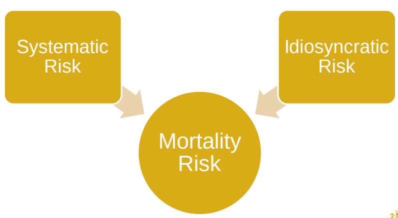
Institute and Faculty of Actuaries

Idiosyncratic Mortality Risk

Murray Wright, JLT Employee Benefits

11 June 2018

Introduction



Institute and Faculty of Actuaries

11 June 2018 2

Idiosyncratic risk

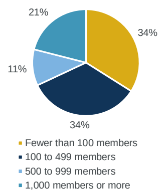
- Idiosyncratic (or non-systematic) mortality risk arises through random fluctuations in a population
- Even if we know the 'correct' mortality distribution for a particular population, we do not know when each individual will die
- Though this risk can be diversified away through pooling, this is not possible for many pension schemes or for individuals

Institute and Faculty of Actuaries

11 June 2018 3

Pension scheme size

Scheme size by number of members



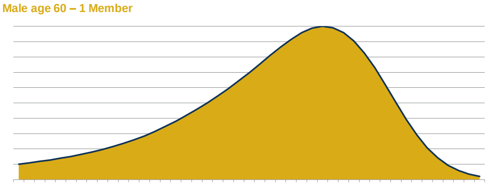
- Approximately 5,400 defined benefit pension schemes across the UK
- 3,700 schemes have less than 500 members
- 1,850 schemes have less than 100 members

Source: The Pensions Regulator, Scheme funding statistics 2017: appendix

Institute and Faculty of Actuaries

Distribution of average age at death

Male age 60 – 1 Member

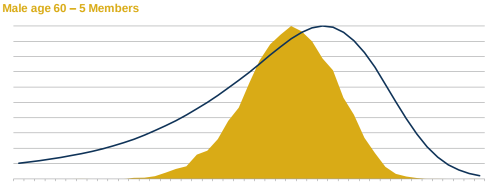


Source: JLT calculations

Institute and Faculty of Actuaries

Distribution of average age at death

Male age 60 – 5 Members

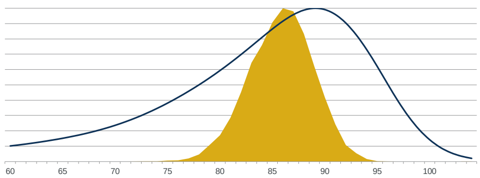


Source: JLT calculations

Institute and Faculty of Actuaries

Distribution of average age at death

Male age 60 – 10 Members



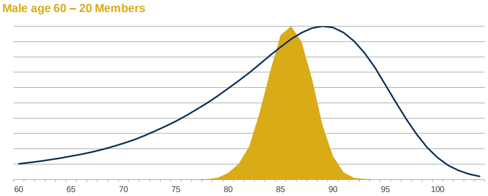
Source: JLT calculations

Institute and Faculty of Actuaries

11 June 2018 7

Distribution of average age at death

Male age 60 – 20 Members



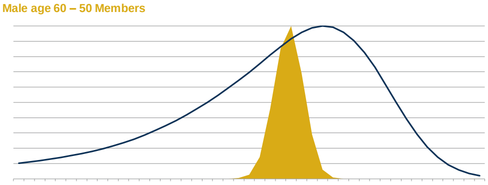
Source: JLT calculations

Institute and Faculty of Actuaries

11 June 2018 8

Distribution of average age at death

Male age 60 – 50 Members



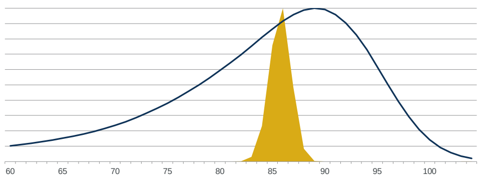
Source: JLT calculations

Institute and Faculty of Actuaries

11 June 2018 9

Distribution of average age at death

Male age 60 – 100 Members



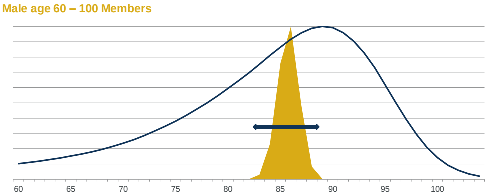
Source: JLT calculations

Institute and Faculty of Actuaries

11 June 2018 10

Distribution of average age at death

Male age 60 – 100 Members

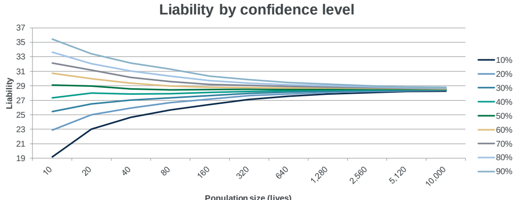


Source: JLT calculations

Institute and Faculty of Actuaries

11 June 2018 11

Example of simulation output



Source: JLT calculations

Institute and Faculty of Actuaries

11 June 2018 12

Mortality assumptions

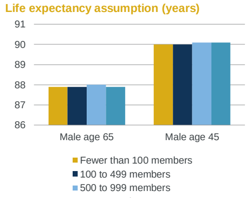
*"the mortality tables used and the demographic assumptions made must be based on **prudent principles**, having regard to the main characteristics of the members as a group and expected changes in the risks to the scheme"*

Occupational Pension Schemes (Scheme Funding) Regulations 2005

Regulation 5(4)(c)

Mortality assumptions

Life expectancy assumption (years)



- Mortality assumptions adopted do not vary by scheme size
- No evidence that more prudent life expectancy assumptions are being adopted for smaller pension schemes

Source: The Pensions Regulator, Scheme funding statistics 2017: appendix

The problem

- Idiosyncratic mortality risk is a real and material risk for a large number of defined benefit pension schemes
- The problem is exacerbated by concentration risk where the majority of the liability sits with a small number of members
- For an individual member or a small pension scheme, the only standalone 'solution' is through an annuity
- A possible future solution is through some of the different forms of aggregation being considered, but not all involve pooling of mortality risks

A proposal

- In the absence of a 'solution', the key is to help trustees (and their advisors) understand and quantify the risk being run
- This will help improve decision making, and highlight the true value of different strategies
- It is reasonably straightforward to carry out simulations for a pension scheme to allow the risk to be quantified and understood
- However, smaller pension schemes will often be the ones who do not have the resources or support available to help them to do this
- We have developed a simplified approach to help

Institute and Faculty of Actuaries

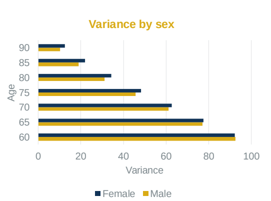
The goal

- The goal is to be able to quantify idiosyncratic mortality risk on an approximate basis without the need to carry out scheme specific simulations
- The output will identify a range of possible liabilities, or average life expectancies, with different levels of confidence
- This will allow pension scheme trustees to
  - consider the amount of idiosyncratic mortality risk the pension scheme is exposed to; and / or
  - incorporate explicit margins for prudence in actuarial valuations if required

Institute and Faculty of Actuaries

Variance of life expectancy

- Use variance as our initial risk measure
- The variance of any individual mortality distribution can be calculated analytically
- Consider what factors drive the variance to allow us to produce a parsimonious model
- For example, sex is not a material factor even at higher ages

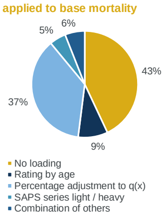


Source: JLT calculations

Institute and Faculty of Actuaries

Key factors

Loadings applied to base mortality tables

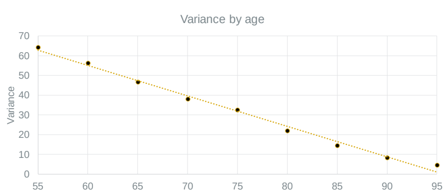


Source: The Pensions Regulator, Scheme funding statistics 2017: appendix

- Key factors are
  - Age
  - Contingent spouse proportion
  - 'Shape' of mortality distribution
- For this analysis we ignore shape by simply referring to the 'S2' Series mortality tables
- 92% of defined benefit pension schemes currently use SAPS

Institute and Faculty of Actuaries

Approximating variance of (joint) life expectancy



Source: JLT calculations

Institute and Faculty of Actuaries

Applying to data

- We require the following member data for each member $i = 1 \ldots n$
  - Age (A_i)
  - Amount of pension (P_i)
- We calculate the variance for each member (V_i) by reference to age and a simple linear approximation, for example V_i = 150 – 1.5 x A_i
- The variance for each member is weighted by the amount of pension

Weighted average variance = $\dfrac{\sum_{i=1}^{n} P_i^2 V_i}{\left(\sum_{i=1}^{n} P_i\right)^2}$

Institute and Faculty of Actuaries

Using the variance

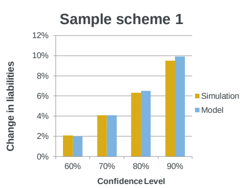
- We can then use the weighted average variance to produce scheme specific confidence intervals
- For example, assume the weighted average life expectancy is 20 years
- The average variance is calculated to be 5
- We can calculate a confidence interval by reference to a normal distribution, so for example with 95% confidence average life expectancy for the population will be no more than

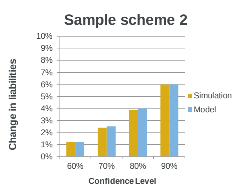
$$20 + 1.6445 \times \sqrt{5} = 23.7 \text{ years}$$

Institute and Faculty of Actuaries

11 June 2018 22

Our model compared to a full simulation





Source: JLT calculations

Institute and Faculty of Actuaries

11 June 2018 23

Impact on small scheme funding

- Consider aggregate funding position of schemes with less than 100 members
- Assume these schemes will eventually target self-sufficiency if they do not buyout
- Apply 90% confidence level as need to allow for idiosyncratic risk
- Almost doubles the funding shortfall

	No allowance for idiosyncratic risk	With allowance for idiosyncratic risk (90% confidence)
Assets	£16.1bn	£16.1bn
Liabilities	£17.9bn	**£19.5bn**
Surplus / (Deficit)	(£1.8bn)	**(£3.4bn)**
Funding level	90%	**83%**

Source: The Pensions Regulator, Scheme funding statistics 2017: appendix; The Purple Book 2017; JLT calculations

Institute and Faculty of Actuaries

11 June 2018 24

Outcome

- We have arrived at a quick and straightforward method for calculating the value of idiosyncratic mortality risk for a pension scheme
- The impact of this risk can then be communicated to trustees and employers and included in funding reserves if desired
- This provides support for long-term strategy discussions. For example:
  - What value does a scheme buy-in / buyout provide?
  - If we target self-sufficiency how do we allow for this risk?
  - How could annuity top slicing benefit the pension scheme?
- This could also be used by financial advisors to help model this risk when providing advice to individuals

Institute and Faculty of Actuaries

Questions **Comments**

Institute and Faculty of Actuaries