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2004 Current Issues in Life Assurance
MORTALITY UPDATE

28 April 2004

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Mortality update - Agenda

- Update on self- administered pensioner investigation
- Update on CMI investigations
  - Data collection and observations
  - The work on the "00" Series of tables
- Working Paper 3

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The SAPS mortality investigation

- 99 Schemes
- Number of records in database 1.04m
- 6 largest schemes cover 50% of the data
- 9 Consultancies have contributed data
- Data for 1996 to 2003
- 13 industry types, significant amounts of data for 7

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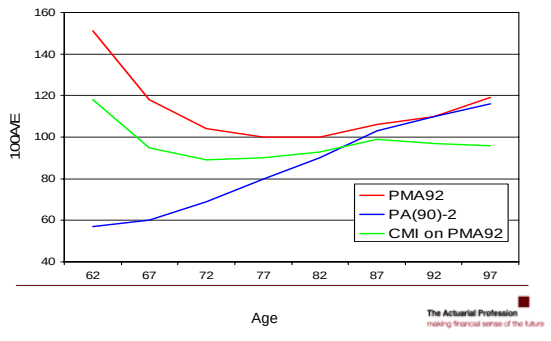
Mortality of self-administered pensioners 2000-02
All retirements : Males : Amounts



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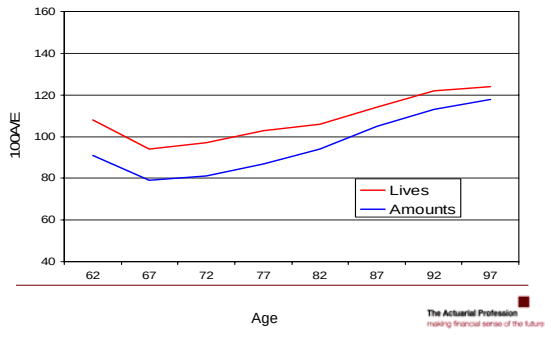
Mortality of self-administered pensioners 2000-02
Normal : Males : Lives *v* Amounts (on PML92)



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Mortality update - Agenda

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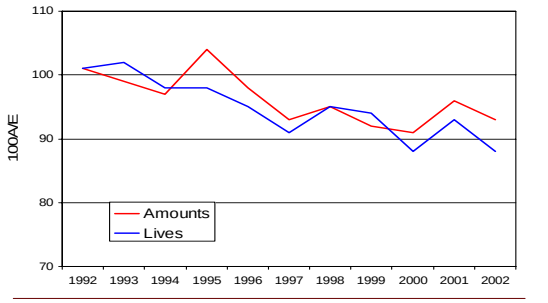
Life Office Pensioners 100A/E using the "92" Series projected mortality rates : Males



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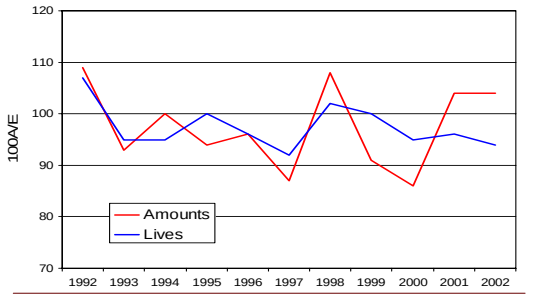
Life Office Pensioners 100A/E using the "92" Series projected mortality rates : Females



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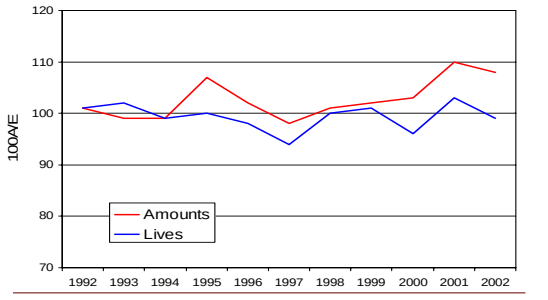
Life Office Pensioners 100A/E using the "92" Series - medium cohort, projected mortality rates : Males



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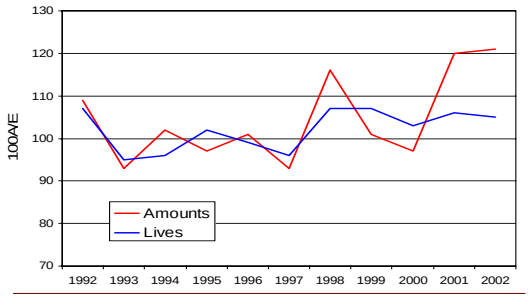
Life Office Pensioners 100A/E using the "92" Series - medium cohort, projected mortality rates : Females



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Expectation of life at age 65 in 2000

Country	*Male*	*Female*	*Country*	*Male*	*Female*
Japan	17.50	22.40	Greece	15.91	18.56
France	17.19	21.63	Norway	15.79	19.68
Switzerland	16.77	20.93	Belgium	15.70	19.65
Australia	16.73	20.23	Austria	15.66	19.61
Sweden	16.65	20.01	Denmark	15.27	17.77
Israel	16.64	18.87	Netherlands	15.13	19.54
New Zealand	16.56	19.93	Finland	15.07	19.18
Italy	16.46	20.57	**United Kingdom**	**15.06**	**18.54**
Spain	16.22	20.23	Germany	15.06	18.91
USA	16.02	19.15	Portugal	14.31	18.01
Canada	15.95	19.75	Ireland	14.25	18.05
Singapore	15.92	18.65			

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Work on the "00" tables

- Projections Working Party
  - WP3 out now
- Graduation Working Party
  - Which tables (not too many!)
  - How should they relate to each other
  - Durations, lives and amounts
- Experience paper (a CMIR)

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"00" Series timetable

- March 04 - Projections W/P
- May 04 - W/P on what to graduate
- 4 June 04 - Staple Inn seminar to discuss W/Ps
- July 04 - Experience CMIR
- Sept 04 - New graduations & possibly, adjusted interim projections
- Sept 04 - Internal CMI workshop on Lee-Carter projection methods
- 1st half 05 - Updated projections

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CMI Working Paper No 3

Background

- WP 1 introduced interim projections based on cohort effect
- Short, medium and long cohort effect
- No recommendation given as to which to use
- Interim until more thorough investigation undertaken
- Projections Working Party set up
- WP 3 first output
- Consultation paper covering several topics for consideration

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CMIB/GAD Seminar 6 October 2003

- CMIB/GAD joint seminar on 6 October 2003
- Invited experts discussed three themes:
  - Projecting aggregate mortality v modelling individual causes
  - Methodology and statistical methods
  - Limits to human lifespan and molecular effects of ageing

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Reasons for new projections

- Experience for 1999 generally lighter than that projected for 1999 under “92” tables, repeating past history of projections in mortality improvement being too low
- Advances in methodologies for projecting mortality
- Need to give some measure of uncertainty

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Longevity risk (1)

- Non diversifiable
- No traded markets in longevity risk, so price not directly observable
- Not easily hedged, though can be offset
- Price for risk is calculated by purchasers (insurance companies)

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Longevity risk (2)

- Similarities with 1950s when interest rates very low and below rates used in pricing bases
- Precipitated move from non-profit to with-profit
- Issuers of long-term guarantees based on future longevity in similar position, but now have methods for measure of systemic risk
- Working Party believes a measure of uncertainty should be provided with projections of future mortality rates ….
- …. but users responsible for approach taken in their own circumstances

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FSA requirements (1)

- Integrated Prudential Sourcebook
- Setting mathematical reserves, margin for adverse deviation should be greater than or equal to market price for risk
- If risk premium not available proxy can be used such as adjusted industry mortality tables
- If large range of possible outcomes, use stochastic techniques to evaluate risk – longevity risk, if significant, may fall into this category

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FSA requirements (2)

In setting prudent mortality rates, should consider:

- Credibility of own experience
- Availability and reliability of published tables
- Anticipated or possible future trends (where this increases liability) including:
  - anticipated improvements
  - changes in market segmentation

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Projection methodologies

- Process based
- Explanatory based
- Extrapolative

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Process-based methodologies

- Model mortality rates from bio medical perspective
- Processes causing death need to be understood
- Mathematical models need to be developed
- Not really practical at present….
- ...but could become more relevant in future

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Explanatory-based methodologies

- Explanatory links need to be understood
- Underlying economic or environmental factors need to be modelled…
- … not just for short term but for 50+ years
- May provide partial attempts for projecting minimum/maximum improvements (e.g. links with patterns of smoking)

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Extrapolative methodologies

- Project historical trends into the future
- Include some subjective element
- Simple extrapolation only reliable to extent that conditions leading to changes in past mortality have similar impact in the future
- Can be invalidated by medical advances or emergence of new diseases

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Projection methodology

- Trend projection – relationship between mortality at different ages often ignored
- Parametric methods – e.g. fitting parameterised curves to past data and projecting trends in parameters forward
- Targeting approach – interpolating between current mortality rates and targets assumed to hold at a given future date

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Other considerations

- Aggregate mortality or cause of death
- Cohort effects
- Measures of uncertainty
- Model should be sensible in the region of the data (trade off between smoothness and goodness of fit)
- In the region of the projection, should behave in reasonable or plausible way

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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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Quantifying uncertainty

- Estimates of parameter uncertainty can be made for regression and time series models, after model has been chosen
- For model uncertainty, can try different models and assess sensitivity of results, but ….
- …. no easy method for providing probabilistic statements on model risk

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What experience(s) should be projected

- Can projections of CMI experience draw on information derived from larger experiences
- CMI experiences not necessarily homogeneous parts of larger experiences (e.g. UK population)
- May be able to use techniques similar to graduation by reference to a standard table to provide measure of uncertainty

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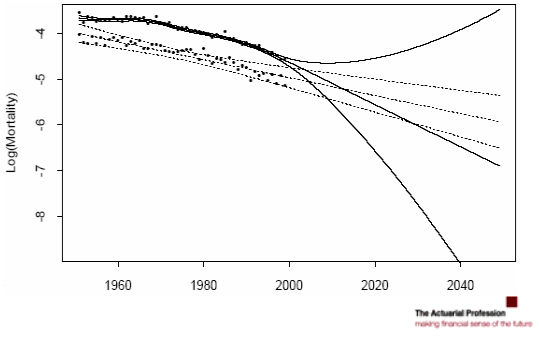
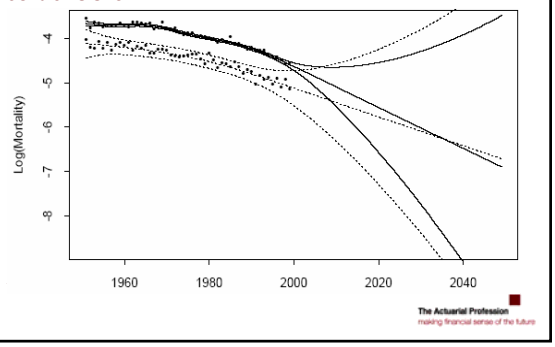
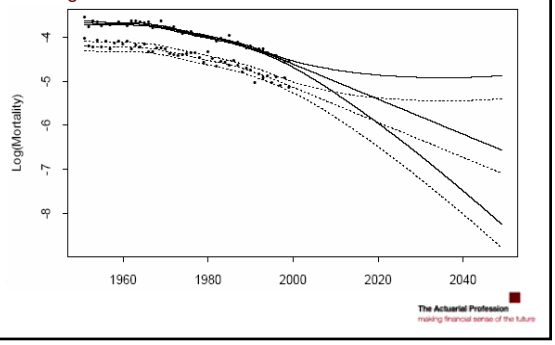
Fitted and projected model of larger (top) and smaller (bottom) mortality experience. P-spline model with separate smoothing parameters. 95% c.i.s shown.



Fitted and projected model of larger (top) and smaller (bottom) mortality experience. P-spline model with smoothing parameter chosen to favour goodness-of-fit. 95% c.i.s shown.



Fitted and projected model log $\mu_{65}(t) = a + \log \mu_{65}(t)$ of larger (top) and smaller (bottom) mortality experience. P-spline model with smoothing parameter chosen to favour goodness-of-fit. 95% c.i.s shown.



Quantifying uncertainty

- Can extend to model of form
  $\log \mu_{60}(t) = f(\theta, \log \mu_{65}(t))$
  where $\log \mu_{65}(t)$ are previously graduated estimates and θ is parameter of suitable dimension
- Assume relationship holds in area of projection
- Model and project larger experience and obtain s.e.s
- Estimate θ and its s.e.s
- Can then estimate s.e.s for smaller experience

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Cause of death projections

Advantages include:

- Takes account of information on behavioural and environmental changes as well as expert medical knowledge when projecting mortality rates

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Cause of death projections

Disadvantages include:

- Deaths from specific causes not always independent; inter-relationships not always understood
- Proportions of deaths due to particular causes shift over time
- Difficulty in determining exact cause of death for elderly
- Changes in methods of diagnosis and classification of causes of death reduce reliability of historical data

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Cause of death projections

- Given difficulties, especially at older ages where CMIB projections are focussed, WP3 recommends that projections of aggregate mortality be adopted
- However, analysis of trends in cause specific mortality can help inform projections of aggregate mortality

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Working Paper 3

- Consultation paper
- Stimulate thinking
- Invite discussion and responses
- Asks various questions

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Invitation to comment

- What base tables and projections do offices use now?
- What level of aggregation is appropriate in projecting future mortality?
- Should we continue to project cohorts?

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Invitation to comment

- Do we need quantitative measures of uncertainty? If so, what form should they take?
- Are distributions or percentiles of future rates of mortality, derived from statistical models of past data, sufficiently meaningful?
- Should projections and any measures of uncertainty be based on the largest available appropriate population?

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Invitation to comment

- Is there currently any preferred methodology?
- What may be the financial consequences of allowing for mortality?

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