NATURAM PRIMUM COGNOSCERE RERUM

Australian
National
University

Workshop on Decomposition Methods

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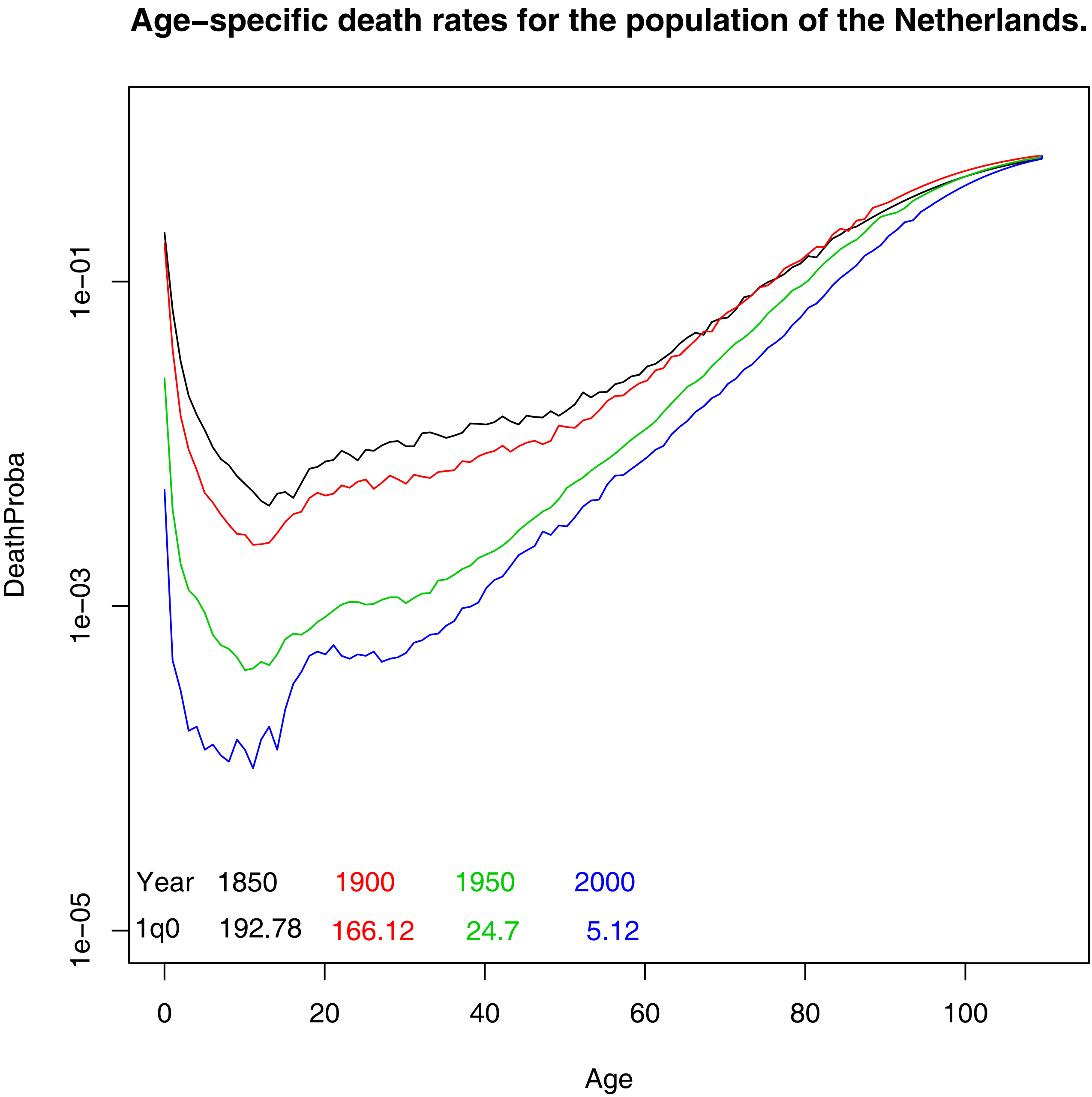
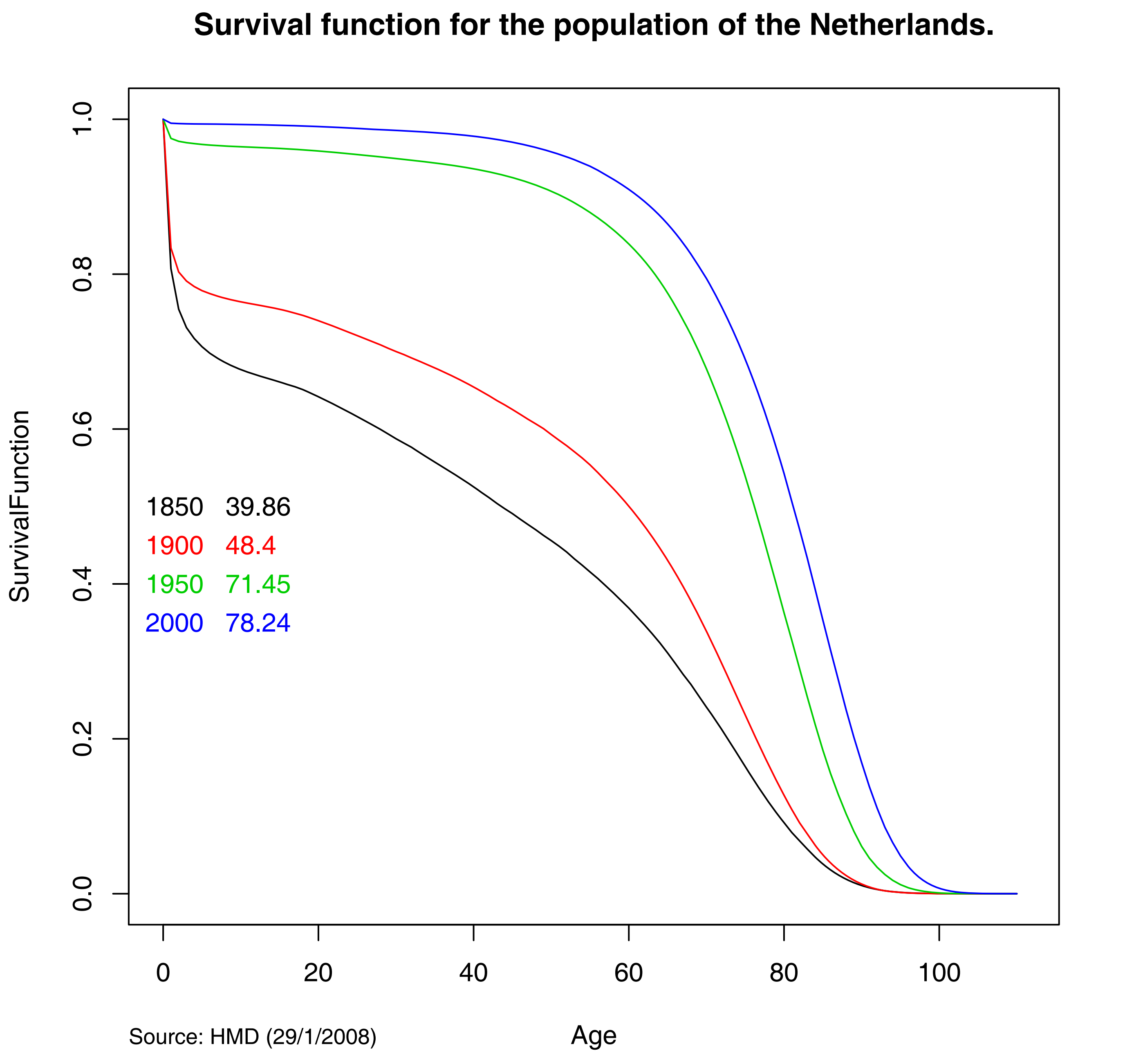
Decomposing Mortality Measures

Life Tables

$q(a)$	Probability of Death
$\ell(a)$	Survival Function
$f(a)$	Function of the Distribution of Deaths

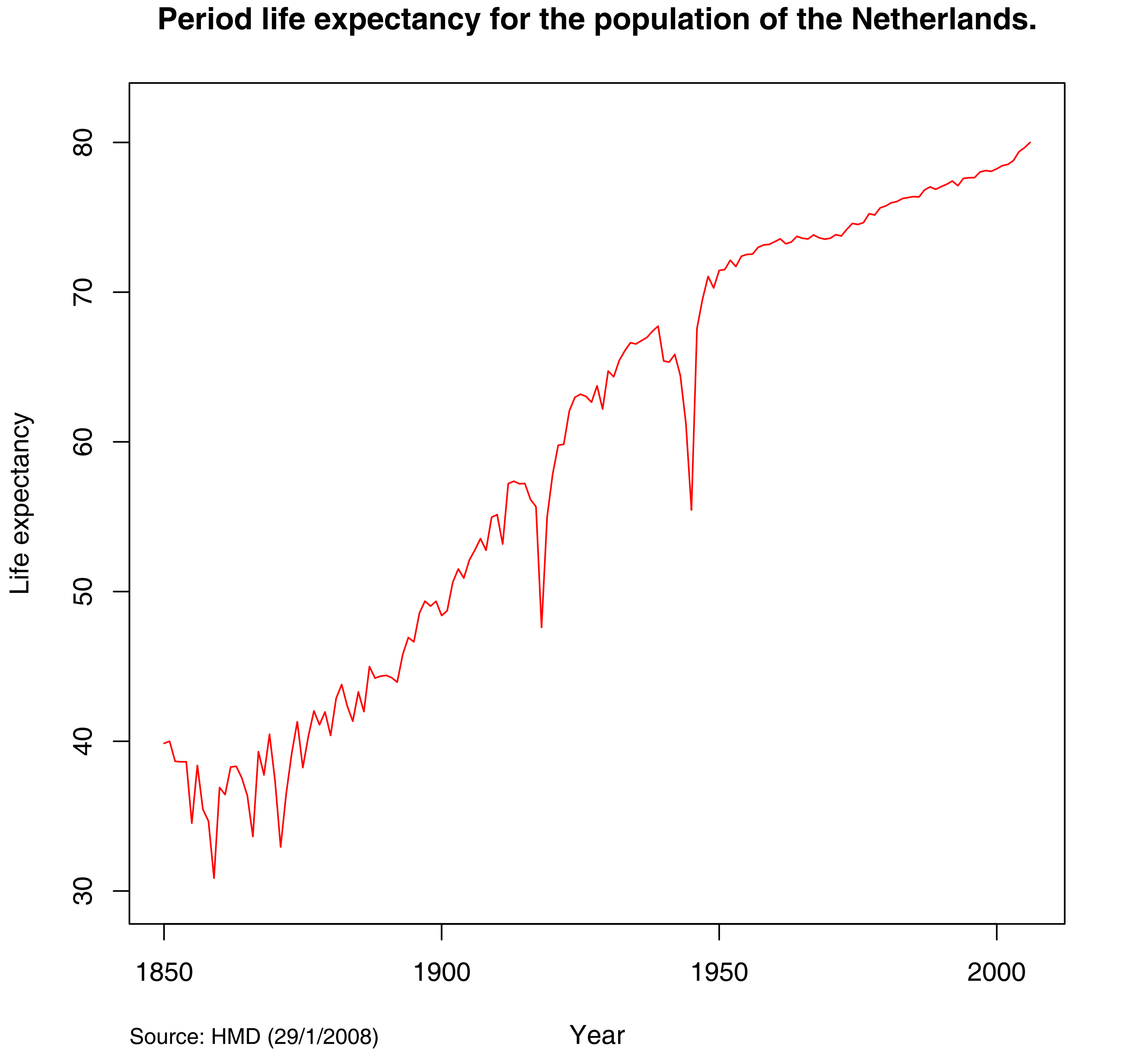


Age−specific death rates for the population of the Netherlands.
DeathProba
1e−01
1e−03
1e−05
Age
0
20
40
60
80
100
Year 1850 1900 1950 2000
1q0 192.78 166.12 24.7 5.12


Survival function for the population of the Netherlands.
SurvivalFunction
1.0
0.8
0.6
0.4
0.2
0.0
1850 39.86
1900 48.4
1950 71.45
2000 78.24
0
20
40
60
80
100
Age
Source: HMD (29/1/2008)

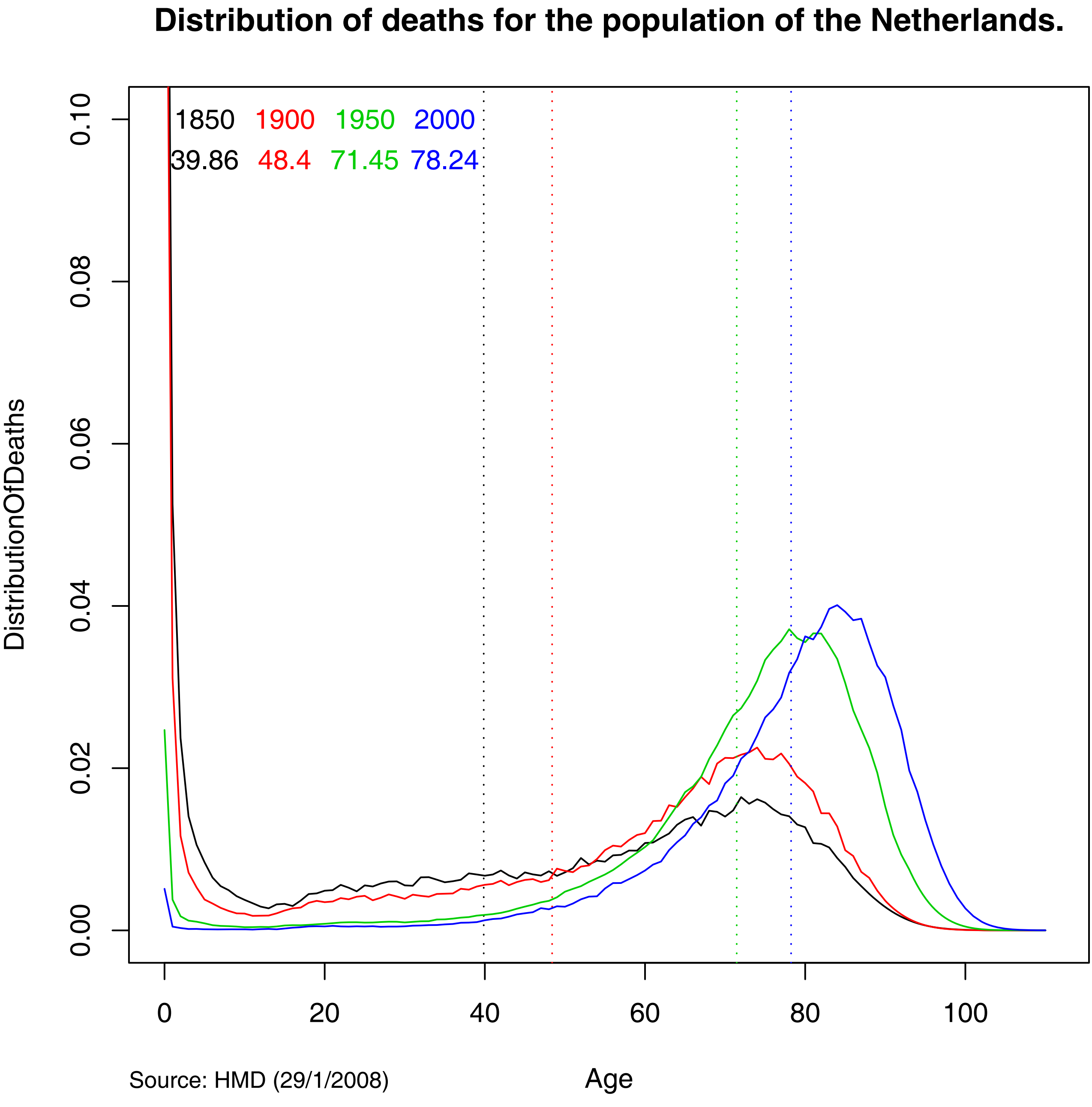
Life expectancy

$$e_0(t) = \int_0^{\omega} \ell(x,t)dx$$


Period life expectancy for the population of the Netherlands.
Life expectancy
30
40
50
60
70
80
1850
1900
1950
2000
Year
Source: HMD (29/1/2008)

Life Tables

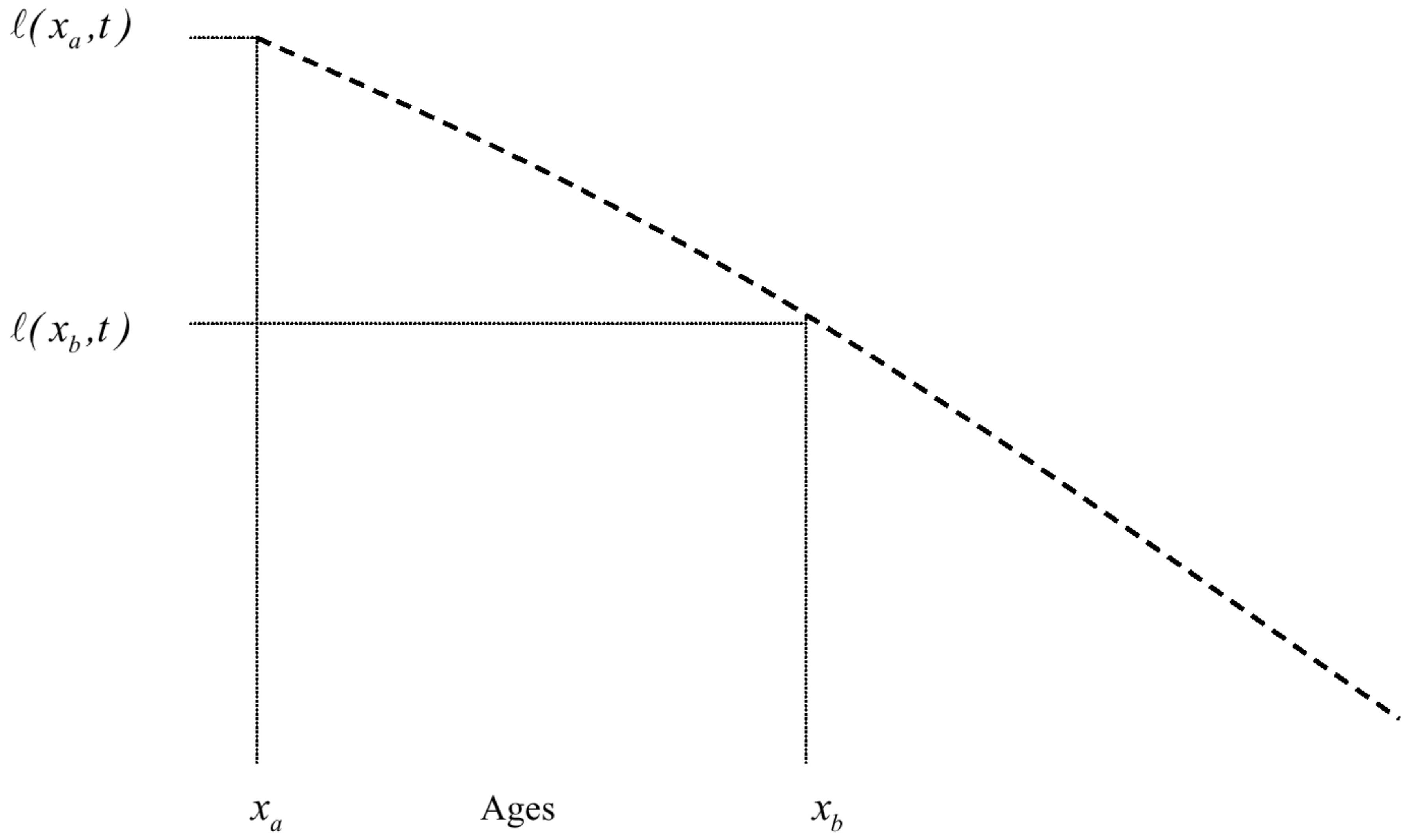
$$f(a) = \ell(a)q(a)$$


Distribution of deaths for the population of the Netherlands.
1850 1900 1950 2000
39.86 48.4 71.45 78.24
DistributionOfDeaths
0.00
0.02
0.04
0.06
0.08
0.10
0
20
40
60
80
100
Age
Source: HMD (29/1/2008)

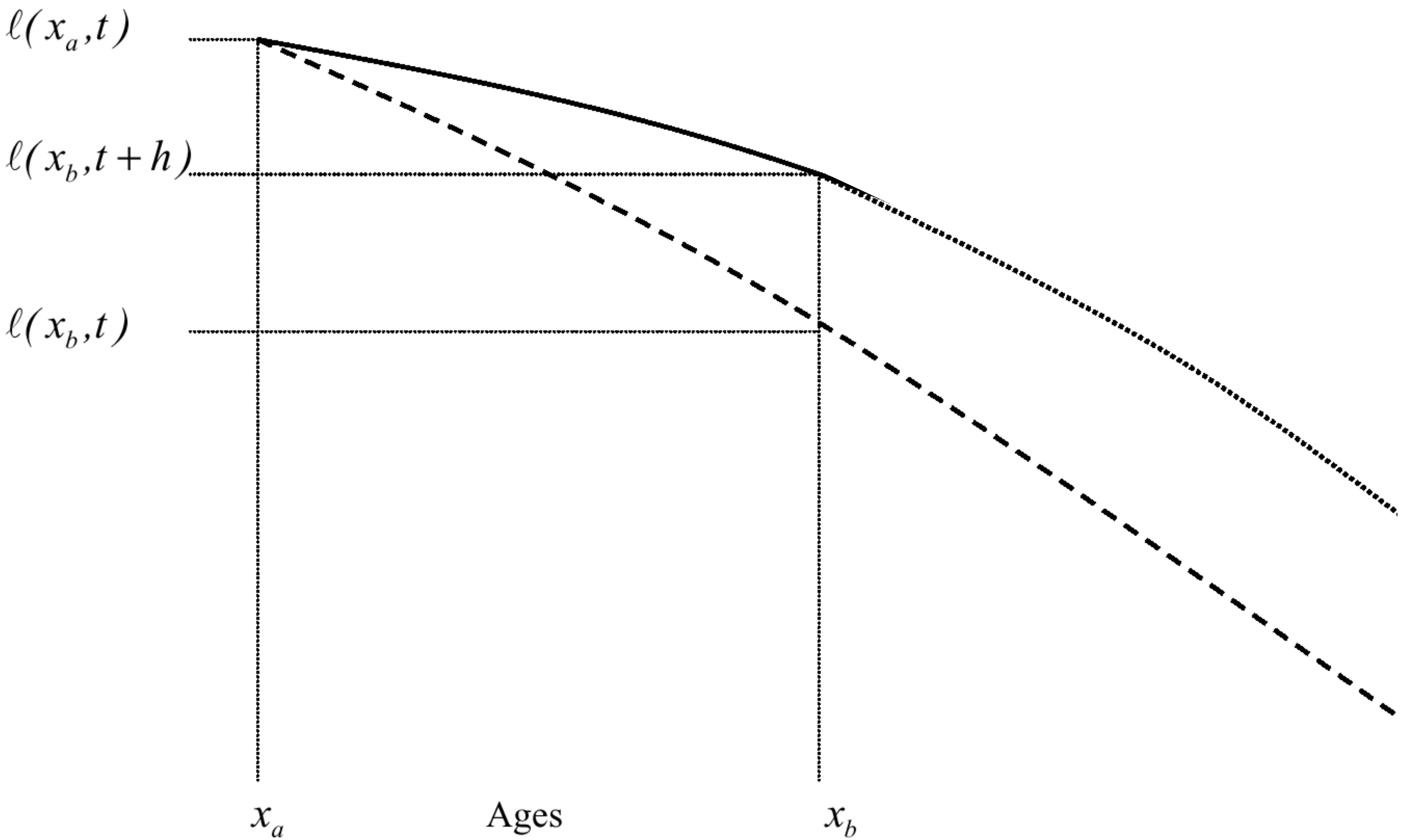
Life expectancy decomposition

$$\Delta e_0 = DE + IE$$

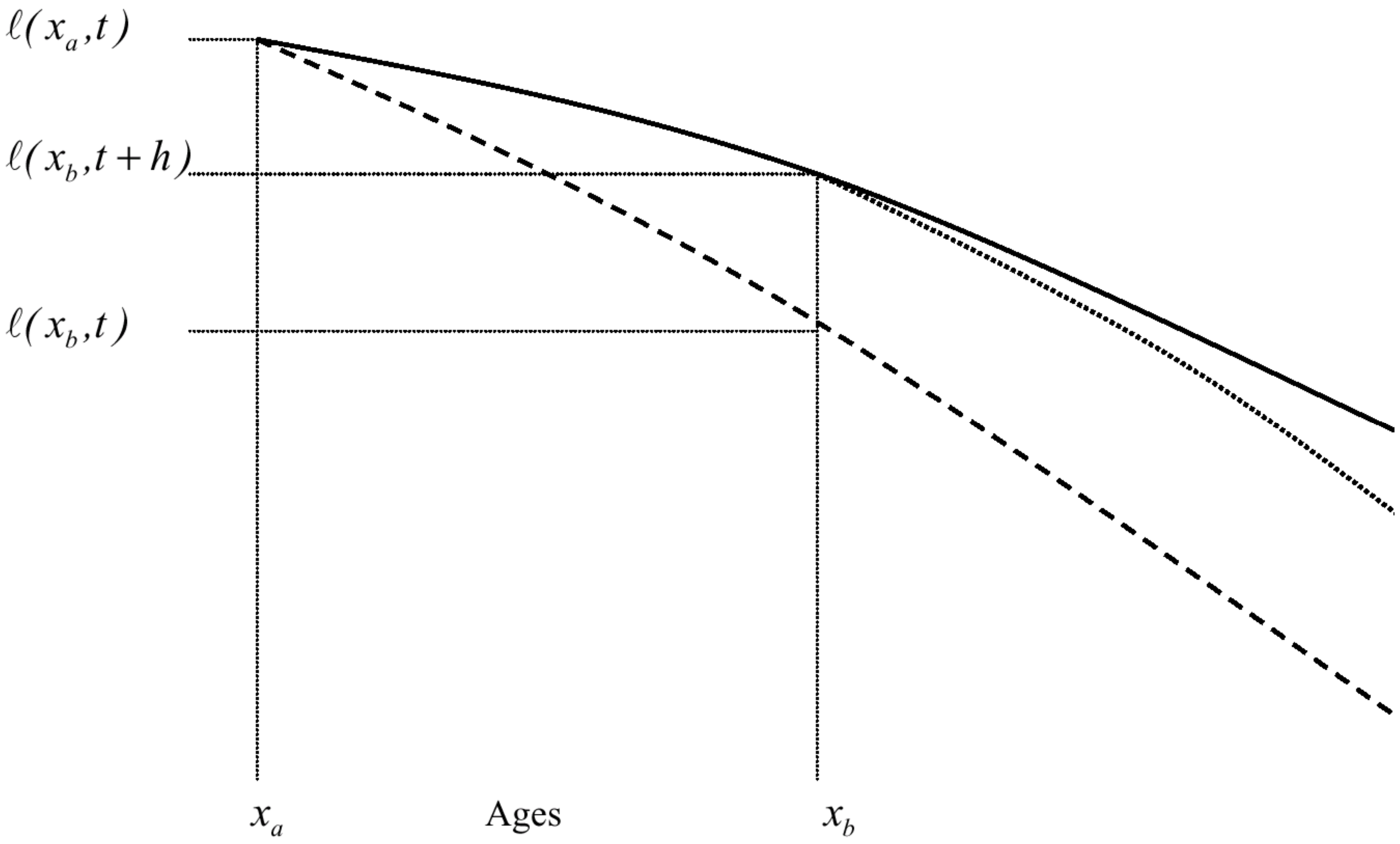
Life expectancy decomposition



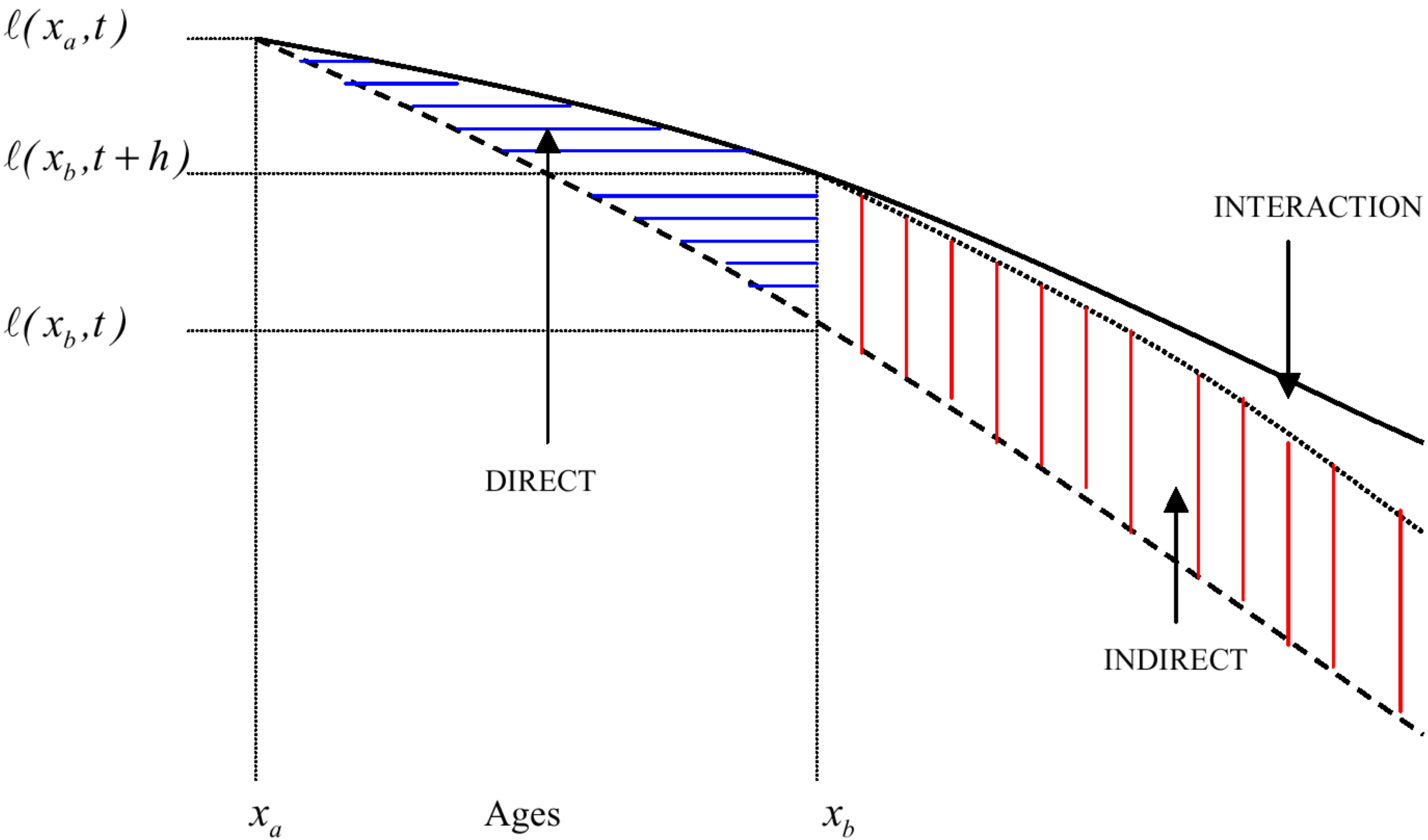
Life expectancy decomposition



Life expectancy decomposition



Life expectancy decomposition



Direct effect

$$DE = \sum_{0}^{\omega-1} l_x^1 \left[\frac{L_x^2}{l_x^2} - \frac{L_x^1}{l_x^1} \right]$$

Indirect effect

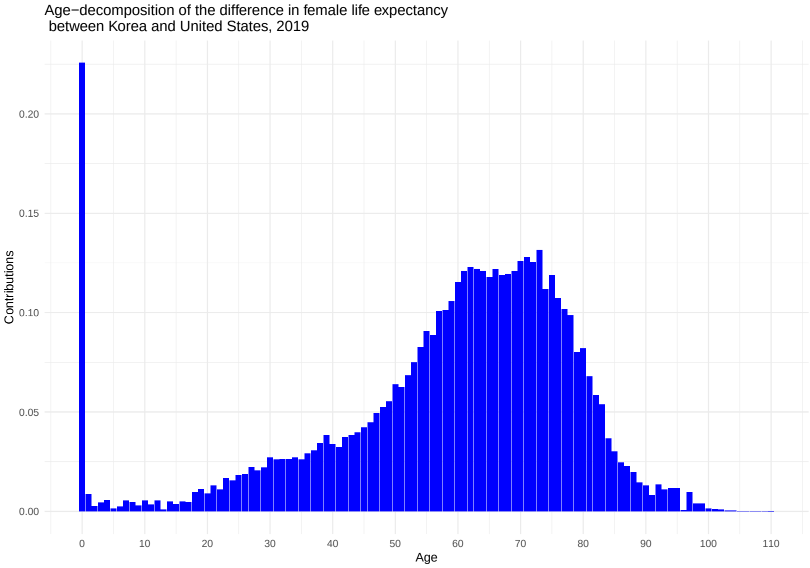
$$IE = \sum_{0}^{\omega-1} T_{x+1}^{2} \left[\frac{l_x^1}{l_x^2} - \frac{l_{x+1}^1}{l_{x+1}^2} \right]$$

Life expectancy decomposition

Table 1: Female life expectancy gap, Korea - USA, 2019

	Arriaga
Life expectancy at birth for Korea	86.3
Life expectancy at birth for USA	81.5
Life expectancy difference betwen Korea and USA	4.9
Estimated difference from decompositon	4.9

Life expectancy decomposition

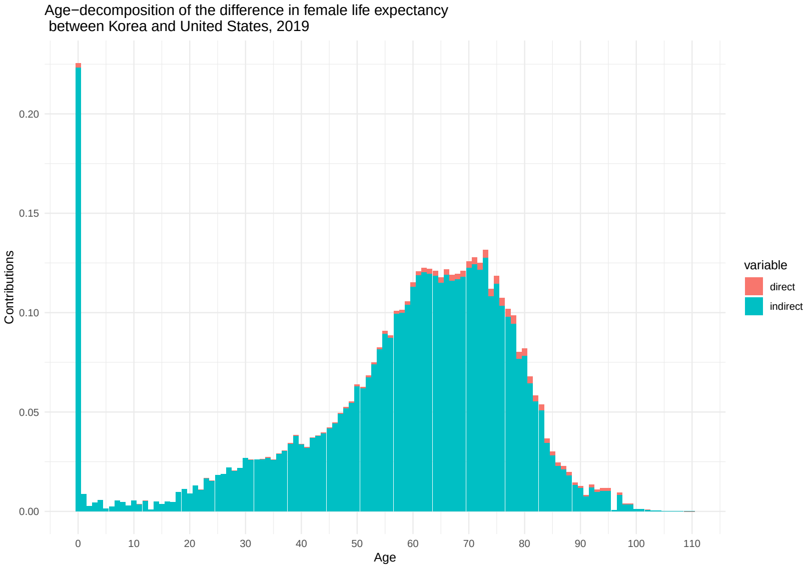


Life expectancy decomposition

Table 2: Female life expectancy gap, Korea - USA, and its components 2019

	Arriaga
Life expectancy at birth for Korea	86.3
Life expectancy at birth for USA	81.5
Life expectancy difference betwen Korea and USA	4.9
Direct component	0.1
Indirect and interaction component	4.7
Estimated difference from decompositon	4.9

Life expectancy decomposition



The Human Cause-of-Death Database

Directors: Dmitri Jdanov (MPIDR) and France Meslé (INED)

The Human Cause-of-Death Database (HCD) is a joint project of the French Institute for Demographic Studies (INED) in Paris, France and the Max Planck Institute for Demographic Research (MPIDR) in Rostock, Germany, based at the MPIDR. We seek to provide free and user-friendly access to coherent time series of cause-specific mortality for researchers, students, journalists, policy analysts, and others interested in analysis of cause-of-death patterns. In contrast to other existing databases on causes of deaths, we provide time series with causes of death classified according to a constant (fixed) list/classification of causes of death. The main goal of the database is to document trends of cause-specific mortality and to facilitate research on their comparative analyses.

Although in each country the original series of vital statistics are based on the currently acting classifications of causes of death, we provide reconstructed data according to the most recent version of the classification in use (see Background for details). We pay special attention to rigorous data checking and documentation and to warranting data comparability across time and countries by means of universal and standardized methodology. Due to peculiarities of the original national cause-of-death nomenclatures and procedures, computational procedures may be somewhat modified accordingly. Respective country-specific information is given in the Background and Documentation text for the country in question.

At present the database contains continuous data series for the following 16 countries:

Detailed data by country			
Belarus	Czech Republic	England & Wales	Estonia
France	Germany	Japan	Latvia
Lithuania	Moldova	Poland	Romania
Russia	Spain	Ukraine	USA

The HCD data series will be updated regularly. For more information, please begin by reading an overview of the database. If you have any comments or questions, or trouble gaining access to the data, please write to us.

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Joint project of the INED and the MPIDR, based at the MPIDR

MAX PLANCK INSTITUTE FOR DEMOGRAPHIC RESEARCH

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- Acknowledgements

LINKS

- Human Mortality Database
- French Institute for Demographic Studies
- Max Planck Institute for Demographic Research

Age- & Cause-decomposition

$$\Delta e_0 = \sum_x \sum_c \Delta_x^c * \Delta_x$$

Age- & Cause-decomposition

$$\Delta_x^c = \frac{R_x^c(2)m_x(2) - R_x^c(1)m_x(1)}{m_x(2) - m_x(1)}$$

Data Description

Human Causes of Death database (HCoD)

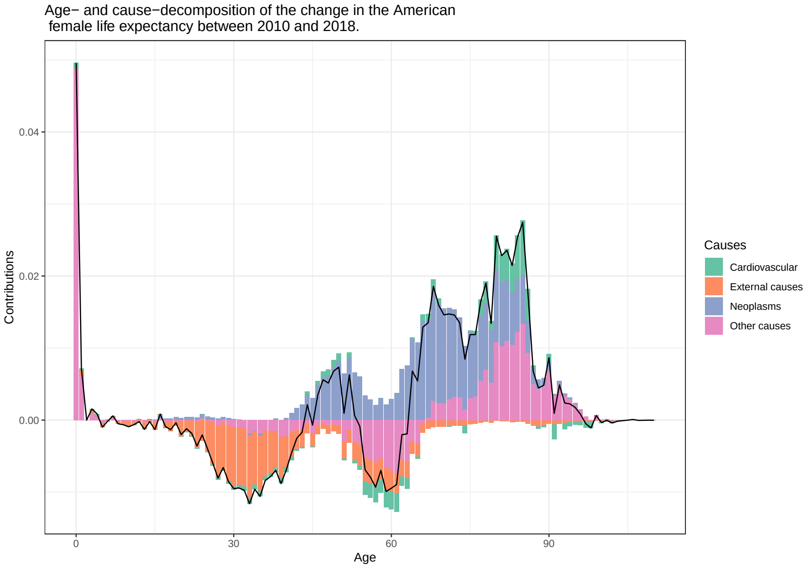
1. Neoplasms
2. Cardiovascular Diseases
3. External causes
4. Other causes

USA Causes-decomposition

Table 3: Arriaga Decomposition by age and cause

	USA
Life expectancy at birth for USA, 2010	81.06
Life expectancy at birth for USA, 2018	81.35
Life expectancy difference betwen 2010 and 2018	0.28
Cardiovascular disease	0.01
Neoplasms	0.35
External causes	-0.20
Other causes	0.11
Estimated total difference from decompositon	0.28

Cause-decomposition



BREAK

RESEARCH ARTICLE | MAY 01 2003

Decomposing change in life expectancy: A bouquet of formulas in honor of Nathan Keyfitz's 90th birthday FREE

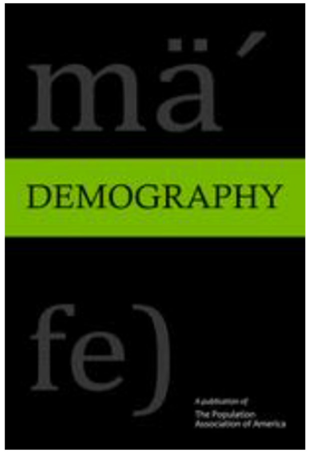
James W. Vaupel; Vladimir Canudas Romo

Demography (2003) 40 (2): 201–216.

https://doi.org/10.1353/dem.2003.0018

Volume 40, Issue 2

May 1, 2003



Abstract

We extend Nathan Keyfitz's research on continuous change in life expectancy over time by presenting and proving a new formula for decomposing such change. The formula separates change in life expectancy over time into two terms. The first term captures the general

Vaupel & Canudas-Romo Decomposition of Life Expectancy

$$\rho(x) = -\frac{\dot{m}_x}{m_x}$$

VCR decomposition

$$e^{\dagger}(t) = \int_0^{\omega} e(x,t) f(x,t) dx$$

VCR decomposition

$$\dot{e}_0(t) =$$

$$\bar{\rho}(t)e^{\dagger}(t) + Cov_f(\rho, e)$$

Decomposing change in life expectancy

Table 1: Life expectancy at birth, $e^o(0,t)$, and the decomposition of the annual change around the first of January of 1903, 1953 and 1998, in Sweden.

t	1903	1953	1998
$e^o(0, t-2.5)$	52.239	71.130	78.784
$e^o(0, t+2.5)$	54.527	72.586	79.740
$\dot{e}^o(0, t)$	0.458	0.291	0.191
$\bar{\rho}$ (%)	1.852	2.083	1.587
$e^\dagger$	22.362	11.988	10.053
$\bar{\rho}e^\dagger$	0.414	0.249	0.159
$C_f(\rho, e^o)$	0.044	0.042	0.032
$\dot{e}^o(0) = \bar{\rho}e^\dagger + C_f(\rho, e^o)$	0.458	0.291	0.191

Source: Vaupel & Canudas-Romo 2003

Population Studies ›
A Journal of Demography
Volume 69, 2015 - Issue 2

Original Articles

Truncated cross-sectional average length of life: A measure for comparing the mortality history of cohorts

Vladimir Canudas-Romo & Michel Guillot

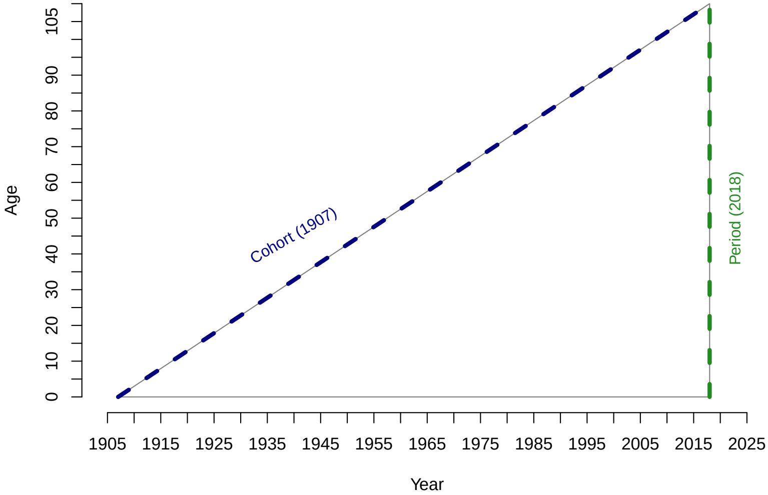
Pages 147-159 | Received 01 Oct 2013, Accepted 01 Oct 2014, Published online: 14 Apr 2015

Download citation https://doi.org/10.1080/00324728.2015.1019955 Check for updates

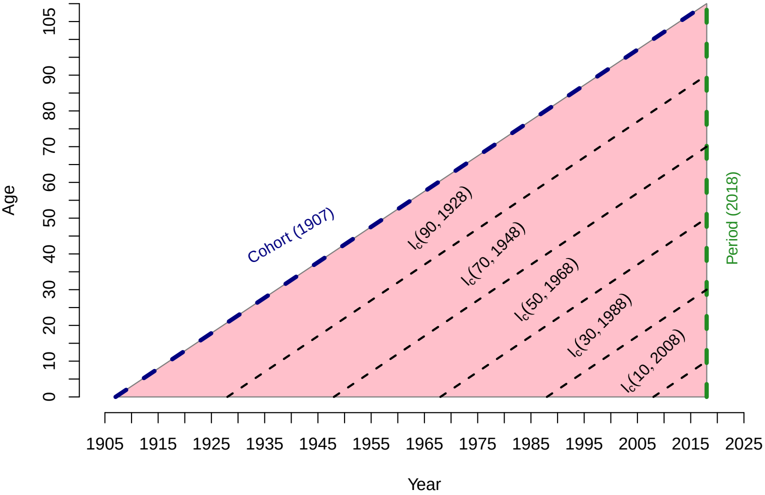
Abstract

Period life expectancies are commonly used to compare populations, but these correspond to simple juxtapositions of current mortality levels. In order to construct life expectancies for cohorts, a complete historical series of mortality rates is needed, and these are available for only a subset of developed countries. The truncated cross-sectional average length of life (TCAL) is a new measure that captures historical

Cross-sectional Average Length of Life (CAL)



Cross-sectional Average Length of Life (CAL)



CAL

$$CAL(t) = \int_0^{\omega} \ell_c(x,t)dx$$

Decomposition of CAL

$$\ell_c(x, t, i) =$$

$$p_0(t - x, i) ... p_{x-1}(t - x, i)$$

Decomposition of CAL

$$\dot{C}AL(t,\xi) =$$

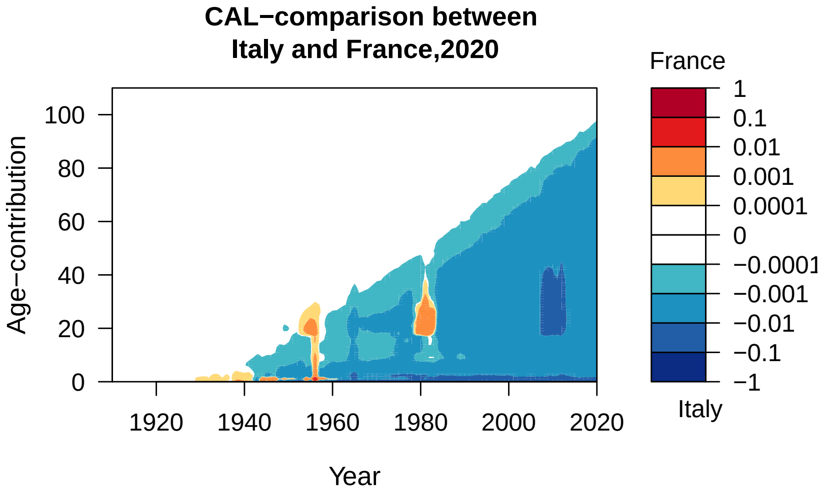
$$\int_0^{\omega} \ell_c^*(x,t,\xi) \left[\sum_{a=0}^{x} \frac{\dot{p}_a(t-x,\xi)}{p_a(t-x,\xi)} \right] dx$$

CAL decomposition

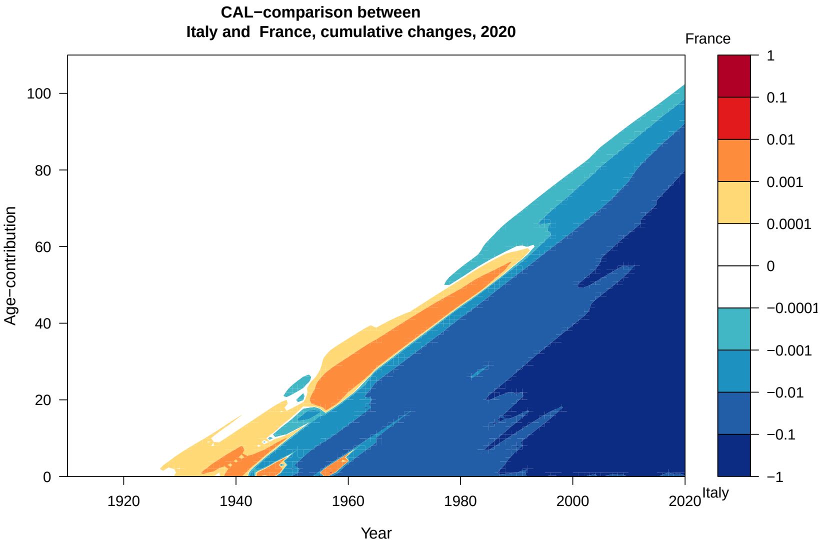
Table 5: CAL decomposition between France & Italy

CAL- France	CAL- Italy	Diff	est-Diff
43.33	61.77	-18.44	-18.83

CAL decomposition



CAL decomposition



Relative derivatives estimation (Step 1)

$$\acute{v}(x,t) \approx$$

$$\ln\left[\frac{v(x,t+h)}{v(x,t)}\right]/h$$

Mid point estimation (Step 2)

$$v\left(x, t + \frac{h}{2}\right) \approx$$

$$[v(x,t)v(x,t+h)]^{\frac{1}{2}}$$

Derivatives estimation (Step 3)

$$\dot{v}\,(x,t) = \acute{v}(x,t)v\left(x, t+\frac{h}{2}\right)$$

Assignment 3

Select one of the measures in the examples of this section and apply to a different population from HMD or HFD.

Submit ONE page: one Figure (or Table) and a brief paragraph describing the results that you find.