Longevity stresses – the challenge

The challenge
Complexity of the problem
Amount of potential analysis
Key Judgements – differing views
Governance
Communication

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Agenda

On the agenda

- Overview
- Anatomy of an annuity company – business and risks
- Components of longevity risk
- Setting a 1-in-200-year stress.

Not on agenda

- Calibration of best estimate – assumed to be true best estimate
- Aviva's longevity stress calibration
- Detail regarding choice of distribution.

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Overview: how will the stress be used?

Calculating economic capital

- Regular reporting
- Capital planning.

New Business pricing

- Assumptions need to be appropriate for new business as well as for overall in-force
- Always consider new business implications.

Insight

- Better understanding of the business
- Better understanding of longevity (e.g. pattern of future longevity improvements).

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Overview: A number of decisions

Granularity

- Describe the business accurately
- Don't over-engineer …
- … especially where you don't have data
- New business vs in-force
- Materiality (but future-proof).

Format of longevity stress

- Base table – reduction in qx's
- Improvements – flat addition to future improvements
- [Compared with Standard Formula: 20% reduction in qx's].

Interaction with other risks

- One stress or several - depends on whether correlations will be different
- Materiality.

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Overview: governance and review

Internal

- Panel of experts
- Finance Technical Committee
- Senior management
- Second line (Risk function)

External

- Consultants
- Auditors
- FSA / PRA

Documentation

- Level 1 Directive of the European Parliament (2009) – overall Solvency II framework
- Level 2 Draft Solvency II Implementing Measures (2011) – detailed rules
- Technical Actuarial Standards (TASs)
- Internal Risk Control Framework

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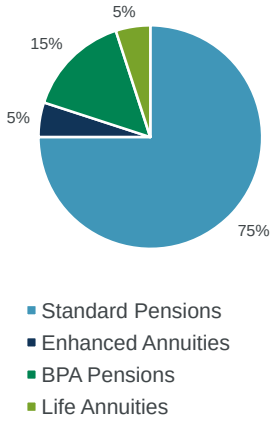
Anatomy of an annuity company: liabilities



Main areas of focus:

- Standard Pensions annuities carry the most longevity risk
- Enhanced Annuities are a small (but growing) proportion of the business
- There is a substantial amount of BPA business, which has probably grown up over the last few years
- Life Annuities represent a small proportion of the business.

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Anatomy of an annuity company: categories of business

Individual pensions business

- Large volume of business, including new business
- Maturing pensions policies
- May be internal vesting or external / OMO
- Typically not underwritten, but may be anti-selective

BPA business

- Pensions schemes – some very large
- Different demographic
- Different underwriting process

Enhanced annuities (definition?)

- Individually underwritten
- Worse-than-average health

Life business

… so talk to people in the business who understand the products.

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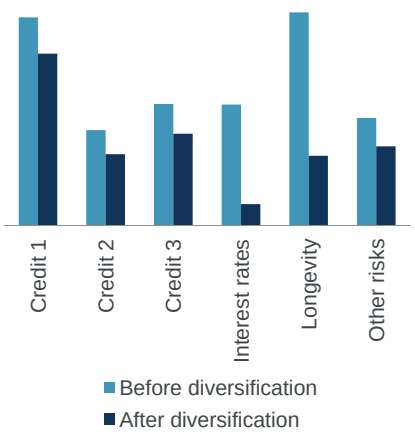
Anatomy of an annuity company: risks



- The company's biggest risk is credit risk, from different credit-risky asset categories
- But longevity risk is very material …
- … even though it diversifies away substantially.

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Elements of longevity risk

Mis-estimation risk

- How wrong could our base mortality assumptions be, or: what if our historical experience did not reflect the underlying mortality?

Anti-selection adjustment risk

- What is the risk of our adjustment for anti-selection being materially incorrect?

Volatility

- How might one year's adverse experience affect the balance sheet?

Trend risk

- What is the distribution of future improvements around the best estimate assumptions?

Additional trend risk

- What risks do trend risk not capture?
- Model risk
- Basis risk.

Correlations

- How do the intra-risk elements interact?

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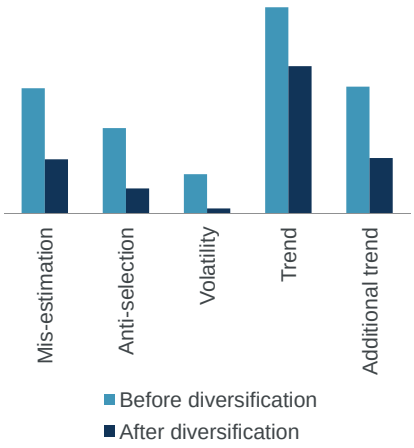
Elements of longevity risk



- The biggest risks are trend risk, mis-estimation risk and additional trend risk
- The smaller risks diversify away most…
- … but the overall level of diversification depends on the intra-risk correlations.

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Stress calibration – stats or scenarios?

Stress	Stats	Scenario(s)
Mis-estimation	Yes	
Anti-selection	No	Yes
Volatility	Yes	
Trend	Yes	
Additional trend	No	Yes

- Mis-estimation risk lends itself to statistical analysis if there is sufficient accurate data
- Anti-selection risk is difficult to quantify and put a distribution to
- Volatility risk can be estimated from the expected deaths in a year
- Trend risk can be analysed through stochastic mortality projection
- Additional trend risk might be analysed stochastically, but more realistically it is likely to be through "what if?" scenarios.

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Mis-estimation risk

Analyse a large volume of internal data

- Sounds straightforward, but …
- How many years – longer period reduces the risk/stress
- What period is used for assumptions-setting?
- What assumptions are you making – e.g. independence?
- Duplicate policies?
- Amounts vs lives?
- Males and females separately?
- What about systematic errors?

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Anti-selection risk

How wrong could the anti-selection adjustment be?

- Consider the best estimate assumption
- Use any data available (e.g. size of the enhanced annuity market, proportion of policies that are GAOs/small, emerging experience that includes anti-selection, experience of enhanced annuity business, etc.)
- … but probably still need to choose a 1-in-200 scenario.

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Trend risk: one-year VaR or run-off? – both!

One-year Var	Run-off
How might my best estimate of future improvements change under 1-in-200 year mortality?	How might unfavourable experience emerge as the business runs off?
Closer to ICA / S2 methodology	Longevity experience emerges slowly
	More software available
More computationally demanding	
	Which percentile?

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Trend risk: which models?

Wide choice of models …

- Lee-Carter
- Renshaw-Haberman
- Age-period-cohort
- P-spline (age-period and age-cohort)
- Cairns-Blake-Dowd and derivatives
- Cause of death models
- Medical process-based models
- etc…

… or is there?

- Beware telling yourself that you're covering lots of models when they are all similar

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Model comparison / appraisal

Have some objective criteria (before you see the results!)

- E.g. robustness, reasonableness, simplicity, running/programming and maintenance, wide support, verification, sources of uncertainty, projection quality/plausibility

Stochastic models vs cause of death models vs medical process-based models

- Does the model describe longevity convincingly?
- Is the source data reliable?
- What are the main assumptions?
- Are the projections plausible?
- Related to “real-world” events?

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Additional trend risk: what does statistical analysis not capture?

Medical developments

- What might happen in one year that would affect our view of future longevity that would not be manifest in the data?
- “Cure for Cancer”
- Can be informed by cause of death analysis – proportions of deaths due to different causes.

Model risk

- Does the range of models used in the calibration materially capture the variability in the risk?

Basis risk

- If the statistical analysis is based on a population other than the actual business, what is the risk that the experience of the actual business is not the same as that population?
- Statistical analysis of basis risk is still developmental
- Look at different socio-economic groups.

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Correlations and diversification

Correlations	Mis-est	Anti-sel	Volatility	Trend	Add. trend
Mis-estimation	100%				
Anti-selection	0%	100%			
Volatility	0%	0%	100%		
Trend	0%	0%	0%	100%	
Additional trend	0%	0%	0%	0%	100%

No correlation:

- Least prudent assumption
- Intra-risk diversification benefit 51%.

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Correlations and diversification

Correlations	Mis-est	Anti-sel	Volatility	Trend	Add. trend
Mis-estimation	100%				
Anti-selection	0%	100%			
Volatility	0%	0%	100%		
Trend	0%	0%	0%	100%	
Additional trend	0%	0%	0%	50%	100%

Trend and additional trend positively correlated:

- Intra-risk diversification benefit 47%.

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Correlations and diversification

Correlations	Mis-est	Anti-sel	Volatility	Trend	Add. trend
Mis-estimation	100%				
Anti-selection	0%	100%			
Volatility	0%	0%	100%		
Trend	50%	0%	0%	100%	
Additional trend	50%	0%	0%	50%	100%

Trend, additional trend and mis-estimation positively correlated:

- Intra-risk diversification benefit 41%.

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Calibrating the whole distribution

- Not just a 1-in-200 scenario
- In fact, very unlikely to be
- Where to you need to be particularly accurate?
- Maybe at the 1-in-10 level
- Consider a range of possible distributions …
- … but don't over-engineer

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Calibrating the whole distribution

Mis-estimation risk

- Automatically Normal? (be careful)

Anti-selection adjustment risk

- If not Normal, what else?
- Materiality.

Volatility

- Materiality.

Trend risk

- Amenable to statistical analysis.

Additional trend risk

- What else?
- Very material, but also subjective.

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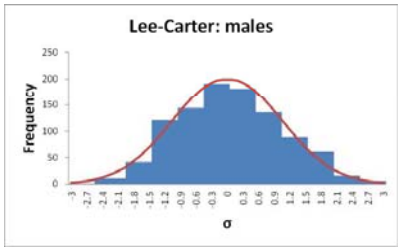
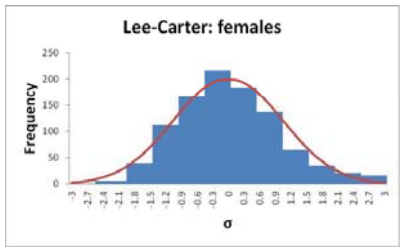
Calibrating the whole risk – trend risk





Model	Sample Mean	Std Dev	Skewness	Kurtosis
LC_M	-0.02%	0.41%	0.16	-0.47
LC_F	-0.01%	0.29%	0.69	1.16
MLC_M	-0.01%	0.26%	-0.06	0.39
MLC_F	-0.01%	0.28%	-0.07	0.37
CBD_M	-0.01%	0.35%	-0.08	0.19
CBD_F	-0.01%	0.34%	-0.09	0.17
PS_M	-0.01%	0.26%	-0.02	0.69
PS_F	-0.01%	0.31%	-0.14	0.45

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Conclusions

Analysis

- Use own data where it is available, relevant and reliable
- Use techniques appropriate to the nature of the risk, available data and materiality
- Keep an eye on the bigger picture.

Process

- Plan the work, but be flexible
- Involve people who know the business as well as longevity experts
- Allow plenty of time for review, particularly of assumptions that materially affect the business.

Use

- Make sure the stress is fit for purpose, but …
- … don't let your analysis get ahead of your systems.

Communication

- Keep talking, and listening
- Keep late surprises to a minimum.

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Longevity stresses – the response to the challenge

The challenge	The response
Complexity of the problem	Practical stats
Amount of potential analysis	Focus on the material issues
Key Judgements – differing views	Allow plenty of time; anticipate (and respect) differing views
Governance	Make the governance work for you
Communication	Keep the stakeholders informed; make the analysis accessible

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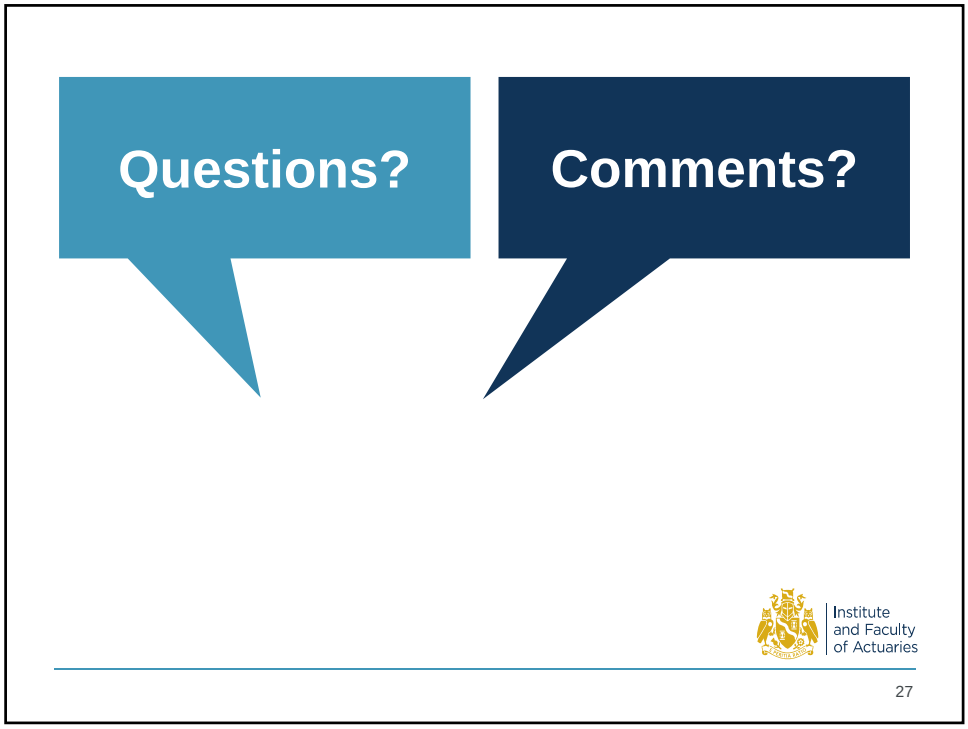
Questions?
Comments?
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