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Macro patterns in the evolution of human aging

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MaxO

SDU

MAX-PLANCK-INSTITUT FÜR DEMOGRAFISCHE FORSCHUNG

MAX PLANCK INSTITUTE FOR DEMOGRAPHIC RESEARCH

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Background

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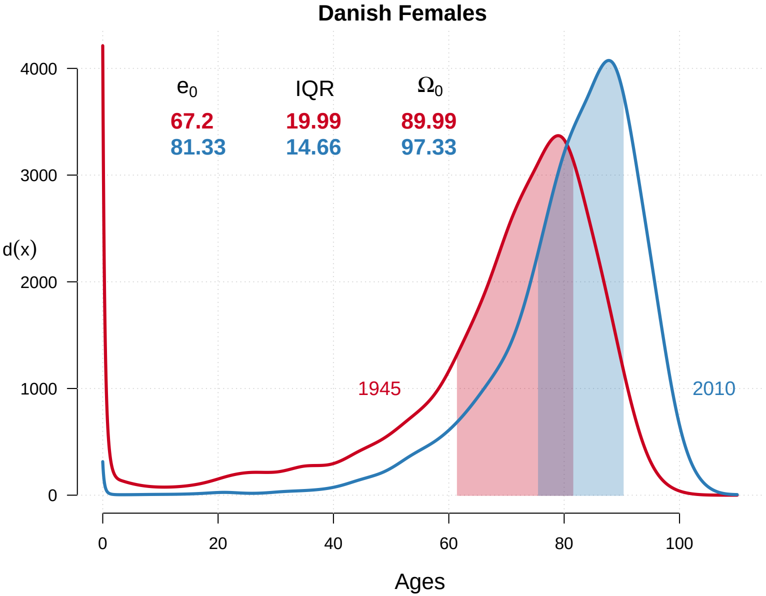
- Demographers also use **modal** or **median** age at death.
- They **conceal variation of lifespans** and other aspects of the age at death distribution.


Danish Females
e_0
IQR
Ω_0
67.2
19.99
89.99
81.33
14.66
97.33
d(x)
4000
3000
2000
1000
0
1945
2010
0
20
40
60
80
100
Ages

Key formulas

Consider the conditional death distribution

$$f(y \mid a) = \frac{1}{\ell(a)} \mu(a+y) \ell(a+y)$$

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$\mu(a) \longrightarrow$ force of mortality at age a
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Key point: $f(y \mid a) \longrightarrow$ **probability of surviving to and dying at age** $a+y$ **given survival to age** a**.**

Remaining life expectancy conditional on survival to age a is

$$e(a) = \frac{1}{\ell(a)} \int_0^\infty \ell(a+y)dy$$

The conditional deaths distribution can be described by its moments about $e(a)$

Moment generator function defined as

$$\eta_n(y \mid a) = \int_{y=0}^{\infty} (y - e(a))^n f(y \mid a) dy$$

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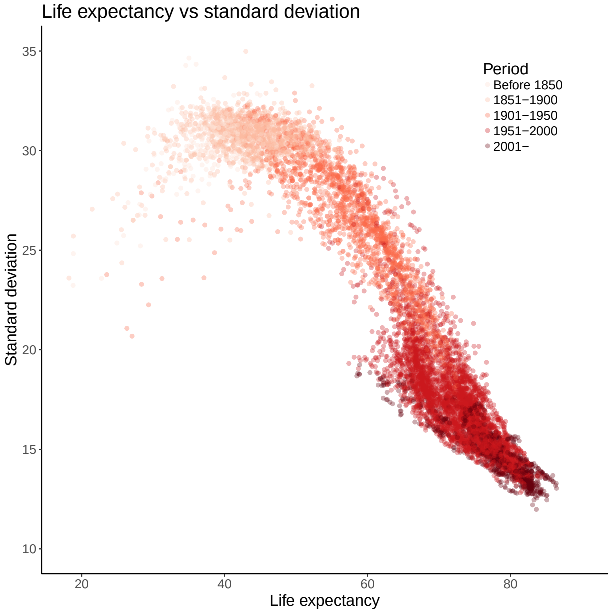
Skewness $\longrightarrow Skew(y \mid a) = \frac{\eta_3(y|a)}{\sigma^2(y|a)}$

Kurtosis $\longrightarrow Kurt(y \mid a) = \frac{\eta_4(y|a)}{\sigma^3(y|a)-3}$

$$\vdots$$


Life expectancy vs standard deviation
Standard deviation
35
30
25
20
15
10
Life expectancy
20
40
60
80
Period
Before 1850
1851−1900
1901−1950
1951−2000
2001−

What if we take different **ages** ?

What if we take different **ages** ?

What if we take different **years**?

What if we take different **ages** ?

What if we take different **years**?

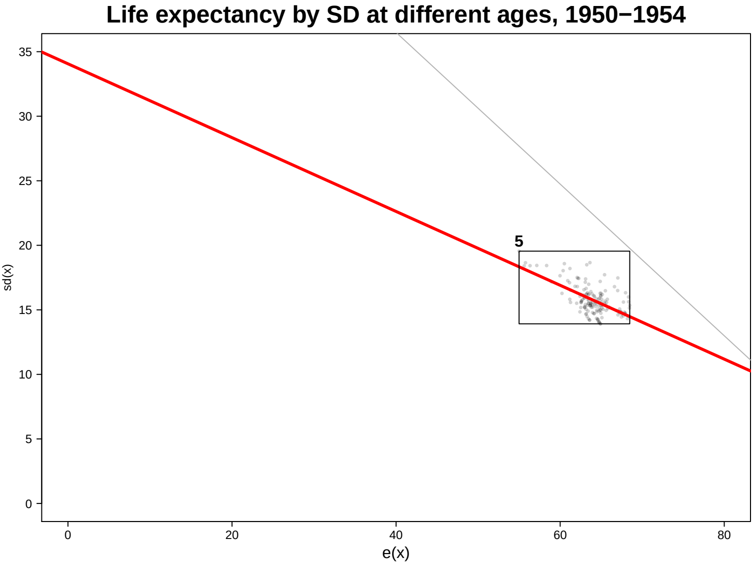
We explore with our framework


Life expectancy by SD at age 0, 1751−2013
sd(x)
e(x)
0
5
10
15
20
25
30
35
0
20
40
60
80


Life expectancy by SD at age 0, 1950−2013
sd(x)
e(x)
0
5
10
15
20
25
30
35
0
20
40
60
80

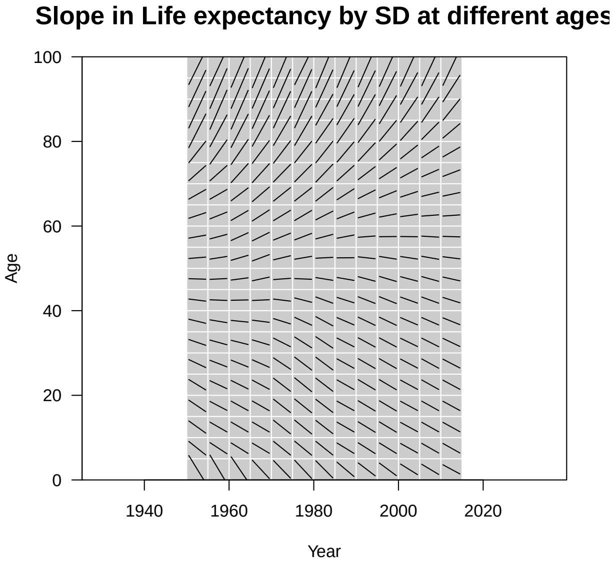

Life expectancy by SD at age 0, 1950−1954
sd(x)
e(x)
0
5
10
15
20
25
30
35
0
20
40
60
80


Life expectancy by SD at age 80, 1950−1954
sd(x)
e(x)
0
5
10
15
20
25
30
35
0
20
40
60
80


Life expectancy by SD at different ages, 1950−1954
35
30
25
20
15
10
5
0
sd(x)
0
20
40
60
80
e(x)
5


Slope in Life expectancy by SD at different ages
100
80
60
40
20
0
Age
1940
1960
1980
2000
2020
2040
Year


Slope in Life expectancy by SD at different ages
100
80
60
40
20
0
Age
1940
1960
1980
2000
2020
2040
Year


Slope in Life expectancy by SD at different ages
Age
100
80
60
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20
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1940
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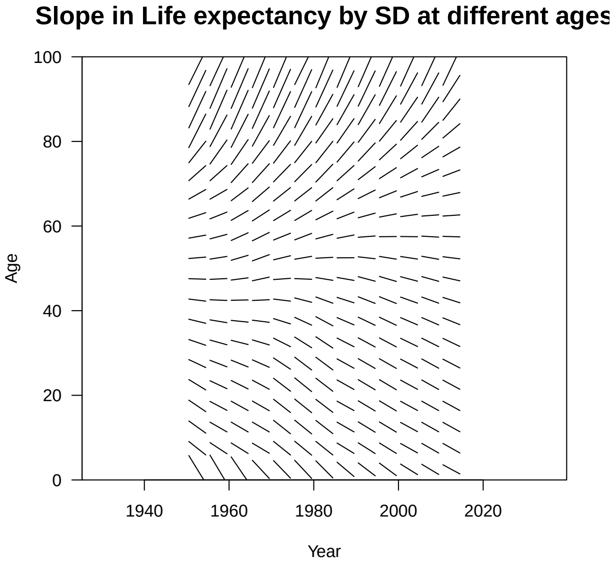
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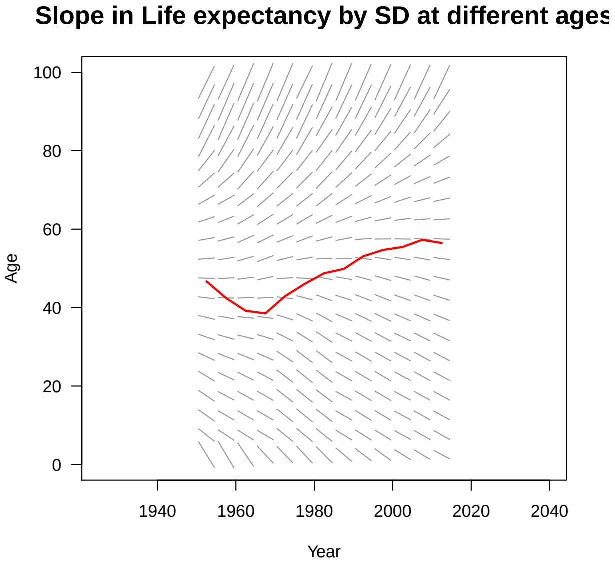
Slope in Life expectancy by SD at different ages
Age
Year
100
80
60
40
20
0
1940
1960
1980
2000
2020
2040

Go beyond the mean!

More information:

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