

Kin-Age-Cohort analysis

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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:

$$OD_{(a,c,p)}^k = \sum_{x=\alpha}^a {}_1F_{(x,c,p)} - \sum_{x=\alpha}^a {}_1F_{(x,c,p)} {}_1l_{(\min(a-x,k),c+x,p)}$$

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 mothers per 1,000 mothers

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

$${}_1q_{(a,c,p)}^k = 1 - e^{-h(a,c,p)}$$

where $h(a, c, p) = OD_{(a+1,c,p)}^k - OD_{(a,c,p)}^k$ is the hazard rate of experiencing the death of a child younger than k (Wachter 2014). We create a multiple decrement life table (Preston, Heuveline, and Guillot 2001) where a woman can exit the population of “non-bereaved women” either by losing a child ${}_1q_{(a,c,p)}^k$ or by dying herself ${}_1q_{(a,c,p)}^{mother}$ so that ${}_1q_{(a,c,p)} = {}_1q_{(a,c,p)}^k + {}_1q_{(a,c,p)}^{mother}$ is the probability of leaving the state of being a non-bereaved woman. For a unit radix $l_0^k = 1$, $FOD_{(a,c,p)}^k = 1 - {}_1l_{(a,c,p)}^k$ is the fraction of women in a cohort who ever experienced the death of a child younger than k .

Strictly speaking, these estimates do not refer to mothers, since the input UN WPP demographic rates do not report the fraction of women who are mothers. We rescale our estimates using a similar life table approach where 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 $FAM_{(a,c,p)}$ 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 :

$$mOM_{(a,c,p)}^k = FOD_{(a,c,p)}^k * \frac{1}{FAM_{(a,c,p)}} * 1000.$$

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

References

Keyfitz, N. (1985). *Applied Mathematical Demography*. New York: Springer.

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