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Extension, Compression, and Beyond

A Unique Classification System for Mortality Evolution Patterns

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Agenda

Key question

Classification of mortality evolutions in the past

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A new classification framework

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Application

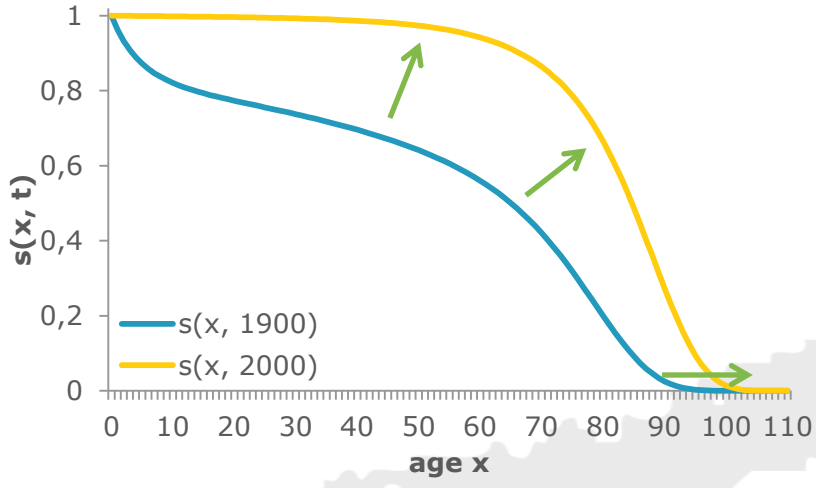
Summary

Key question

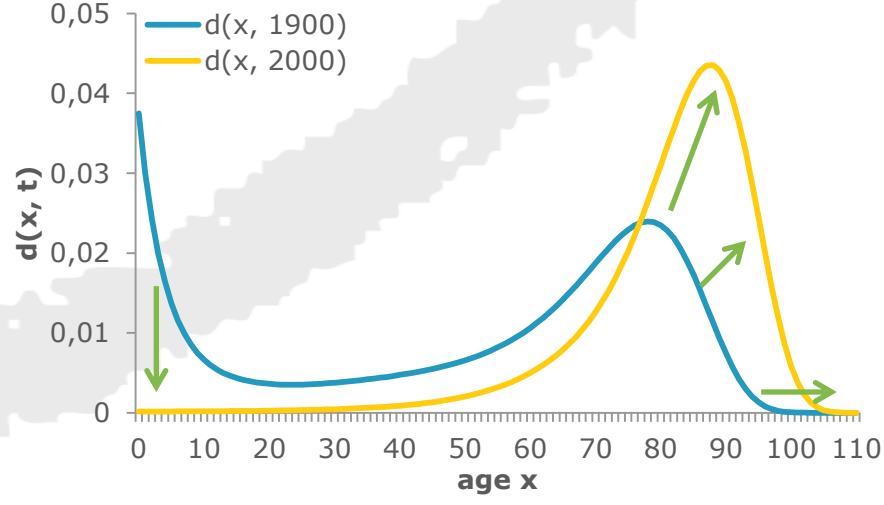
Life expectancy increases in many countries.

- Intuitive Question: What is the structure of the change?
  - We consider the survival curve *s(x)* and the deaths curve *d(x)* over time.
  - *s(x)* = number of survivors to age *x* starting from a fixed number of newborn
  - *d(x)* = number of people dying at age *x*

Survival curve of Swedish females 1900 and 2000



Deaths curve of Swedish females 1900 and 2000

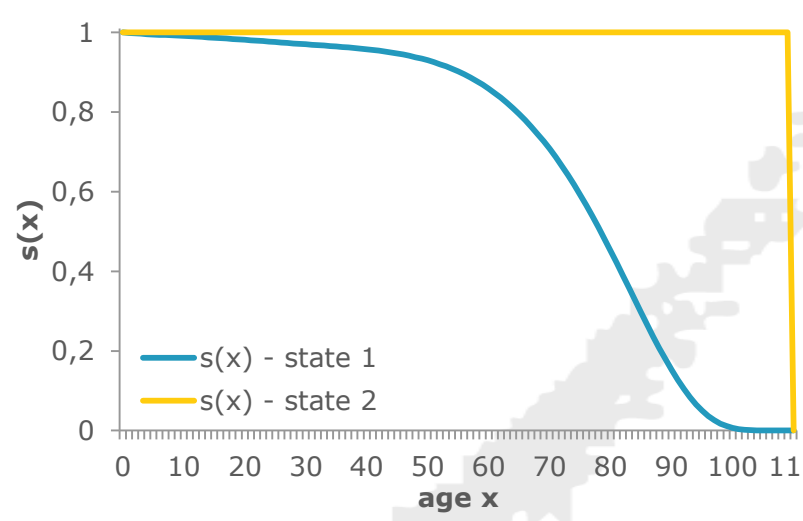


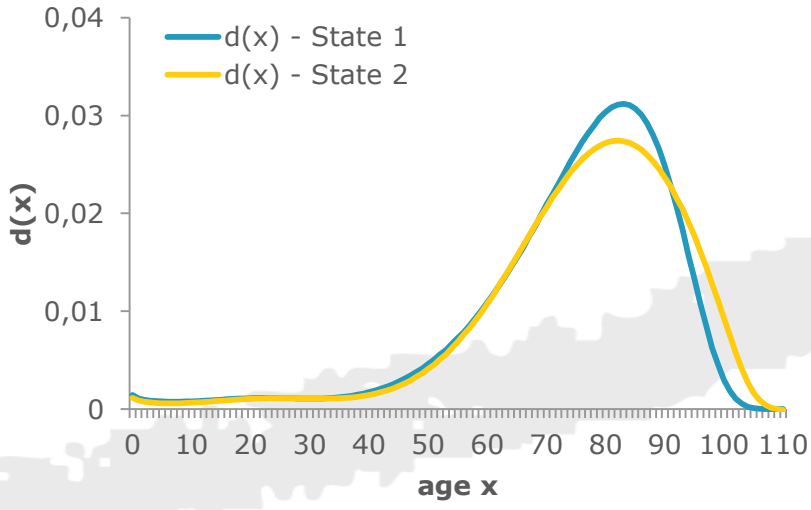
- Concrete question: **How does the shape of these curves change over time?**

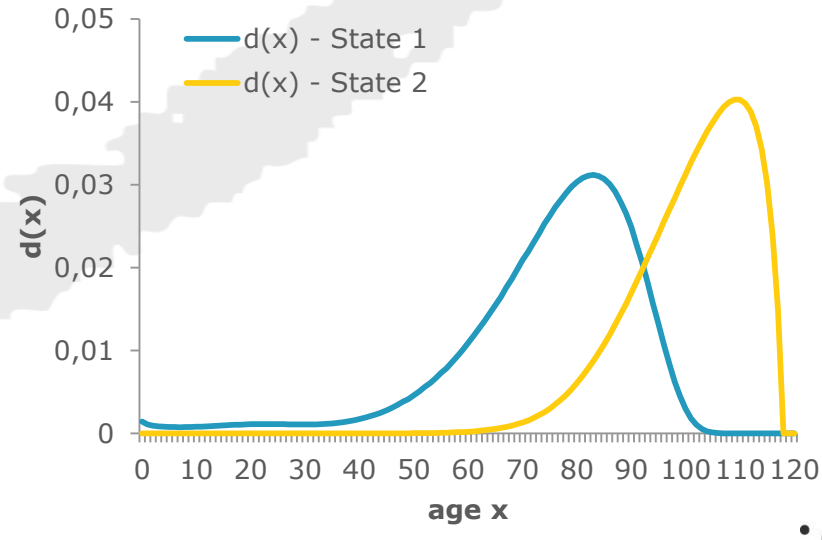
Classification of mortality evolutions in the past

Shortcomings

- Mortality scenarios are often **defined imprecisely.**
  - E.g., **rectangularization** is defined by a final state.
- Sometimes mortality scenarios are assumed to be **mutually exclusive.**
  - E.g., **compression** and **shifting mortality** are assumed to be opposing scenarios.



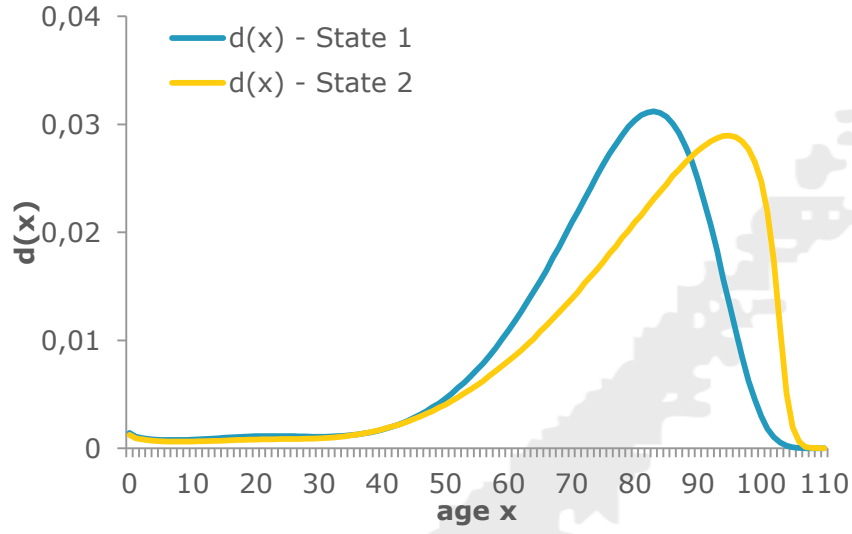


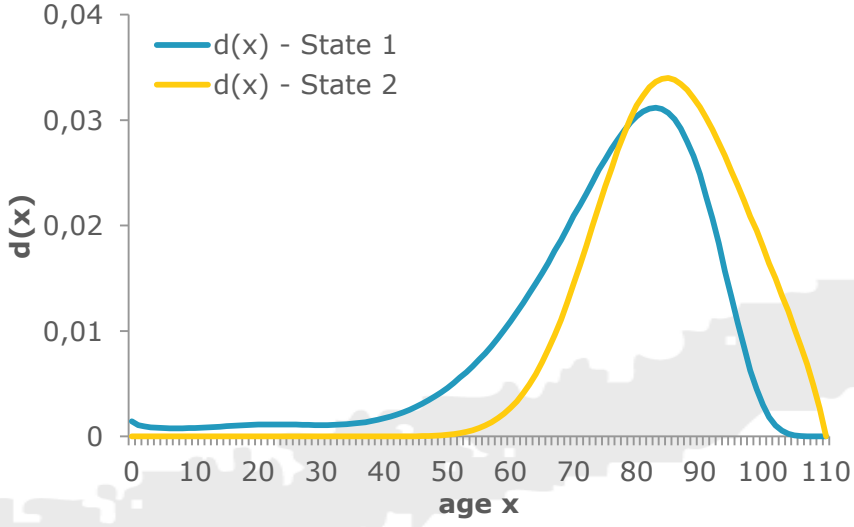


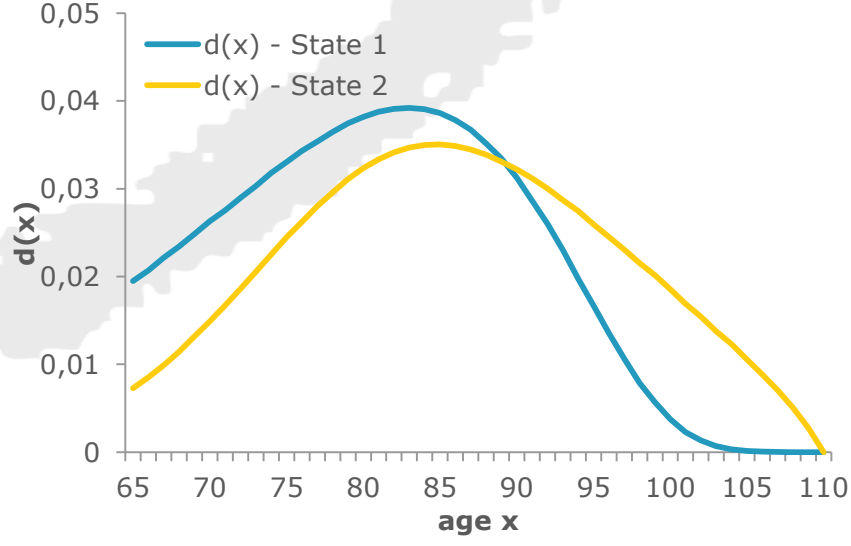
Classification of mortality evolutions in the past

Shortcomings

- Sometimes **insufficient or misleading statistics** are being used.
  - E.g., compression cannot always be detected by an exclusive analysis of **M and SD(M+).**
- The choice of the **age range matters.**
  - The age range should be chosen depending on the question at hand.







A new classification framework

Requirements

In light of these shortcomings of previous approaches, we postulate that a new classification system should…

- … capture every observed and theoretically possible mortality evolution,
- … allow for mixed scenarios,
- … build on statistics that can be feasibly calculated and easily interpreted,
- … be applicable to different age ranges,
- … be extendable by additional components if needed.

Our new approach:

- We use the deaths curve as basis for the framework.
- We define 4 characteristics of the deaths curve for a unique classification of observed mortality evolutions.

A new classification framework

Details

A new classification framework

Details

Each scenario is defined by a **4-dimensional vector** where each component can have three specifications:

	component	attainable states
position of the deaths curve	**M**	right shift / neutral / left shift
	UB	extension / neutral / contraction
shape of the deaths curve	**DoI**	compression / neutral / decompression
	d(M)	concentration / neutral / diffusion

- This allows for $3^4=81$ different scenarios (some of which might not be relevant in practice), including pure and mixed scenarios.
- Each observed mortality evolution can uniquely be classified in one of those scenarios.
- The framework can be applied to age ranges starting at any given age up to UB.

In the paper, we discuss different issues in estimating these statistics.

A new classification framework

Application: The mortality evolution of Swedish females

Example

age range 10 to UB:

Scenario Component	Statistic Used	1860s	1870s	1880s	1890s	1900s	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
1	M	right-shift				neutral					right-shift					
2	UB	extension						neutral			extension					
3	DoI	neutral				compression						neutral		compression		
4	d(M)	neutral		concentration								neutral		concentration		

- Each component of the vector develops independently from the others (no redundant information).
- We observe mixed scenarios (rather the rule than an exception).

age range 60 to UB:

Scenario Component	Statistic Used	1860s	1870s	1880s	1890s	1900s	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
1	M	right-shift				neutral					right-shift					
2	UB	extension						neutral			extension					
3	DoI	decompression				compression										
4	d(M)	neutral						concentration				diffusion		concentration		

- We observe different scenarios for different age ranges (age range matters).

In the paper, we analyze this application in more detail.

A new classification framework

Summary

In the paper, we have

- identified **shortcomings** of previous approaches for classification of mortality scenarios,
- derived **requirements** for a new framework,
- identified 4 central **characteristics** of the deaths curve,
- derived a **new classification framework** based on these characteristics, which
  - builds on clear scenario definitions,
  - provides a unique classification for each mortality evolution,
  - allows for mixed scenarios,
  - is applicable for different age ranges,
- **applied the framework** to concrete data.

Thank you for your attention!

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