

The Actuarial Profession
making financial sense of the future


Understanding the Interactions Between Causes of Death – Mortality Projections by Cause Research Group

Adrian Pinington, TSAP Consulting
Scott Reid, Aon Benfield

23rd March 2009








Outline


- Introduction
- Scenarios – flat and steep improvement trends
- Heat Charts
- Scenario funnel against Lee-Carter Percentiles
- Caveats and Conclusions
- Where Next



The Actuarial Profession
making financial sense of the future

Mortality Projection by Cause Research Group Members

Adrian Pinington	Harry Palmes	Niel Daniels	Garth Lane
			
Richard Morris	Input from others:	Neil Robjohns	Scott Reid
	Dr R Croxson Dr R Wyse Dr A Luczak Dr J Wiiden		



The Actuarial Profession
making financial sense of the future

Introduction

Mortality Projections “By Cause” Research Group
Terms of Reference – Our Aims

- To examine underlying trends in the factors influencing UK population mortality rates, and from these, to assess:
 - Historical overview of mortality by cause in the UK
 - Review of literature on the key drivers of recent changes in mortality by cause in the UK, including research done by other professions
 - Investigate and review data sources available
 - Investigate and model past and future mortality improvements by cause.
 - Investigate and model past and future mortality improvements by cause to sub-populations – smoker status, socio-economic categories and immigration patterns (with associated genetic and socio-cultural mortality differences)
 - Investigate and model the potential for mortality “shocks”, either short-term or via the advent of new diseases, by way of example, reduction in the incidence of heart attack due to the introduction of a smoking ban or obesity.
- Formed in December 2007

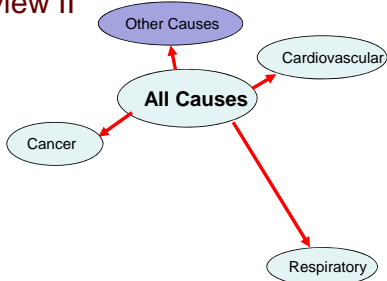
Introduction

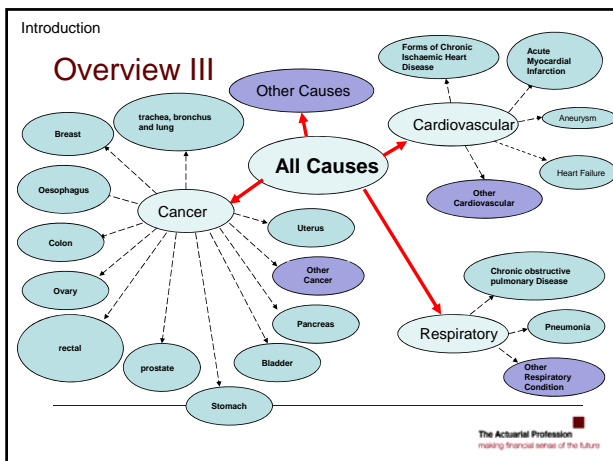
Overview I

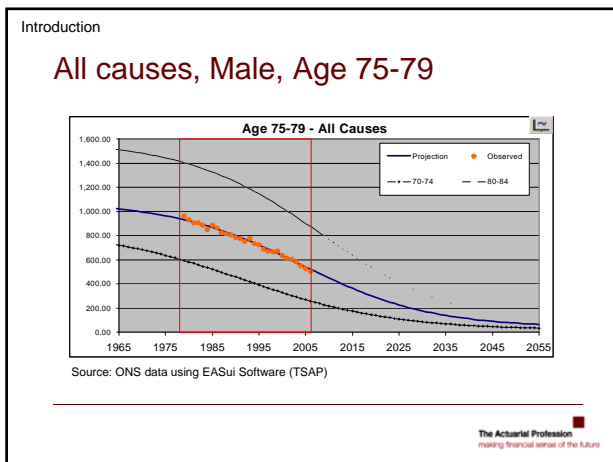


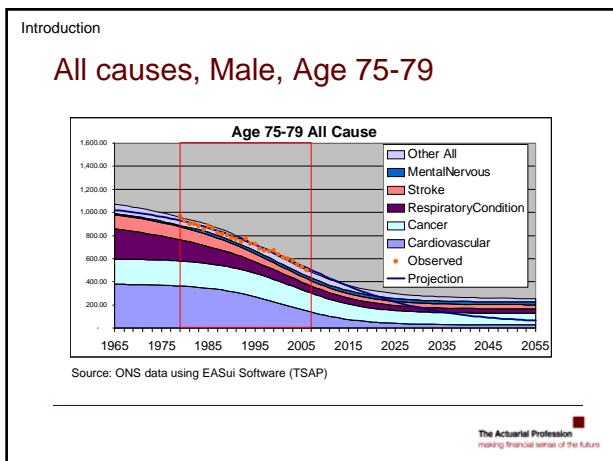
Introduction

Overview II



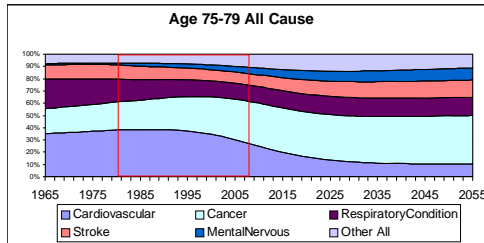






Introduction

All causes, Male, Age 75-79



Source: ONS data using EASui Software (TSAP)

The Actuarial Profession
making financial sense of the future

Outline

- Introduction
- Scenarios – flat and steep improvement trends
- Heat Charts
- Scenario funnel against Lee-Carter Percentiles
- Caveats and Conclusions
- Where Next

The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

- Explain terminology and technique
- Comparison International mortality by cause
- Illustration approach for a few specific causes

The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

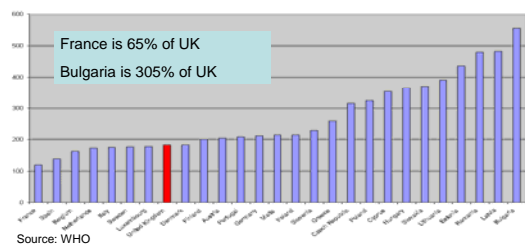
Approach

- By eye fit using the historical data as a guide
 - Flat mortality improvement trend
 - Steep mortality improvement trend
 - Carried out at **group cause** and **sub-cause** level for chosen conditions
- Further medical input for scenarios still required
- Variation in Mortality rate by cause internationally

The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

Variation in Mortality rate by cause internationally – Mortality Rates for Cardiovascular condition across 24 EU countries



The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

Cardiovascular – Medical History

- Myocardial Infarction has been the key driver of mortality improvement over the last 30 years
- These improvements may well continue for some time to come – scenarios attempt to capture this uncertainty
- But, Cardiovascular is a much smaller cause of death now, and
- It will stop (reincarnations aside)

The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

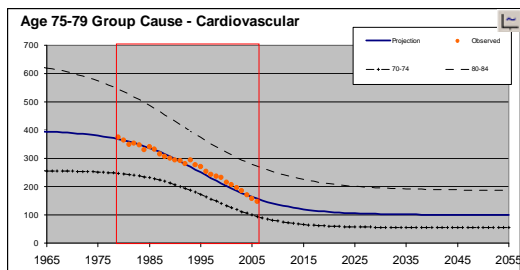
Cardiovascular – Medical History

- Medical input (Dr Croxson)
 - Polypill is not on market but clinical trials show this drug may reduce illnesses by more than 80%
 - Expected to impact Heart Attack and “Forms of Ischaemic Heart Disease” equally
- Smoking ban in UK is also expected to have a beneficial effect

The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

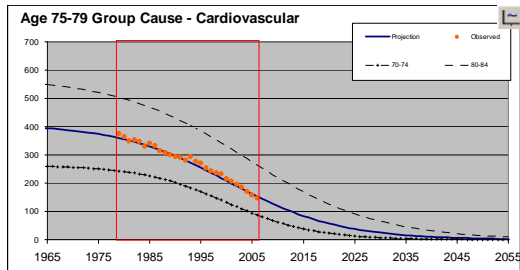
Cardiovascular – Flat Scenario



The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

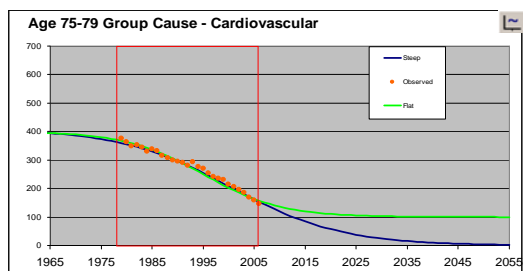
Cardiovascular – Steep Scenario



The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

Cardiovascular – Funnel of Doubt

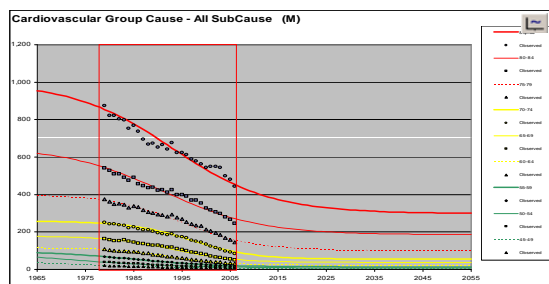


Source: ONS data using EASui Software (TSAP)

The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

Cardiovascular – All Ages (Flat)

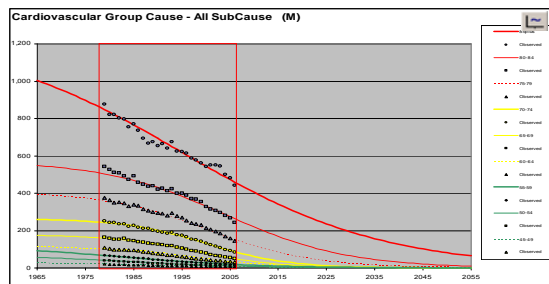


Source: ONS data using EASui Software (TSAP)

The Actuarial Profession
making financial sense of the future

Scenarios – flat and steep

Cardiovascular – All Ages (Steep)



Source: ONS data using EASui Software (TSAP)

The Actuarial Profession
making financial sense of the future

Outline

- Introduction
- Scenarios – flat and steep improvement trends
- Heat Charts
- Scenario funnel against Lee-Carter Percentiles
- Caveats and Conclusions
- Where Next

The Actuarial Profession
making financial sense of the future

Heat Charts

- Approach
- Heat Charts specific Group causes:
 - Cardiovascular Disease, Breast and Lung Cancer
- Aggregate Flat Scenarios-
 - With Cardiovascular Disease, Breast and Lung cancer switched to steep
- Observations

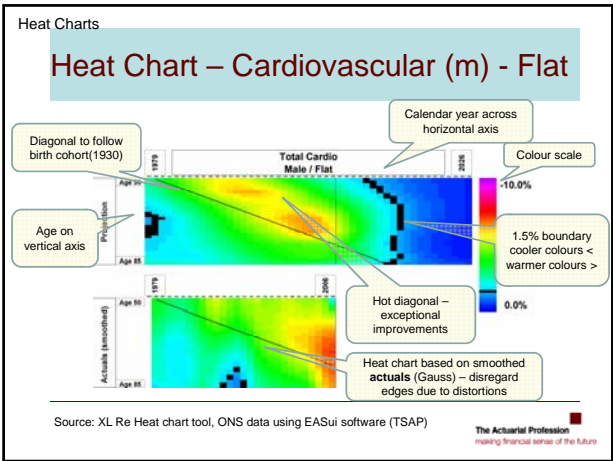
The Actuarial Profession
making financial sense of the future

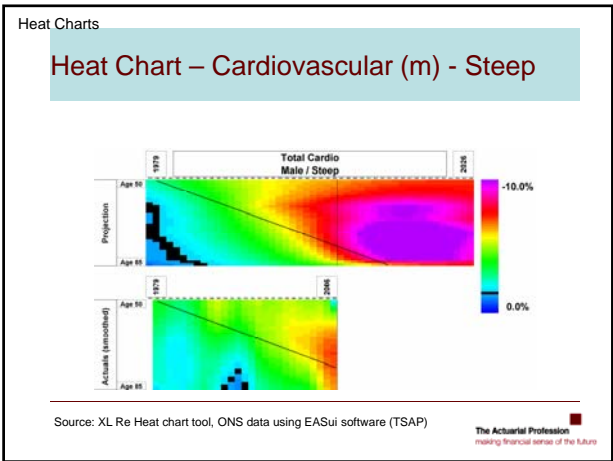
Heat Charts

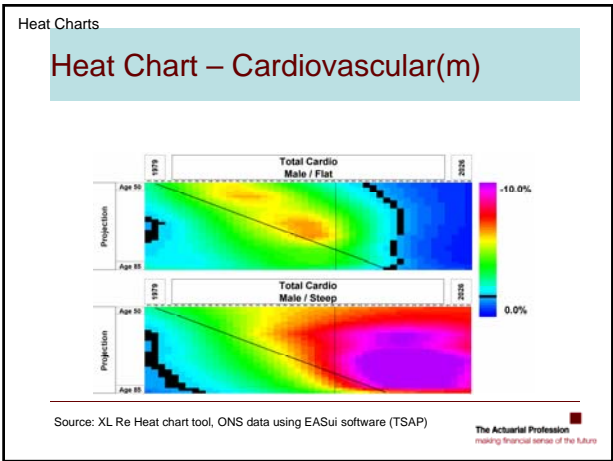
Heat Chart

- Covers range of ages pictorially
- Projections against Actual
- Smoothing has been applied to Actual "Gaussian smoothing"
- Projected 20 years into the future
- Investigate the Heat Charts for **group cause** and **sub-cause**
- Investigate the impact of scenarios on the aggregate level

The Actuarial Profession
making financial sense of the future

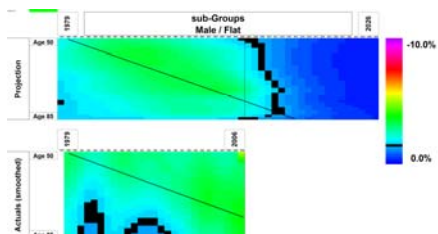






Heat Charts

Aggregate Flat - Males

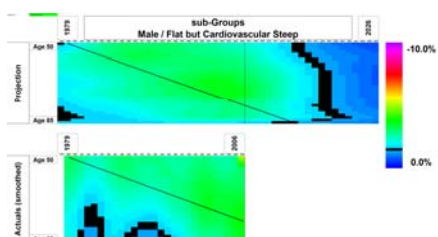


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Aggregate Flat with Cardiovascular Steep (m)

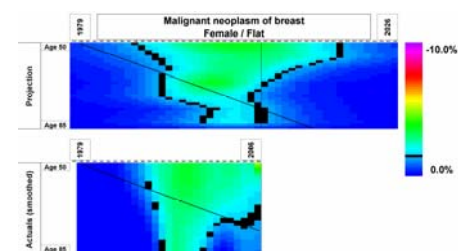


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Heat Chart – Breast Cancer (f) - Flat

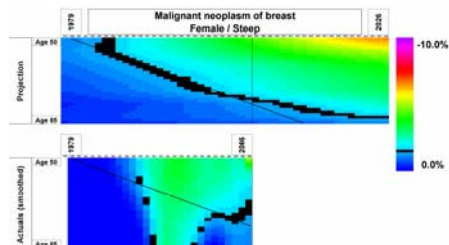


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Heat Chart – Breast Cancer (f) - Steep

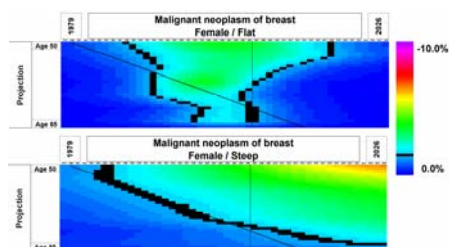


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Heat Chart – Breast Cancer (f)

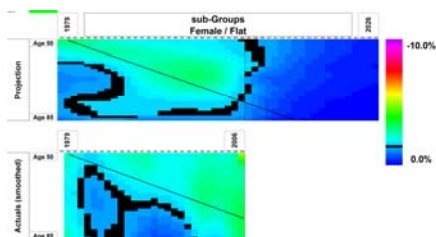


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Aggregate Flat (f)

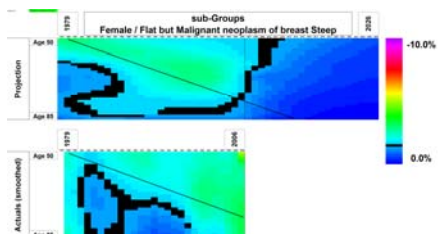


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Aggregate Flat with Breast Cancer Steep (f)

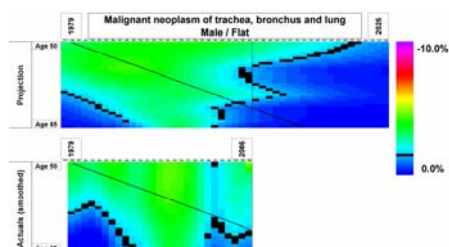


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Heat Chart – Lung Cancer (m) - Flat

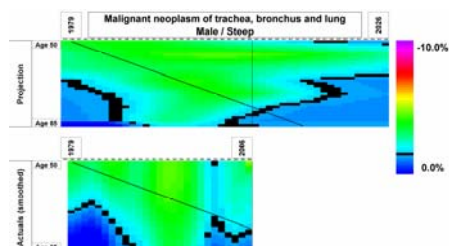


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Heat Chart – Lung Cancer (m) - Steep

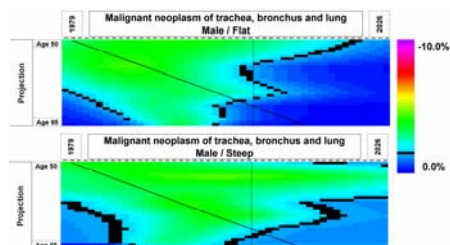


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Heat Chart – Lung Cancer (m)

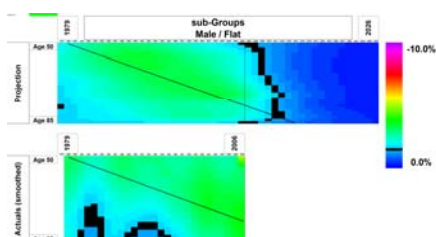


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Aggregate Flat - Males

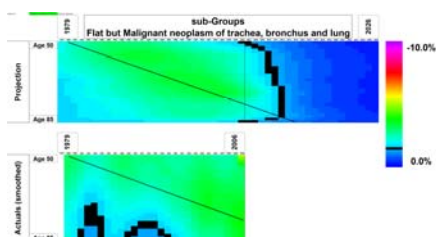


Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Heat Charts

Aggregate Flat with Lung Cancer steep (m)



Source: XL Re Heat chart tool, ONS data using EASui software (TSAP)

The Actuarial Profession
making financial sense of the future

Scenario funnel against Lee-Carter Percentiles

Heat Charts - Observations

- Cardiovascular
 - Improvements have some way to go
 - But diluted at aggregate level as becoming smaller cause and trend flattening
- Breast Cancer
 - Screening has created improvements in mortality trend
 - Future improvements more at younger ages (50-60) rather than the older ages (60+)
 - At Aggregate level impact small

The Actuarial Profession
making financial sense of the future

Scenario funnel against Lee-Carter Percentiles

Heat Charts - Observations

- Lung Cancer
 - Impact of steep much more significant at younger ages.
 - But steep scenario impacts all ages
 - Females benefit slightly more compared to males – female smoking epidemic started later compared to males and therefore has further to go in steep scenario
 - At aggregate level small impact

The Actuarial Profession
making financial sense of the future

Outline

- Introduction
- Scenarios – flat and steep improvement trends
- Heat Charts
- Scenario funnel against Lee-Carter Percentiles
- Caveats and Conclusions
- Where Next

The Actuarial Profession
making financial sense of the future

Scenario funnel against Lee-Carter Percentiles

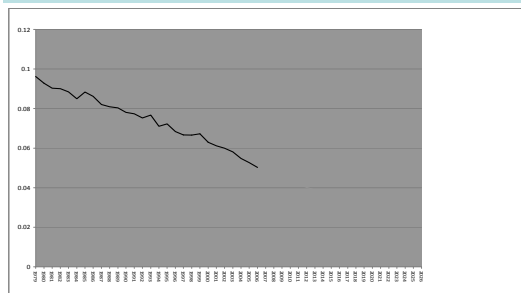
Background: Lee-Carter

- Lee-Carter stochastic model
 - Using ReMetrica software (Aon Benfield) for stochastic output
 - Basic model
 - Calibrated using HMD from 1979 to 2006
 - Used 20 intervals (for each year), 10000 trials
 - Projected in single ages but grouped post simulation
- No jumps to allow for extreme mortality events
 - i.e. Pandemics
- UK – caveat – cohort effect is not captured in this model

The Actuarial Profession
making financial sense of the future

Scenario funnel against Lee-Carter Percentiles

Graphic of scenario funnel against Lee-Carter Percentiles, all cause mortality, age 75-79 males

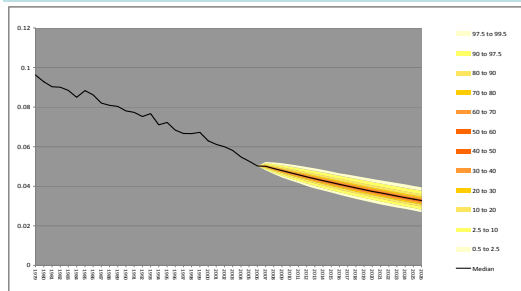


Source: ONS data, EASui software (TSAP) and ReMetrica software (Aon Benfield)

The Actuarial Profession
making financial sense of the future

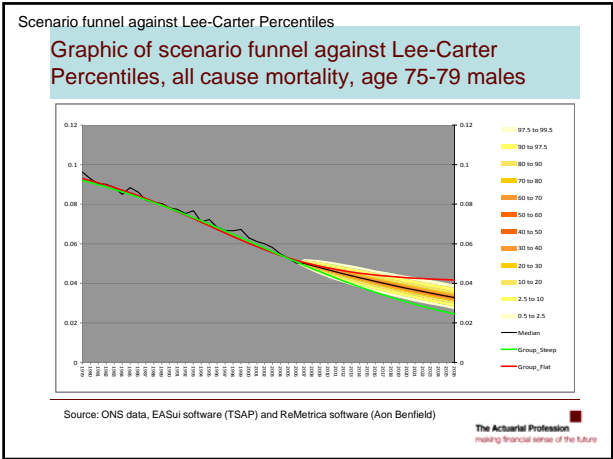
Scenario funnel against Lee-Carter Percentiles

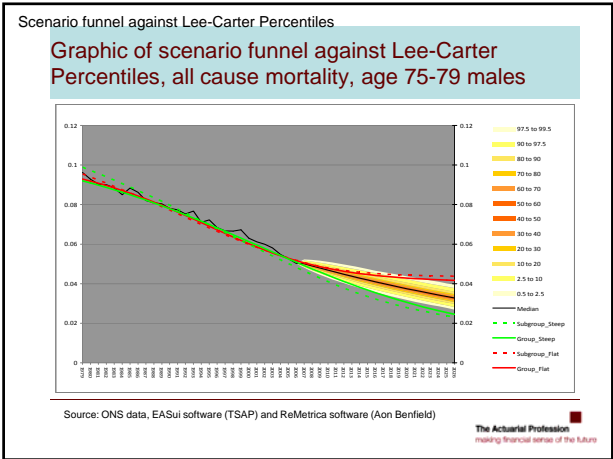
Graphic of scenario funnel against Lee-Carter Percentiles, all cause mortality, age 75-79 males

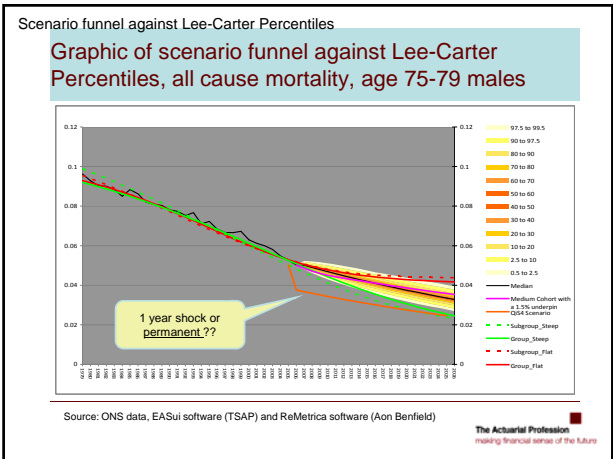


Source: ONS data, EASui software (TSAP) and ReMetrica software (Aon Benfield)

The Actuarial Profession
making financial sense of the future

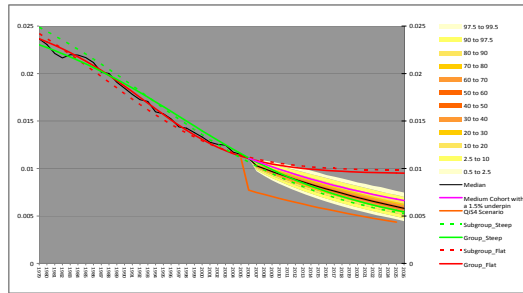






Scenario funnel against Lee-Carter Percentiles

Graphic of scenario funnel against Lee-Carter Percentiles, all cause mortality, age 60-64 males



Source: ONS data, EASui software (TSAP) and ReMetrica software (Aon Benfield)

The Actuarial Profession
making financial sense of the future

Scenario funnel against Lee-Carter Percentiles

Observations

- Age group 75-79
 - Output is consistent with funnels
 - Cohort effect is strong for this age group and the Lee-Carter variant allowing for cohort effect will be steeper
- Age group 60-64
 - Output is steeper compared to scenario funnels
 - Lee-Carter will replicate historical data into future
- Lee-Carter fans rapidly in first few years and then widens very gradually thereafter

The Actuarial Profession
making financial sense of the future

Scenario funnel against Lee-Carter Percentiles

Observations

- QiS 4 is extremely conservative and significantly outside our funnel scenarios
- Our funnel scenarios are extreme as we are assuming all conditions are either flat or steep
- "The longevity shock to be applied is a (permanent) 25% decrease in mortality rates for each age" (CEIOPS (2008))
 - Does permanent make sense in context of Solvency II ?
 - Is it a 1 year shock or permanent ?

The Actuarial Profession
making financial sense of the future

Outline

- Introduction
- Scenarios – flat and steep improvement trends
- Heat Charts
- Scenario funnel against Lee-Carter Percentiles
- Caveats and Conclusions
- Where Next

The Actuarial Profession
making financial sense of the future

Conclusions

Caveats

- Based on past extrapolation of dependent rates
- Correlations poorly understood
- Cause of death codification subject to changes in practice and error
- Base projection has no deliberate allowance for new medical advances accelerating pace of improvement....

The Actuarial Profession
making financial sense of the future

Conclusion

Conclusions

- Scenarios by cause give great insight
 - Reasonable feel for the extreme boundaries
 - Can allow for medical input
 - Allows lucid Communication of variability
- Allows validation against stochastic output
- Gives a reasonable shape for future trends compared to short, medium and long with an under pin.

The Actuarial Profession
making financial sense of the future

Outline

- Introduction
- Scenarios – flat and steep improvement trends
- Heat Charts
- Scenario funnel against Lee-Carter Percentiles
- Caveats and Conclusions
- Where Next

The Actuarial Profession
making financial sense of the future

Where Next

- Consolidation of research work
- Peer review within Actuarial Profession
- Publication of findings
- Continuing research and model refinement
- Decision maker education

The Actuarial Profession
making financial sense of the future