BaRcelona Summer School for Demography

Module 2: Demography in R

7 July, 2025

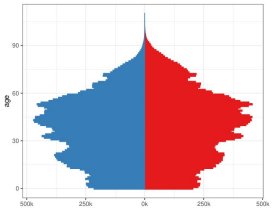
Instructor: Tim Riffe

Universidad del País Vasco

Euskal Herriko Unibertsitatea

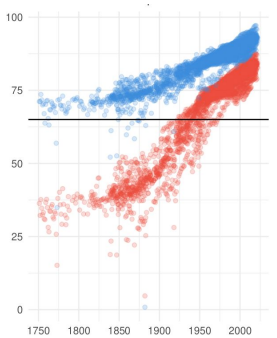
Objectives

(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, 7-11 July, 2025

1: Monday	**Intro concepts, and R setup**
2: Tuesday	Mortality and fertility
3: Wednesday	Standardization & decomposition
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/6ec2zfyy

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Basic data and concepts

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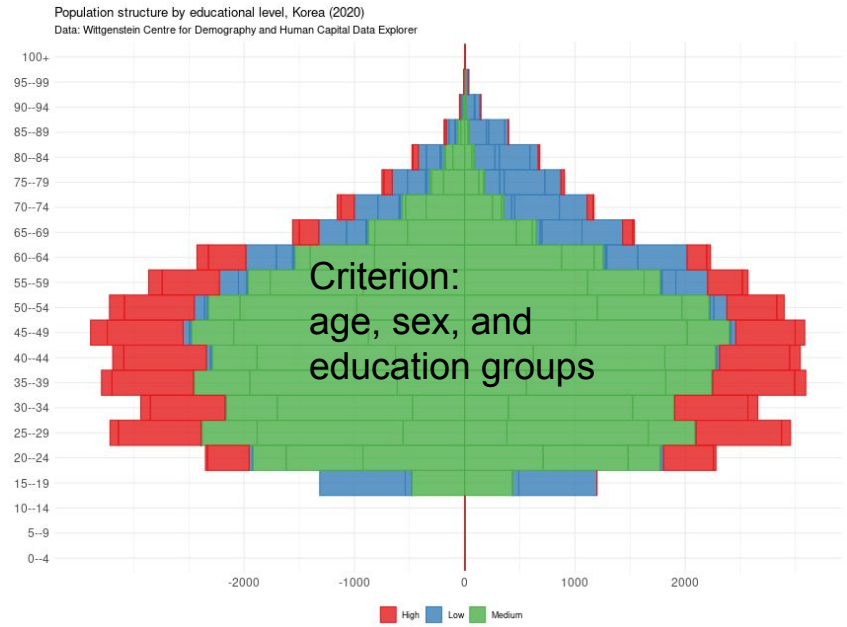
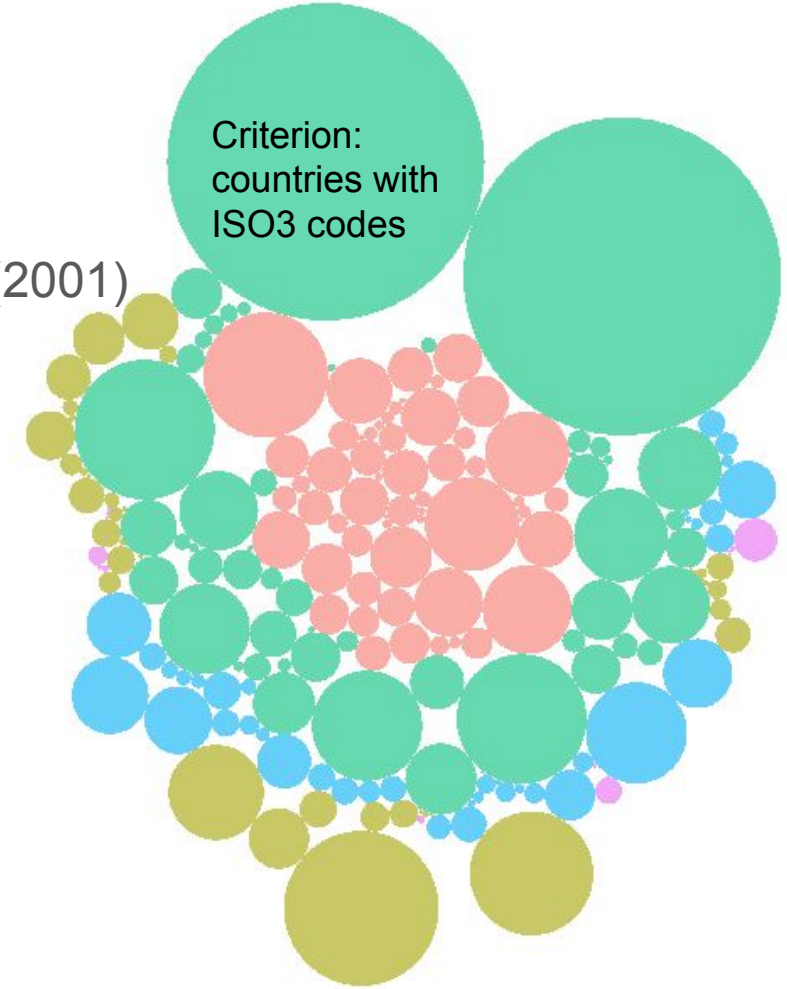
Population:

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

Preston et al (2001)





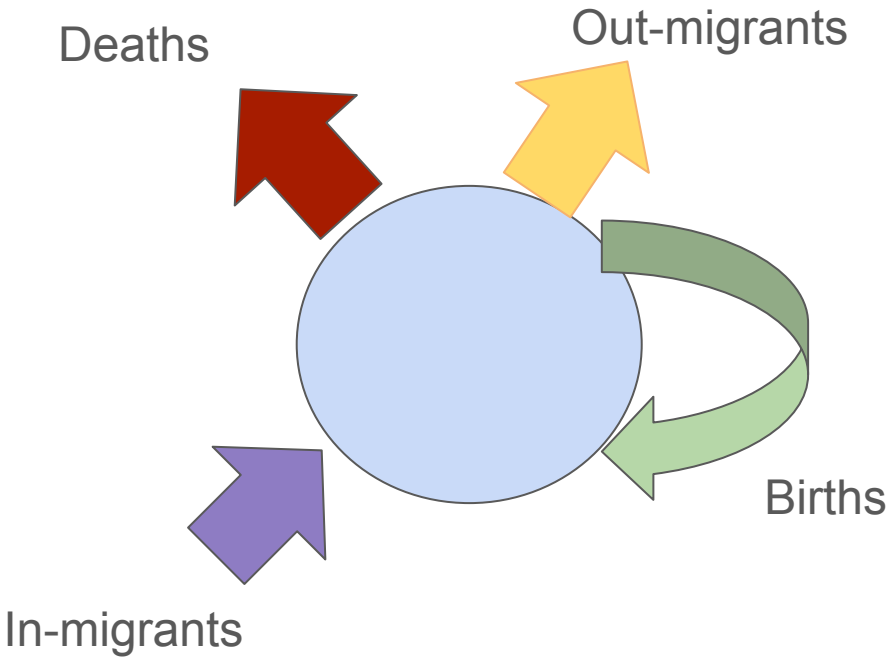
Demography:

“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

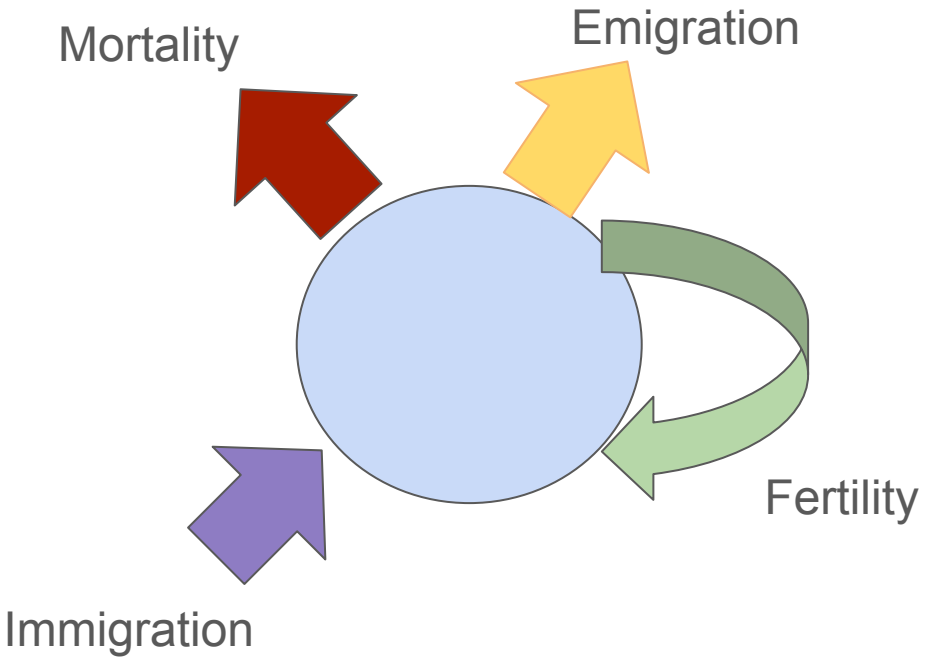
“The study of statistics such as births, deaths, income, or the incidence of disease, which illustrate the changing structure of human populations”- Oxford dictionary

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

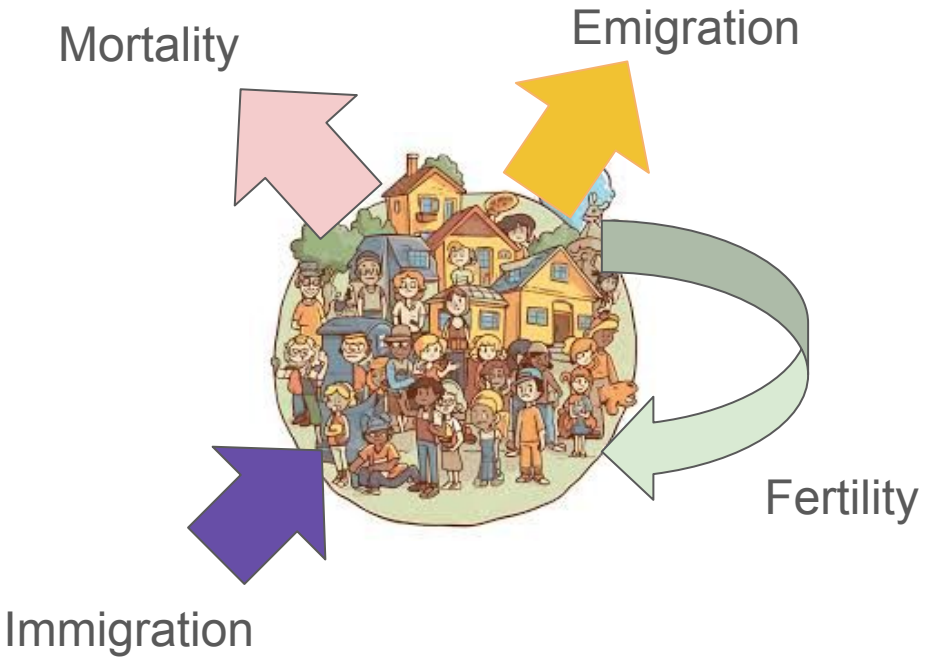
Demographic flows



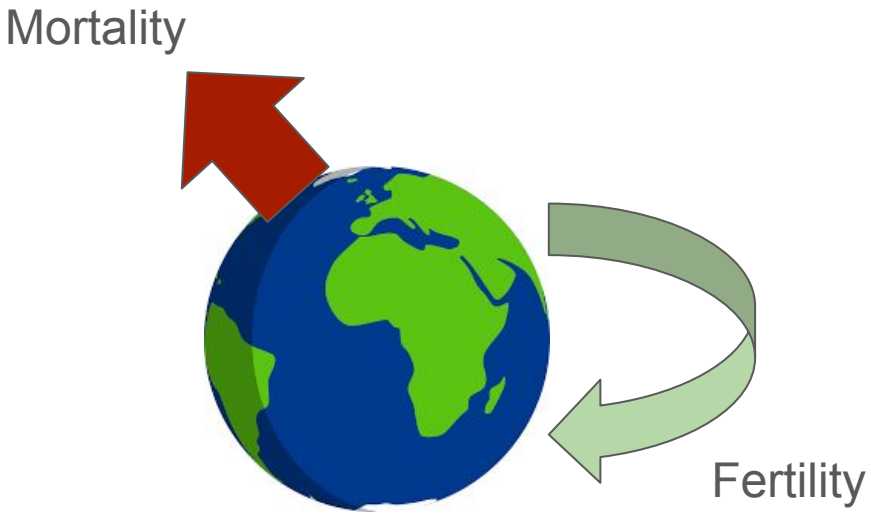
Demographic flows



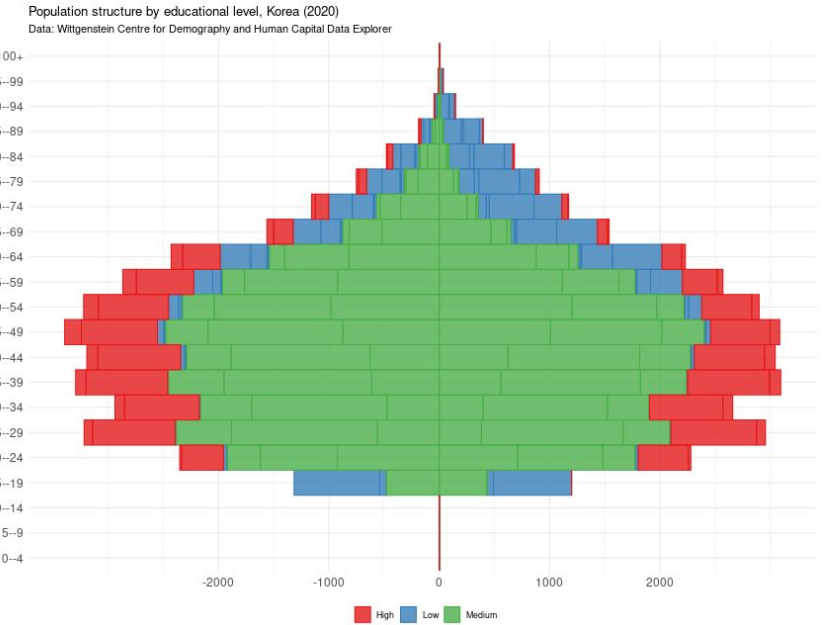
Demographic flows - scale matters

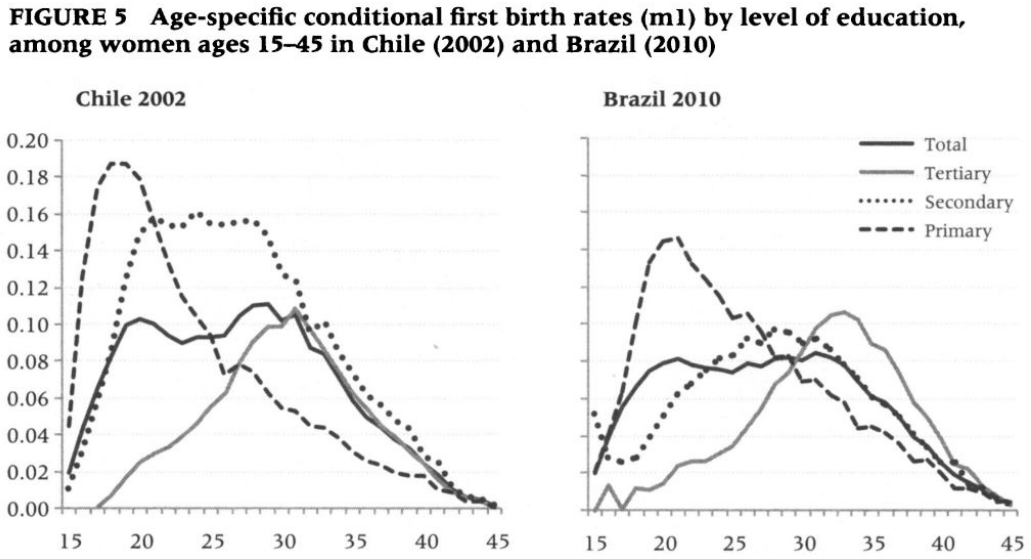


Demographic flows - scale matters



Demographic flows - structure matters

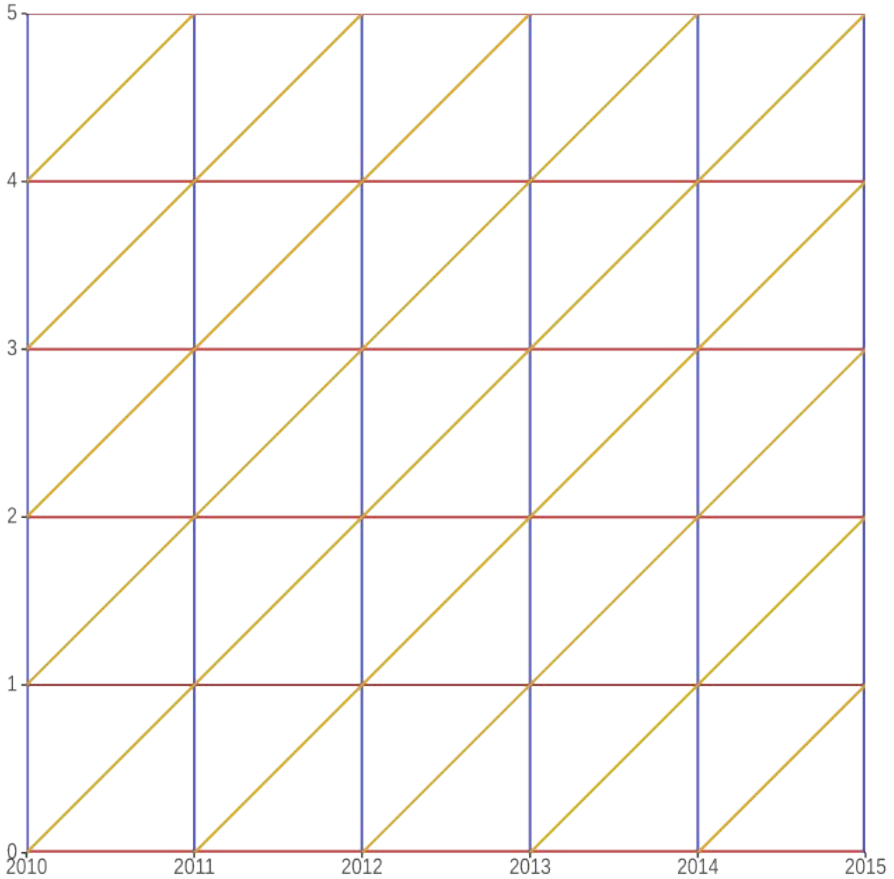




(Lima et al 2018)

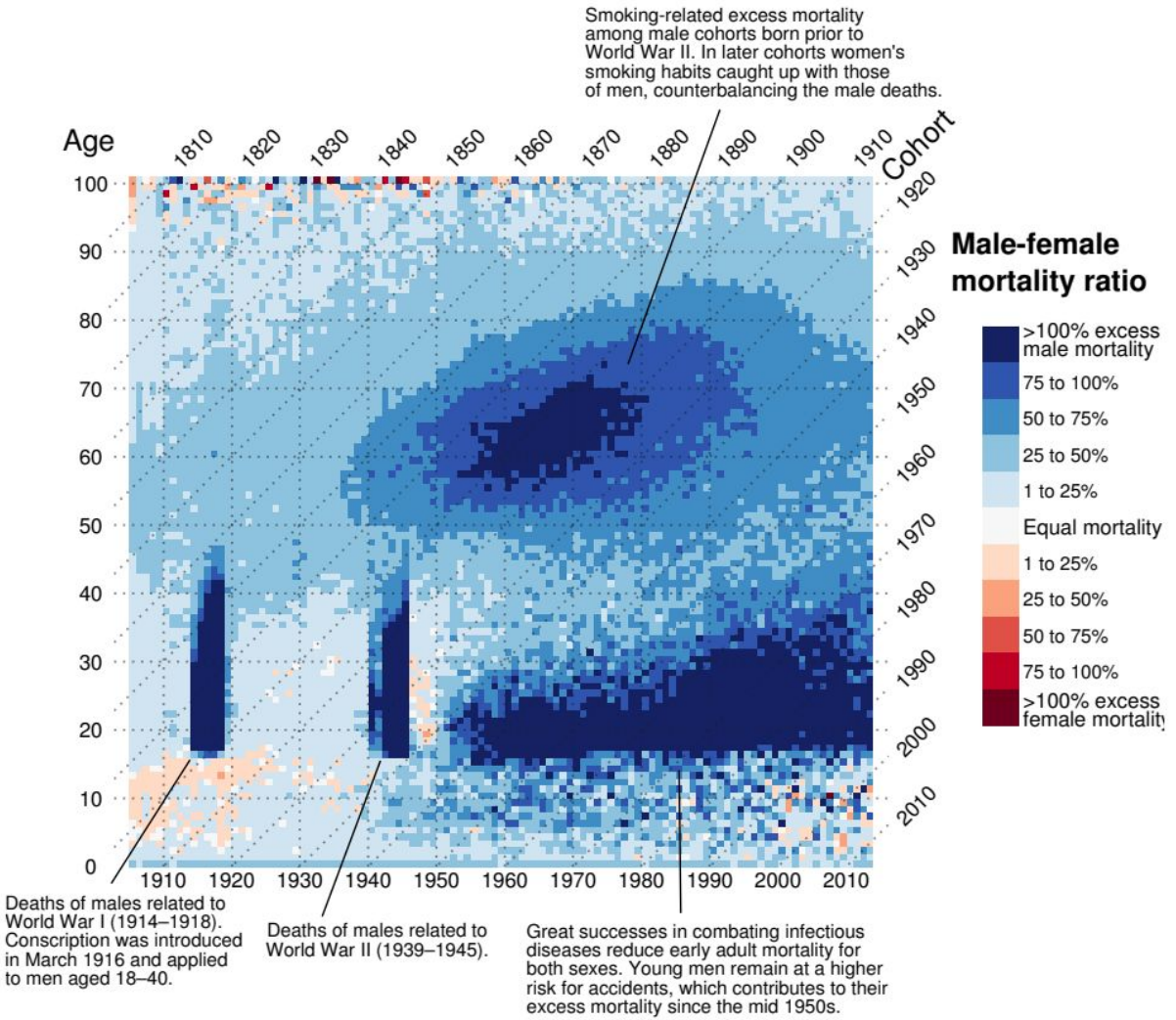
Time as structure

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)

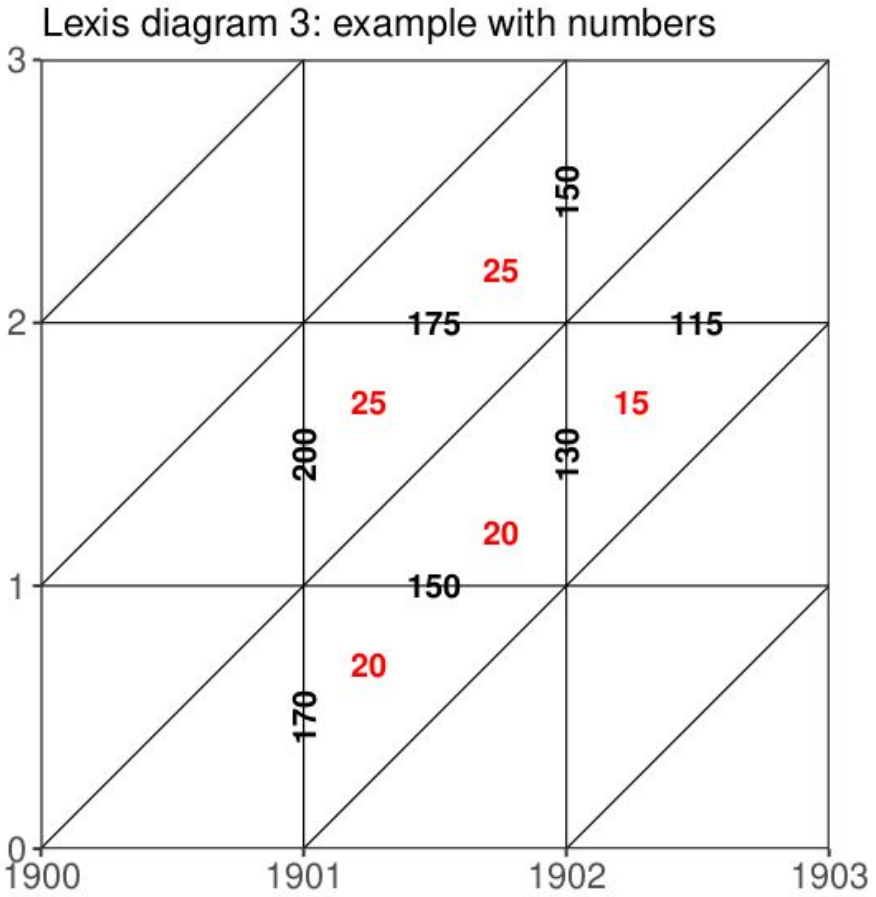


Probabilities vs rates

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

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

Probabilities vs rates



Crude rates

Korea 2014 data

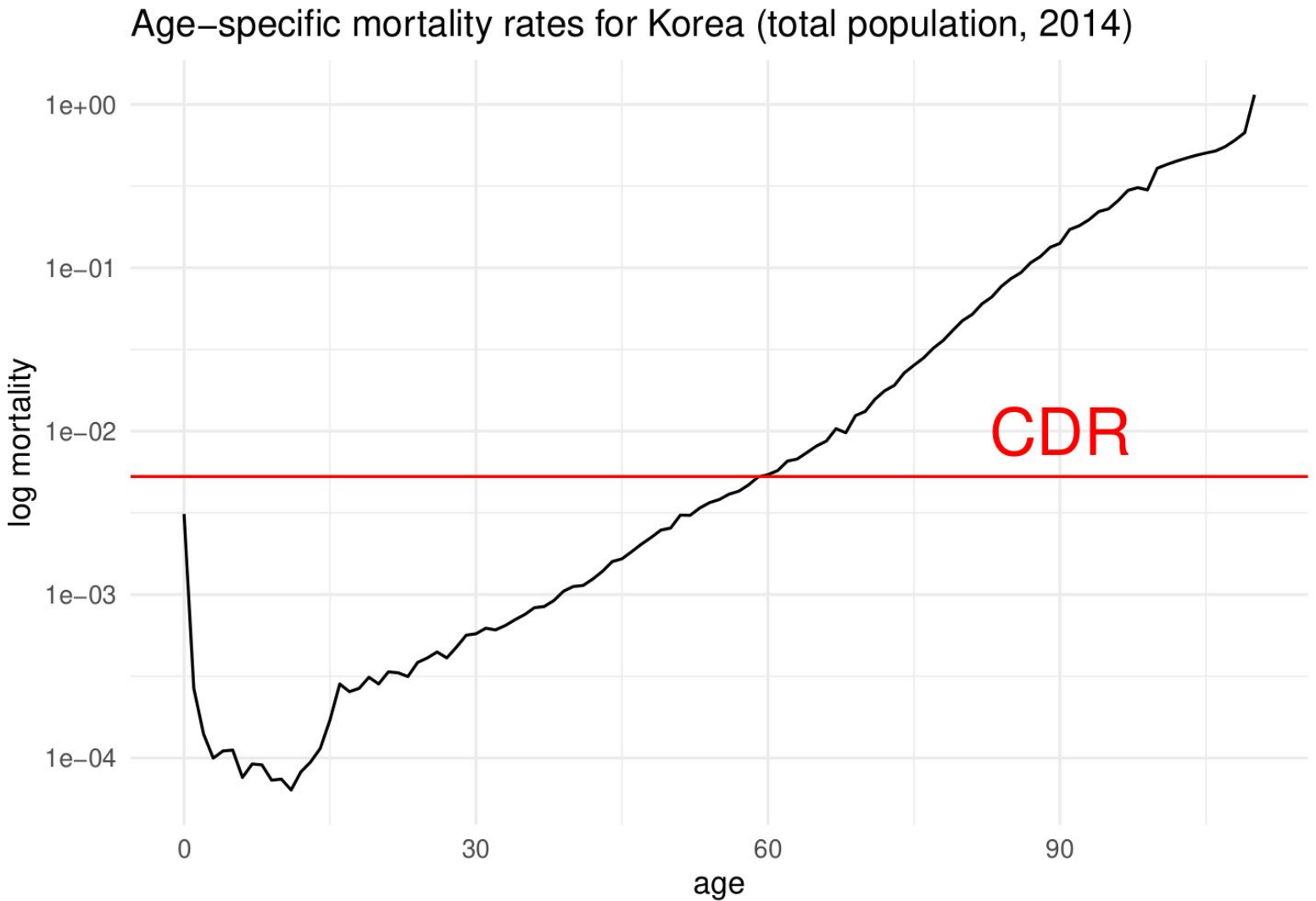
E (Exposure, population): 50,765,887 (HMD estimate)

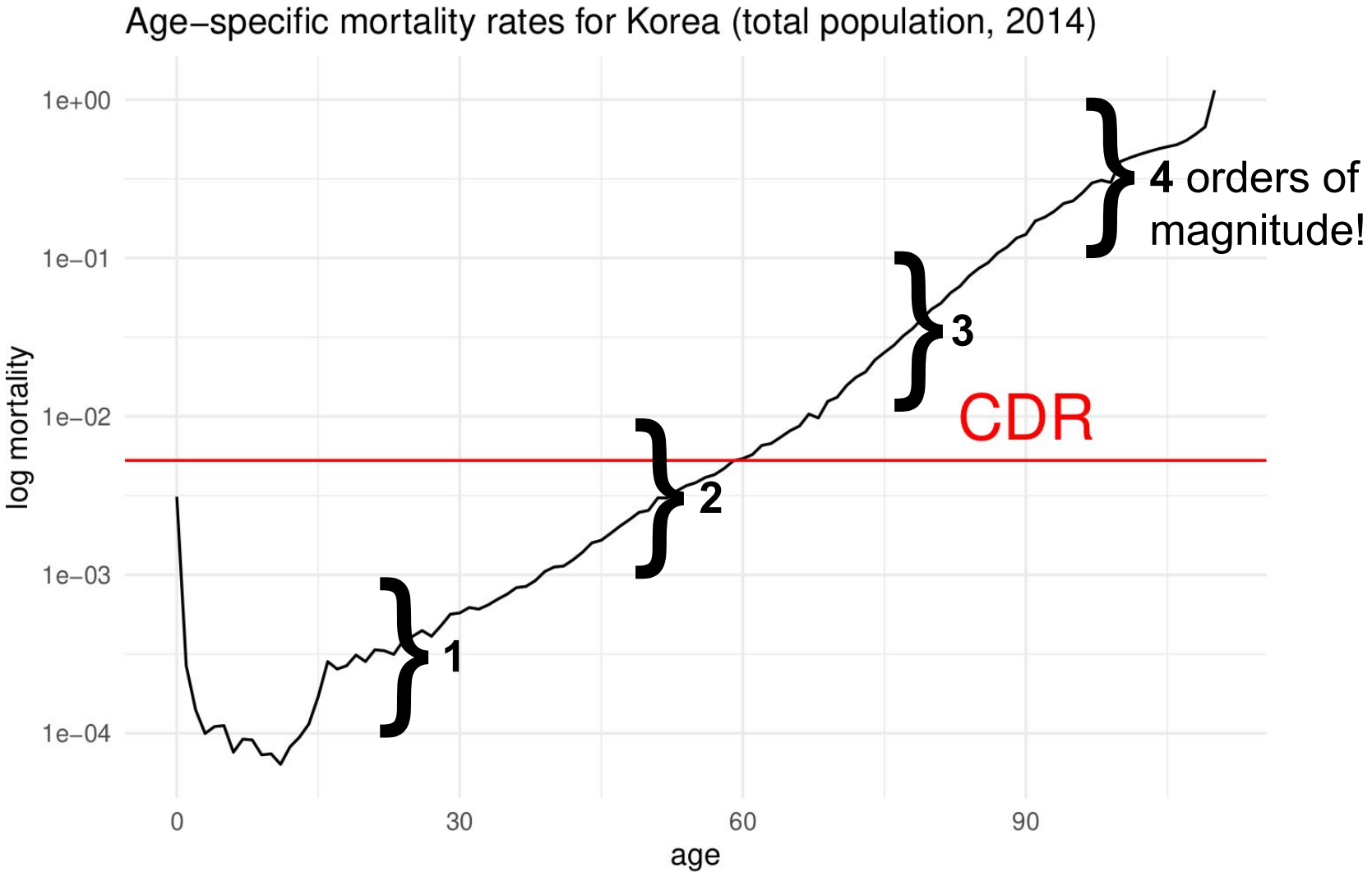
B (Births): 435,435

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)
log mortality
1e+00
1e−01
1e−02
1e−03
1e−04
CDR
0
30
60
90
age


Age−specific mortality rates for Korea (total population, 2014)
log mortality
1e+00
1e−01
1e−02
1e−03
1e−04
0
30
60
90
age
1
2
3
4 orders of magnitude!
CDR

Time for us to move to R!