



Continuous
Mortality Investigation
Institute and Faculty of Actuaries

CMI update

Cobus Daneel, Chair of CMI Mortality Projections Committee
Matt Fletcher, Chair of CMI SAPS Committee
Dave Grimshaw, CMI Secretary

CMI

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- Independent executive and management

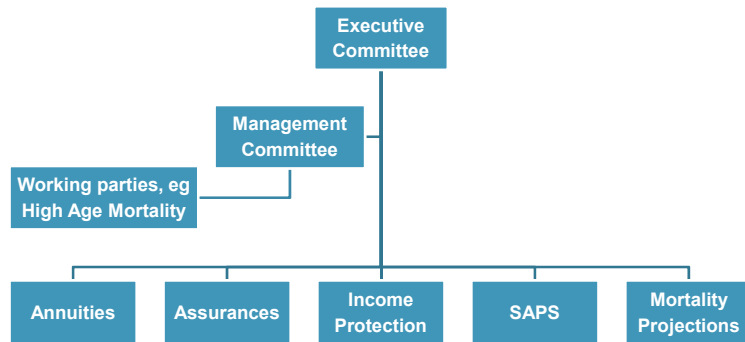
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Mission

*To produce **high-quality impartial analysis, standard tables and models** of mortality and morbidity for long-term insurance products and pension scheme liabilities on behalf of subscribers and, in doing so, to further actuarial understanding.*

Our vision is to be regarded across the world as setting the benchmark for the quality, depth and breadth of analysis of industry-wide insurance company and pension scheme experience studies

CMI structure



Annuities

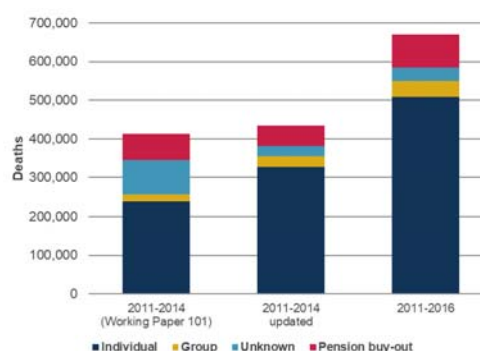
Annuities Committee activity

Date	Activity
October 2013	Experience report for 2007-2010 (WP70)
April 2015	Proposed "08" Series annuitant mortality tables released for consultation (WP78)
June 2015	Final "08" Series annuitant mortality tables released (WP81)
December 2015	Experience report for Enhanced Annuities in 2007-2010 (WP87)
July 2017	Experience report for 2011-2014 (WP101)
October 2017	Results of survey of data contributors
Nov 2018	Additional analyses of 2011-2014 data (WP112)
Feb 2019	Experience report for 2011-2016 (WP117)
In progress	Trial graduations of 2011-2016 dataset

2011-2016 Annuities data

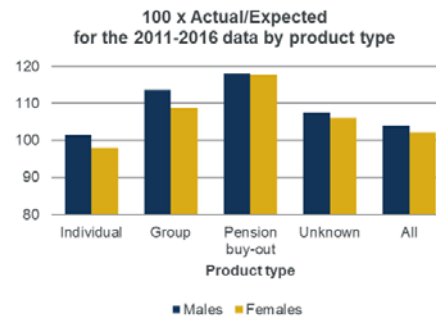
- Several insurance companies resubmitted data for earlier years
- In some cases, we understand, following (significant) data cleansing exercises
- Appears to have a significant impact on some results, particularly by product type
- Reduces our confidence in the 2011-2014 data underlying WP101 and WP112 but we believe this has resulted in improved data quality in the 2011-2016 dataset
- Results for 2011-2016 issued in WP117

Data volumes (number of deaths) by year for the 2011-2014, updated 2011-2014 and 2011-2016 datasets



2011-2016 Annuities experience

- “08” Series tables do not differentiate by product type
- Now working on a new set of tables using the 2011-2016 dataset that we expect will differentiate by product type
- May use the whole dataset to maximise data volumes or 2013-2016 to use only the more recent years
- May repeat some of the analyses from WP112 to inform our view of the new tables



Assurances

Assurances Committee activity

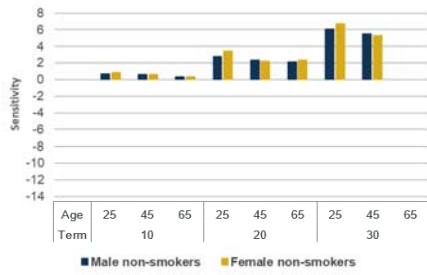
Date	Activity
December 2014	Experience report for 2007-2010 (WP75)
May 2016	Proposed "08" Series accelerated critical illness tables released for consultation (WP89)
October 2016	Proposed "08" Series term assurance mortality tables released for consultation (WP92)
January 2017	Final "08" Series accelerated critical illness and term mortality tables released (WP94)
June 2018	Experience report for 2011-2015 (WP108) and survey on future data collection / analyses
October 2018	Using the CMI Model for term assurances (WP110)
Mid-2019	Experience report for 2011-2017

Younger ages and assured lives

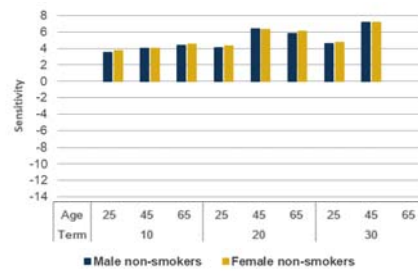
- The CMI Model is primarily used for pensioner/annuitant populations. Working Paper 110 discusses considerations for its use for assured lives and younger ages.
- Improvements at young ages in recent years have been high, particularly for males.
 - The high improvements are allocated to a cohort effect, but a constraint applies at ages ≤ 30 .
 - Removing or adjusting the constraint has a material impact on initial improvements.
- Calibrating the model only to ages 20-65 has a material impact on initial improvements.
- Uncertainty in exposure data due to high net migration at younger ages is not material.
- The Model's improvements may not be appropriate for assured lives populations due to differing socio-economic profiles, underwriting, and the use of smoker-specific rates.
- Can't reliably calibrate the model to CMI Assurances data – low volume and lack of consistency.
- Users should apply judgement for their populations.

CMI Model for term assurances Sensitivity of (indicative) premium rates

Sensitivity to a long-term rate improvement of 1.0% pa (compared with 1.5% pa)



Sensitivity to period smoothing parameter $S_k = 6.5$ (compared with 7.5)



See Working Paper 110 for details of calculations

Income Protection

Income Protection Committee activity

Date	Activity
July 2010	IPM 1991-98 graduations finalised (WP48)
February 2012	Experience report for 2003-2006 (WP60) Summary statement of revised methodology (WP59)
April 2014	IP Rate Table Tool released to help practitioners make use of published graduations
April 2014	Report and database of experience by cause of sickness, 1991-2009 (WP72)
March 2017	Experience report for 2007-2010 (WP96)
August 2017	Report on 2003-2010 experience by benefit amount and policy duration (WP102)
July 2018	Proposed "IP06" claim inception rates (WP109)
Mar 2019	Final "IP06" claim inception rates (WP120)
Late summer 2019	2011-16 experience report
Spring 2020	New terminations graduations expected to be released for consultation

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"IP06" claim inception rates

- Claim graduations – previously CMI has started from sickness graduations
- Used generalised linear models (GLM) 'borrow strength'
 - Enabled us to graduate data for females and smaller occupation classes

$$\log(\mu_g) = \sum_{i=1}^s a_i \cdot D_i(g)$$

- Graduate all data together – but with DPs split – so that, e.g.
 - Male and female data combined used to determine effect of occupation classes
 - Occupation class data combined used to determine effect of being male/female

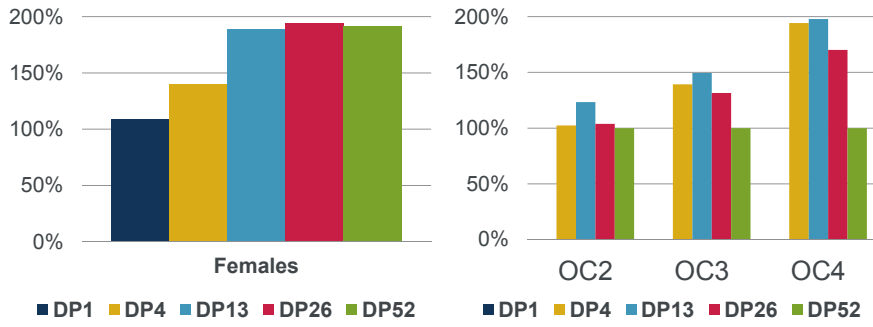
Deferred period	Model
DP1	Intercept + Age (quartic) + Sex
DP4	Intercept + Age (linear) + Sex + OC
DP13	Intercept + Age (quadratic) + Sex + OC (excl female data for ages 55+)
DP26	Intercept + Age (linear) + Sex + OC
DP52	Intercept + Age (quadratic) + Sex

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**“IP06” claim inception rates
Multiplicative factors (versus males/OC1)**



Mortality Projections

Mortality Projections Committee activity

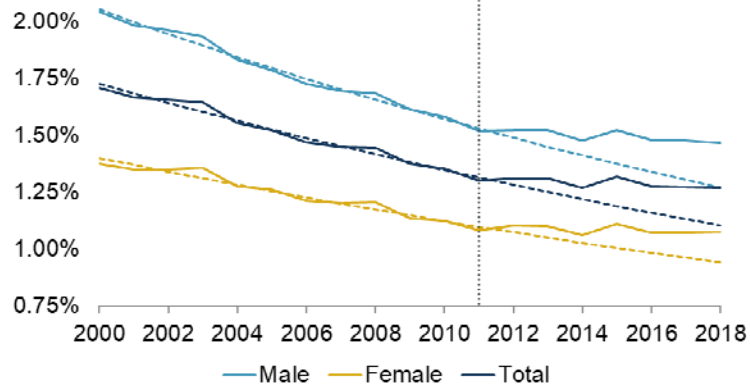
Date	Activity
Nov 2017	Mid-year update working paper (WP103)
March 2018	CMI Mortality Projections Model: CMI_2017 (WP105)
Oct 2018	Regular monitoring of England & Wales population mortality; consultation on proposed methodology (WP111)
Dec 2018	Consultation on the value of the smoothing parameter, S_K , in the Core CMI_2018 model
Dec 2018	Interim update working paper (WP115)
Feb 2019	Confirmation of a change to the value of S_K in Core CMI_2018 (WP116)
Mar 2019	CMI Mortality Projections Model: CMI_2018 (WP119)
Quarterly	Monitoring of England & Wales population mortality
Late 2019	Interim update working paper
Feb/Mar 2020	Publication of CMI_2019

CMI Mortality Projections Model

- A model of projected mortality improvements.
 - First version, CMI_2009, published in November 2009.
 - Latest version, CMI_2018, published in March 2019.
- Mortality improvements are projected by blending between:
 - “initial improvements” – estimated current mortality improvements, calibrated to historical mortality data; and
 - “long-term rate” – an assumption provided by the user of the Model, recognising that levels and causes of improvements change over time.
- The “Core” Model is calibrated to England & Wales, but can use data for other countries, from the Human Mortality Database, or user-specified.

Historical mortality rates

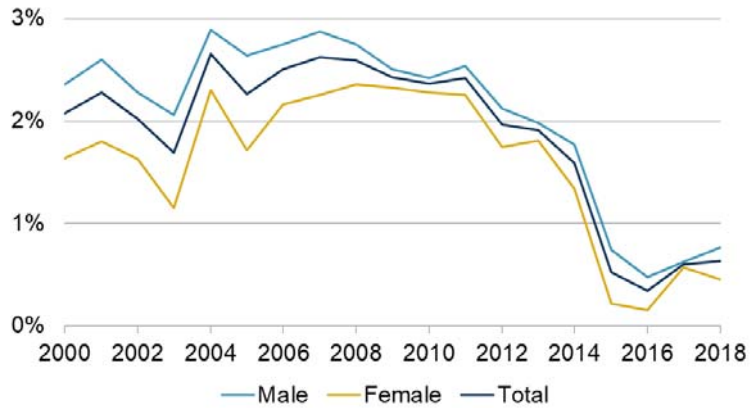
Standardised mortality rates, with 2000-2011 trend lines



Source: CMI calculations based on ONS data for England & Wales.

Historical mortality improvements

Five-year average standardised mortality improvements



Source: CMI calculations based on ONS data for England & Wales.

Mortality monitoring

- Since October 2018, CMI has published quarterly reports monitoring mortality in England & Wales.
- Analysis is based on provisional weekly deaths data published by the Office for National Statistics (ONS).
- Here we show the latest figures, based on data to 17 May 2019.

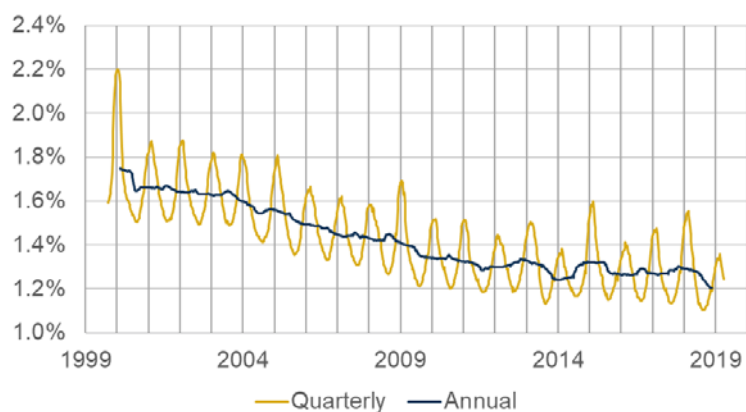
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Seasonal mortality

Quarterly and annual average standardised mortality



Source: CMI calculations based on ONS data for England & Wales.

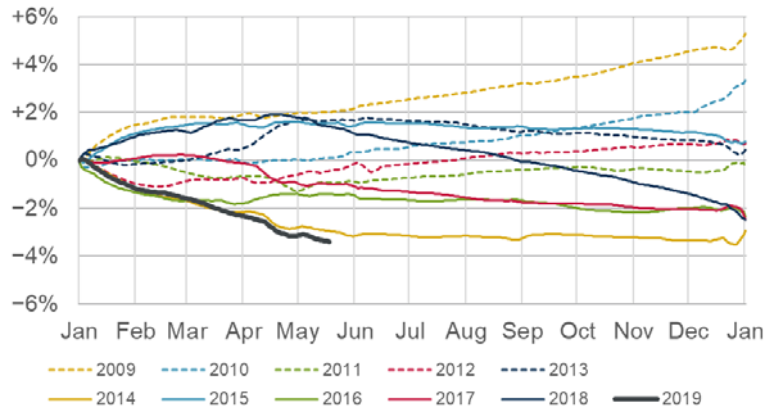
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Relative mortality

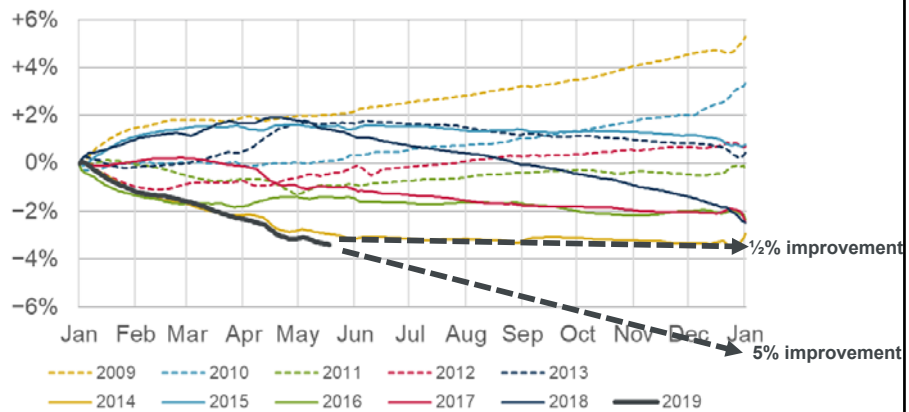
Cumulative standardised mortality relative to the 2009-2018 average



Source: CMI calculations based on ONS data for England & Wales.

Relative mortality

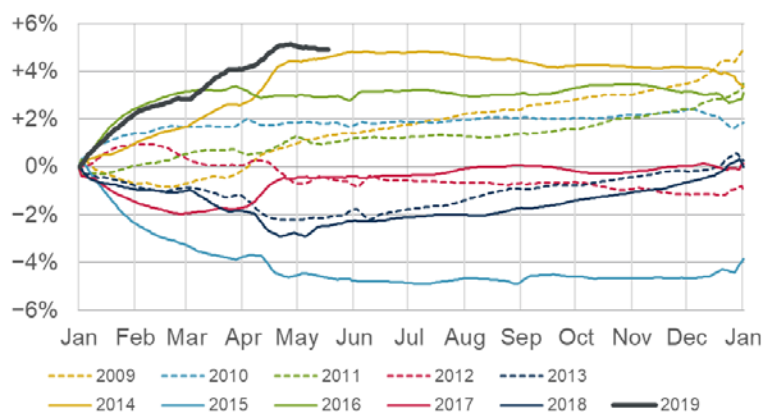
Cumulative standardised mortality relative to the 2009-2018 average



Source: CMI calculations based on ONS data for England & Wales.

Mortality improvements

Cumulative annual standardised mortality improvement



Source: CMI calculations based on ONS data for England & Wales.

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Implications for CMI_2019

- Based on data to 17 May 2019, we have seen an improvement of 5%.
- That would lead to CMI_2019 showing an **increase** in cohort life expectancy of around 2½ months at age 65, compared to CMI_2018.
- If we instead saw an improvement of ½%, that would lead to a **decrease** in life expectancy of around 2 months at age 65.

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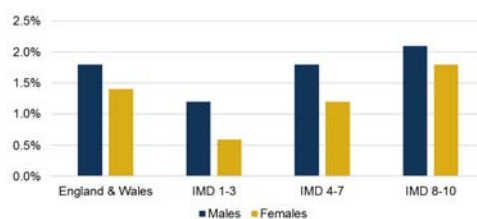
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Mortality improvements and deprivation

- Index of Multiple Deprivation (IMD) is a measure of “relative deprivation” (poverty, crime, unemployment etc) for around 33,000 areas in the UK
- Individuals living in less-deprived areas have experienced higher mortality improvements.

Average mortality improvements between 2008 and 2015



Source: CMI Working Paper 115.

Mortality improvements in pension schemes

- The CMI’s SAPS dataset contains mortality data for members of self-administered pension schemes in the United Kingdom.
- SAPS pensioners have experienced higher mortality improvements on average than general population

Comparison of annualised mortality improvements for males and females combined

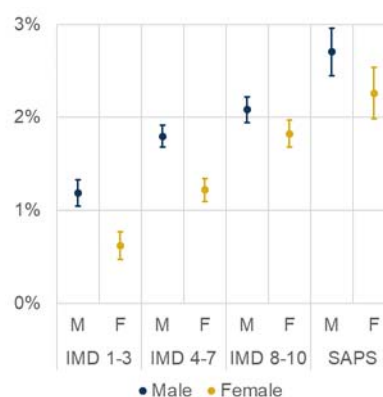
Years	England & Wales	SAPS (amounts weighted)
2008-11	+2.8%	+3.7%
2012-16	+0.4%	+2.7%
2008-16	+1.5%	+3.1%

Source: CMI Working Paper 115.

Initial mortality improvements

- The CMI Model is calibrated to data for England & Wales
- There is evidence of higher recent mortality improvements for less-deprived areas, and for SAPS pensioners
- We encourage users of the Model to adjust the Core parameters to suit the population they use it for.

Average mortality improvements 2008-2015 with 95% observational confidence intervals



How to adjust initial improvements?

- Period smoothing parameter S_K
 - Intended to reflect how quickly we recognise new data
 - Some users have used it to modify initial improvements
 - Impact on improvements of a given change in S_K varies over time
- Recommend use of the “initial addition to mortality improvements” (A)
 - Introduced in CMI_2018
 - Specifies additional initial age-period improvements at ages 20-85
 - Tapers to nil at age 110 (like the Core shape of the long-term rate)
 - Affects historical improvements also; relevant since the base table date
- More complex changes possible using Advanced parameters
- Software being updated to allow “A” to be used with Advanced parameters

How much to adjust initial improvements?

- Historical analyses of specific datasets can be a guide to past differences in mortality improvements.
- For projections, also need to consider other factors, including:
 - Credibility of analyses – statistical uncertainty, and any artefacts of the data
 - Which factors have caused past differences, and whether they are likely to persist
 - The extent to which mortality rates for different groups may converge or diverge over the convergence period

SAPS

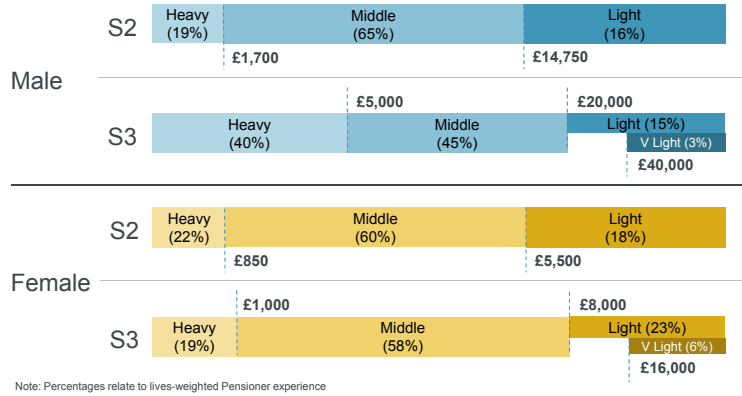
SAPS Committee activity

Date	Activity
Nov 2015	Mortality experience by industry classification of SAPS pensioners for the period 2006-2013 (WP86)
Feb 2016	Mortality experience of SAPS pensioners for the period 2007-2014 (WP88)
Feb 2017	Mortality experience of SAPS pensioners for the period 2008-2015 (WP95)
Jan 2018	Mortality experience of SAPS pensioners for the period 2009-2016 (WP104)
May 2018	Proposed "S3" Series mortality tables released for consultation (WP107)
Dec 2018	Final "S3" Series mortality tables (WP113)
Feb 2019	Mortality experience of SAPS pensioners for the period 2010-2017 (WP118)
May 2019	Mortality experience by industry classification of SAPS pensioners for the period 2009-2016 (WP121)

Range of tables – S3 compared with S2

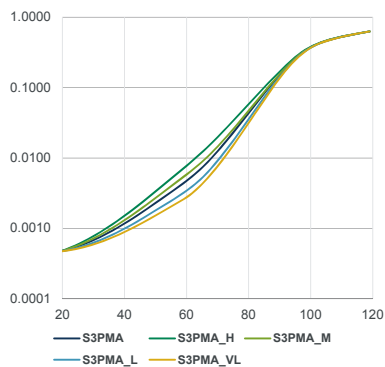
Type	Gender	Lives	Amounts				
			All	Heavy	Middle	Light	Very Light
Pensioners	Male						NEW
Pensioners	Female				NEW		NEW
Normal health	Male				NEW		NEW
Normal health	Female				NEW	NEW	NEW
Ill-health	Male						
Ill-health	Female						
Dependants	Male	NEW	NEW				
Dependants	Female					NEW	NEW

Amount bands

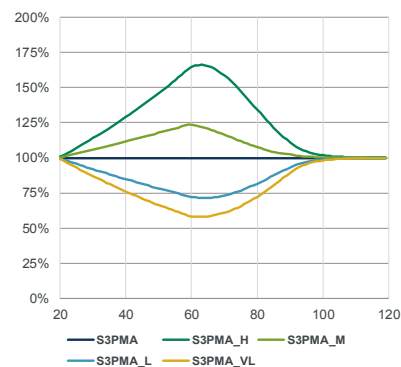


Male Pensioner amounts tables

Mortality (q_x) on a logarithmic scale



Mortality relative to S3PMA



	All S3PMA	Heavy S3PMA_H	Middle S3PMA_M	Light S3PMA_L	Very Light S3PMA_VL
e_{60}	24.9	22.4	24.2	26.3	27.1

Composition of dataset – public and private sector

- S3 tables contained higher proportion of public sector data than S1 or S2
- Table shows flat scaling factors for private sector data relative to S3 tables, including 95% confidence intervals

	Table	Flat scaling factor
Male Pensioners amounts	S3PMA	102.4% ± 0.7%
Male Normal health amounts	S3NMA	104.7% ± 0.9%
Male Dependants amounts	S3DMA	102.3% ± 3.6%
Female Pensioners amounts	S3PFA	109.5% ± 1.3%
Female Normal health amounts	S3NFA	112.1% ± 1.7%
Female Dependant amounts	S3DFA	100.6% ± 0.9%

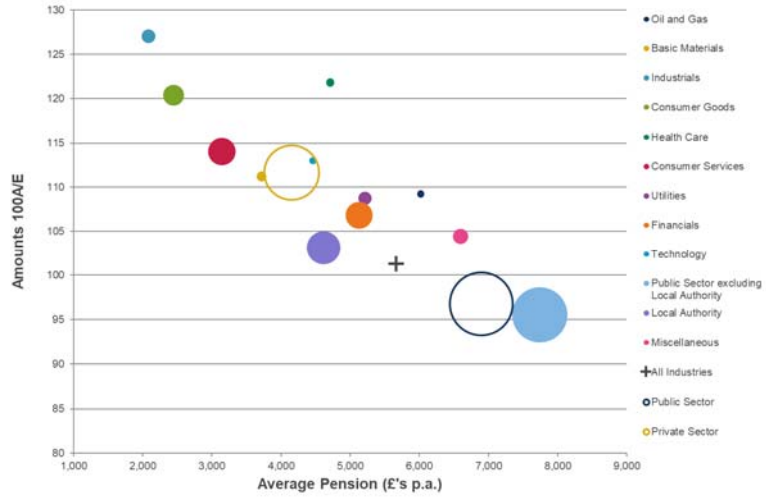
- Note: scaling factor for Female Pensioners amounts relative to S3PFA_M is 100.8%

Changes from S2 to S3

- Key differences between S2 and S3 tables are:
 - New “Very Light” and male Dependants tables
 - Composition of the SAPS dataset
 - Changes to Heavy / Middle / Light amount table cut offs
 - Technical methodology changes, e.g. choice of formulae underlying tables, extension of tables to high and low ages
- Mortality improvements for pension scheme members in S3 dataset higher than general population over period between S2 and S3

Users should consider whether similarly named S3 table is still appropriate when updating from S2 to S3.

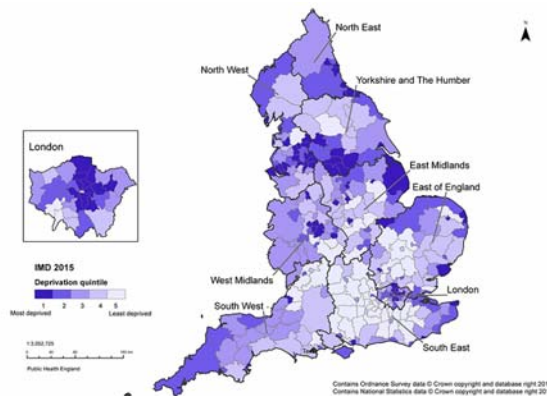
Experience by industry classification



And finally...

The CMI Postcode mapping tool

- CMI wants to analyse mortality/morbidity by socio-economic status
- We are now seeking a data field that data contributors have pre-mapped from postcode to the Index of multiple deprivation
- The tool generates two measures:
 - A UK-wide academic measure
 - A Country- or region-specific measure (splitting England into nine regions)



Future CMI investigations

- Responses to survey of Subscribers included lots of suggestions for future work
- Areas currently under consideration:
 - Redemptions under Equity Release Mortgages
 - Guaranteed acceptance Whole of Life plans
 - Persistency risk under corporate pensions
 - Lapses under protection products
 - Proportion married / marital status / age differences (Annuities and SAPS)





Questions



Comments

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

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Mission, Vision, Aims & Objectives

Mission

- To produce high-quality impartial analysis, standard tables and models of mortality and morbidity for long-term insurance products and pension scheme liabilities on behalf of subscribers and, in doing so, to further actuarial understanding.

Vision

- To be regarded across the world as setting the benchmark for the quality, depth and breadth of analysis of industry-wide insurance company and pension scheme experience studies.

Mission, Vision, Aims & Objectives

Aims & Objectives

- Publish collated experience analysis results to subscribers on a regular basis, including relevant benchmarking of each firm's own results
- Publish standard decrement tables and projections (where appropriate) in line with the relevant actuarial standards for each product line
- Publish papers detailing the methods employed in producing the standard tables and the research conducted to justify these
- Publicise the work of the CMI to employees within subscribers and, where appropriate, more widely
- Obtain regular feedback from subscribers on what their needs are to ensure that output continues to remain valuable and relevant
- Maintain the number of firms subscribing to the CMI and increase the number where possible
- Identify new opportunities to provide data analysis for the benefit of our subscribers
- Provide value for money to our subscribers and produce all material for the benefit of our subscribers and not for profit
- Work with the Institute and Faculty of Actuaries to promote the expertise of the Actuarial Profession in the fields of mortality and morbidity.

Formatting your presentation

Page setup

- This presentation is set to A4 document size. Do not reset the size to any other screen size
- Do not alter anything in the master slides.

Type and typography

- Only use the font Arial and never use type smaller than 10pt
- Titles, headings and sub-headings should be in 'mid blue' (RGB 64/150/184) – appears as 'Aqua' in the palette.
- Text blocks, body copy and chart text should always be 'dark grey' (RGB 63/69/72)

Content styling

- A selection of different title slides is offered, all accessible via the layout tab
- Do not use clip art.

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- The full colour palette is to the left hand side of every slide. Do not use non-palette colours.
- Note that you can save this colour palette in PowerPoint (Design/Colors/Create New Theme Colors) and then use it in other MS Office applications.
- Where possible, paste graphs as Excel graphs (as opposed e.g. to metafiles) so we can reformat them. Do not paste anything in as bitmap if you can avoid it.

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Tables

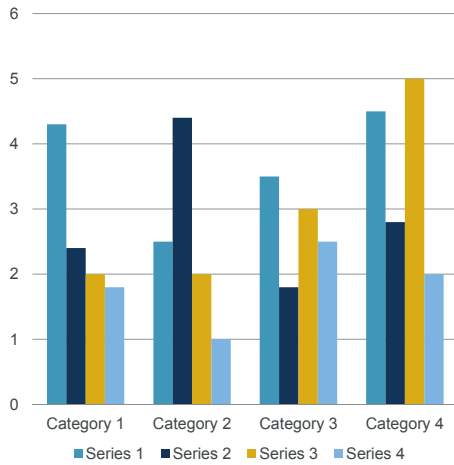
Column title	Column title	Column title
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When making tables:

- The eye follows the pale blue cells so the direction of the pale blue cells should match the direction in which the data will be read

Sample bar chart



When making charts:

- Remove vertical lines
- Remove tick marks
- Move the legend down below the chart
- Do not use 3D charts

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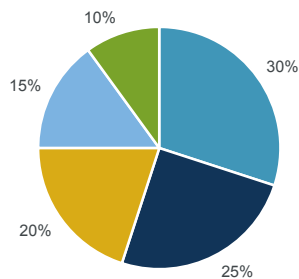
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Pie charts

Chart title



- 1st Data title
- 2nd Data title
- 3rd Data title
- 4th Data title
- 5th Data title

When making pie charts:

- Segments should have a 2pt white border
- Data tags should always be outside the chart
- Data legends should go below the chart
- Do not use 3D pie charts

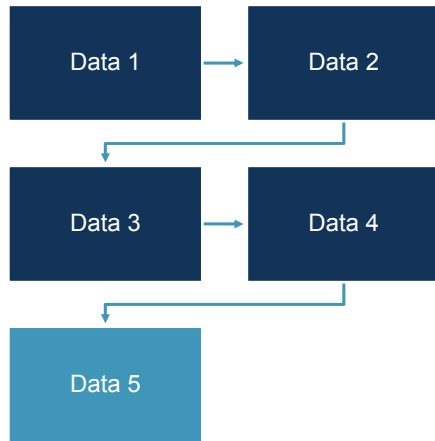
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Flow charts



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- Boxes should have square corners, not rounded corners
- Circles may be used but not ovals
- 'Mid blue' should be used as the highlight colour
- Do not use the 3D options

Flow charts – more samples

