Mortality Modeling of Partially Observed Cohorts Using Administrative Death Records

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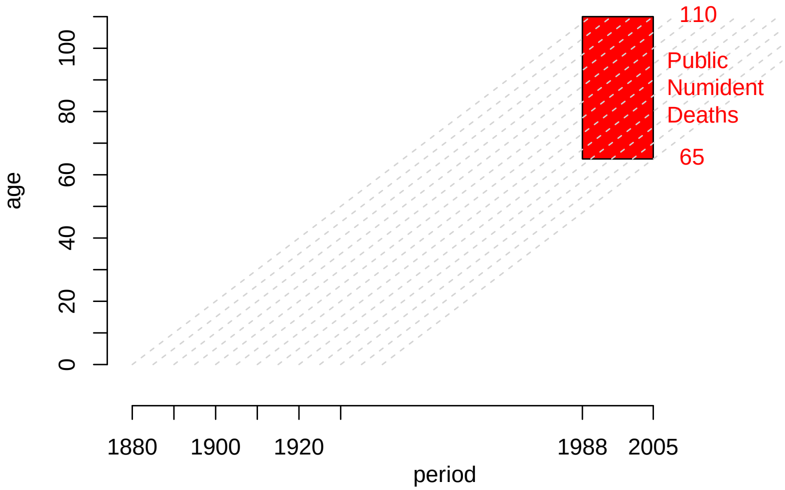
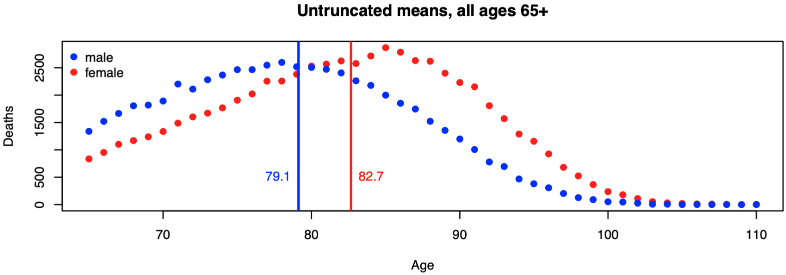
Our problem

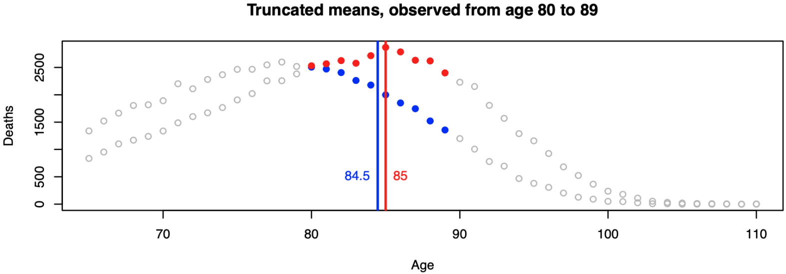
- Administrative data often complete only for limited years
- So we see only limited variation in ages at death
- This truncation biases all “effects’ (education, weather, income, neighborhood, race, ...) toward zero
- Our goal is to remove this bias and get “true” effect

Our Truncation Problem: Public-released Social Security Numident Data

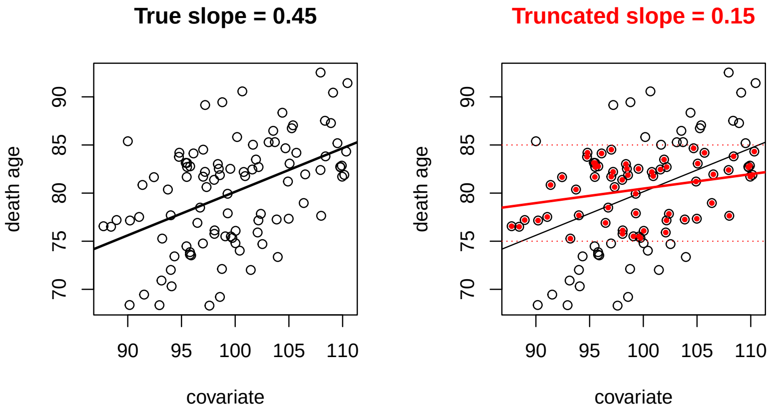


Artificial example of truncation bias (Sweden 1900 cohort – Human Mortality Database)





Regression example, simulation with covariate



Truncation removes lowest lows and highest highs, which tend to be at extremes of covariate, flattening the estimated slope.

Our Solution: Maximum Likelihood Accounting for Truncation

- Assume Gompertz mortality, with proportional effects (other choices allowed)
- Conditional probability of observed death age, given truncation

$$f(x \mid L < x < R) = \frac{f(x)}{F(R) - F(L)}$$

- Maximize the likelihood

$$\mathsf{L} = \prod_i \frac{f(x_i)}{F(R_i) - F(L_i)}$$

Note: direct output is proportional effect on hazard, but can transform to $e(65)$

Application to education, cohort of 1915

In CenSoc Numident, we have complete deaths for 1988-2005, ages 73-90. Can artificially make window narrower and see what happens

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Marginal effect of 1-year of education on e(65)
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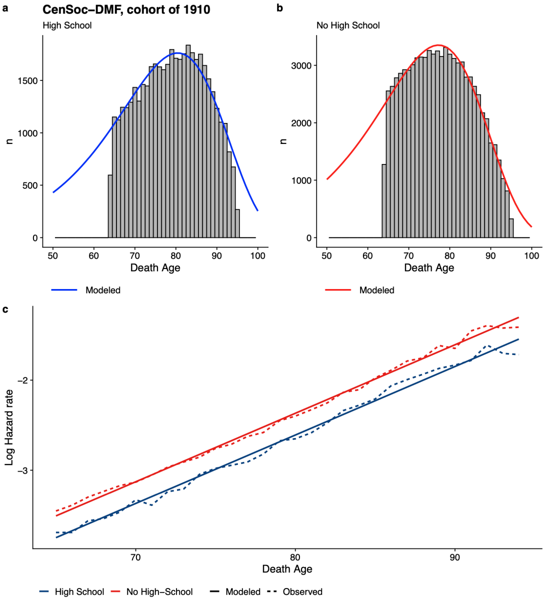
	regression	Our method
1988-2005	0.17	0.63
1991-2002	0.09	0.58

Two important results:

1. Truncation has huge downward bias (estimates only 1/4 the size)
2. Differential truncation influences regression, but not our method

Graphical diagnostics



Applications

Method motivated by

- CenSoc (www.censoc.org) linked data sets to 1940 Census
- Berkeley Unified Numident Mortality Database

(These very large individual-level data sets allow analysis of mortality based on any individual or small area characteristics in 1940 census)

But other potential applications

- Matched data, false survivorship, and "Methusela Effect"
- Deaths-only data from medfly experiments and biodemography
- Other deaths-only data (genealogies, death indices etc)

Conclusions

- Partially observed cohort mortality (without denominators) can still produce good estimates
- Don't just regress on age-at-death, or you'll be biased.
- Easy to take truncation into account using maximum likelihood
- Good results (comparable to estimates in literature)
- `gompertztrunc` package for R