

BaRcelona Summer School for Demography

Module 2: Demography in R

7 July, 2025

Instructor: Tim Riffe



Universidad
del País Vasco



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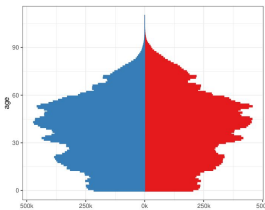
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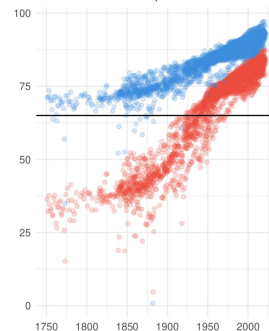
Objectives

- (1) Fundamental demographic concepts and measures



$$nq_x = \frac{n \cdot {}_nM_x}{1 + (n - {}_nA_x) \cdot {}_nM_x}$$

$$r = \frac{\ln\left(\frac{N(T)}{N(0)}\right)}{T}$$



- (2) Basic R coding skills for demographic data analysis and visualization

```
KOR2014 |>
  filter(sex == "total") |>
  mutate(nMx = deaths / exposure,
         nAx = if_else(age == 0, .1, .5),
         n = 1,
         nqx = calc_nqx(nMx = nMx, nAx = nAx, n = n),
         lx = calc_lx(nqx = nqx)) |>
  ggplot(aes(x = age, y = lx)) +
  geom_line() +
  ylim(0,1) +
  labs(title = "lx Korea, 2014",
       subtitle = "Data: HMD") +
  theme_minimal()
```

Workshop plan, 23-27 June, 2025

- | | |
|--------------|-----------------------------|
| 1: Monday | Intro concepts, and R setup |
| 2: Tuesday | Mortality and fertility |
| 3: Wednesday | Structure |
| 4: Thursday | Growth |
| 5: Friday | Projection |

Materials

Open course repository:

https://github.com/timriffe/KOSTAT_Workshop1

- [xx_presentation.pdf](#)
- [xx_handout.pdf](#)
- [xx_session.Rmd](#) (R markdown file)

Google Doc for code snippets, questions, etc:

<https://tinyurl.com/6ec2zfy>

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Basic data and concepts

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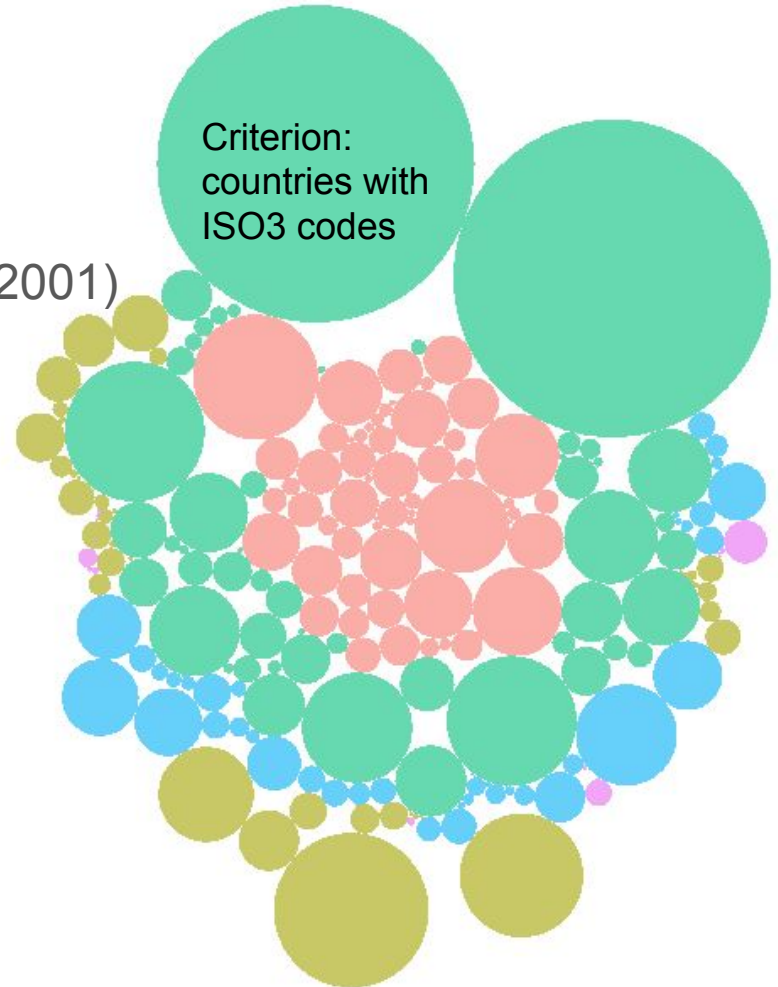
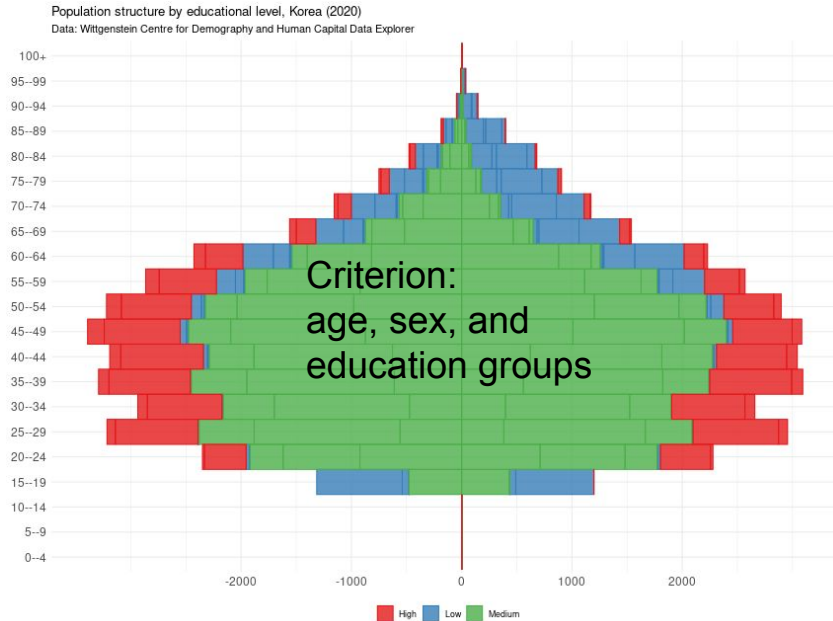


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Population:

the collection of persons alive at a specific point in time who meet certain criteria

Preston et al (2001)



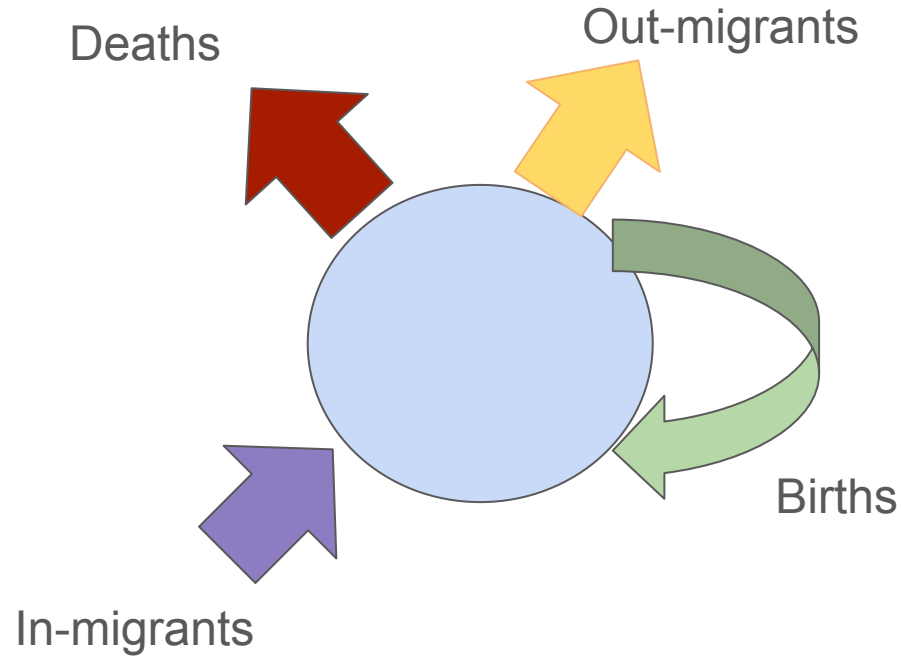
Demography:

“Demography is the science of populations. Demographers seek to understand population dynamics by investigating three main demographic processes: birth, migration, and aging (including death)”- MPIDR

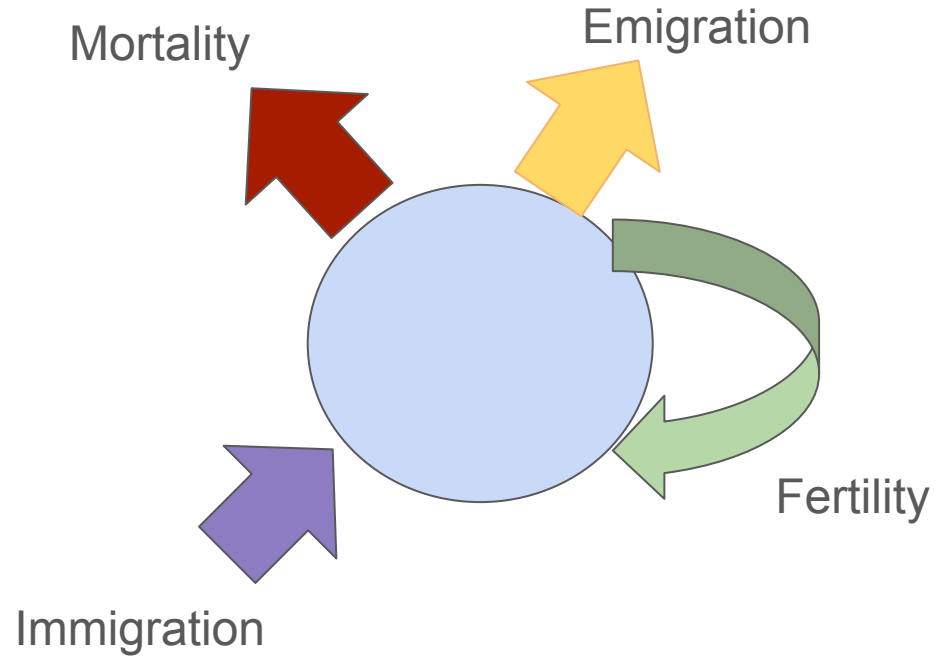
“The study of statistics such as births, deaths, income, or the incidence of disease, which illustrate the changing structure of human populations”- Oxford dictionary

“Demography is the study of the size, territorial distribution, and composition of population, changes therein, and the components of such changes” - Hauser 1959

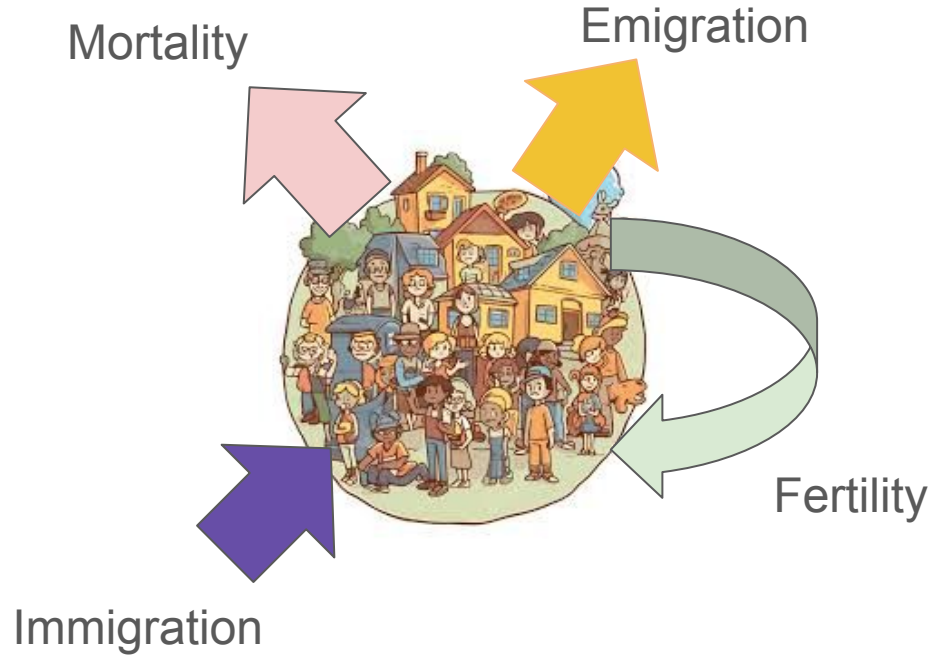
Demographic flows



Demographic flows

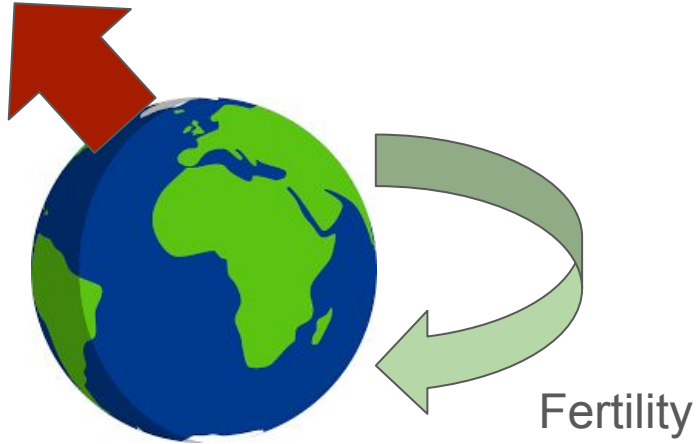


Demographic flows - scale matters



Demographic flows - scale matters

Mortality



Demographic flows - structure matters

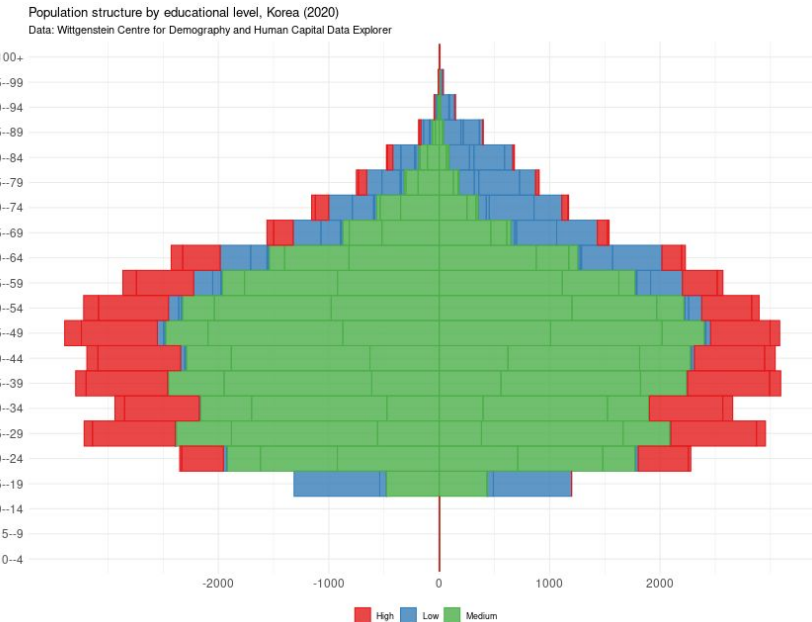
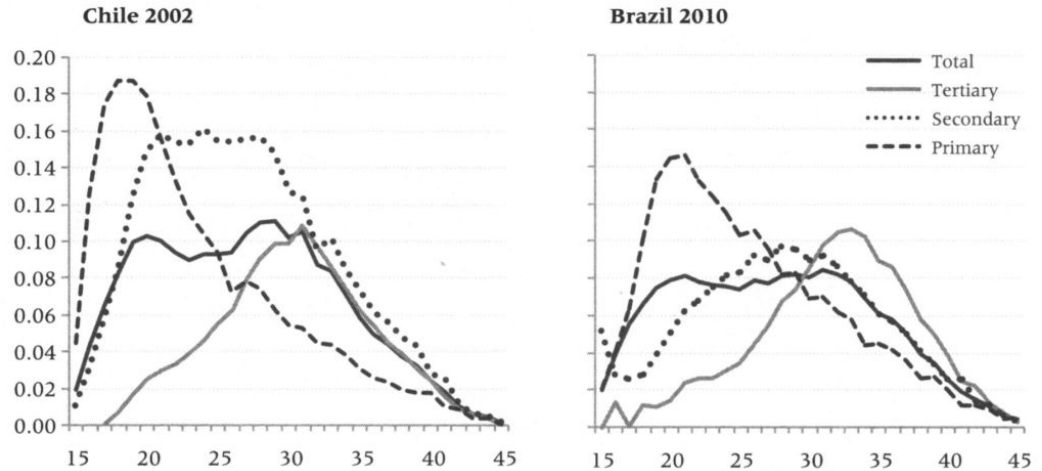


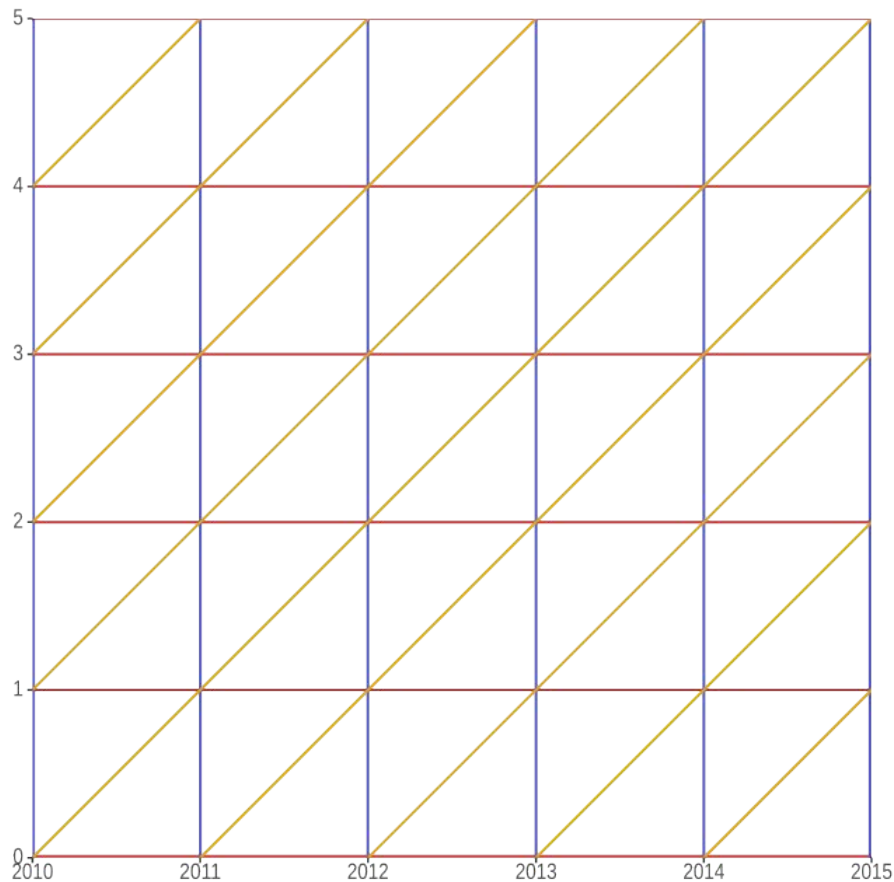
FIGURE 5 Age-specific conditional first birth rates (m1) by level of education, among women ages 15–45 in Chile (2002) and Brazil (2010)



(Lima et al 2018)

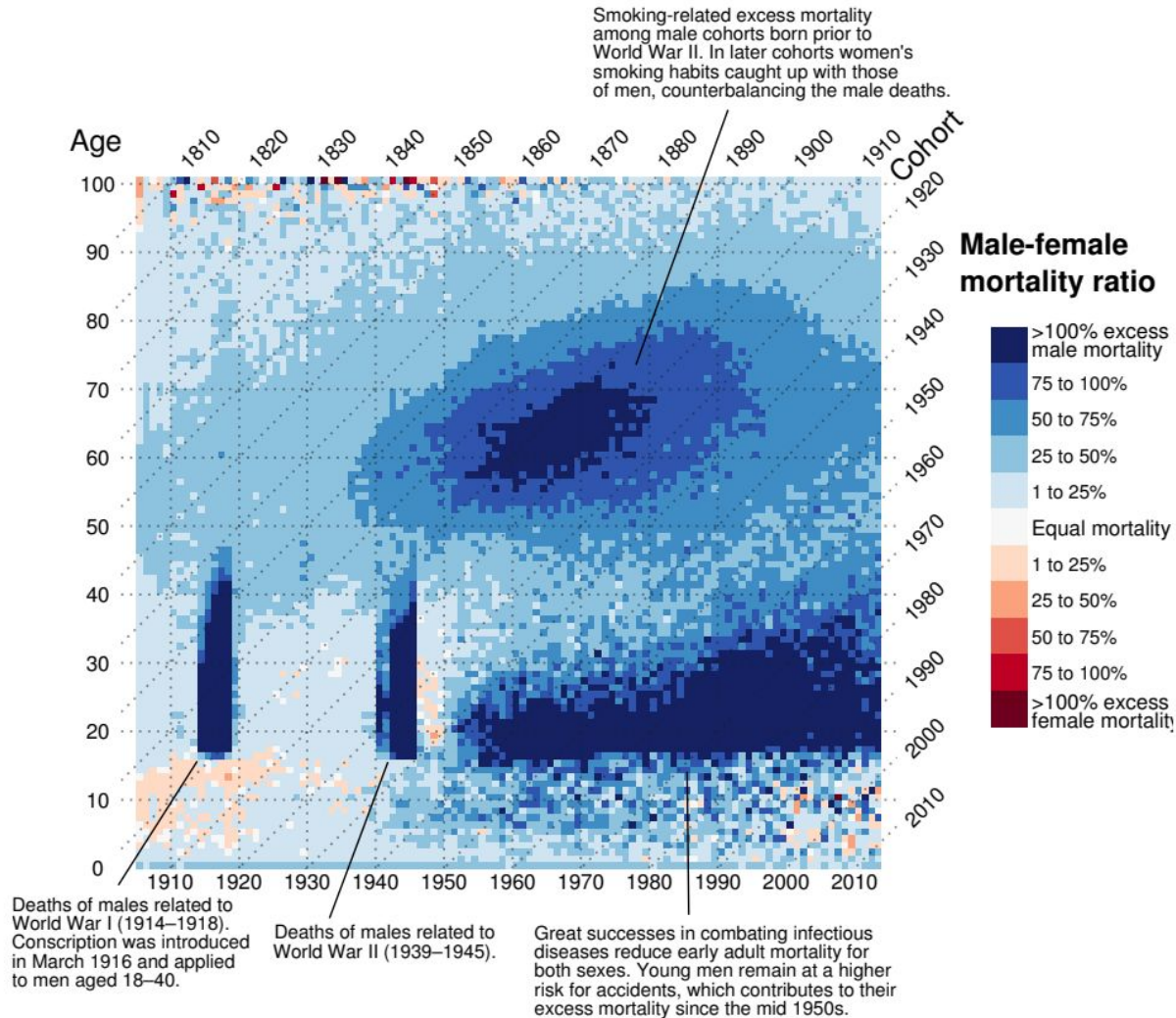
Time as structure

The Lexis diagram relates the dimensions of **age**, **period**, and **cohort** on a single plane.



Time as structure

“Lexis surface” with features in the **age**, **period**, and **cohort** perspectives. From Schoeley & Willekens (2017)

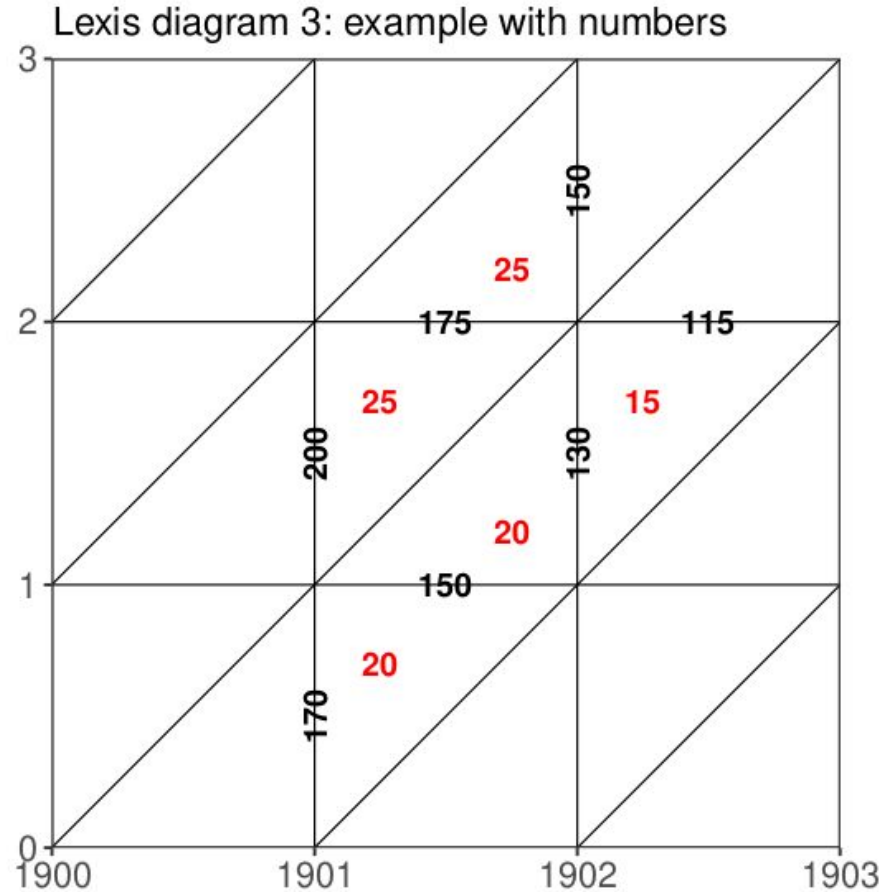


Probabilities vs rates

$$\textit{Probability} = \frac{\textit{Number of Occurences}}{\textit{Number of preceeding Events or trials}}$$

$$\textit{Rate} = \frac{\textit{Number of Occurences}}{\textit{Number of person - years lived}}$$

Probabilities vs rates



Crude rates

Korea 2014 data

E (Exposure, population): 50,765,887 (HMD estimate)

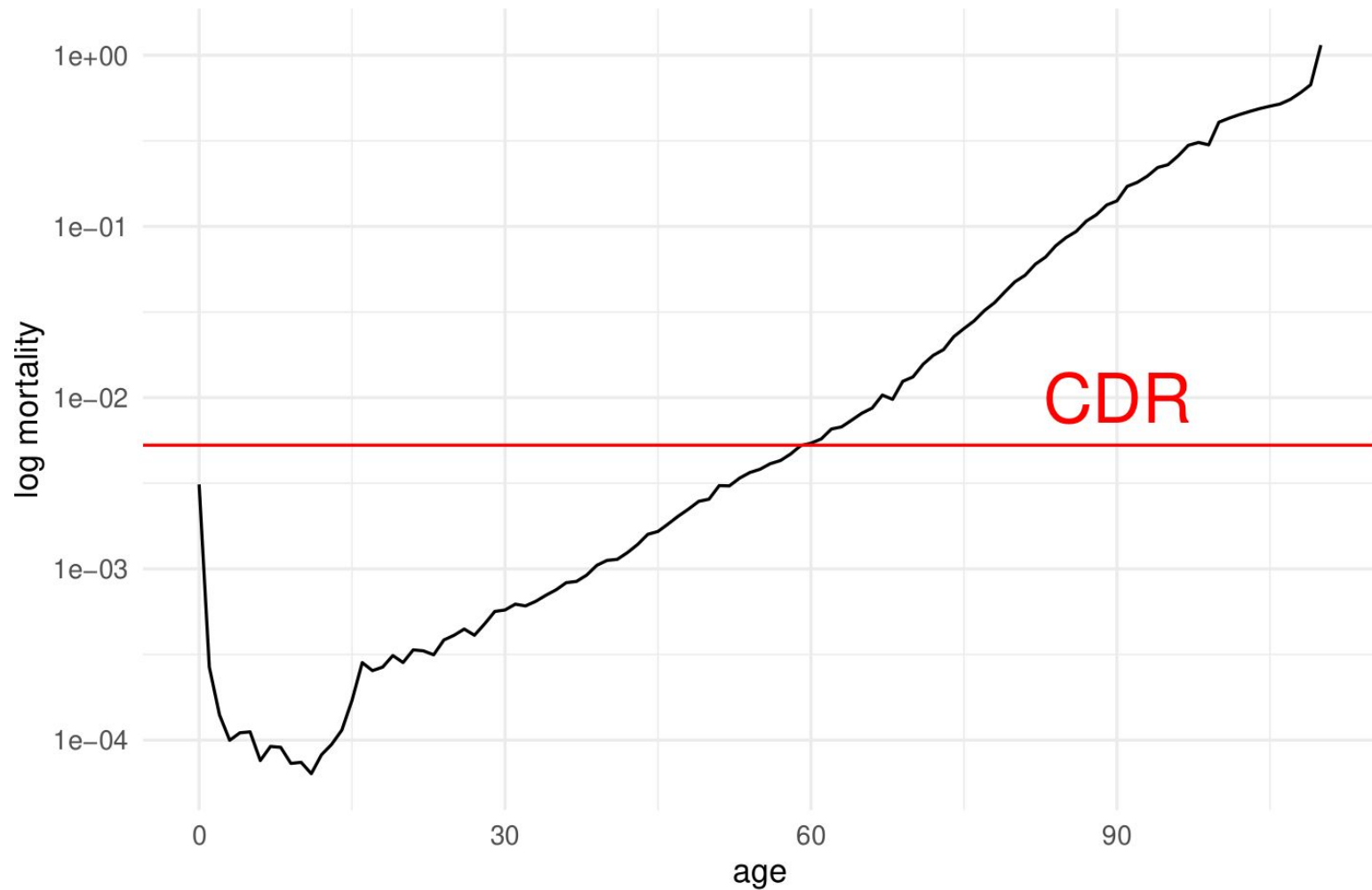
B (Births): 435,435

D (Deaths): 267,692

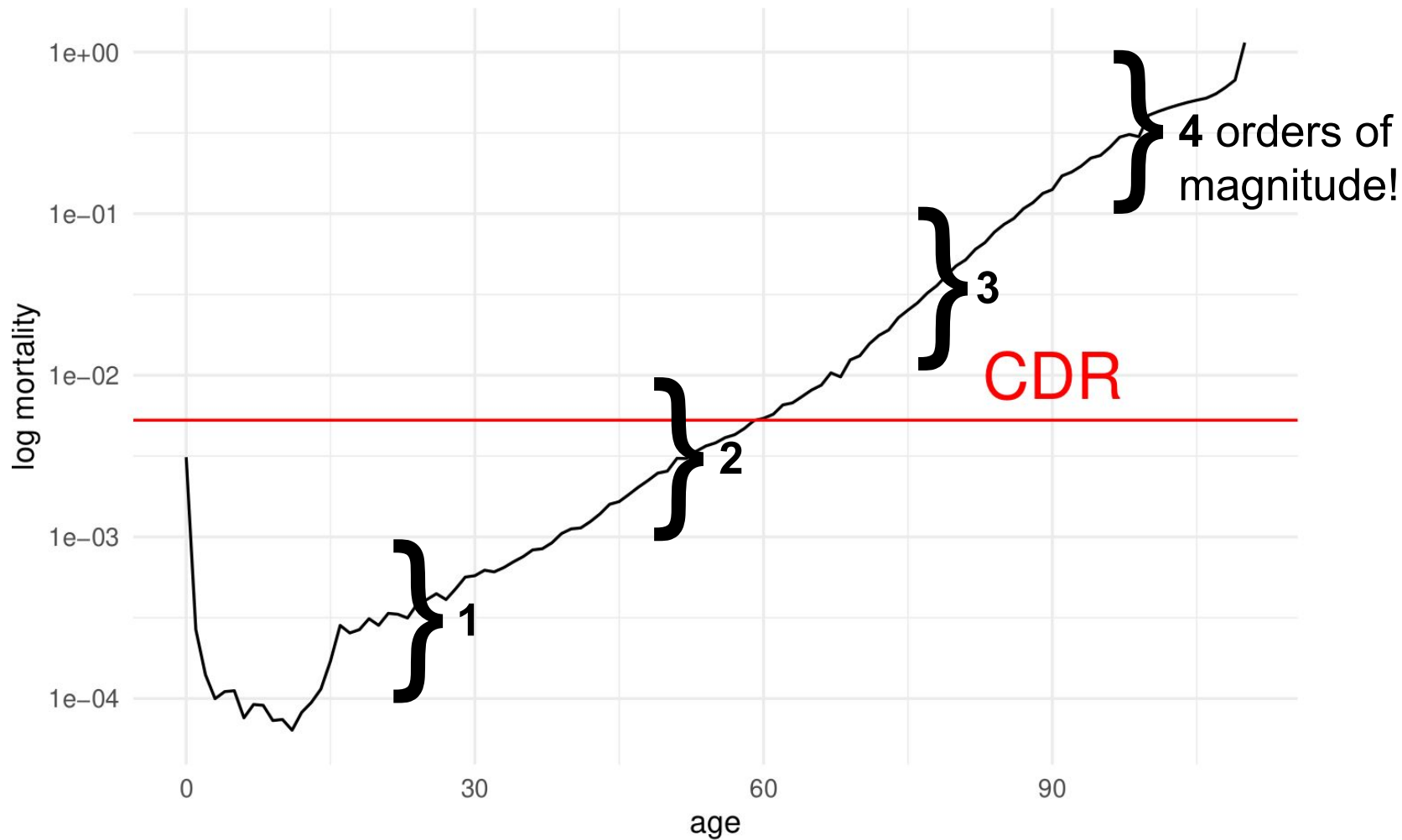
CDR(2014) = $D / E = 0.00527$ or 5.3 per 1000

CBR(2014) = $B / E = 0.00857$ or 8.6 per 1000

Age-specific mortality rates for Korea (total population, 2014)



Age-specific mortality rates for Korea (total population, 2014)



Time for us to move to R!