KOSTAT-UNFPA Summer Seminar on Population

Workshop 1: Demographic Analysis: Methods and Tools in R

Projection

5 July, 2024

Instructor: Tim Riffe
Assistant: Inchan Hwang

opik
eman ta zabal zazu
Universidad del País Vasco
Euskal Herriko Unibertsitatea
ikerbasque
Basque Foundation for Science
Statistics Korea
UNFPA

Workshop plan, July 1-5, 2024

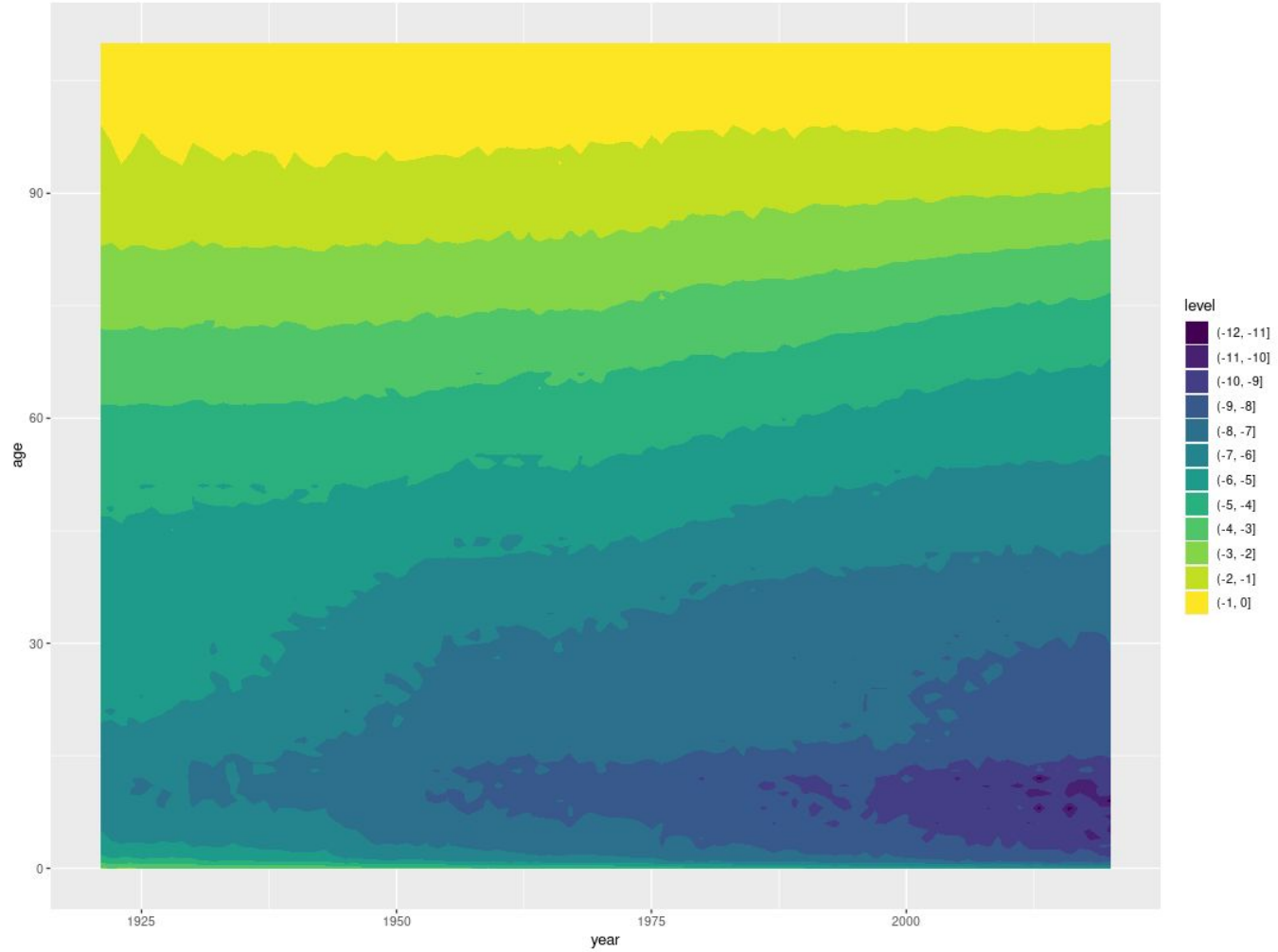
1: Monday	Intro concepts, and R setup
2: Tuesday	Mortality and fertility
3: Wednesday	Structure
4: Thursday	Growth
5: Friday	**Projection**

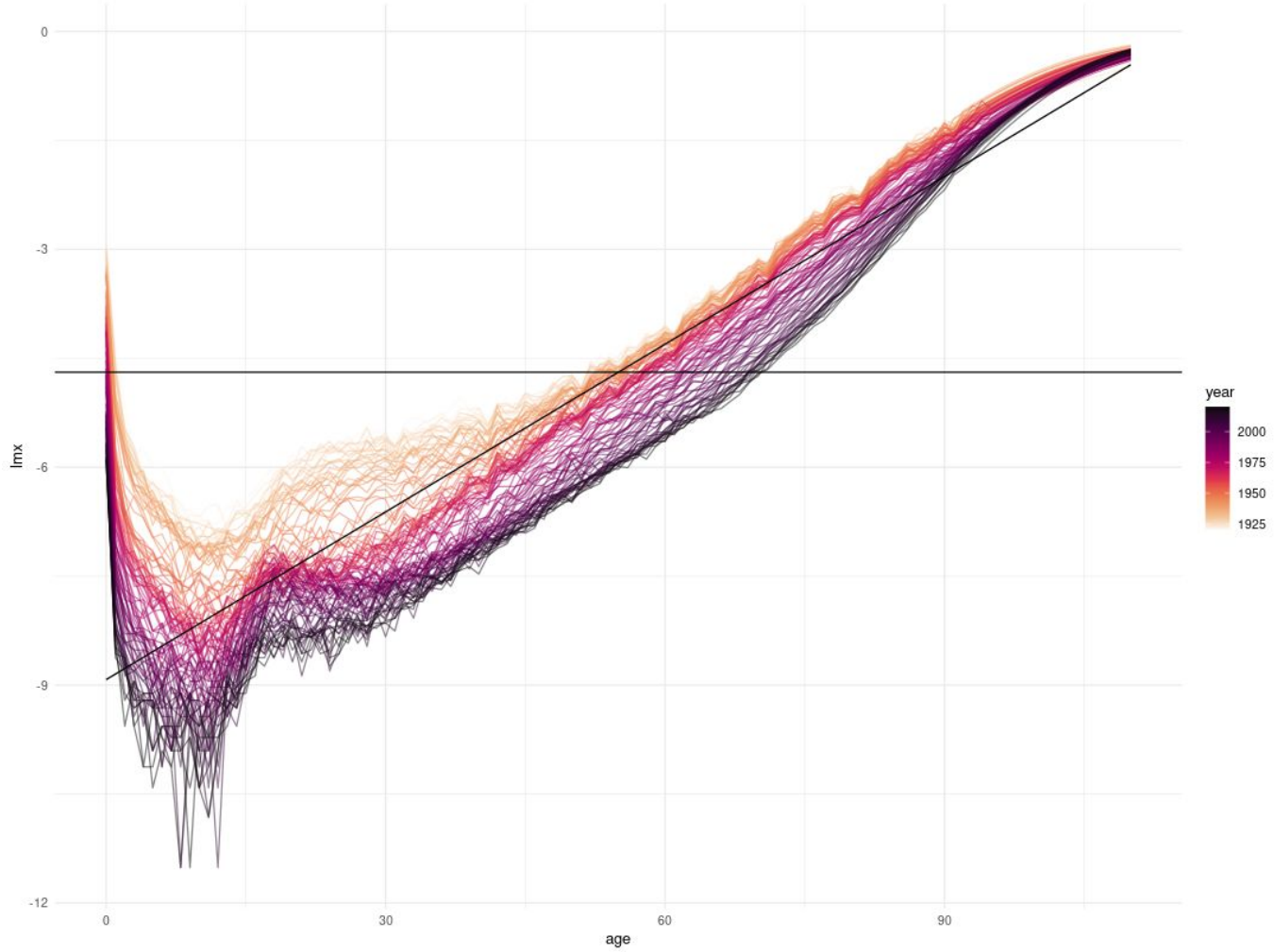
Review of session 4

- Geometric and exponential growth
- Stationary and stable structure
- Stable structure in periods; stationary structure in cohorts
- Stable populations don’t happen; change is constant
- Period perspective justifiable for life expectancy, but net reproductivity results are not.
- `colorspace` for good palettes.
- Pyramid tips
- `cross_join()`

Projection

- Predict the past/present to predict the future
- Simplify
- Extrapolate


age
90
60
30
0
1925
1950
1975
2000
year
level
(-12, -11]
(-11, -10]
(-10, -9]
(-9, -8]
(-8, -7]
(-7, -6]
(-6, -5]
(-5, -4]
(-4, -3]
(-3, -2]
(-2, -1]
(-1, 0]


0
-3
-6
-9
-12
lmx
0
30
60
90
age
year
2000
1975
1950
1925

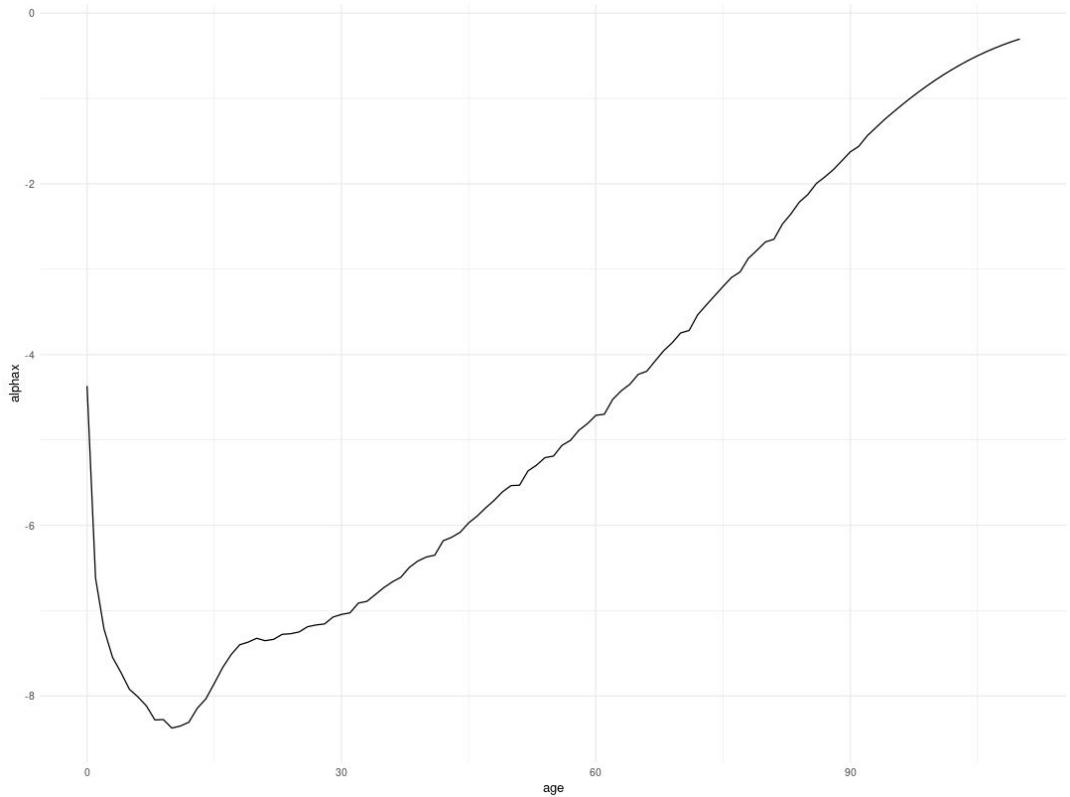
% Variance (of log rates) explained

Parameters	
1 (simple intercept)	Total var = 276
2 (line)	**66.4 %**
3 (simple plane)	**72.9 %**
4 (plane with tilt)	**75.0 %**
200 (each year has own line)	**75.2 %**
111 (age intercepts)	**76.5 %**
222 (each age has own line)	**93.9 %**

Lee Carter method

$$ln(m_x(t)) = \alpha_x + \beta_x \kappa(t) + \epsilon_x(t)$$

Alpha



Calculating beta and kappa

SVD - singular value decomposition

Factorize a matrix **M** into pieces **d**, **U**, **V**, such that:

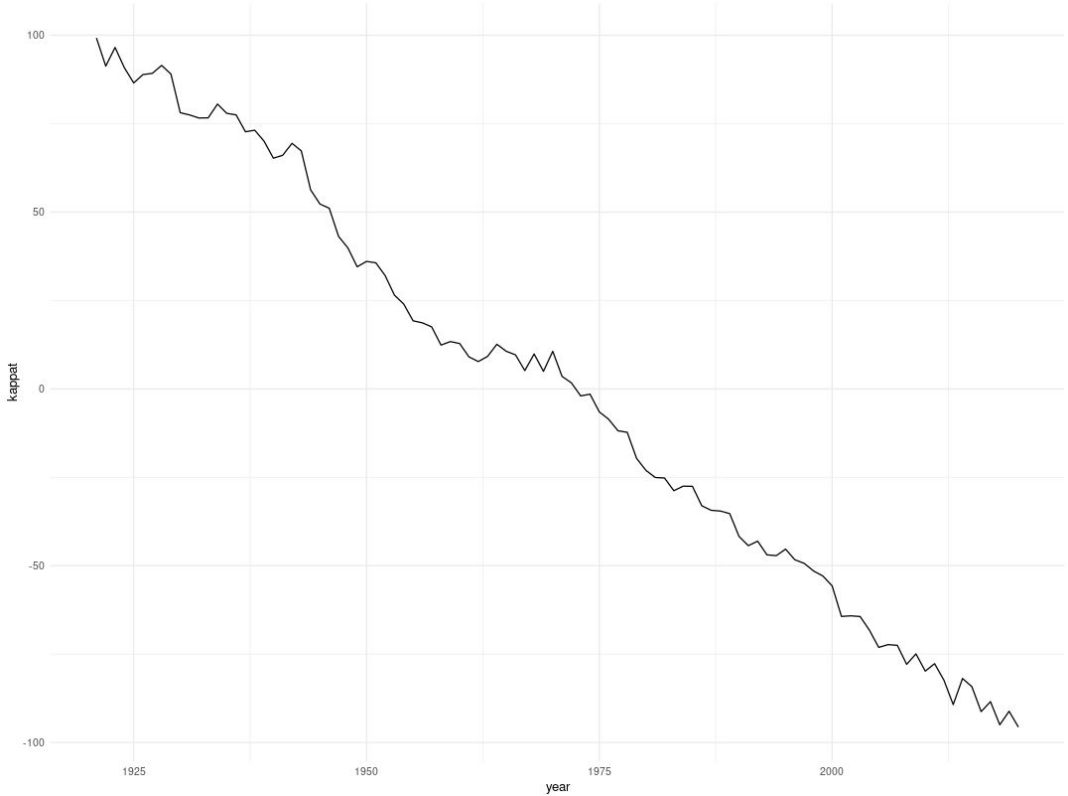
M = U diag(d) V^T

$\beta(x)$ (age slopes) derived from **U** (scale first column to 1)

$\kappa(t)$ (secular change) derived from **V** (scale first column of **V** to sum to first element of **d**

Beta(x) age slopes

Kappa(t) the trend to extrapolate



% Variance (of log rates) explained

Parameters	
1 (simple intercept)	Total var = `276`
4 (plane with tilt)	**`75.0 %`**
200 (each year has own line)	**`75.2 %`**
111 (age intercepts)	**`76.5 %`**
222 (each age has own line)	**`93.9 %`**
224 (LC, simple)	**`94.2 %`**

Modeling and Forecasting U. S. Mortality

Ronald D. Lee; Lawrence R. Carter

Journal of the American Statistical Association, Vol. 87, No. 419 (Sep., 1992), 659-671.

Stable URL:
http://links.jstor.org/sici?sici=0162-1459%28199209%2987%3A419%3C659%3AMAFUSM%3E2.0.CO%3B2-T

$$ln(m_x(t)) = \alpha_x + \beta_x \kappa(t) + \epsilon_x(t)$$