

# Lecture 2 - Part 1: Mortality forecasting: an introduction

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IDEIM 117  
*Advances in Mortality Forecasting*

*International Advanced Studies in Demography*

28 June - 02 July, 2021

# Models for mortality forecast: A possible classification

- Structure:
  - Parametric models
  - Principal component methods
  - Relational models
  - Non-parametric approaches
- Aim:
  - A single population
  - More populations
  - Strata of population
- Data:
  - Age-specific death rates/probabilities
  - Age-at-death distributions
  - Age-specific survival improvements
  - Summary measures

Note: Models with cohort effects or for limited data are not considered

# Quick overview on the model structure

## Parametric models

- + parsimonious (for adult ages)
- large number of parameters is often necessary
- hard to disentangle physical meaning of each parameter
- simultaneous forecast of all parameters is a challenge
- time and age changes are often considered independently
- rigid structure

## Principal component methods

- + (univariate) time index condenses mortality development
- + easy interpretation of the outcomes
- fix age effect over time
- lack of smoothness in forecast
- extremely large number of parameters
- rigid structure

## Relational models

- + exploiting demographic regularities
- + extremely useful with low quality data
- hard to generalize
- difficulties in including uncertainty measures

## Nonparametric approaches

- + extremely good fit
- + flexible structure
- + wisely parsimonious
- purely data-driven

# Quick overview on the used data

## Age-specific death rates (probabilities)

- + standard tools for describing mortality (time-to-event)
- + easy to incorporate stochasticity of the phenomenon
- latest longevity processes may be missed

## Age-at-death distributions

- + latest longevity processes can be described
- + alternative interpretations ( $\sim$  AFT models)
- often applicable only for adult ages

## Survival improvement

- + exploit regularities in mortality derivatives
- prior model of the original data necessary
- difficulties in including uncertainty measures

## Summary measures

- + straightforward interpretation
- + easy to impose prior assumptions
- hard to move to complete age-time mortality profiles

# Placing some reference

Single population  
More populations  
Strata of population

	Data			
	Rates/Probabilities	Age-at-death distributions	Rates-of-change	Summary measures
Parametric	Classic models (1825-) Cairn et al. (2006) <b>Alai et al. (2018)</b>	Janseen & De Beer (2016)	Haberman & Renshaw (2012)	Raftery et al. (2013)
Principal component	Lee & Carter (1992) + variants Li & Lee (2005) Li et al. (2019)	Oeppen (2008) Bergeron-Boucher et al. (2017) Kjærgaard et al. (2019)	Mitchell et al. (2013) Bohk & Rau (2017)	
Relational	De Beer (2012)	Basellini & Camarda (2019)		Torri & Vaupel (2012)
Non-parametric	Currie et al. (2004) Camarda (2019)			

# Illustrative data structures for the course

England & Wales, females, 1960-2018, ages 0-105.  
Source: Human Mortality Database.

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