



Postcode-Level Longevity Risk Heterogeneity in the UK

Implications for Pension Buyouts and Annuity Pricing

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Longevity 21



Agenda

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The £38bn granularity question

02

Data and method: 12.1m deaths, all open source

03

What postal districts reveal

04

What it costs: £36m on a 1,000-member scheme

05

What it means for insurers, trustees and regulators

01

The £38bn granularity question

A record pipeline, priced on coarse geography

£38.2bn

UK bulk annuity
volume in 2025 – a
third consecutive
year above £38bn

367

transactions in 2025,
a record count

£350bn+

LCP-projected buy-ins
over the coming
decade (£350–
550bn)

~7,000

residents per
postcode sector - the
unit pricing uses
today

Sources: LCP UK Pension Risk Transfer Report 2025; CMI S3PA practice; FCA Consumer Duty (2024); PRA Insurance Supervision 2026 Priorities.

The granularity problem

Today's practice

- S3PA base tables plus a postcode-SECTOR adjustment
- ~7,000 residents per sector
- 8,852 sectors in England and Wales
- Implicitly assumes within-sector homogeneity

The open question

- Postal DISTRICT: ~ 2,500 residents
- 2,315 districts in England and Wales
- Does the finer unit carry mortality signal that moves price?
- Matters most for geographically concentrated DB schemes

£38bn a year changes hands on mortality assumptions.

How much geography is hiding inside them?

02

Data and method

Everything from public data

12.1m

death registrations,
2001-2023, by sex,
five-year age band
and LSOA

2,315

postal districts
analysed (2,070 pass
the credibility filter)

2.6m

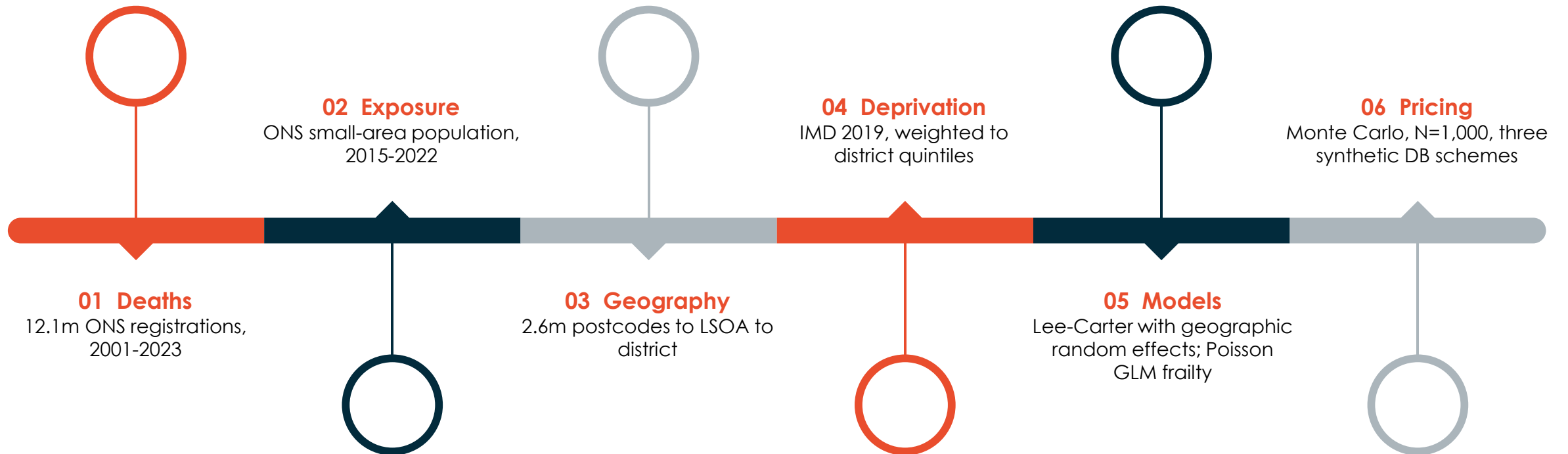
postcodes mapped
through the ONS
postcode-to-LSOA
lookup

100%

publicly available
ONS and MHCLG
data - fully
reproducible

Credibility filter: minimum 30 deaths at ages 65+ per district-sex combination over 2015-2019. IMD 2019 covers 32,844 LSOAs.

From open data to a priced liability



Two models, one question

Model 1 Lee-Carter + geographic RE

- National Lee-Carter fitted by SVD
- District standardised mortality ratios computed
- $\log(\text{SMR}) \sim \text{IMD score} + (1 \mid \text{district})$
- The random intercept $\text{delta}(g)$ is mortality that deprivation does not explain

Model 2 Poisson GLM + district frailty

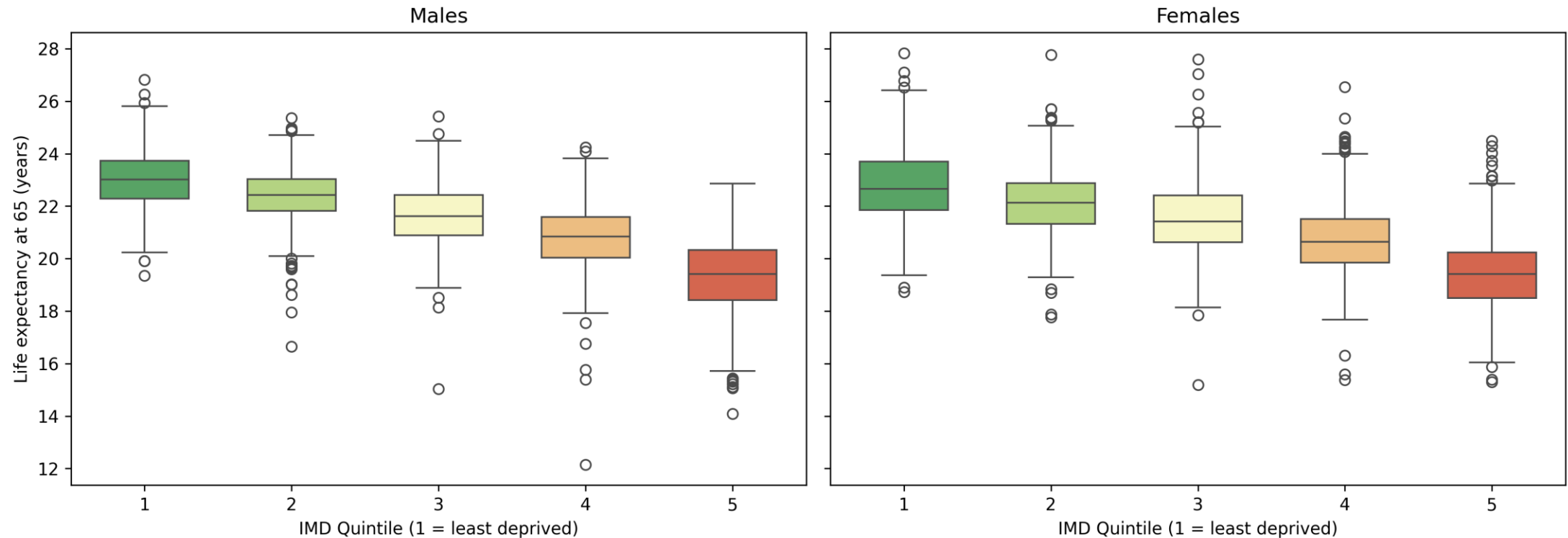
- $\log E[\text{deaths}] = \log(\text{exposure}) + \text{IMD quintile} + \text{sex} + \text{age group}$
- Grouped-data Poisson with log-exposure offset
- District frailty variance from a Poisson GLMM
- Gives hazard ratios directly comparable across quintiles

03

What postal districts reveal

Finding 1 A steep, monotonic deprivation gradient

LE65 by Postal District and IMD Quintile



3.7 years of male life expectancy at 65 separate the least and most deprived quintiles - and 1.1-1.5 years of spread remain INSIDE each quintile

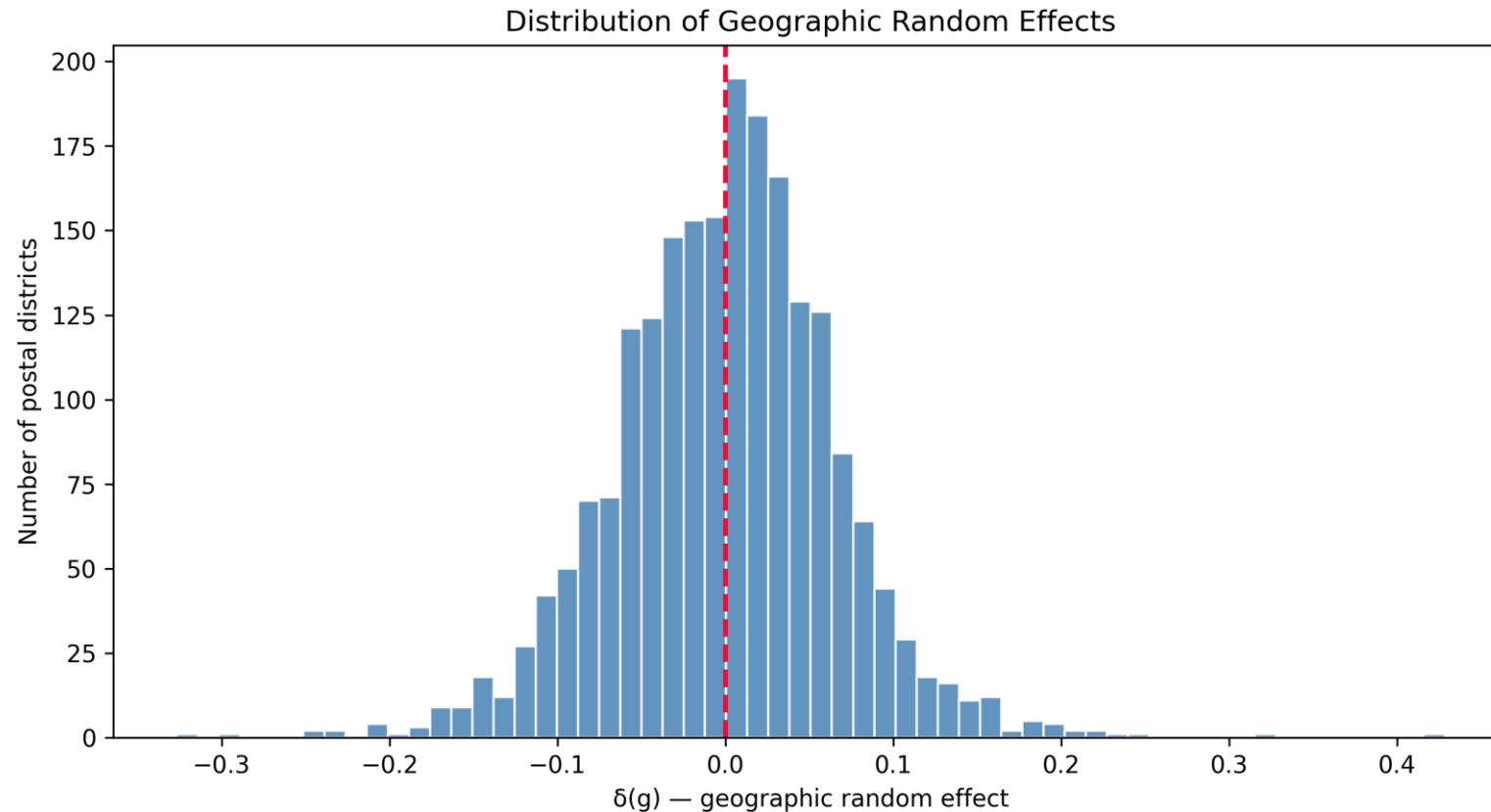
Life expectancy at 65 by deprivation quintile

IMD quintile	Male n	Male LE65	Male SD	Female n	Female LE65	Female SD
Q1 least deprived	414	22.98	1.11	411	22.78	1.39
Q2	419	22.38	1.10	415	22.17	1.25
Q3	414	21.66	1.19	414	21.54	1.46
Q4	408	20.82	1.27	408	20.77	1.45
Q5 most deprived	409	19.28	1.50	406	19.46	1.52
Gap Q1 to Q5		3.70 yrs			3.32 yrs	

Each quintile step costs about 0.9 years of life expectancy at 65

Period life expectancy at age 65, years. Pooled 2015-2019, 2,070 postal districts in England and Wales (Table 1).

Finding 2 Geography beyond deprivation



IMD deprivation explains 58% of district mortality variation – the residual 42% is local variation that no standard table prices

Deprivation explains 58% of district mortality variation.

The other 42% is geography we are not pricing.

Finding 3 Mortality rises 57% from least to most deprived

Variable	Hazard ratio	95% CI	p-value
IMD quintile 2 (vs Q1)	1.079	1.076 - 1.082	< 0.001
IMD quintile 3	1.176	1.173 - 1.179	< 0.001
IMD quintile 4	1.315	1.312 - 1.318	< 0.001
IMD quintile 5 most deprived	1.570	1.566 - 1.574	< 0.001
Male (vs female)	1.040	1.039 - 1.042	< 0.001

A clean monotonic ladder: +8%, +18%, +32%, +57% - all significant on 12.1m death registrations

Poisson GLM with log-exposure offset, 12.1m death registrations across 2,315 postal districts, 2001-2023 (Table 2).

Finding 4 The same city, £36,000 apart

Sheffield

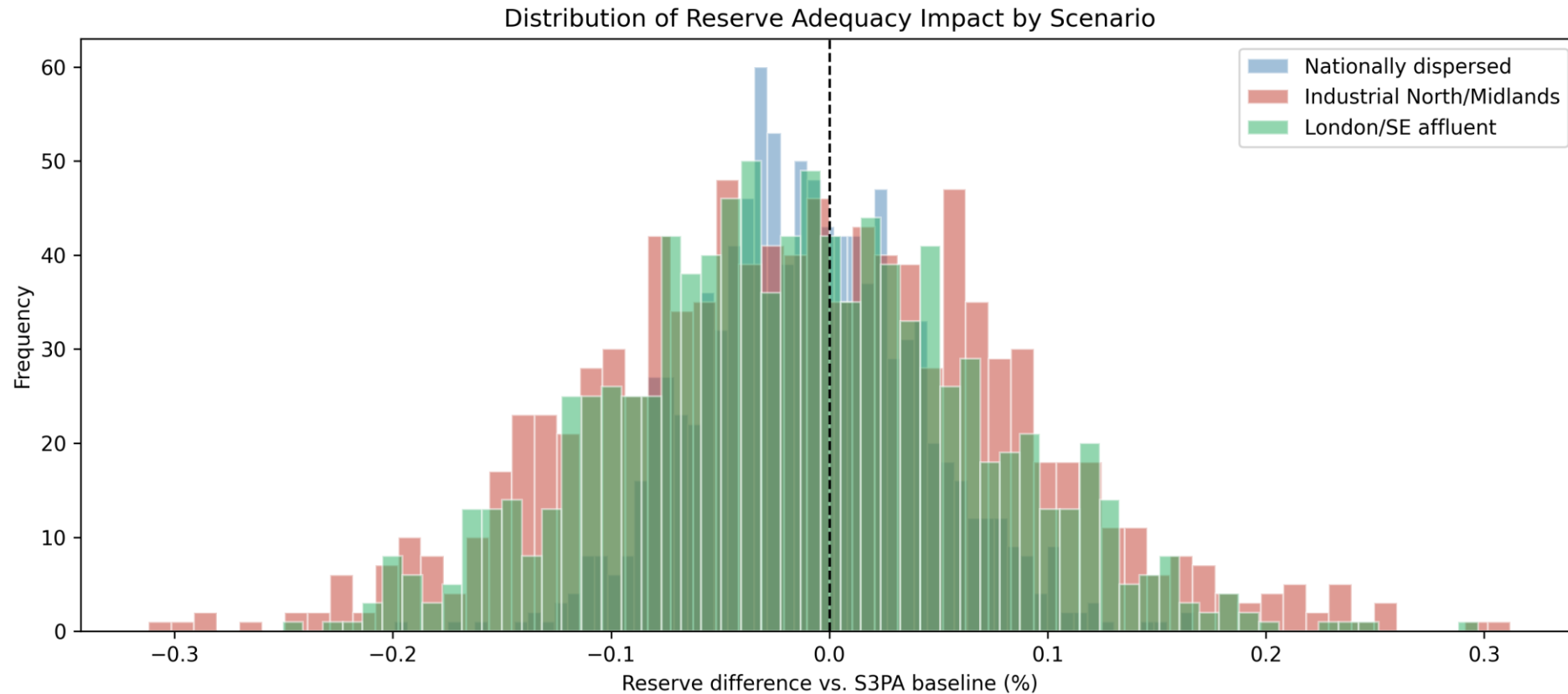
- S1 city centre, $\delta = +0.24 \rightarrow \text{£}139,559$
- S19 Dronfield, $\delta = -0.15 \rightarrow \text{£}175,698$
- **Difference: £36,139 per member (26%)**
- **1,000 concentrated members $\rightarrow \text{£}36\text{m}$**

Leeds

- LS1 city centre $\rightarrow \text{£}162,152$
- LS23 Boston Spa area $\rightarrow \text{£}200,671$
- **Difference: £38,519 per member (24%)**
- **1,000 concentrated members $\rightarrow \text{£}39\text{m}$**

Basis: 65-year-old male, £10,000 p.a. pension, 4% discount rate, 2.5% escalation. Both district pairs sit inside the same postcode area – invisible to sector-level pricing.

Finding 5 Concentration, not average, drives the tail



Nationally dispersed schemes diversify geography away; concentrated schemes do not - and the impact runs both ways

Reserve adequacy: dispersed versus concentrated

+0.12%

A nationally dispersed, 10,000 members, £1,737m – 99.5th percentile

+0.24%

B industrial North / Midlands, £842m – about £2m at the 99.5th pct

+0.20%

C London / South East affluent, £917m – 99.5th percentile

Monte Carlo N=1,000. Positive values indicate under-reserving under standard assumptions. 5th-95th percentile ranges: A -0.09/+0.08, B -0.16/+0.15, C -0.15/+0.12 (Table 3).

The apparent paradox - and how it resolves

The tension

- Nested ANOVA: 99.9% of LE65 variance sits BETWEEN sectors
- Only 0.1% sits within sectors
- On that measure alone, sector-level tables look sufficient

The resolution

- Annuity value depends on the age-specific mortality curve, not aggregate LE65
- Two districts with equal LE65 can differ where most payments actually fall
- Hence 24-26% liability gaps inside a single city

04

So what?

What this changes

Insurers

- Sharper BPA pricing for concentrated schemes
- Documentary evidence for FCA Consumer Duty fair value
- Bidirectional adjustments: precision, not prudence

Trustees and sponsors

- Profile membership longevity before going to market
- Know whether your geography is a discount or a loading
- Open data, no vendor dependency

Regulators

- Transparent, reproducible basis for review
- Supports PRA Solvency UK supervisory expectations
- Auditable end to end from published sources

Limitations and next steps

Known limitations

- Population denominators are total persons, not sex-specific
- COVID-19 mortality (2020-2021) may distort recent estimates
- Public aggregates rather than individual-level records
- IMD is a relative measure and does not capture every dimension

Next steps

- Sex-specific small-area population estimates
- Extend to postcode-unit granularity
- Machine-learning mortality prediction
- Extend coverage to Scotland and Northern Ireland

Four numbers to take away

3.7 yrs

male LE65 gap
between the least
and most deprived
quintiles

58%

of district mortality
variation explained
by IMD - the rest is
geography

1.57×

mortality hazard ratio,
most versus least
deprived quintile

£36m

liability gap on a
1,000-member
scheme inside one
city

Sector-level tables capture the large-scale pattern. District-level detail is where concentrated-scheme pricing is won or lost.



Thank You

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