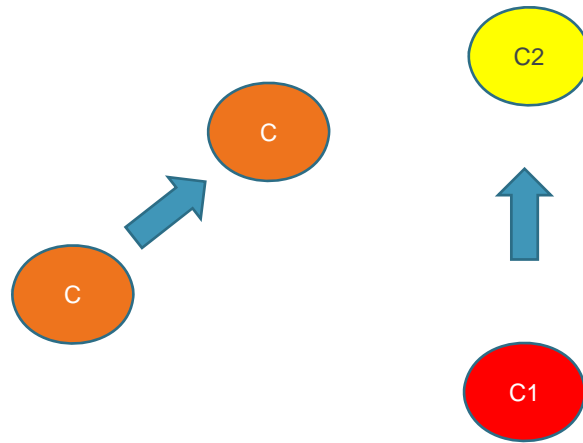
## What is Mortality Improvement?



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## What is Mortality Improvement?



## Summary

- Changes in Behaviour and Model Risk are important
- But Basis Risk may be your key trend risk
- Need to understand:
  - Who are your annuitants
  - Why has mortality improved and for whom
- Wider Thought:

*Has the concept of a “mortality trend assumption” had its day?*

**Questions**

**Comments**

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

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

