

# MortalityLaws R Package

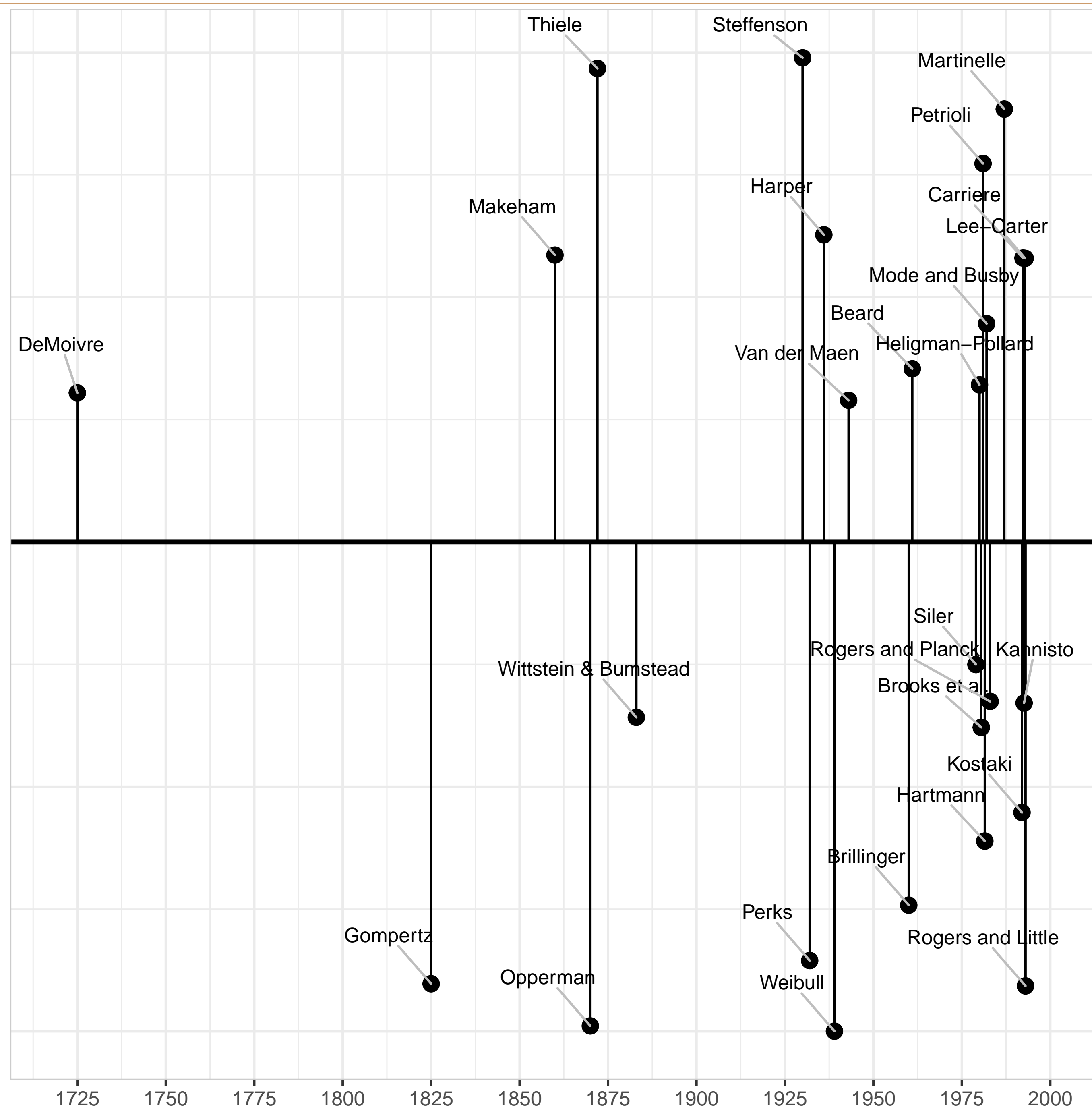
## A History of Mortality Modeling from Gompertz to Lee-Carter

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### MORTALITY MODELLING TIMELINE

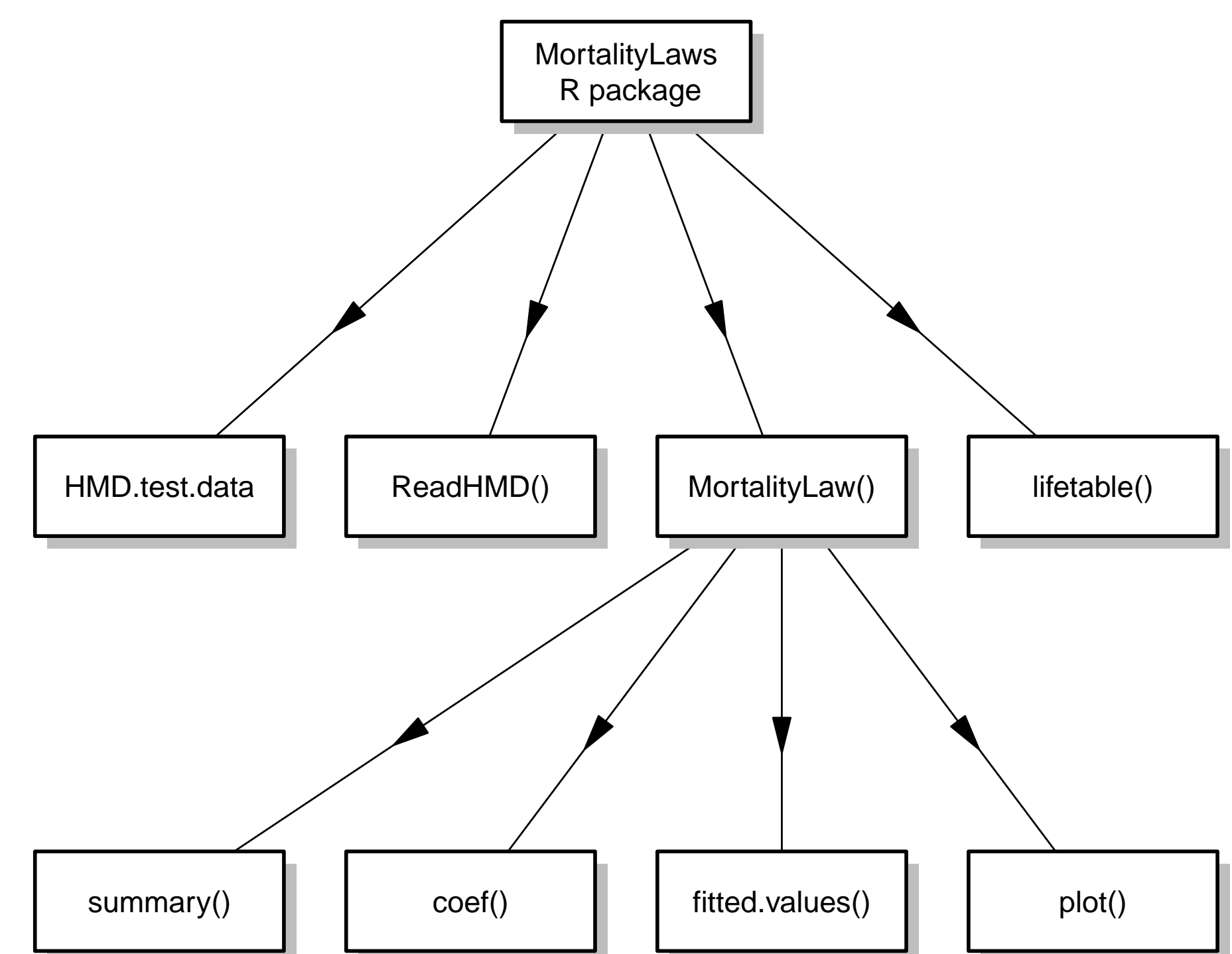


### MAIN OBJECTIVE

Build an R package that is capable of performing multiple tasks in a matter of seconds. For example:

- Download and save HMD data;
- Fit mortality laws over different age intervals;
- Provide multiple fitting procedures for the same model (MLEs, loss functions etc.);
- Smooth data;
- Construct life tables given different type of input data ( $q_x, m_x, D_x, E_x$  etc.);
- Facilitate comparisons of mortality improvements accros time and ages;
- Generate instant plots and goodness of fit measures.

### THE STRUCTURE OF THE MORTALITYLAWS R PACKAGE



### IMPLEMENTED PARAMETRIC FUNCTIONS & GENERIC PLOTS

Mortality laws	Predictor	Code
Gompertz	$ae^{bx}$	gompertz0
Gompertz	$\frac{1}{\sigma} \exp\left\{\frac{x-m}{\sigma}\right\}$	gompertz
Inverse-Gompertz	$\frac{1}{\sigma} \exp\left\{\frac{x-m}{\sigma}\right\} / \left(\exp\left\{e^{-\frac{x-m}{\sigma}}\right\} - 1\right)$	invgompertz
Makeham	$ae^{bx} + c$	makeham0
Makeham	$\frac{1}{\sigma} \exp\left\{\frac{x-m}{\sigma}\right\} + c$	makeham
Inverse-Makeham	$\frac{1}{\sigma} \exp\left\{\frac{x-m}{\sigma}\right\} / \left(\exp\left\{e^{-\frac{x-m}{\sigma}}\right\} - 1\right) + c$	invmakeham
Opperman	$\frac{a}{\sqrt{x}} + b + c\sqrt{x}$	opperman
Thiele	$a_1e^{-b_1x} + a_2e^{-\frac{1}{2}b_2(x-c)^2} + a_3e^{b_3x}$	thiele
Wittstein & Bumstead	$\frac{1}{m}a^{-(mx)^n} + a^{-(M-x)^n}$	wittstein
Weibull	$\frac{1}{\sigma}\left(\frac{x}{m}\right)^{\frac{m}{\sigma}-1}$	weibull
Inverse-Weibull	$\frac{1}{\sigma}\left(\frac{x}{m}\right)^{-\frac{m}{\sigma}-1} / \left(\exp\left\{\left(\frac{x}{m}\right)^{-\frac{m}{\sigma}}\right\} - 1\right)$	invweibull
Siler	$a_1e^{-b_1t} + a_2 + a_3e^{b_3t}$	siler
Heligman - Pollard	$A(x+B)^C + De^{-E(\ln x - \ln F)^2} + GH^x$	HP
Kannisto	$\frac{ae^{bx}}{1+ae^{bx}} + c$	kannisto
Carriere	$s(x) = \psi_1s_1(x) + \psi_2s_2(x) + \psi_3s_3(x)$	carriere1

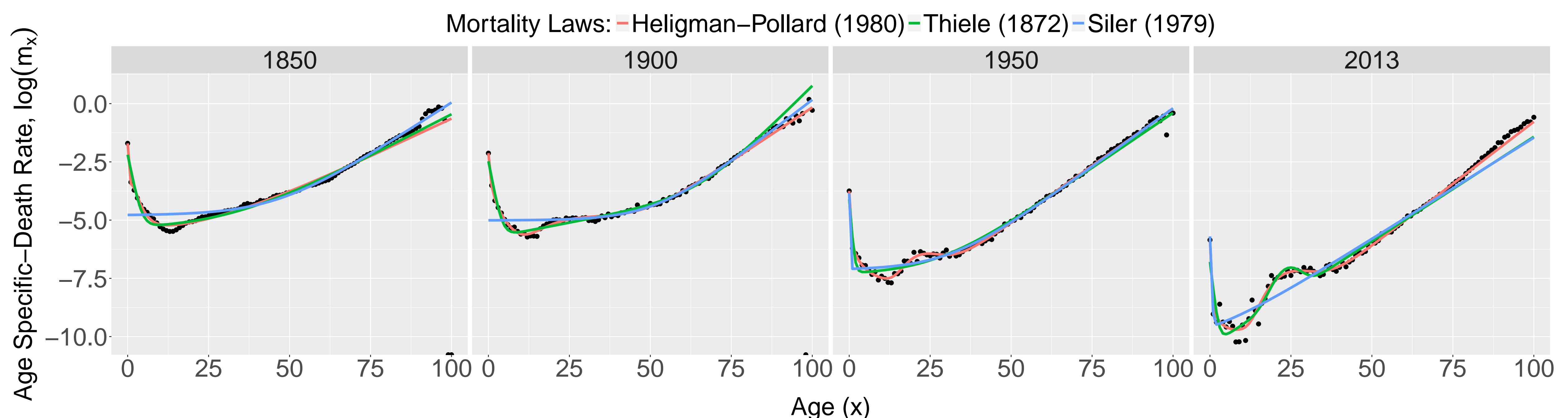
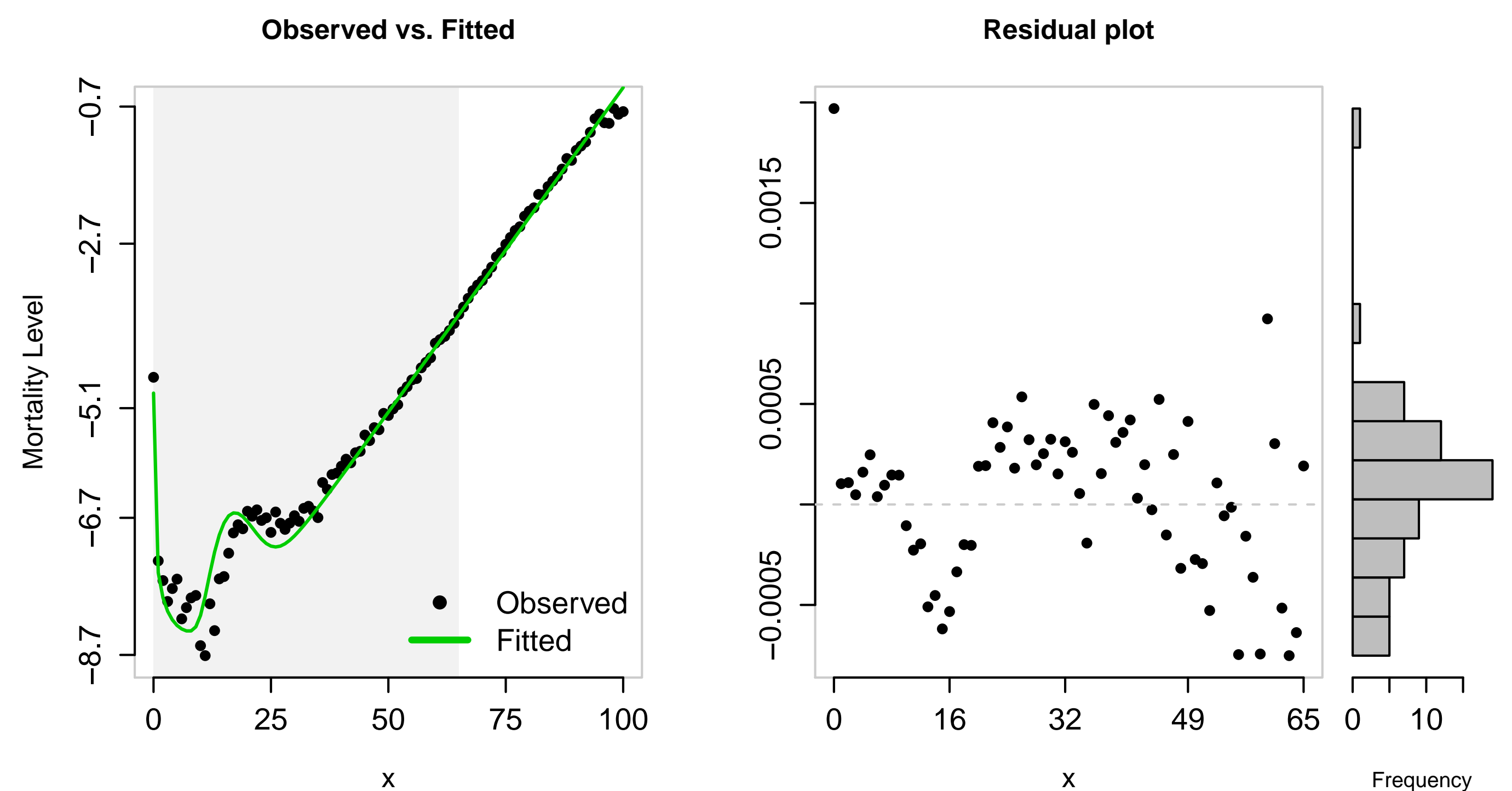


Figure 1: Observed and fitted death rates between age 0 and 80 for male population in Sweden. The mortality is extrapolated up to age 100.