Kin-Cohort analysis

Diego Alburez-Gutierrez

13 Feb 2020

Cumulative child death

We propose an extension to the Goodman-Keyfitz-Pullum kinship equations (GKP equations) (Keyfitz 1985), to estimate the cumulative number of offspring deaths experienced by a woman surviving to age *a*, standing before us:

$$OD^{k}_{(a,c,p)} = \sum_{x=\alpha}^{a} {}_1F_{(x,c,p)} - \sum_{x=\alpha}^{a} {}_1F_{(x,c,p)} \; {}_1l_{(\min(a-x,k),c+x,p)} \qquad (1)$$

where $k = 1$ for infant deaths, $k = 5$ for child deaths and $k = 100$ for all-age offspring deaths. We restrict the female reproductive age $[\alpha, \beta]$ to $(\alpha, \beta, n) = (15{,}50{,}1)$, so that $a \leq \beta + k$ for all cases.

Proportion of bereaved women per 1,000 women

In order to determine the prevalence of bereaved women in a population, we start by considering the age-specific probability that an average woman will experience the death of a child:

$${}_1q^{k}_{(a,c,p)} = 1 - e^{-h(a,c,p)} \qquad (2)$$

where $h(a,c,p) = OD^{k}_{(a+1,c,p)} - OD^{k}_{(a,c,p)}$ is the hazard rate of experiencing the death of a child younger than *k* (Wachter 2014). We create a life table (Preston, Heuveline, and Guillot 2001) with a unit radix $l^{k}_{0} = 1$ where ${}_1q^{k}_{(a,c,p)}$ is the probability of losing a child. We define $FOD^{k}_{(a,c,p)} = 1 - {}_1l^{k}_{(a,c,p)}$ as the fraction of women aged *a* in cohort *c* who ever experienced the death of a child younger than *k*. Next, we account for the mortality of women with the help of $\mathrm{FWS}_{(a,c,p)}$, the fraction of women that survived up to age *a* after the start of reproductive age α in each birth cohort (where $\alpha < a$). We approximate this using country-specific period life tables from the UN WPP. The proportion of women (per 1,000 mothers) who have ever lost one or more children younger than *k* is:

$$wOM^{k}_{(a,c,p)} = FOD^{k}_{(a,c,p)} * FWS_{(a,c,p)} * 1000. \qquad (3)$$

We estimate an equivalent measure for mothers by rescaling our estimates using a similar life table approach. We consider fertility as a "hazard rate" to approximate the number of women that "survive" having children (i.e. remain childless) after experiencing a set of age-specific fertility rates. The fraction of women who have ever been mothers $FM_{(a,c,p)}$ is approximated as 1 minus the fraction of childless women. We can now define, for a given cohort, the proportion of mothers (per 1,000 mothers) who have ever lost one or more children younger than *k*:

$$mOM^{k}_{(a,c,p)} = wOM^{k}_{(a,c,p)} * FM_{(a,c,p)}. \qquad (4)$$

We generate period estimates of the prevalence of bereaved mothers, comparable to the empirical DHS estimates, using different combinations of cohort and age.

References

Keyfitz, N. (1985). *Applied Mathematical Demography*. New York: Springer. http://public.eblib.com/choice/publicfullrecord.aspx?p=3084208.

Preston, S.H., Heuveline, P., and Guillot, M. (2001). *Demography: Measuring and Modeling Population Processes*. Malden, MA: Blackwell Publishers.

Wachter, K.W. (2014). *Essential Demographic Methods*. Cambridge, Mass.: Harvard Univ. Press.