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Life expectancy is the death-weighted average of the reciprocal of the survival-specific force of mortality

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Abstract

The hazard of mortality is usually presented as a function of age, but can be defined as a function of the fraction of survivors. This definition enables us to derive new relationships for life expectancy. Specifically, in a life-table population with a positive age-specific force of mortality at all ages, the expectation of life at age x is the average of the reciprocal of the survival-specific force of mortality at ages after x , weighted by life-table deaths at each age after x , as shown in (6). Equivalently, the expectation of life when the surviving fraction in the life table is s is the average of the reciprocal of the survival-specific force of mortality over surviving proportions less than s , weighted by life-table deaths at surviving proportions less than s , as shown in (8). Application of these concepts to the 2004 life tables of the United States population and eight subpopulations shows that usually the younger the age at which survival falls to half (the median life length), the longer the life expectancy at that age, contrary to what would be expected from a negative exponential life table.

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Keywords

age-structured population, force of mortality, Jensen's inequality, life expectancy, life table, longevity, negative exponential distribution, survival, USA

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