

Chapter 4

Surface Plots of Observed Death Rates

4.1 From Death Counts to Death Rates

The basic units of any mortality analysis are death counts. In most scientific disciplines those counts are expressed as rates by dividing them by a unit of time. Examples are heart rates counting beats per minute or becquerel measuring the radioactive decay of nuclei per second. Things are more complicated when death counts are analyzed: For instance, 30,140 people died at age 80 in Germany in 2000. The corresponding number of Austria is 2,765 (HMD, 2017). Inferring that the risk of dying is more than ten-fold higher in Germany than in Austria is obviously wrong. Death rates are—as all demographic rates—therefore standardized dividing the counts by the corresponding number of life-years lived (see, for example Chap. 1.4 in Preston et al. 2001). The latter are often called “exposures” and are typically approximated by an estimate of the mid-year population. In the example above, the death rates at age $x = 80$ in year $t = 2000$, usually denoted as $m(x, t)$ would correspond to:

$$\begin{aligned} \text{Austria : } m(x, t) &= \frac{D(x, t)}{N(x, t)} = \frac{2765}{42,070.77} = 0.06572259 \\ \text{Germany : } m(x, t) &= \frac{D(x, t)}{N(x, t)} = \frac{30140}{444,400.81} = 0.06782166 \end{aligned}$$

with death counts and exposures denoted as $D(x, t)$ and $N(x, t)$, respectively. Hence, mortality is still higher in Germany than in Austria but only by about three per cent and not by an order of magnitude. Death rates at those single ages x , that are used

exclusively in this book, are often a good approximation for the continuous force of mortality at the middle of that age $\mu(x + 0.5)$ (Thatcher et al. 1998). Nearly all of the analyses contained in this volume are based on such death rates.

4.2 Results

The raw surface plots on the following pages depict the observed death rates for women and men in a few selected countries. Death rates were estimated for single ages and single years from 1950 until the last available year in the Human Mortality Database, in most cases 2014 (see Chap. 3). Our color scheme ranges from blue to green to red. To facilitate interpreting the plots, we added contour lines for various levels of mortality similar to the ones for elevation on topographic maps. The levels of 1 death per 10 person-years lived, per 100 person-years lived, per 1,000 person-years lived, and per 10,000 person-years lived have been printed as bold lines as visual cues not because of any implicit distinct meaning apart from the digit preference.

Generally speaking, we do not think that raw surface plots are the best option to visualize mortality dynamics. That is why we only depict a few countries here. One of the main problems is that the observed rates suffer from random fluctuations. At young ages because death rates are so low; at older ages because there are so few people left. Thus, the numerator for the observed death rates is relatively small in the first case whereas the denominator is relatively small in the latter case.

What we can observe for Australian women and men in Figs. 4.1 and 4.2 is representative for many countries in the Human Mortality Database¹: Most contour lines tend to move upwards over time. This indicates that the same level of mortality is being observed at higher and higher ages. Or, expressed differently, mortality is continuously decreasing at almost any given age. Switzerland and Spain in Figs. 4.3, 4.4, 4.5 and 4.6 are further examples of this general trend. It seems to be noteworthy that the late 1990s seems to be an important era for major improvements in mortality among young males.

We can already observe here the unfortunate mortality developments that took place in Russia (Figs. 4.7–4.8) as well as in many other eastern European countries

¹See Figs. A.1–A.6 in the appendix for corresponding plots for France, England and Wales, and Norway.

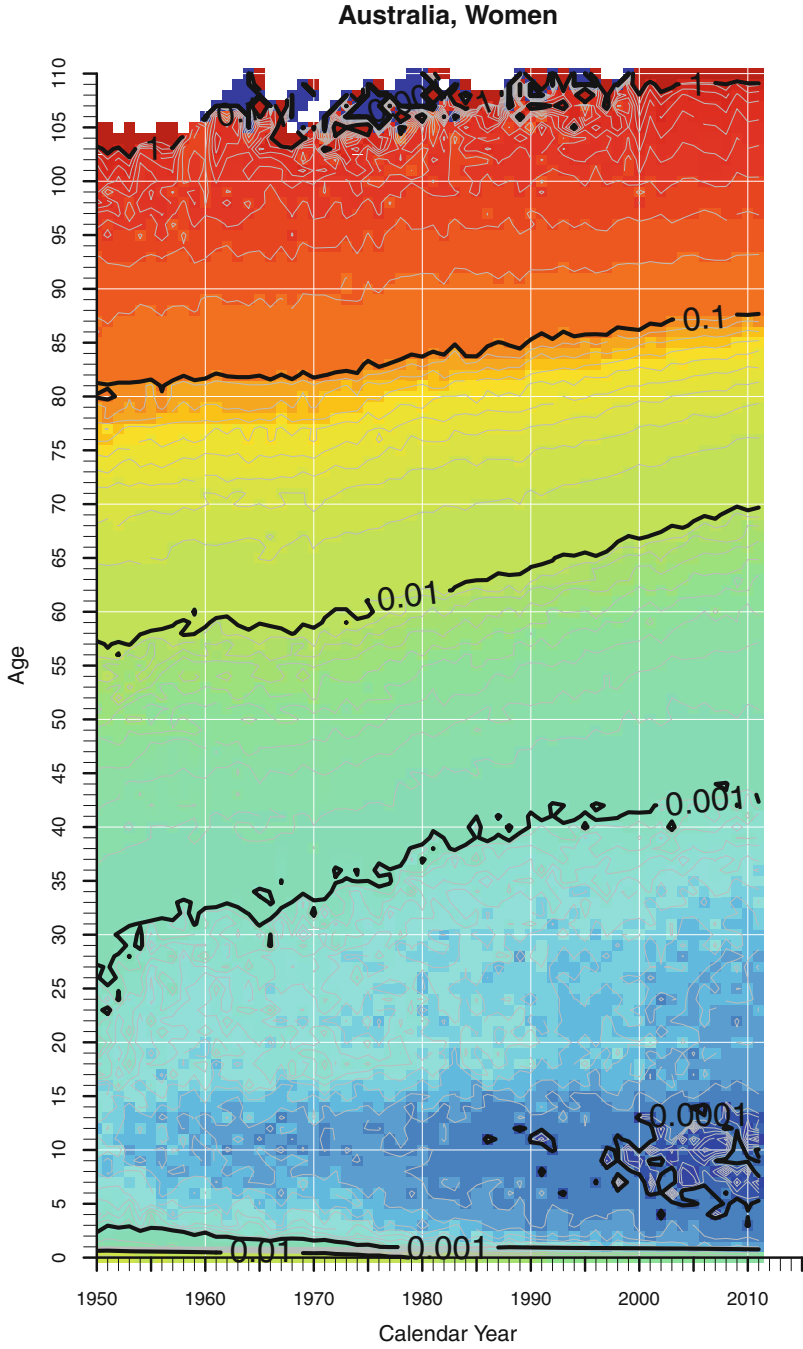


Fig. 4.1 “Raw” death rates for women in Australia, 1950–2011 (Data source: Human Mortality Database)

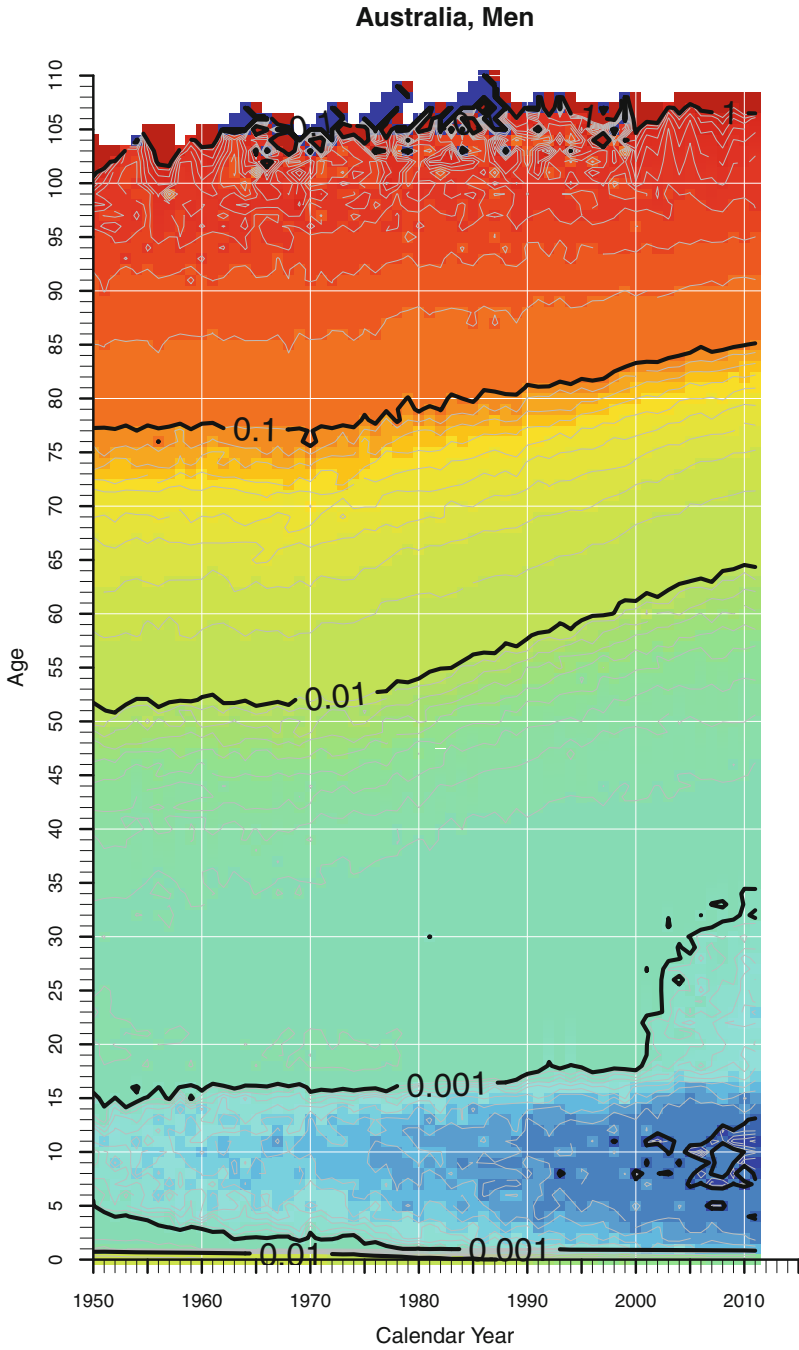


Fig. 4.2 “Raw” death rates for men in Australia, 1950–2011 (Data source: Human Mortality Database)

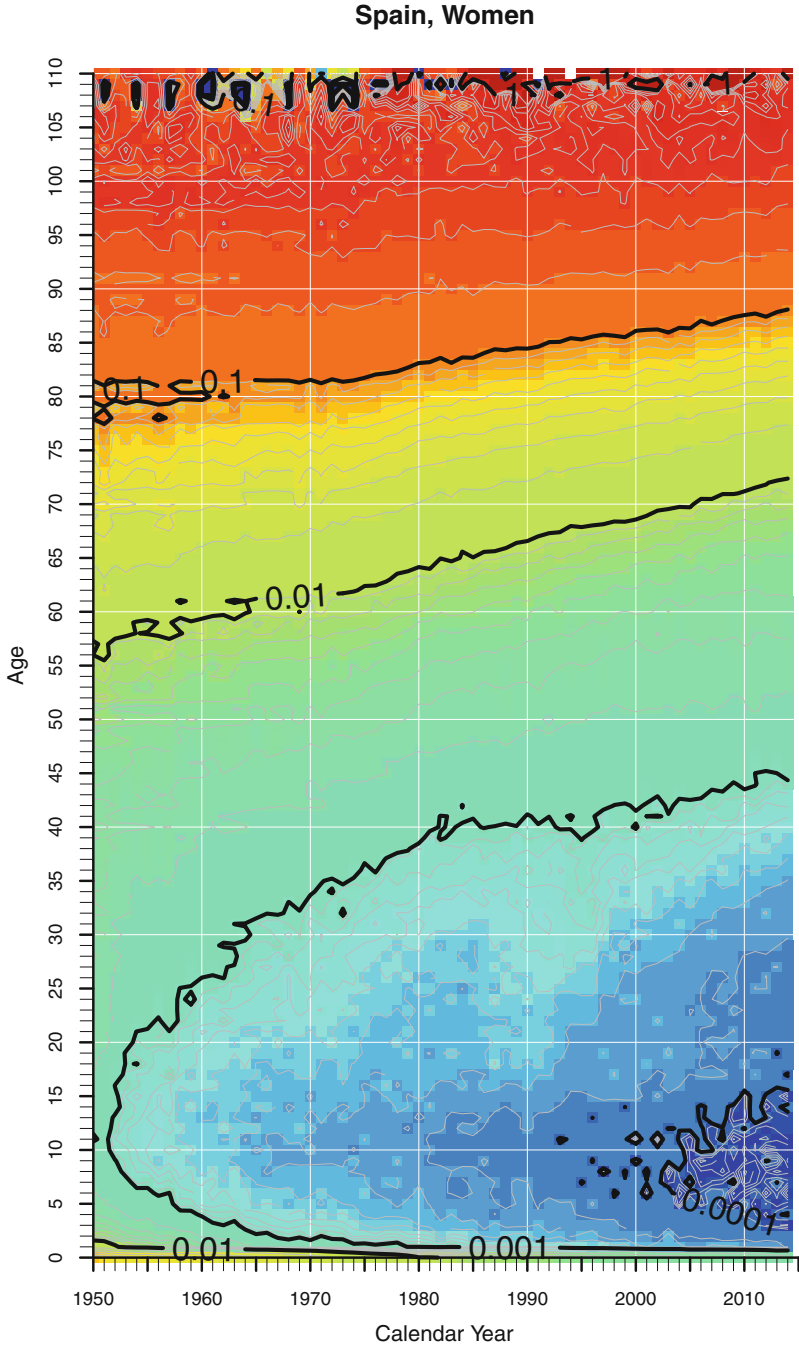


Fig. 4.3 “Raw” death rates for women in Spain, 1950–2014 (Data source: Human Mortality Database)

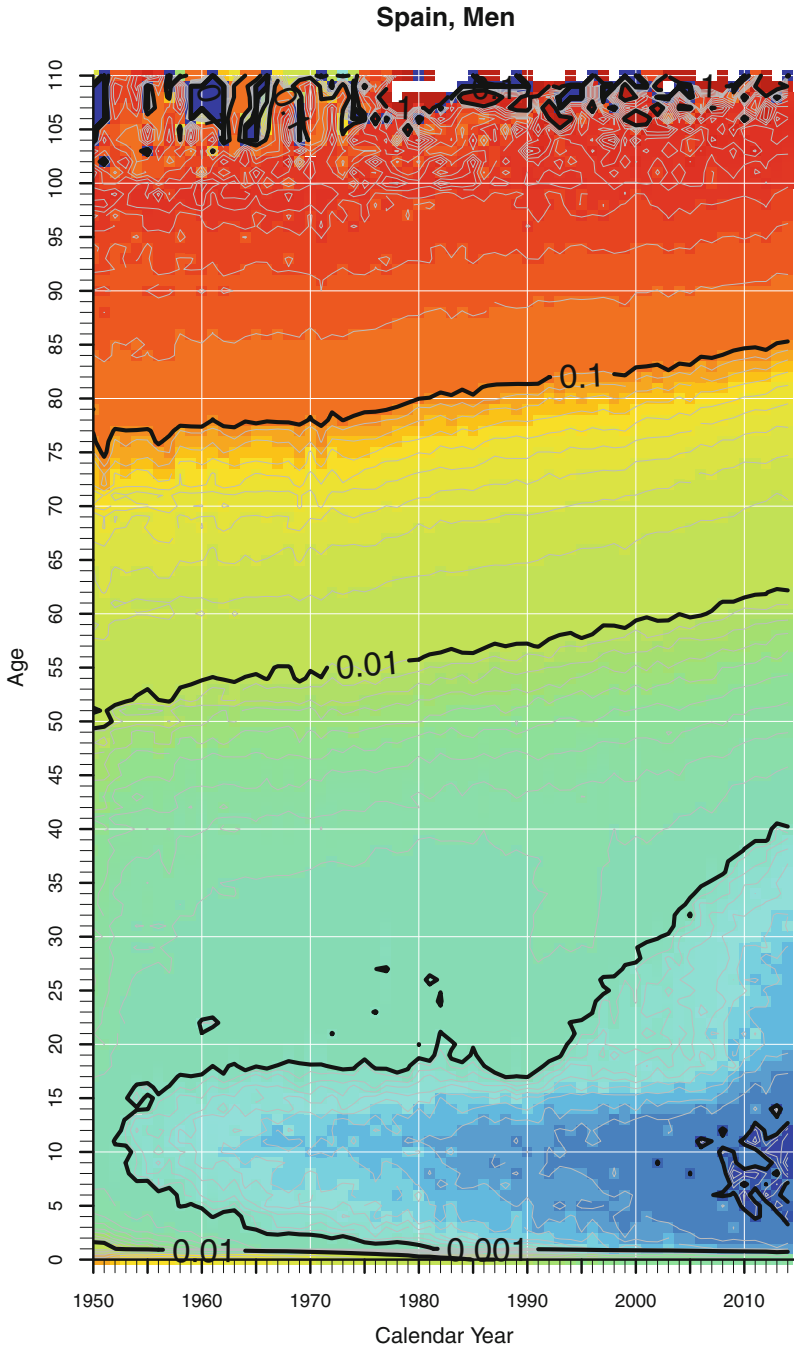


Fig. 4.4 “Raw” death rates for men in Spain, 1950–2014 (Data source: Human Mortality Database)

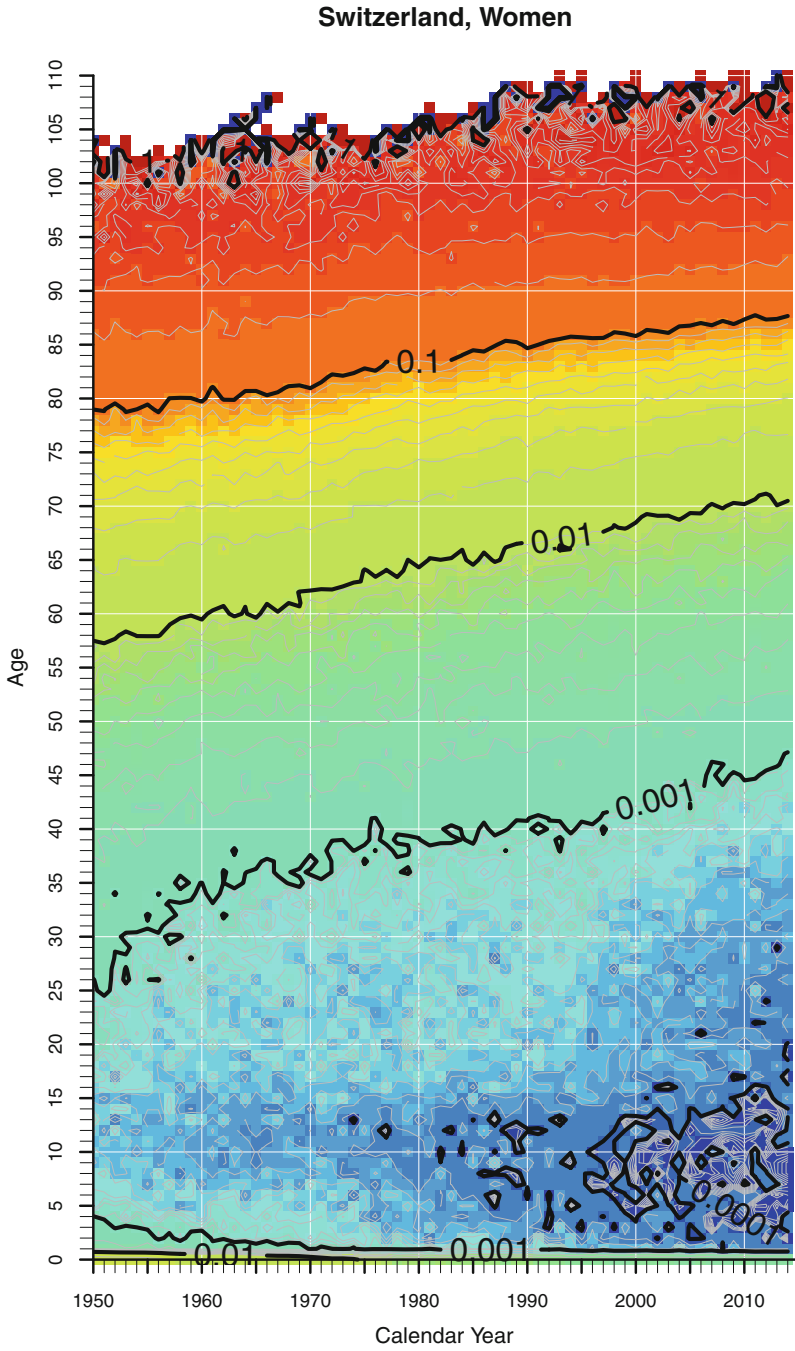


Fig. 4.5 “Raw” death rates for women in Switzerland, 1950–2014 (Data source: Human Mortality Database)

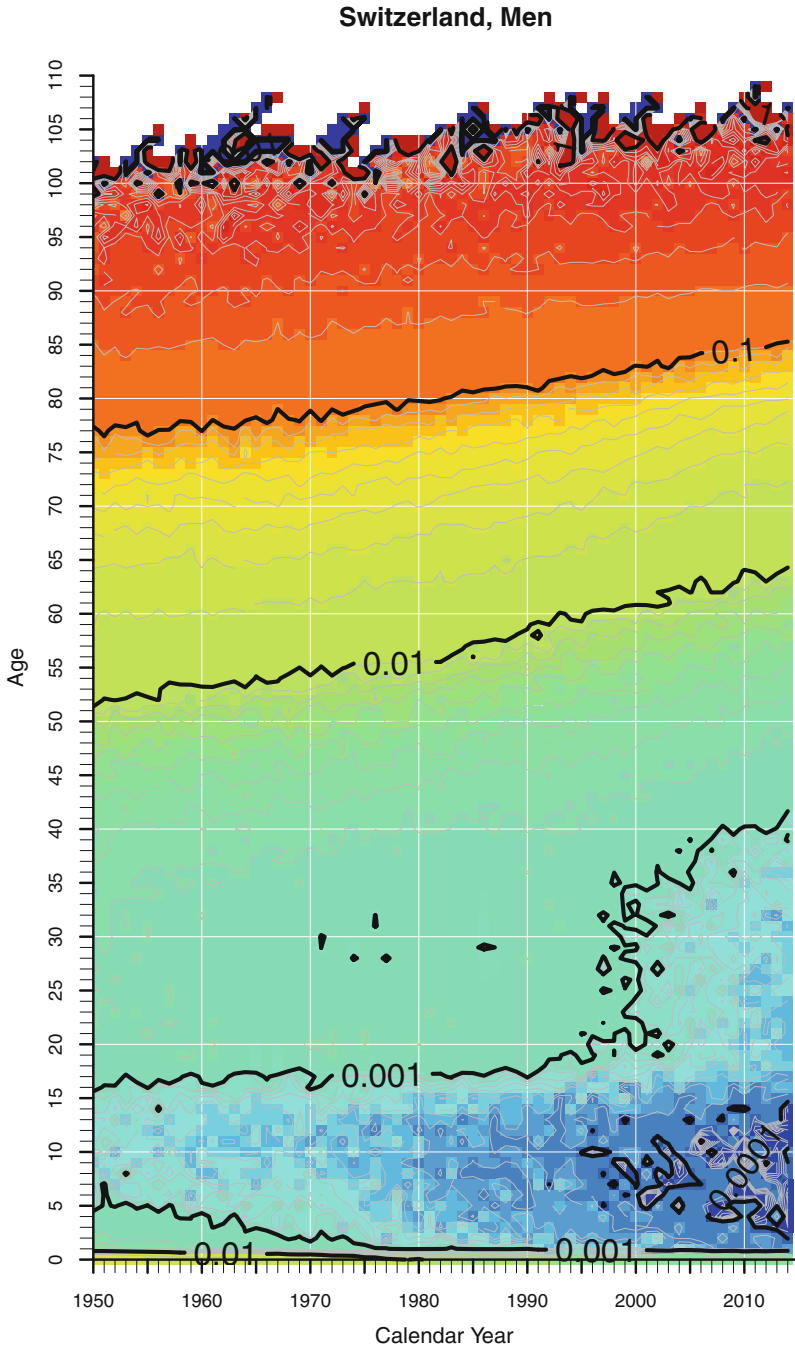


Fig. 4.6 “Raw” death rates for men in Switzerland, 1950–2014 (Data source: Human Mortality Database)

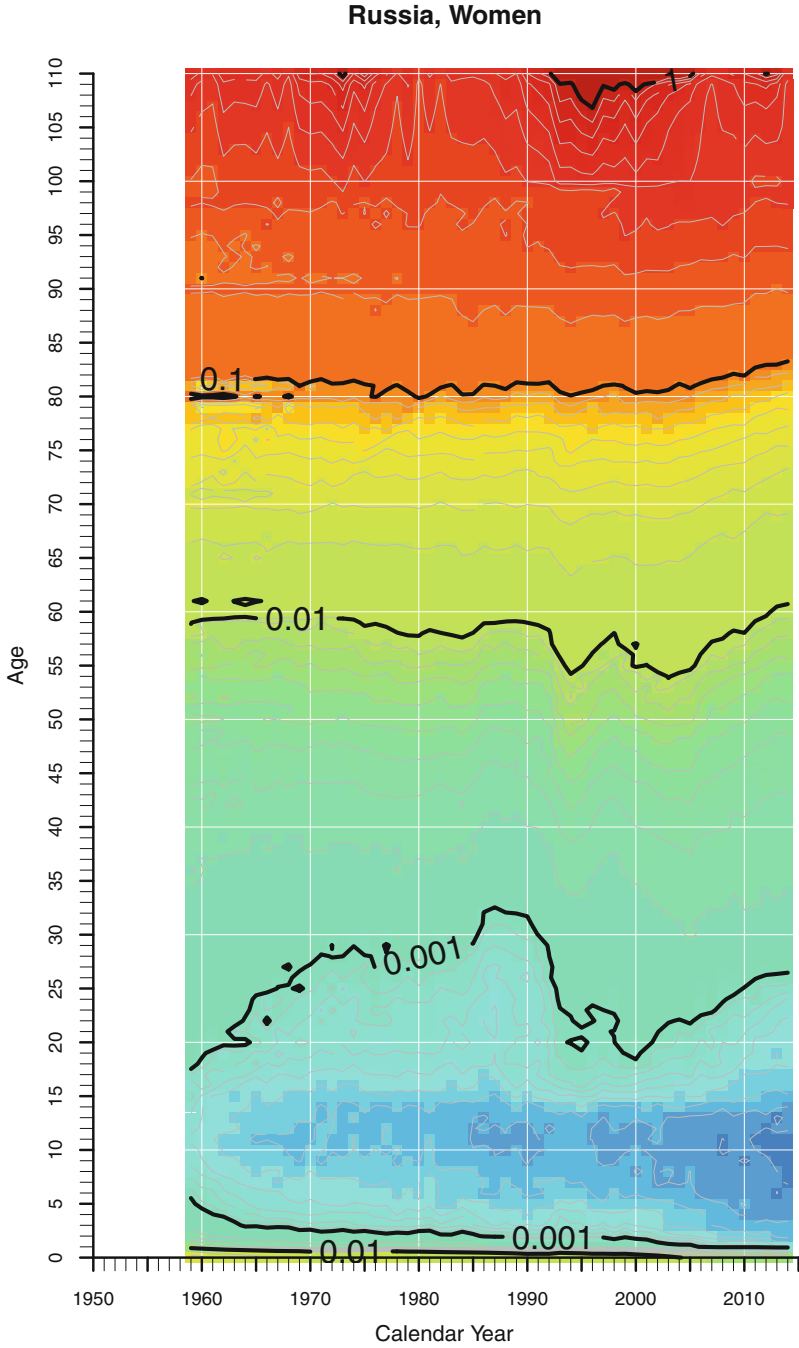


Fig. 4.7 “Raw” death rates for women in Russia, 1959–2014 (Data source: Human Mortality Database)

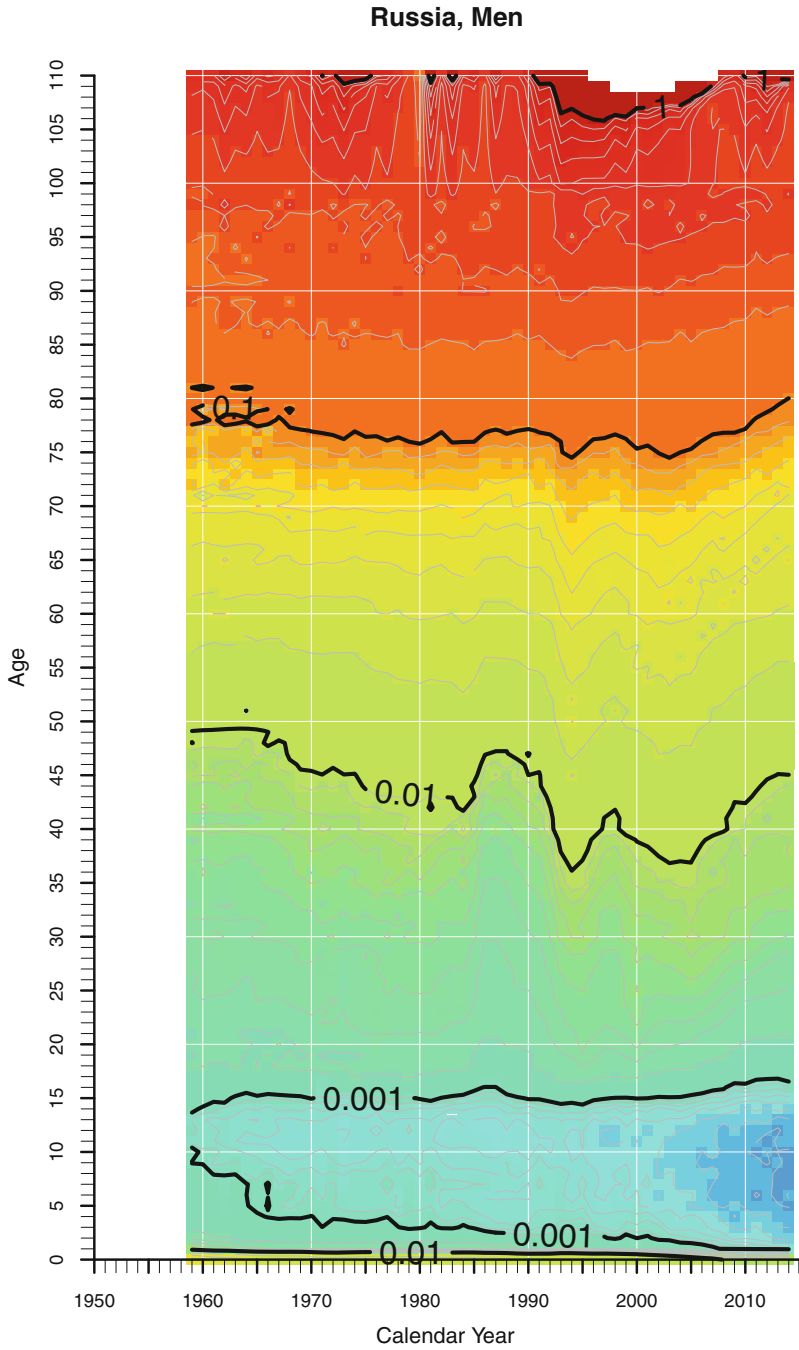


Fig. 4.8 “Raw” death rates for men in Russia, 1959–2014 (Data source: Human Mortality Database)

(not shown here) that have been distinct from the rest of Europe: Irregular trends, especially among males, and even increasing mortality as depicted by the downward contour lines have been rather the rule than the exception between the 1960s and the early 2000s.

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