Heriot-Watt University, Edinburgh

Business applications of survival models

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Contents

1. About the speaker

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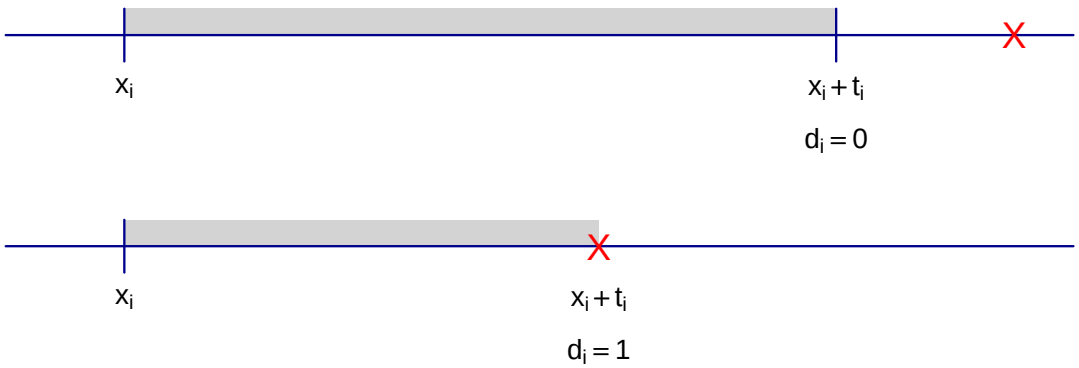
- Graduated twice from Heriot-Watt: 1990 (BSc) and 2012 (PhD).
- Independent consultant on longevity risk since 2005.
- Founded longevity-related analytics businesses in 2006:

- Joint venture with Heriot-Watt in 2009:

2. Survival models

2. Survival models

- Longitudinal study.
- Life enters observation aged x_i and is observed for time t_i.
- Binary indicator, d_i, tells you if life is alive at age $x_i + t_i$.



Time observed, t_i, is shown in grey, while deaths are marked $\times$.

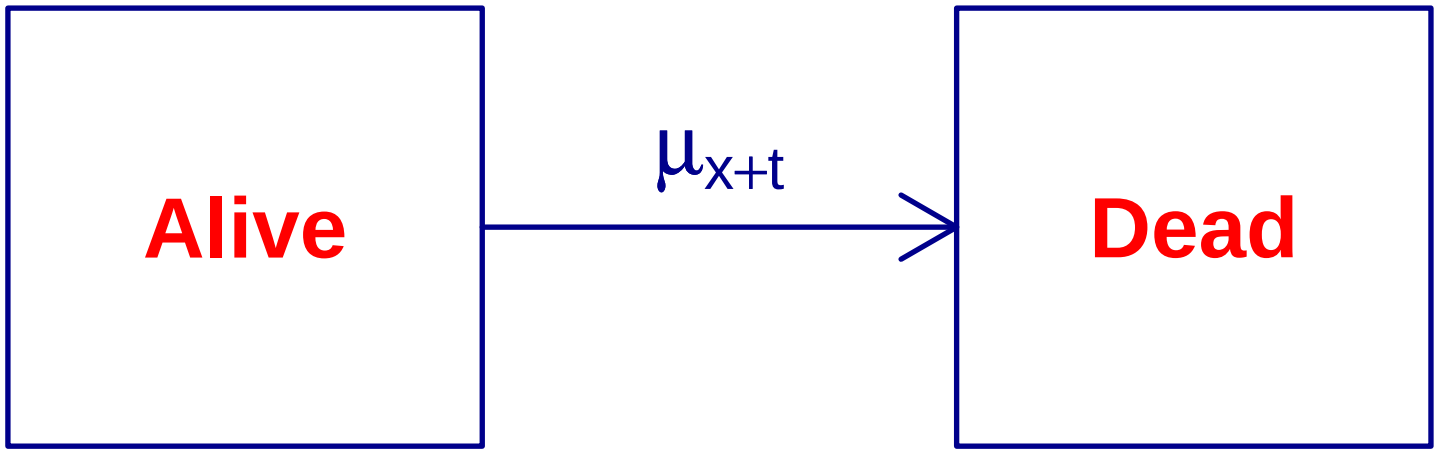
2. Survival models

- Time observed, t_i, is *waiting time* (*central exposed-to-risk* to actuaries).
- d_i is the event indicator.
- t_i and d_i not independent, so considered as a pair $\{t_i, d_i\}$.
- Not all lives are dead, so survival times are *right-censored*.
- Lives enter at age $x_i > 0$, so data is also *left-truncated*.

2. Survival models

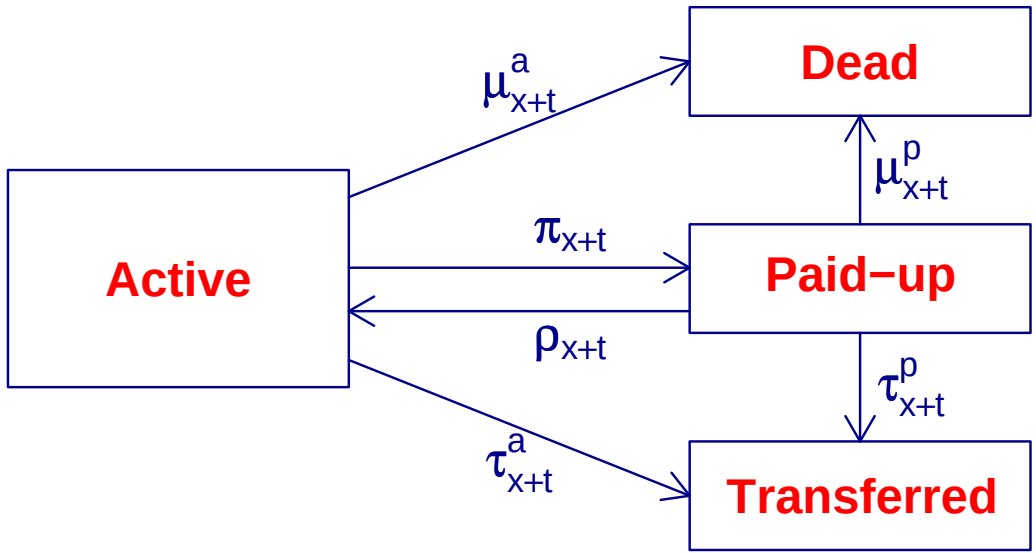
- Survival models are ideal for actuarial work — Richards (2008, 2012).
- A portfolio of risks is like a medical study with continuous recruitment.
- Rapid uptake of survival-modelling techniques in actuarial work.
- Foundation of our main business line!

2. Mortality model for annuities



Source: Longevitas Ltd.

2. Persistency model for personal pensions



Source: Longevitas Ltd.

3. Actuarial exceptionalism — data

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- Actuaries have specific modelling requirements. . .

  . . .which are not always shared with other users of survival models.

- Main differences lie with (i) data preparation and (ii) model structure.

3. Data preparation for non-actuaries

- Data is usually collected on lives.
- Can often model straight after validation.

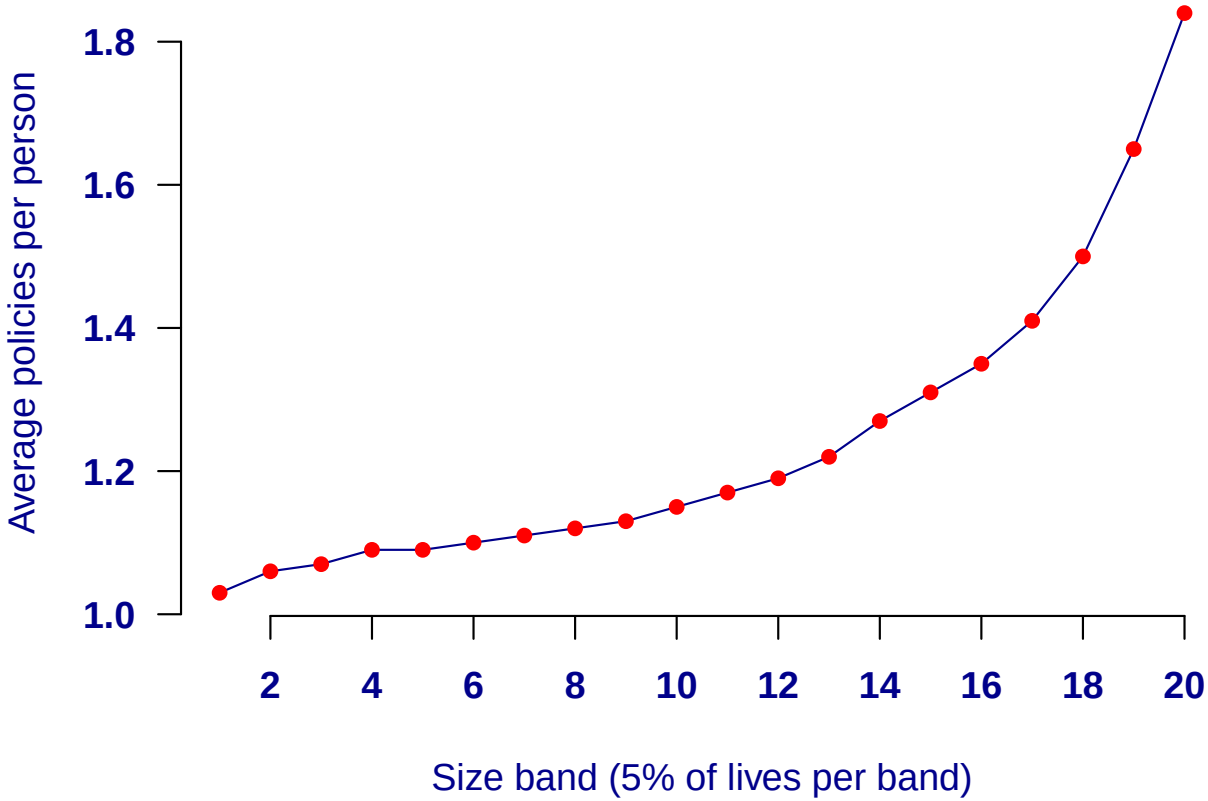
3. Data preparation for actuaries

- Data is *benefit-* or *policy-oriented*.
- People have multiple policies.
- Need to ensure independence assumption.
- Need to find n independent lives behind p dependent policies ($p \geq n$).

$\rightarrow$ Actuaries need a process of *deduplication*.

More details on deduplication can be found at www.longevitas.co.uk.

3. Wealth and duplicates



Source: Richards and Currie (2009).

3. Deduplication challenges

Problem: client identifier not always reliable or unique.

Solution: use combination key made up from reliable fields, e.g.

- Date of birth
- Gender
- Surname
- First initial
- Postcode

3. What's in a name?

Problem: teleserviced data contains mis-spellings of same surname, e.g.

- Ritchie
- Richie
- Richey

Solution: use metaphone encoding of names.

3. What's in a name?

Problem: metaphone structured for Anglo-Saxon names. What about:

— Muhammed

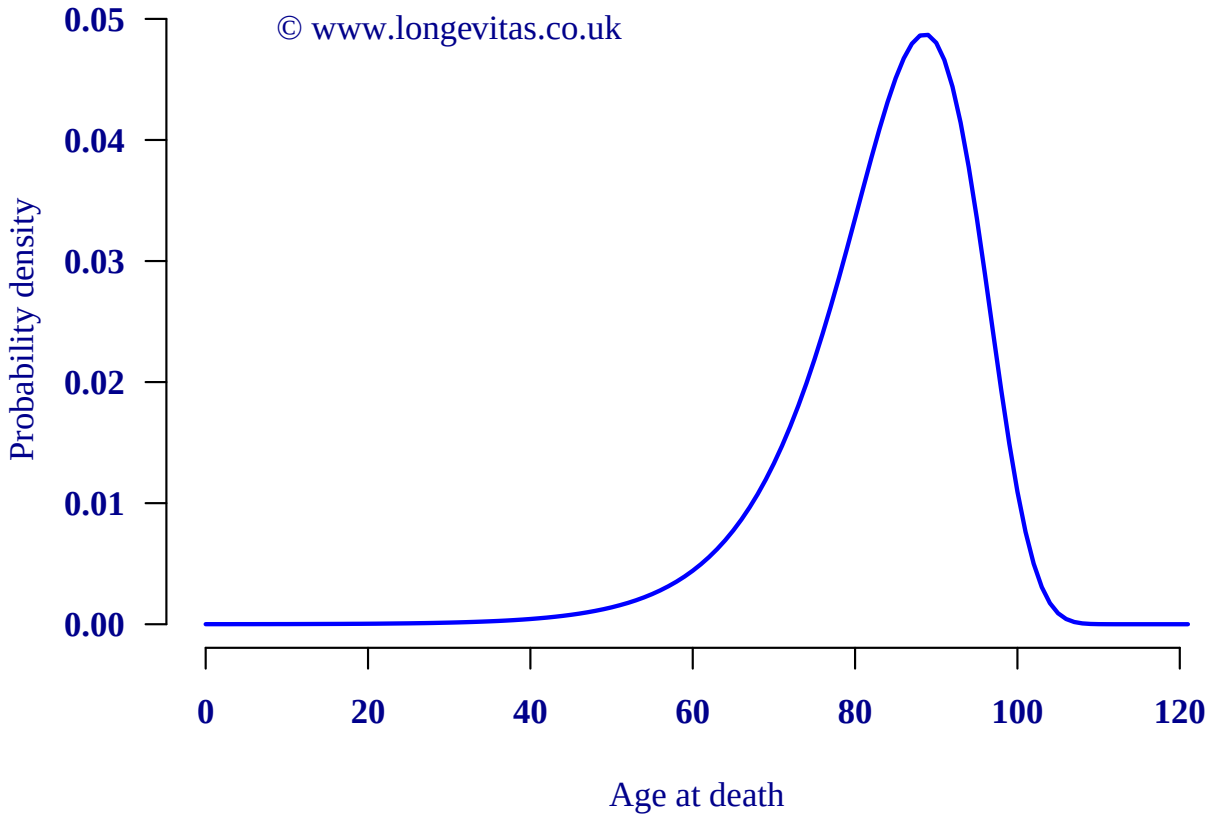
— Muhammad

— Mohammed?

Solution: use double metaphone encoding of Philips (1990).

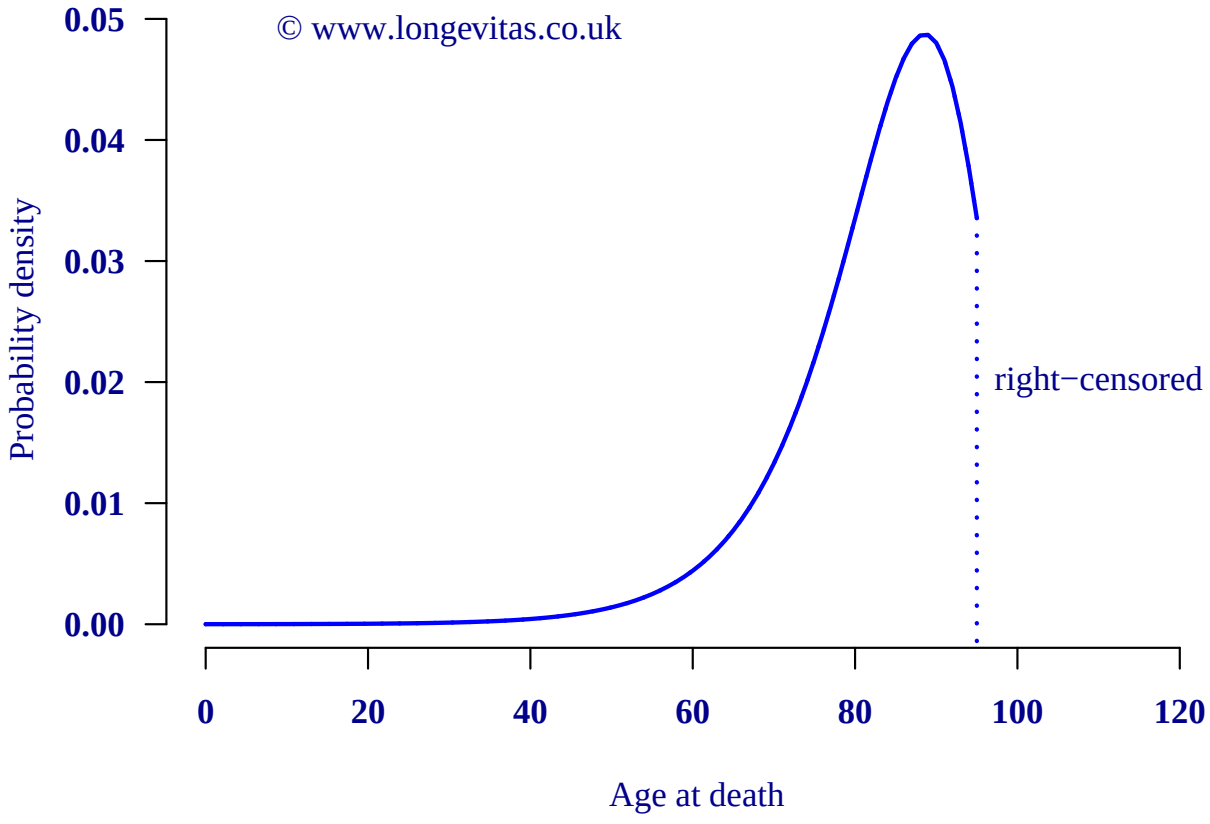
4. Actuarial exceptionalism — models

4. Lifetime distribution



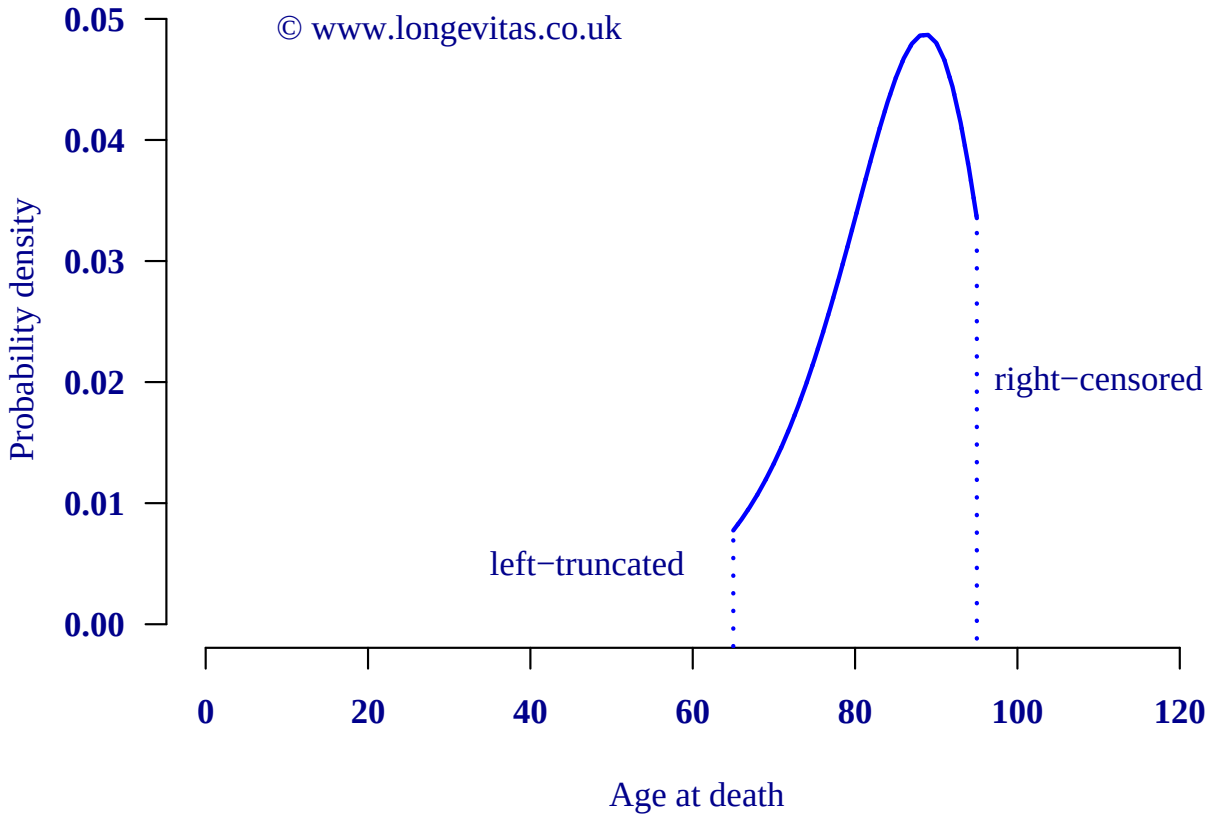
Source: Longevitas Ltd.

4. Lifetime distribution



Source: Longevitas Ltd.

4. Lifetime distribution



Source: Longevitas Ltd.

4. Model structure for non-actuaries

- Survival models in medical trials usually deal with observation times.
- Left-truncation is a relatively uncommon problem for non-actuaries.

→ Standard software has few options for left-truncated data.

4. Model structure for actuaries

- In contrast, policyholders enter well into their adult life.
- Actuarial data is therefore almost always left-truncated.

$\rightarrow$ Often need purpose-built software for this.

5. Conclusions

5. Conclusions

- Survival models are a natural fit to life-office or pension-scheme data.
- Portfolios are like medical trials with continuous recruitment.
- Actuarial data has specific requirements not common elsewhere.
- Bespoke software is typically needed for actuarial work.

References

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