Pension Systems / Demography & Mortality

Lecture notes: Demography – part I

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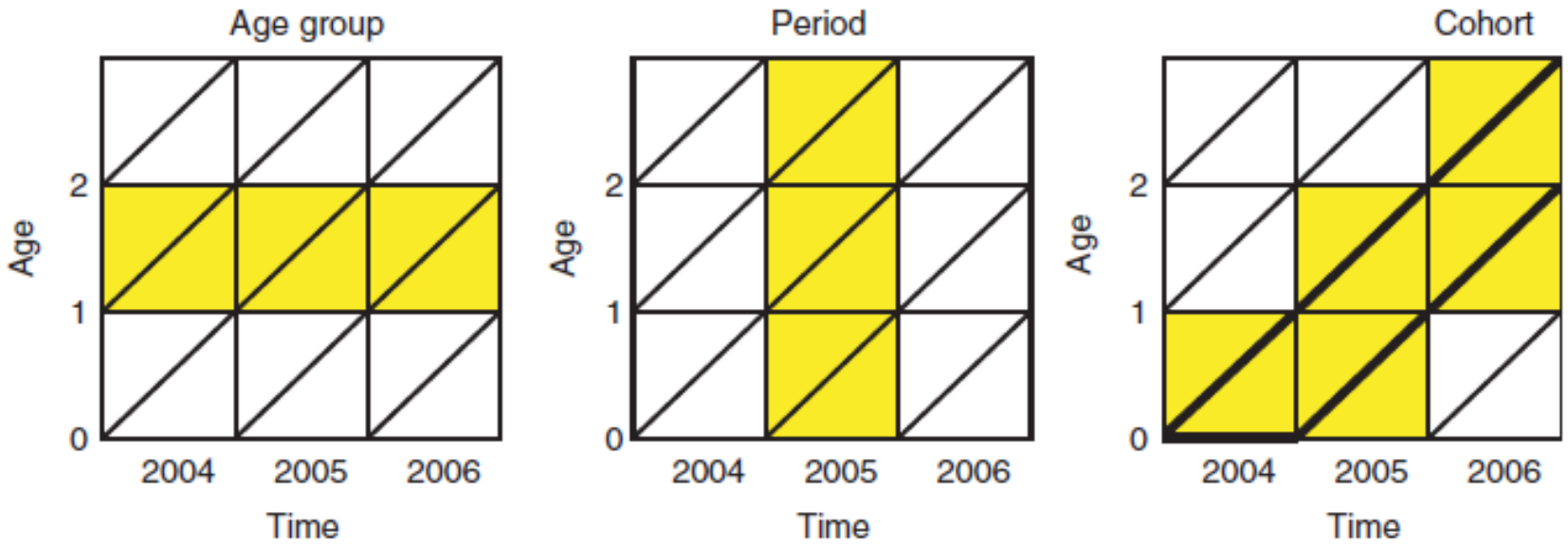
Overview

- The Lexis Diagram
- Human Mortality Database (HMD)

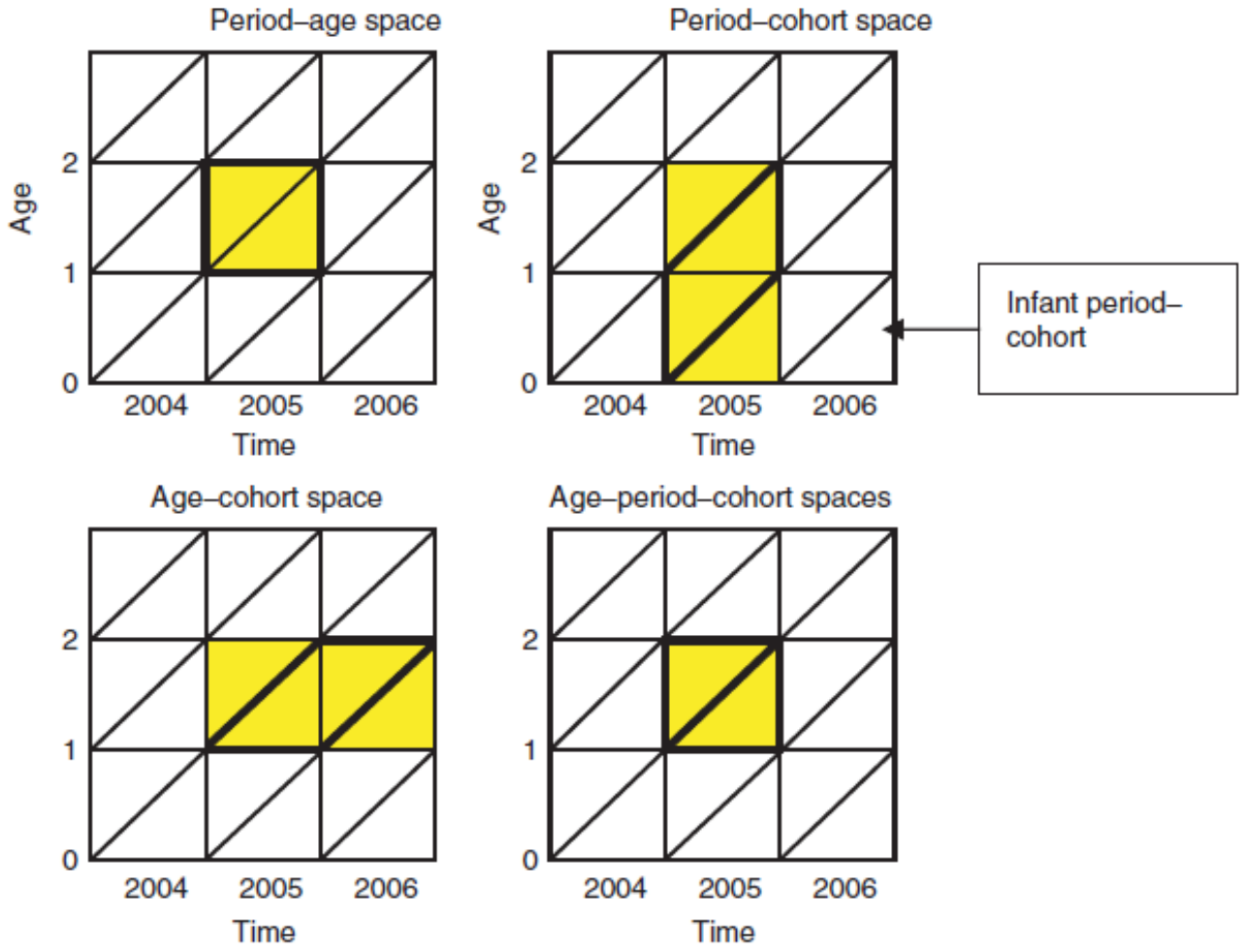
1. The Lexis diagram

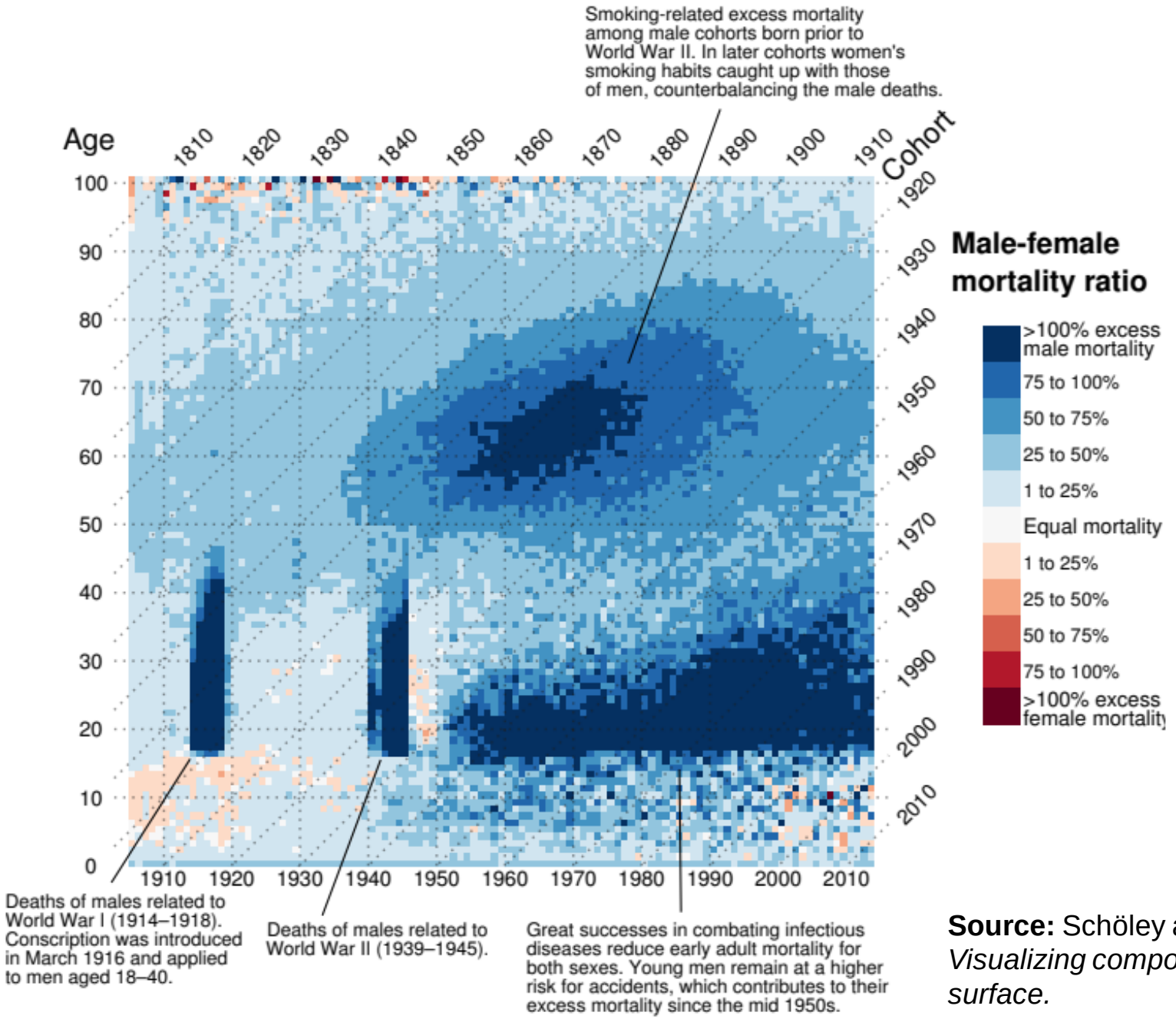
- An age-time diagram is also called a Lexis diagram
  - The usual unit is 1x1 age-time cells; the persons in a cell are defined by “age last birthday”
  - The triangles are needed for keeping track of birth cohorts over time
- Demographic events, e.g. births, deaths and migrations, correspond to a point on the diagram
- Illustration of the concepts of age groups, period (an interval of time), and (birth) cohorts



1. The Lexis diagram

- Period-age (A-sets)
  - E.g., deaths in a calendar year to persons aged 80 at death
- Period-cohort (B-sets)
  - E.g., survivors of one age group at the start of the year to the next age group end-year
- Age-cohort (C-sets)
  - E.g., survivors from a given birthday in a given year to the next birthday the next year
- Age-period-cohort
  - E.g., deaths in a calendar year to persons aged 80 at death with given year of birth

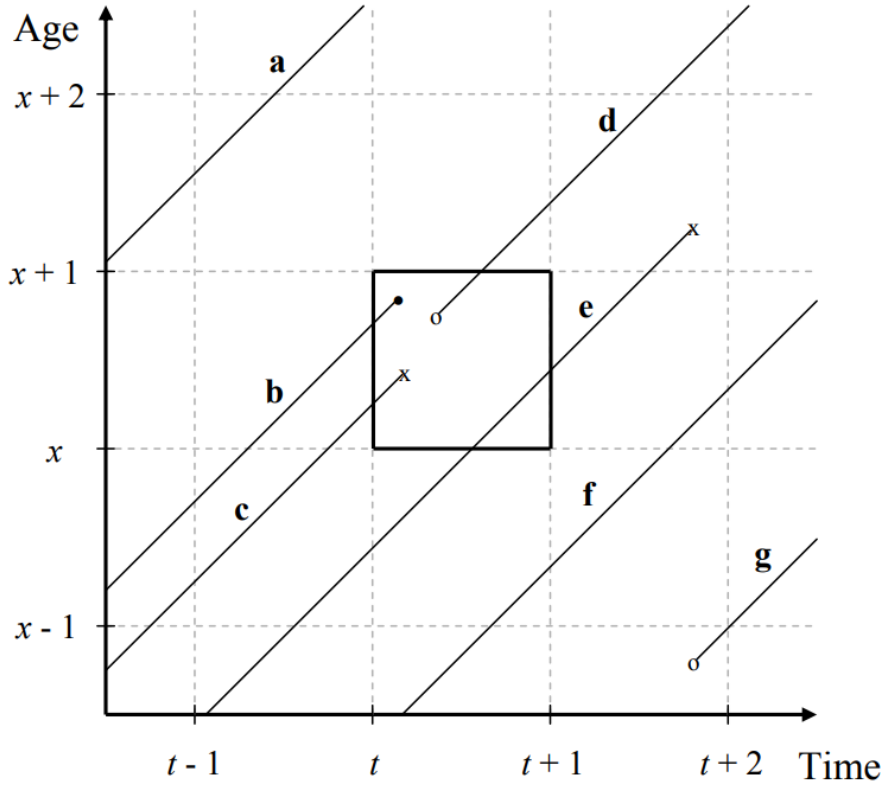




Source: Schöley and Willekens (2017). *Visualizing compositional data on the Lexis surface.*

1. Using the Lexis diagram

- We can use the Lexis diagram to depict raw data
- Each 45° line represents an individual lifetime, which may end in
  - death (x, lines c and e),
  - out-migration (solid circle, line b)
  - In-migration (open circle, lines d and g).
- Other life-lines may merely pass through the section of the Lexis diagram under consideration (lines a and f).
- Exact life-lines are rarely known in studies of national populations



2. Human Mortality Database (HMD) – mortality.org

The Human Mortality Database

Vladimir Shkolnikov, *Director*	Max Planck Institute for Demographic Research
Magali Barbieri, *Associate Director*	University of California, Berkeley and INED, Paris
John Wilmoth, *Founding Director*	United Nations and formerly University of California, Berkeley

In response to the COVID-19 pandemic, the HMD team decided to establish a new data resource: **Short-term Mortality Fluctuations (STMF) data series.** Objective and internationally comparable data are crucial to determine the effectiveness of different strategies used to address epidemics. Weekly death counts provide the most objective and comparable way of assessing the scale of short-term mortality elevations across countries and time. Here we provide weekly death counts for 38 countries: Austria, Australia (Doctor certified deaths), Belgium, Bulgaria, Chile, Canada, Croatia, Czech Republic, Denmark, England and Wales, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Israel, Italy, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Northern Ireland, Norway, Poland, Portugal, Republic of Korea, Russia, Scotland, Slovenia, Slovakia, Spain, Sweden, Switzerland, Taiwan and the USA. The same data in the pooled CSV file are available for download here. Data formats and methods are described in the STMFNote. We also strongly recommend reading the metadata text. Following the HMD practice, we also publish original input data in standardized format. During the next few weeks data will be frequently updated and new countries will be added.

The STMF data is published under a CC-BY 4.0 License. The most recent STMF update is: 2021-09-01.

New: We invite you to explore this data with our online STMF visualization toolkit.

The Human Mortality Database (HMD) was created to provide detailed mortality and population data to researchers, students, journalists, policy analysts, and others interested in the history of human longevity. The project began as an outgrowth of earlier projects in the Department of Demography at the University of California, Berkeley, USA, and at the Max Planck Institute for Demographic Research in Rostock, Germany (see history). It is the work of two teams of researchers in the USA and Germany (see research teams), with the help of financial backers and scientific collaborators from around the world (see acknowledgements). The Center on the Economics and Development of Aging (CEDA) French Institute for Demographic Studies (INED) have also supported the further development of the database in recent years.

We seek to provide open, international access to these data. At present the database contains detailed population and mortality data for the following 41 countries or areas:

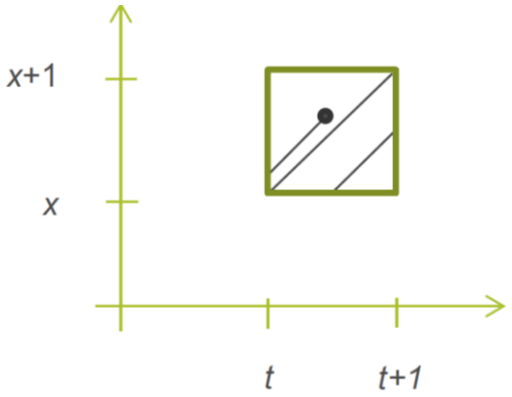
Australia	Finland	Latvia	Slovenia
Austria	France	Lithuania	Spain
Belarus	Germany	Luxembourg	Sweden
Belgium	Greece	Netherlands	Switzerland
Bulgaria	Hong Kong	New Zealand	Taiwan
Canada	Hungary	Norway	U.K.
Chile	Iceland	Poland	U.S.A.
Croatia	Ireland	Portugal	Ukraine
Czechia	Israel	Republic of Korea	
Denmark	Italy	Russia	
Estonia	Japan	Slovakia	

For more information, please begin by reading an overview of the database. If you have comments or questions, or trouble gaining access to the data, please write to us (hmd@mortality.org).

2. HMD data format

- Data consist of death counts and exposures in 1-by-1 time-age cells ('Period-age space')
  - Data originate from national statistics bureaus, but they are cleaned and standardized by HMD

- Notation
  - $D(x,t)$: number of deaths of age x in year t
  - $E(x,t)$: person-years at risk of age x in year t
  - $m(x,t) = D(x,t)/E(x,t)$: (empiric) death rate



At old ages, number of deaths can be higher than the exposure due to high mortality

Denmark, Deaths (period 1x1), Last modified: 23 Apr 2018

Year	Age	Female	Male	Total
...				
2016	0	80.00	114.00	194.00
2016	1	9.00	11.00	20.00
2016	2	2.00	3.00	5.00
...				
2016	106	10.00	2.00	12.00
2016	107	4.00	2.00	6.00
2016	108	2.00	0.00	2.00
2016	109	0.00	1.00	1.00
2016	110+	2.00	0.00	2.00

Denmark, Exposure to risk (period 1x1)

Year	Age	Female	Male	Total
...				
2016	0	29425.92	31138.93	60564.85
2016	1	28297.15	29825.67	58122.82
2016	2	28098.07	29617.17	57715.24
...				
2016	106	12.55	1.35	13.90
2016	107	6.14	0.50	6.64
2016	108	1.88	0.00	1.88
2016	109	0.99	0.33	1.32
2016	110+	1.00	0.00	1.00

Extract from HMD data files for Denmark