

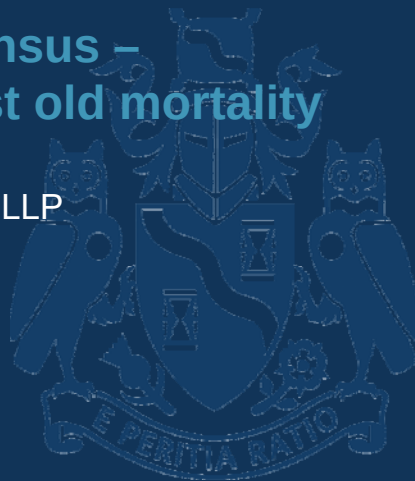


Institute
and Faculty
of Actuaries

Beyond the 2011 Census – understanding oldest old mortality

Dave Grimshaw
Partner, Barnett Waddingham LLP

27 June 2013



2011 Census

- Collects information about the population every 10 years
- Continuous since 1801 (except 1941)
- Latest UK census took place on 27 March 2011
- Reported separately for England & Wales, Scotland, Northern Ireland
- Counts the population by age/gender/etc
- Underpins allocation of public funds for education, transport, health, etc.



Institute
and Faculty
of Actuaries

2011 Census and population estimates

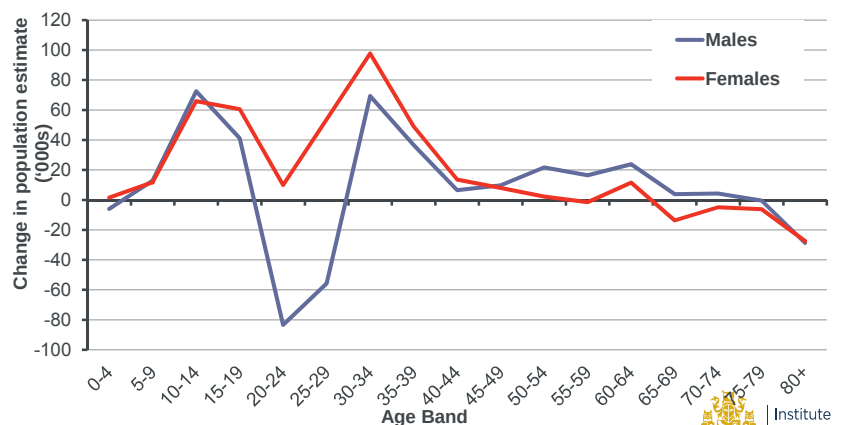


2011 Census and population estimates

- Derivation of population estimates:
 - Count at decennial Census
 - Roll forward year-by-year allowing for ageing, births, deaths and migration
 - Review at next Census
- 2011 Census revealed E&W population of 56.1 million
- 476,000 more than the roll-forward estimate (0.9%), initially attributed:
 - 267,000 from net international migration; and
 - 209,000 from a shortfall in the 2001 Census
- Biggest absolute differences at ages 20-40.

2011 Census and E&W population estimates

2011 Census count compared with roll-forward estimate



Source: ONS; estimates as at Census day 27/03/11; roll-forward estimate underpinned by 2001 Census.

Institute
and Faculty
of Actuaries

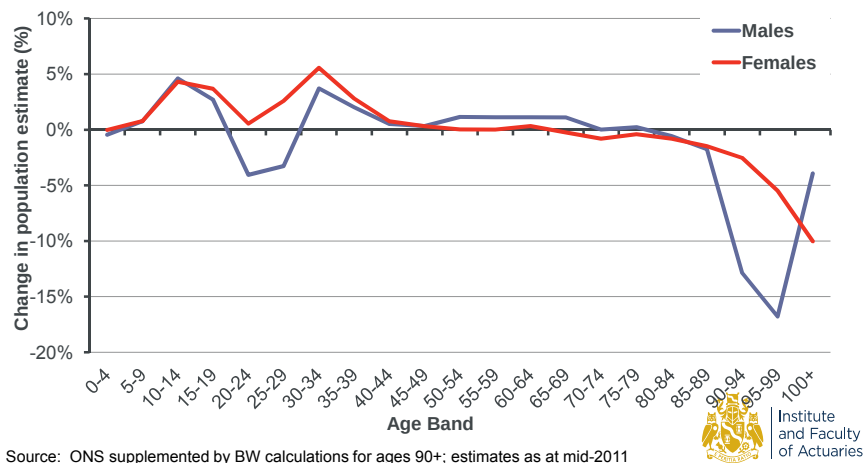
2011 Census and E&W population estimates

- Derivation of population estimates:
 - Count at decennial Census
 - Roll forward year-by-year allowing for ageing, births, deaths and migration
 - Review at next Census
- 2011 Census revealed E&W population of 56.1 million
- 476,000 more than the roll-forward estimate (0.9%), attributed:
 - 267,000 from net international migration; and
 - 209,000 from a shortfall in the 2001 Census
- Biggest absolute differences at ages 20-40
- Of greater interest to us, are the large percentage differences at older ages.

Institute
and Faculty
of Actuaries

2011 Census and E&W population estimates

2011 Census count compared with roll-forward estimate



Population estimates for the older ages

- ONS use Census roll-forward method to estimate population at individual ages to age 89, plus a total for ages 90+
- Use Kannisto-Thatcher survivor ratio method to allocate 90+ total to individual ages
- Extinct cohort method
 - Reconstruct population working back along cohort's path, starting from last survivor and adding back deaths, assuming no migration
- Non-extinct cohorts
 - Estimate current population using survivor ratio
 - $\text{Survivor ratio} = \text{Survivors} \div \text{deaths in cohort in last 5 years}$
 - Assume stability or predictability of survivor ratio across cohorts
 - Then work back along cohort's path as above

Population estimates for the older ages

- As ONS apply a constraint on the K-T method, the total 90+ estimates are determined by the roll-forward method
- These roll-forward estimates are highly sensitive at older ages to accuracy of initial estimate
- 1% error in estimates for ages 80-89 results in:
 - 4% error for females at ages 90-99 at next census; and
 - 7% error for males at ages 90-99 at next census.



Institute
and Faculty
of Actuaries

9

2002-2010 revised E&W population estimates

- In December 2012, ONS released revised population estimates for the inter-census years
- No revisions to 2001 (and prior) estimates
- Differences between estimates were largely attributed to mis-estimation of migration, but 30% unexplained
- Revised estimates implicitly assume significant rates of emigration at high ages.

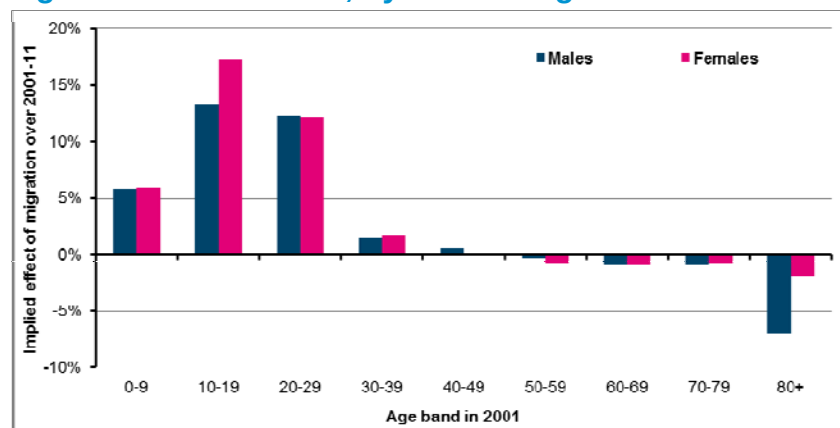


Institute
and Faculty
of Actuaries

10

2002-2010 revised E&W population estimates

Implied population change due to international migration over 2001-11, by sex and age band



Source: BW calculations based on ONS data

11

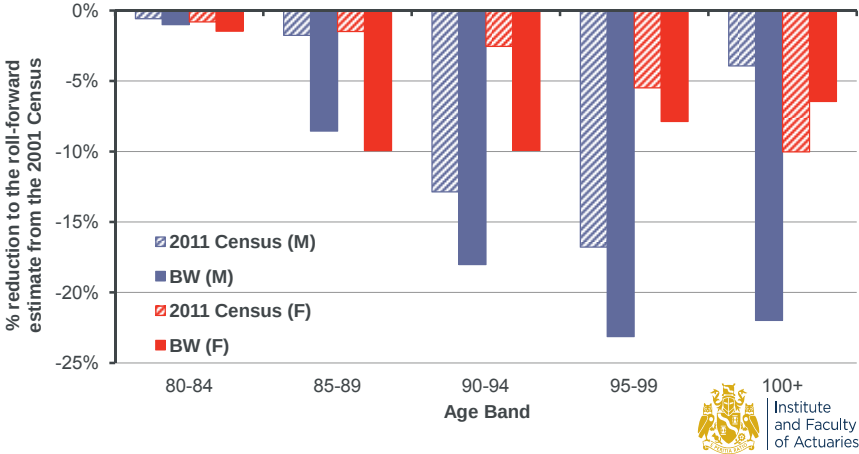
Population estimates for the older ages: an alternative approach

- ONS use Kannisto-Thatcher method to allocate 90+ total to individual ages (but 90+ total based on roll-forward estimates)
- But can also apply K-T methodology without constraint to 90+ total
- Key assumptions:
 - Death registration data is accurate
 - No net migration
 - Survivor ratio is stable / predictable.

Population estimates for the older ages

Comparison of estimates of mid-2011 population for E&W

Alternative estimates compared with roll-forward estimate

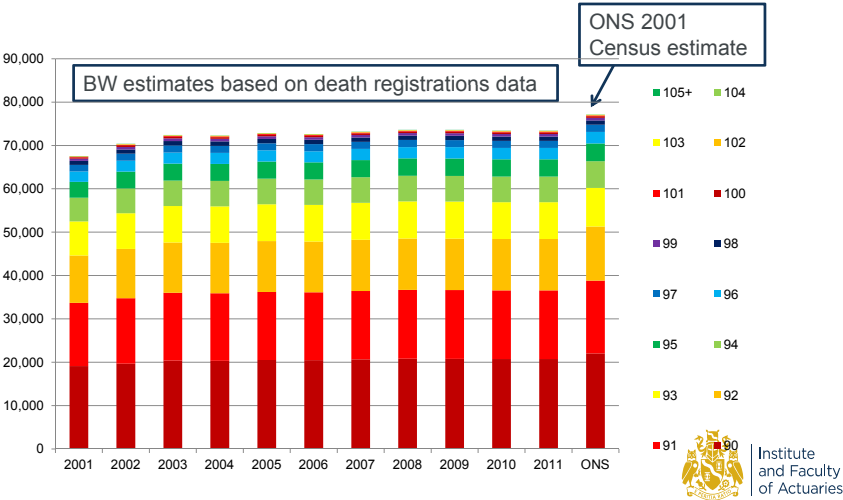


Source: BW calculations using population estimates and death registrations data published by ONS.

13

Population estimates for the older ages

Evolution of mid-2001 E&W male population estimates



Source: BW calculations using death registrations data published by ONS and ONS population estimates.

14

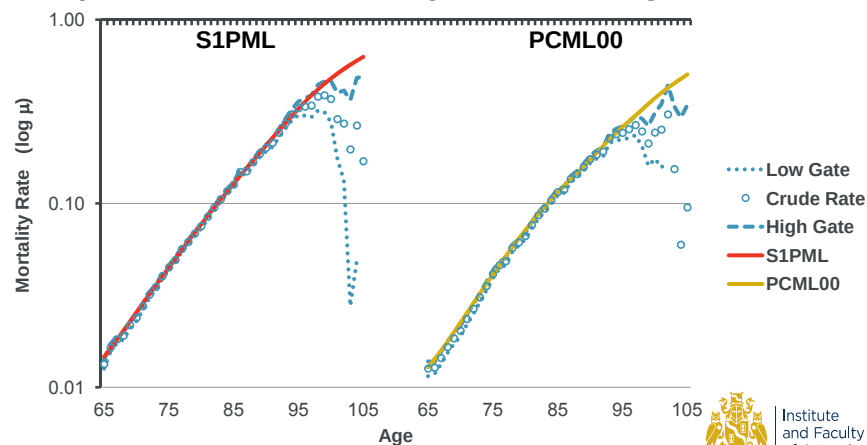
2011 Census – older age mortality rates

- Mortality rate = Deaths ÷ Exposure
 - Death registrations data is considered highly accurate
 - Use mid-year population as estimate of exposure
- Inaccuracy in population estimates => inaccurate mortality rates
- Do population mortality rates matter in insurance/pensions?
 - Portfolio-specific data lacks credibility at older ages
 - Pooled insurance or pension scheme data may lack reliability at older ages



Unreliability of insured and pensioner data at older ages?

Comparison of observed experience with graduations



Source: CMI Working Paper 35 (for S1PML) and CMI Report 23 (for PCML00).

16

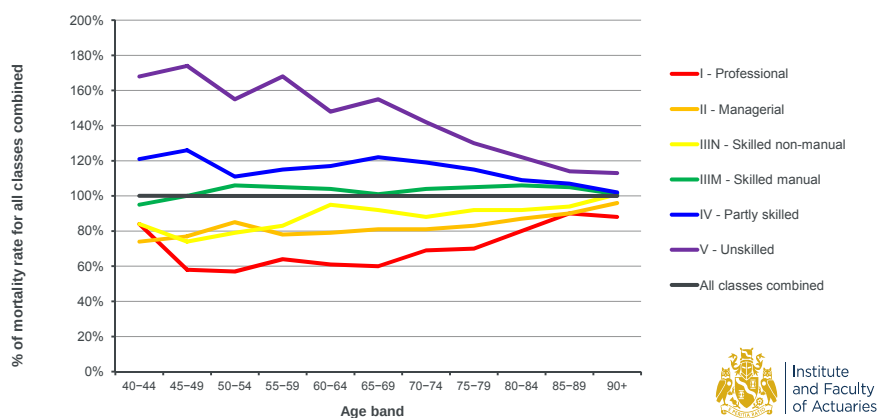
2011 Census – older age mortality rates

- Mortality rate = Deaths ÷ Exposure
 - Death registrations data is considered highly accurate
 - Use mid-year population as estimate of exposure
- Inaccuracy in population estimates => inaccurate mortality rates
- Do population mortality rates matter in insurance/pensions?
 - Portfolio-specific data lacks credibility at older ages
 - Pooled insurance or pension scheme data may lack reliability at older ages
 - Mortality convergence of population subsets at older ages



Convergence of mortality rates at older ages?

Relative crude mortality rates by age band and socio-economic class for males in England and Wales, 1982-2005



Source: BW calculations using data from ONS Longitudinal Study 1982-2005 classified by RGSC

18

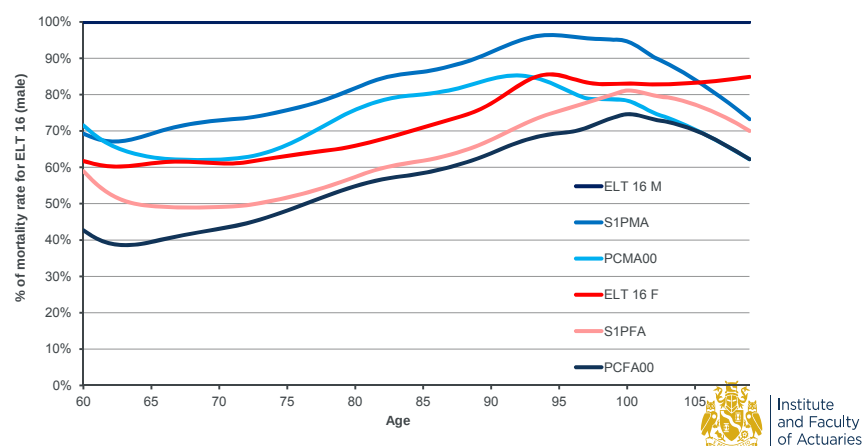
2011 Census – older age mortality rates

- Mortality rate = Deaths ÷ Exposure
 - Death registrations data is considered highly accurate
 - Use mid-year population as estimate of exposure
- Inaccuracy in population estimates => inaccurate mortality rates
- Do population mortality rates matter in insurance/pensions?
 - Portfolio-specific data lacks credibility at older ages
 - Pooled insurance or pension scheme data may lack reliability at older ages
 - Mortality convergence of population subsets at older ages
- So population mortality rates warrant consideration.



Older age mortality rates

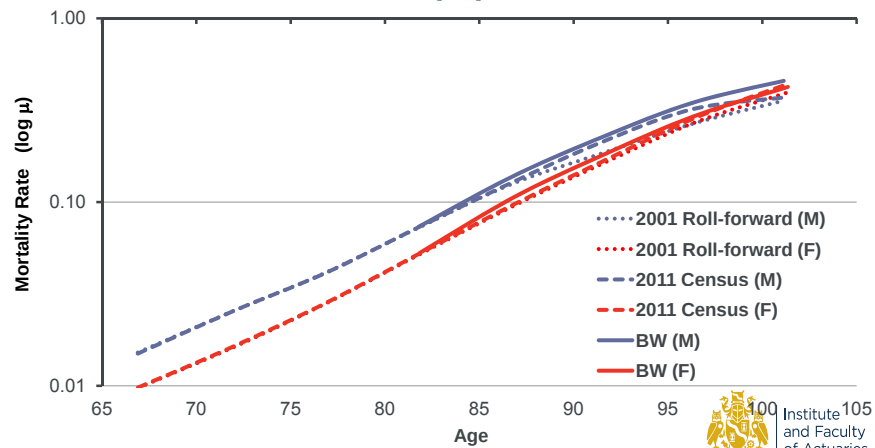
Relative mortality rates by age and sex for selected mortality tables



Source: BW calculations using selected published mortality tables and CMI_2012 (to standardise comparison date) 20

2011 Census – older age mortality rates

Comparison of mortality rate estimates using alternative estimates of mid-2011 E&W population



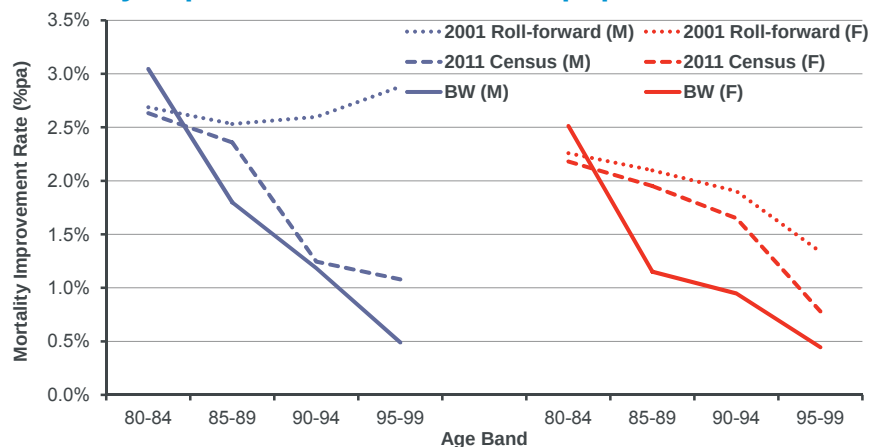
Source: BW calculations using population estimates and death registrations data published by ONS.

2011 Census and older age mortality improvements

- Analysis of mortality improvements necessitates a large dataset
- England & Wales population dataset used for default values in CMI_2012
- Inaccuracy in population estimates => inaccurate mortality improvements.

2011 Census and older age mortality improvements, 2001 - 2011

Mortality improvements / alternative population estimates



Source: Derived from ONS population estimates plus BW calculations using death registrations data.

Beyond the 2011 Census

Beyond 2011

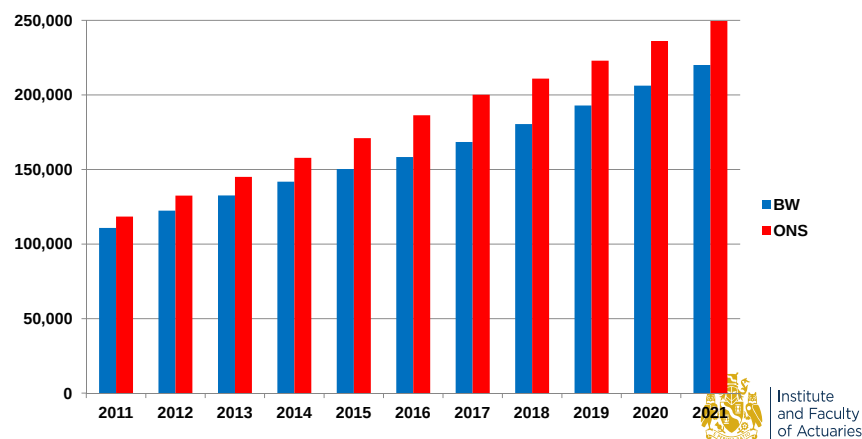
- ONS considering options in place of the current census
- Census options: Full decennial, Rolling, Short Form with sample long form, Short Form with annual survey
- Administrative option: linking (anonymised) records from NHS, HMRC, etc
- Final recommendation due in 2014

High-age population estimates

- ONS is researching:
 - 2011 Census sampling errors at ages 90+
 - Accuracy of death registration data; and
 - Optimum period for calculation of cohort survivors
- Findings due later in 2013.

Beyond the 2011 Census

Comparison of future E&W 90+ male population estimates starting from alternative mid-2011 estimates



Source: BW calculations using Census 2011 population estimates, death registrations data published by ONS and indicative mortality rates.

2011 Census – Summary

- Population data is an important reference point for mortality rates and mortality improvement rates at older ages
- 2011 Census produced significant change in population estimates – and mortality rates – at older ages
- But also raised questions regarding the accuracy of population estimates from the Census
- Current ONS methodology can escalate inaccuracies over time
- Alternative methodology available – but assumes accurate death registration data and no migration.



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. The information in this presentation must not be construed as advice.

