Staple Inn Hall, High Holborn, London

A value-at-risk framework for longevity trend risk

Stephen Richards, Iain Currie and Gavin Ritchie
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The Actuarial Profession

making financial sense of the future

Contents

1. The need for stochastic projections

The need for stochastic projections

"computation of the SCR for longevity risk via the VaR approach obviously requires stochastic modelling of mortality"

Boerger (2010)

The need for stochastic projections

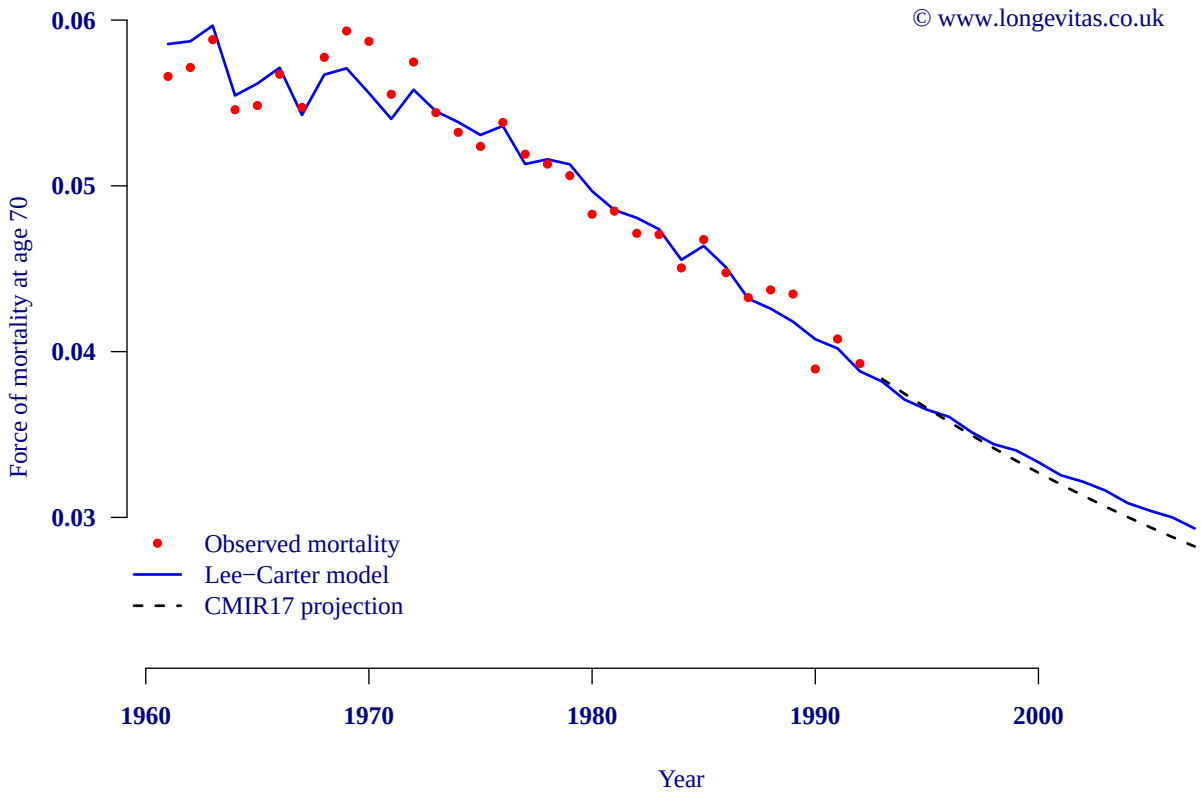
"naturally this requires stochastic mortality rates"

Plat (2011)

An illustration — back-testing

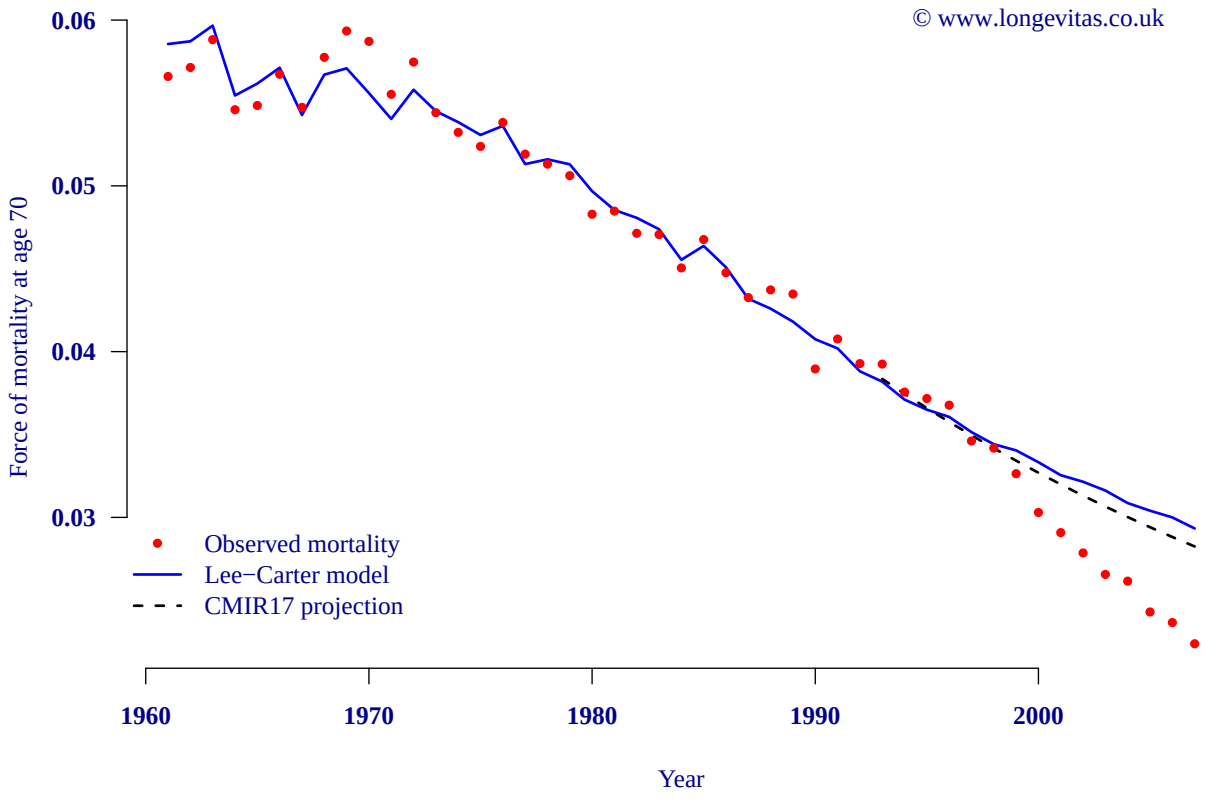
- Take a long data series
- Discard latter years and fit projection model
- Compare projected rates with what actually happened

Back-testing: fit model to data to 1992



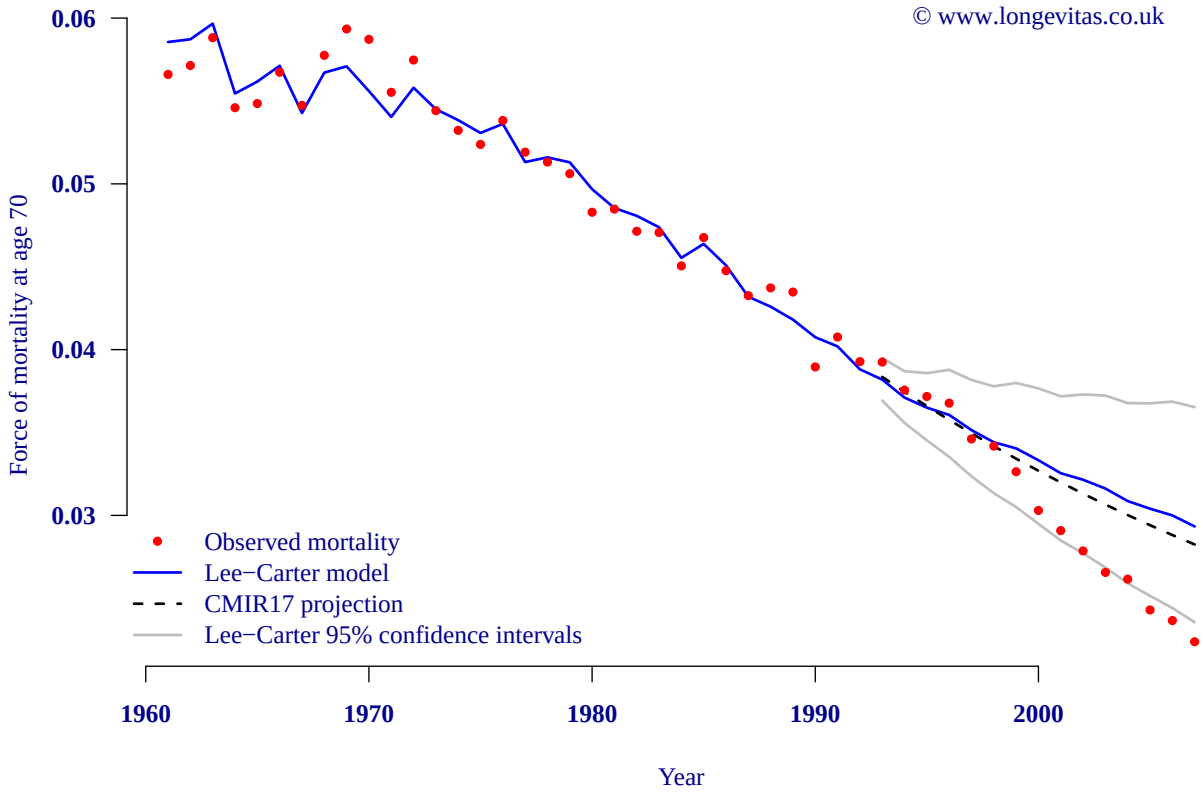
Source: Longevitas Ltd. ONS data, CMIR17

Back-testing: compare projections to actual data



Source: Longevitas Ltd. ONS data, CMIR17

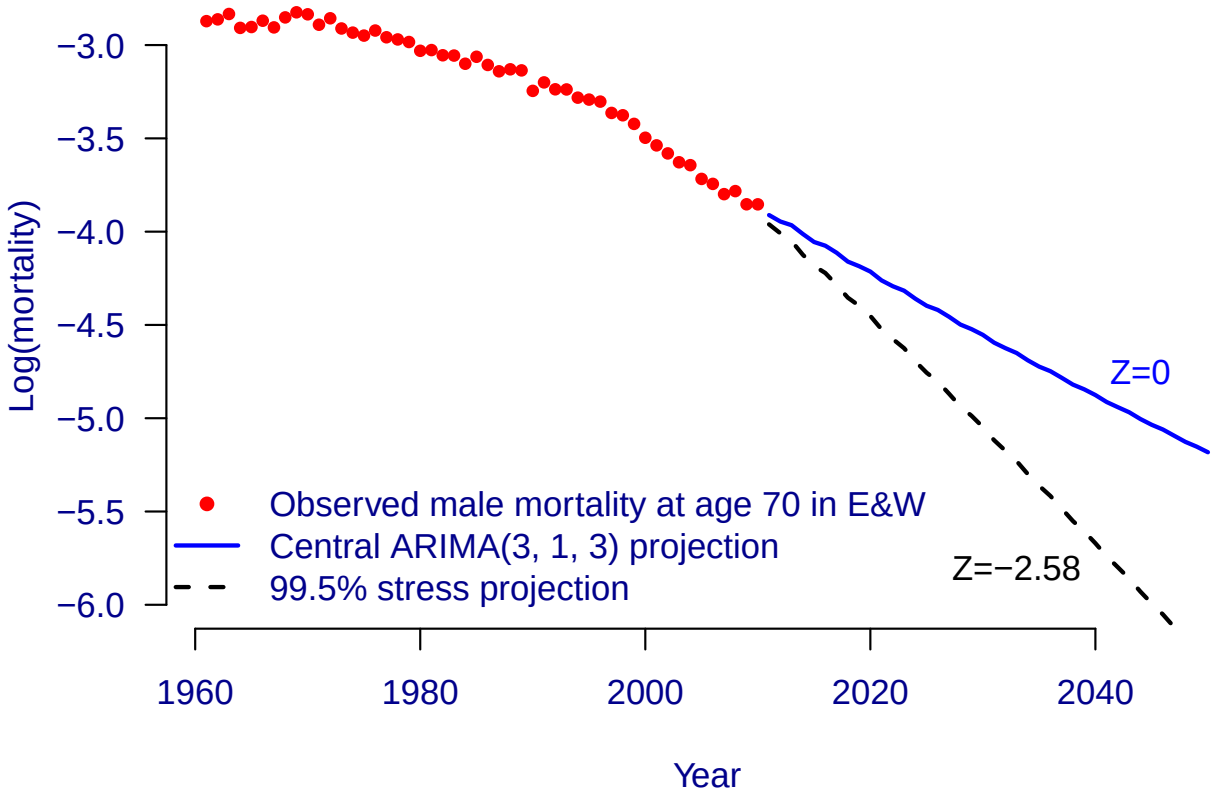
Back-testing: compare data to confidence intervals



Source: Longevitas Ltd. ONS data, CMIR17

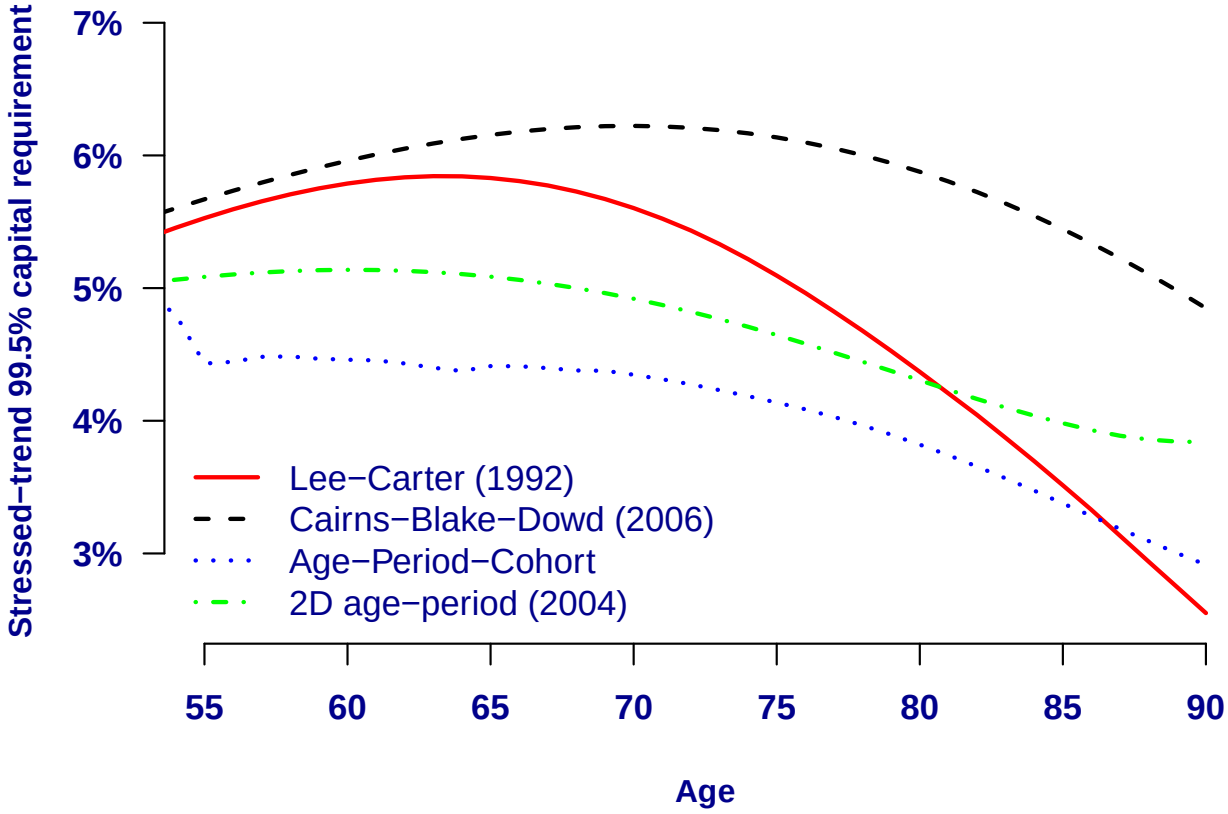
2. The stressed-trend approach

The stressed-trend approach



Source: Richards, Currie and Ritchie (2012), Figure 1.

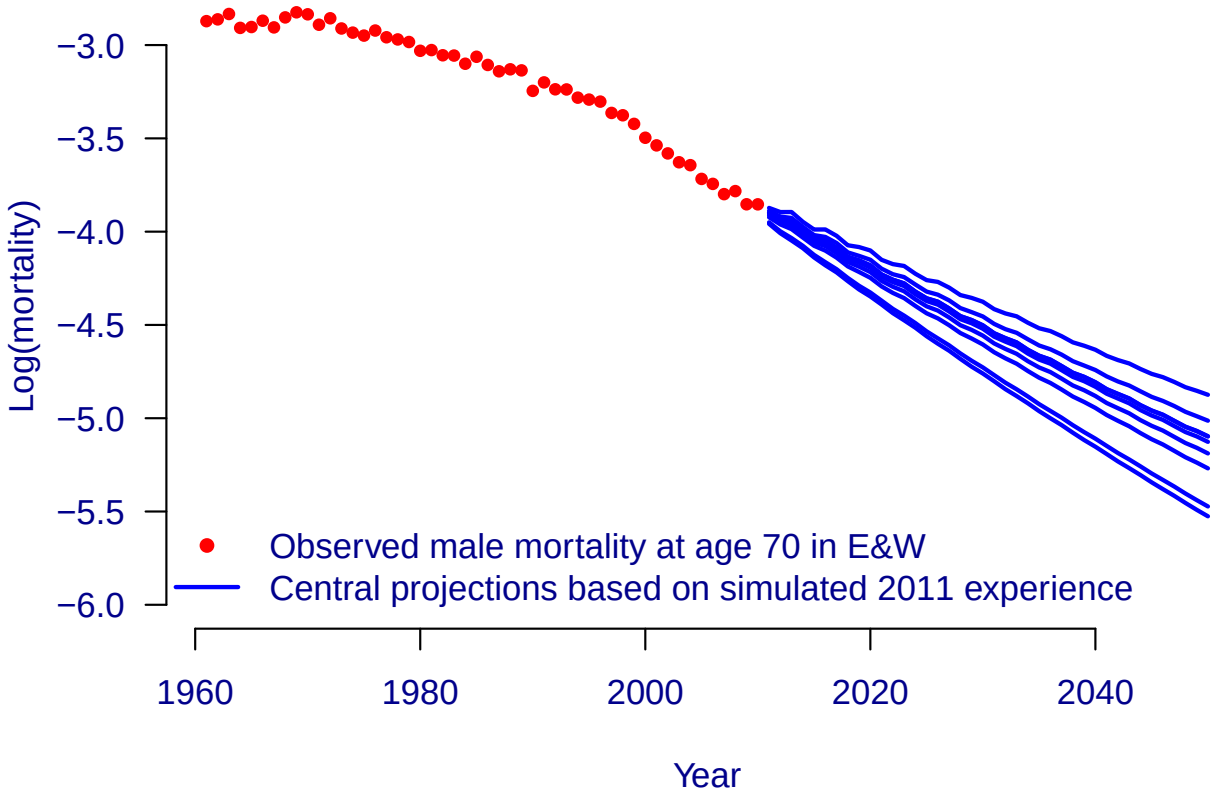
The importance of model risk



Source: Richards, Currie and Ritchie (2012), Figure 2.

3. A value-at-risk (VaR) framework

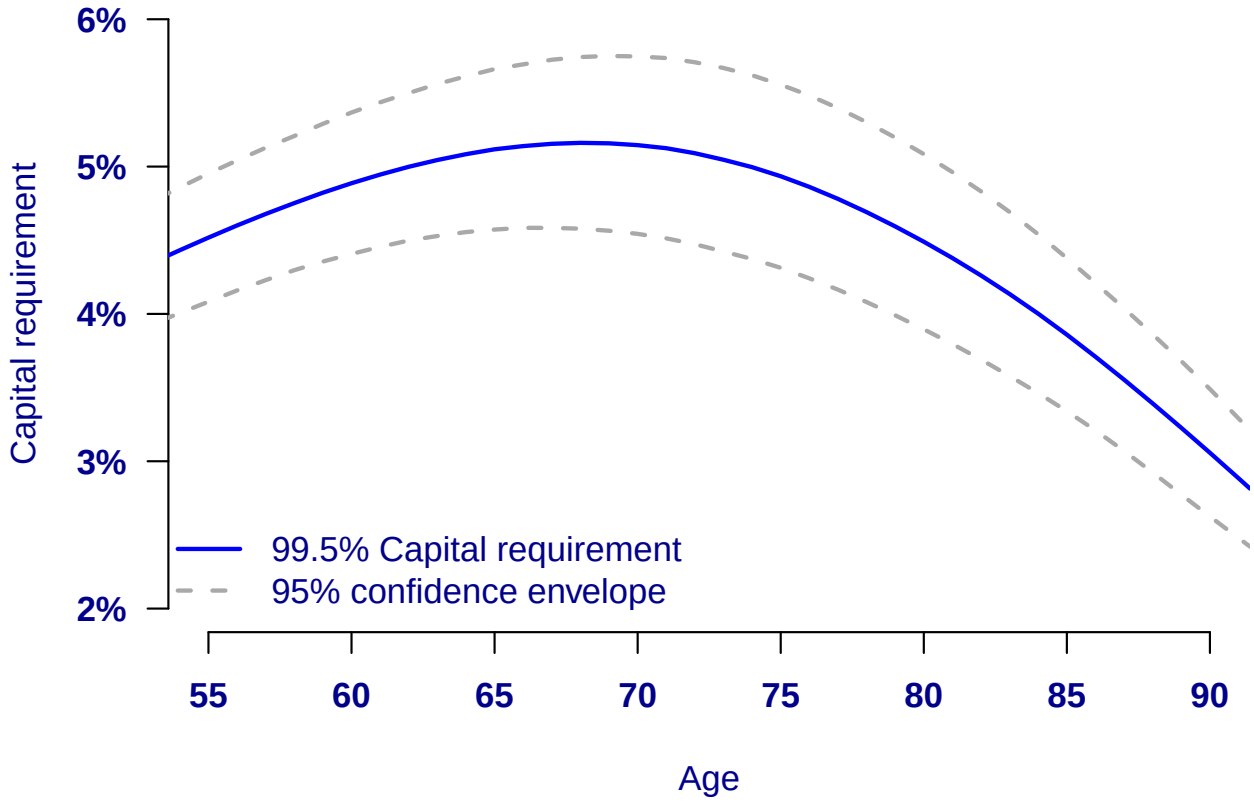
Lee-Carter VaR with 1,000 simulations



Source: Richards, Currie and Ritchie (2012), Figure 5.

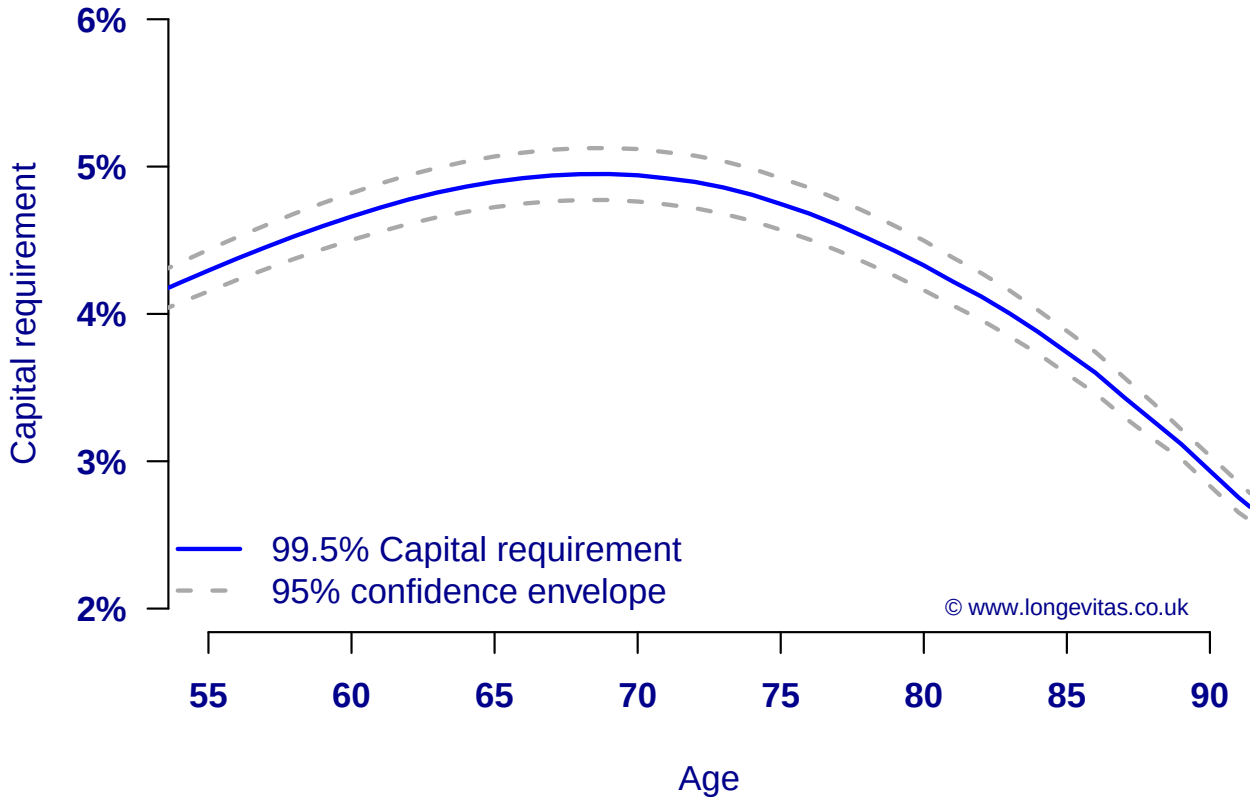
4. Number of simulations required

Lee-Carter VaR with 1,000 simulations



Source: Richards, Currie and Ritchie (2012), Figure 6.

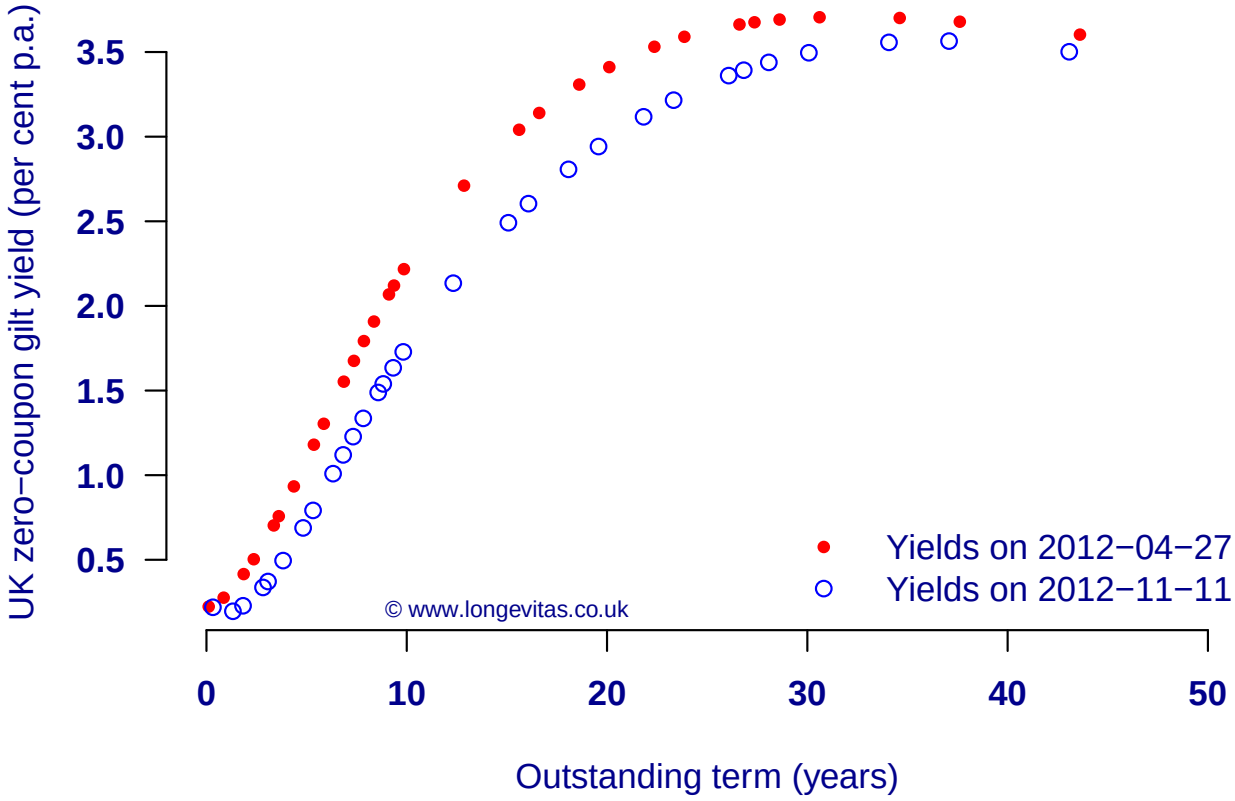
Lee-Carter VaR with 10,000 simulations



Source: Longevitas Ltd.

5. The need to regularly recalibrate VaR capital

UK zero-coupon gilt yield curve



Source: Data from Debt Management Office, http://www.dmo.gov.uk

6. Conclusions

- Deterministic scenarios limited by lack of likelihood
- Stochastic projections needed to include uncertainty
- Stressed-trend approach too strong for one-year view
- Model risk must be acknowledged and different models used
- VaR capital needs to be regularly recalibrated if yield curve changes

References

Börger, M. **2010** *Deterministic shock vs. stochastic value-at-risk: An analysis of the Solvency II standard model approach to longevity risk*, Blätter DGVFM, **31**, 225–259

CMIB (Continuous Mortality Investigation Bureau) **1999** *Report Number 17*, Institute and Faculty of Actuaries

Lee, R. D. and Carter, L. **1992** *Modelling and forecasting the time series of US mortality*, Journal of the American Statistical Association **87**, 659–671

Plat, R. **2011** *One-year Value-at-Risk for longevity and mortality*, Insurance: Mathematics and Economics, **49(3)**, 462–470

Richards, S. J., Currie, I. D. and Ritchie, G. P. **2012** *A value-at-risk framework for longevity trend risk*, British Actuarial Journal (to appear)

Addendum 1: Parallel VaR — 4 processes

Model	Scalability factor
Lee-Carter Gompertz	4.0x
CBD5 P-spline	4.0x
2D Age-cohort	3.9x
CBD5 Gompertz	3.8x
Lee-Carter Original	3.8x
APC Original	3.7x
Lee-Carter Smooth	3.6x

Source: Longevitas Ltd. The scalability factor is the speed increase relative to serial processing.

Addendum 2: Parallel VaR — 7 processes

Model	Scalability factor
Lee-Carter Original	6.6x
Lee-Carter Smooth	6.6x
Lee-Carter Gompertz	6.6x
CBD5 P-spline	5.8x
2D Age-cohort	5.1x
APC Original	5.0x
CBD5 Gompertz	4.1x

Source: Longevitas Ltd. The scalability factor is the speed increase relative to serial processing.