CMI MORTALITY EXPERIENCE

London  28 June 2006

Developments in Longevity

Agenda
- Recent CMI mortality experience
- New mortality tables
- Mortality Improvements
- CMI Mortality Projections work
- Where Next?

Recent CMI mortality experience

Life Office Pensioners 100AE, Ex “92” Series projected mortality rates, Males

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Amounts
Lives
Recent CMI mortality experience

Life Office Pensioners 100A/E, Ez=92* Series medium cohort projection, Males

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New “00” Series base tables
- AM00 & AF00, 2 year select & Combined, Smoker
- TM00 & TF00, 5 year select & non-smoker
- PMA, PML, PFA, PFL
  - Normal, Early, Combined
- PPM, PPF (new, lives only)
  - Vested, Deferred, Combined
- IML, IFL (No amounts this time, funny data)
- WA, WL
- RM, RF (lives only, as before)
  - Vested, Deferred (new), Combined (new)
New “00” Series base tables

- Proposed Tables
  - WP12 – Assured lives – April 2005
  - WP16 – Pensioners & annuitants – Sept 2005
- Minor revisions after consultation
- Approval from FIMC for final tables will be sought shortly
- Will then be published

Comparison - 00 series $q_x$ vs 92 series C2000 sc $q_x$

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Improvements in male mortality 1920 - 1999

Improvements at younger ages
- Conquest of infectious diseases
- TB, typhoid, measles, scarlet fever, diphtheria

<table>
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<tr>
<th>Ages</th>
<th>% of deaths from infectious diseases (E&amp;W)</th>
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<tr>
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<td>1901 – 1910</td>
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<tr>
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<td>Male</td>
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<td>1 - 14</td>
<td>43%</td>
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<td>15 - 44</td>
<td>46%</td>
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<td>45 - 64</td>
<td>16%</td>
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<td>65 +</td>
<td>4%</td>
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Improvements at older ages

- Significant improvements in treatment of killer diseases
  - cancer, heart and respiratory diseases
- Smoking cessation – ongoing effects
  - Reduction in heart disease almost back to “never-smoker” status after 10 years
  - Effects on lung cancer rates take 20+ years to work off (if at all)


Will mortality continue to improve?

Professor Jay Olshansky
University of Illinois, Chicago

Olshansky argues that mortality will not continue to improve at its current rate. The main reasons he gives are obesity, the spread of disease and, most importantly, the existence of biomechanical limits on our lifespan.

Professor Shripad Tuljapurkar
Stanford University, California

Study assumes that lifespans increase in line with current trends until 2010, but that anti-ageing technologies would then become available that would prolong life much further. These drugs and therapies would cause mortality to decline five times faster than historical rates between 2010 and 2030, before normal service was resumed.

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- Self-Administered Pension Schemes (SAPS) investigation
- Mortality Improvements
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The two way table for $q_x$

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The datasets

- Crude $q(x)$ by age and calendar year
- For lives with protection and savings products
  - 1947 to 2003
- For UK population
  - 1960 to 2003
- For ages 20 to 100
- Other datasets much smaller
- Used p-splines to remove noise
- Then tried to see patterns
... so looked at improvement rates

\[ 1 - \frac{q_{x,t}}{q_{x,t-1}} \]
Overview on recent CMI work on projections

- Working Paper 1 – November 2002
  - An interim basis for adjusting the “92” Series mortality projections for cohort effects
  - Offered a range of projections
  - Initial exposure of various projection methodologies
  - Consultation document to guide future work
  - Summary of responses to WP3
  - “green light” to continue work
  - Proposed 2 methods: P-spline and Lee-Carter
  - Sept. 2005, Software and Data, CILA presentation
  - Working Paper 20 – April 2006
  - Guidance on P-spline (Lee-Carter to follow)

Using P-Splines to project mortality

- Percentiles v sample paths
- Age-cohort v Age-period
- Males v Females
- Assured lives v ONS
- Different age ranges – not illustrated
- Back-fitting

Percentiles v sample paths
Assured lives v ONS

P-spline 50% : Age-Cohort penalty : Assured Lives : Age range 20-90 :
Projection from 2003

P-spline 50% : Age-Cohort penalty : ONS data Males : Age range 20-89 :
Projection from 2003
Annuity values – 1993 and on

Projected annuity values for males aged 60 starting from 1993
P-Spline, age-cohort, assured lives fitted from 1947, ages 20-90, PMA92, 4.5%

Year of calculation

Immediate annuity value

1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

Projected annuity values for males aged 60 starting from 1993
P-Spline, age-cohort, assured lives fitted from 1947, ages 20-90, PMA92, 4.5%
Projected annuity values for males aged 70 starting from 1993
P-Spline, age-cohort, assured lives fitted from 1947, ages 20-90, PMA92, 4.5%

Projected annuity values for males aged 75 starting from 1993
P-Spline, age-cohort, assured lives fitted from 1947, ages 20-90, PMA92, 4.5%

\[ \ddot{a}_x @ 4.5\% \]
Projection basis = male assured lives, 1947 to 2003

<table>
<thead>
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<th>Mortality Basis</th>
<th>Male aged</th>
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<tr>
<td>PMA92u04mc</td>
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<td>PMA00u04p-s2.5ap</td>
<td>15.259</td>
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</table>

These results are based on particular knot parameters, different parameters will give different results.
Age-cohort figures based on ages 21-90; age-period on ages 22-90
Source: CMI Working Paper 20
**Projection basis = male assured lives, 1947 to 2003**

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These results are based on particular "knot" parameters, different parameters will give different results.

Age-cohort figures based on ages 21-90, age-period on ages 22-90

Source: CMI (unpublished)

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**Projections - sources of uncertainty**

- Model uncertainty
- Parameter uncertainty
- Stochastic uncertainty
- Measurement error
- Heterogeneity
- Past experience may not be good guide (e.g. change in business mix)

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- Where Next?
Where Next?

- "00" Series base tables
  - Final proposals, all tables to FIMC shortly
  - Publication immediately thereafter
- Status of CMI projections work (work in progress)
  - P-spline working paper currently being reviewed
  - Lee-Carter working paper will follow
  - Peer reviewed, not approved - exposing work to the profession will allow full review and issues to surface
- Future work
  - Other methodologies
  - Further research