

Demographic Analysis

Mortality: Introduction, Measurements

Mortality: Introduction

Why do we want to know about mortality?

- Informs us of the health of the population and how that is changing over time
- Tells about effectiveness of health investments
- Age and sex patterns of mortality tell us where targeted investments in health may be especially beneficial (e.g. children, elderly, etc.).
- Mortality is one of the key components in the balancing equation and a key component needed for cohort component projections

Mortality: Introduction

In mortality lessons in this workshop, we will learn that

- Mortality estimation may use data from a variety of measurement systems, including vital registration, sample surveys, and censuses, and may involve a number of procedures.
- The methods for measuring mortality depend not only on the quality but also on the detail of the information available.
- If data are reliable, mortality can be estimated directly. If not, then specific techniques are required to estimate mortality indirectly.

Mortality: Introduction

We will also discuss

- “Life table” construction from reported data
- Tools for evaluating the quality of, and for adjusting, death data
- Various indirect methods to estimate mortality
 - Based on partial information (e.g. one age group)
 - Based on age structure
 - Based on survival of cohorts

We begin in this lesson with a review of basic measures of mortality and their interpretation ...

Mortality: Introduction

For further reading, see Chapter 3 of the
Census Bureau's

Population Analysis with Microcomputers

which provides more details about the importance of mortality data, techniques for estimating mortality levels and patterns, and methods for adjusting mortality data.

POPULATION ANALYSIS

WITH

MICROCOMPUTERS

Volume I

PRESENTATION OF TECHNIQUES

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Direct Estimation

When accurate and reliable information on deaths and population is available from censuses (or vital registration systems), or from questions asked about deaths in a household survey, *direct calculations* of mortality can be made based on these data.

Common Measurements

- Deaths
- Crude death rates (CDR)
- Deaths by age, Age-specific death rates (ASDR)
 - Infant mortality (IMR), child mortality, etc.
- Life expectancy (e_0)

Direct Estimation

Each of these measurements of mortality can also be derived through *indirect* methods if death and population data are unavailable or of poor quality,

- We now review the definition of key mortality indicators, proceeding from simpler to the more detailed, keeping in mind the following key concepts:
 - Numbers vs. rates
 - Crude population rates vs. age-specific rates
 - The effectiveness of each statistic to indicate actual health and mortality conditions

Deaths

Deaths are commonly recorded in countries throughout the world, sometimes broken down by age group and sex. These statistics are useful for many purposes, but they do not indicate health and mortality conditions.

Quiz - Can you tell which country is worse off?

Country X - 300,000 deaths in 2010, or
Country Y - 500,000 deaths in 2010

Country A - 20,000 infant deaths, or
Country B - 90,000 deaths at ages 60 and above

Crude Death Rate (CDR)

Large numbers of deaths may not indicate poor health, but rather that the population is large. A better indication of the *risk of mortality* in a population is the **crude death rate**, which divides deaths (typically during the year) by the population (ideally, at midyear).

Crude death rate (CDR) = Deaths / Population

For example, the CDR for Chile in 1986 is obtained as follows:

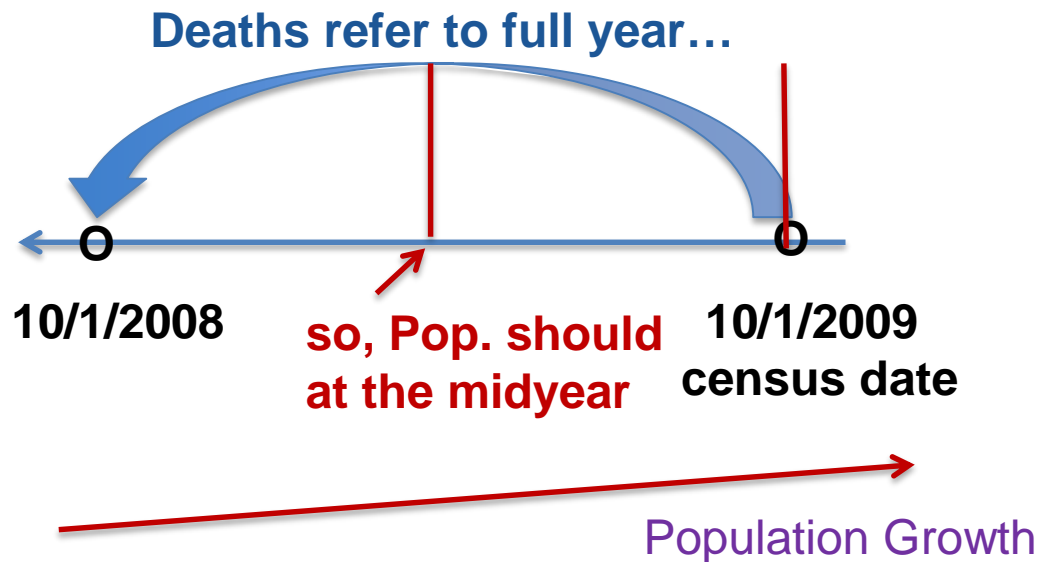
$$\frac{72,209}{12,258,000} \times 1,000 = 5.89$$

(deaths) (population)

There were 6 deaths per 1,000 population in Chile in 1986.

Why Midyear?

Deaths in many censuses are reported for the year prior to the census date. Since the CDR is a kind of average death rate over that year, the population denominator should be based at the midyear. When a population is growing, use of a census population will bias the CDR downwards, because the denominator will be too large:



Crude Death Rate – Helpful, but Limited

Advantages of the crude death rate:

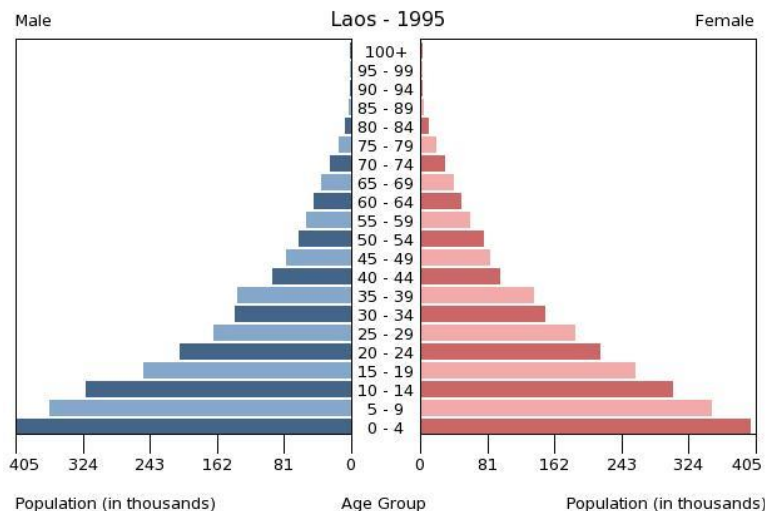
- Provides overview of risk of death in the population.
- It is part of the population growth *balancing equation*

Disadvantages

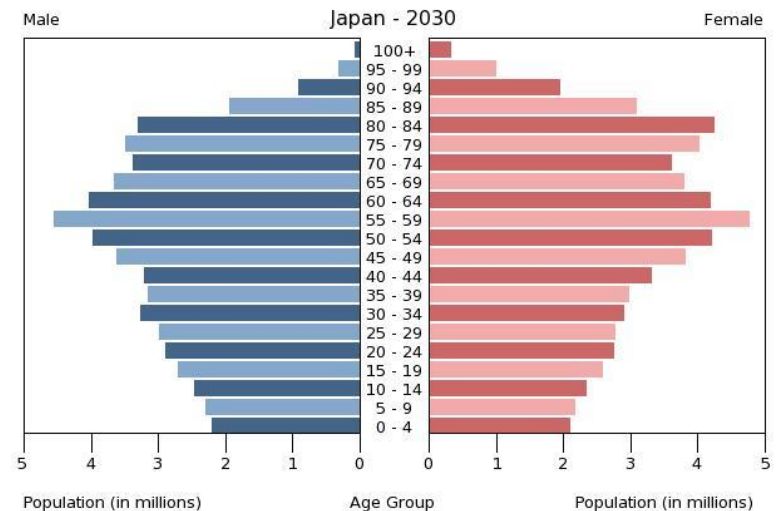
- Not very intuitive
- Comparisons of CDRs may be misleading
 - Two populations may have different crude death rates even if mortality at each age is the same.
 - Country A may have lower mortality at each age than B, yet A may have a higher CDR! ... how??

Crude Death Rate – Helpful, but ...

The Crude Death Rate is heavily influenced by AGE STRUCTURE. If a country has a higher proportion of people at ages where people tend to die, the crude death rate will be higher. If health conditions were the same, which of the following societies would have a higher CDR?



Source: U.S. Census Bureau, International Database.
<http://www.census.gov/population/international/data/idb/region.php?N=%20Results%20&T=12&A=separate&RT=0&Y=1995&R=-1&C=LA>

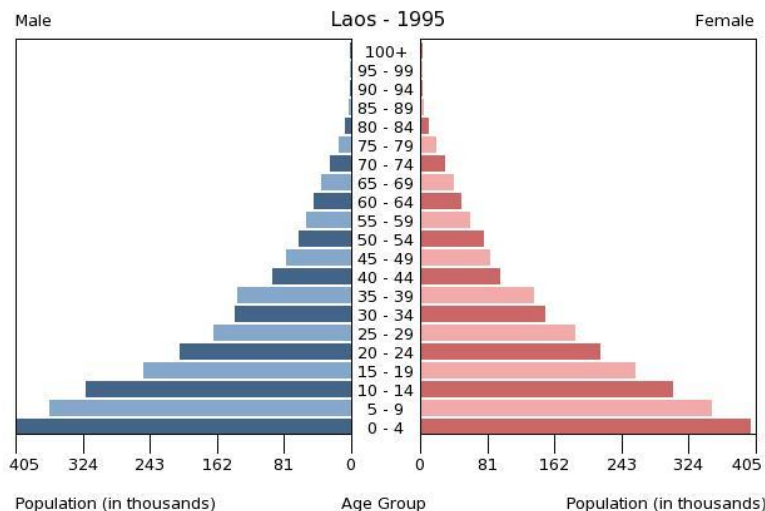


Source: U.S. Census Bureau, International Database.
<http://www.census.gov/population/international/data/idb/region.php?N=%20Results%20&T=12&A=separate&RT=0&Y=2030&R=-1&C=JA>

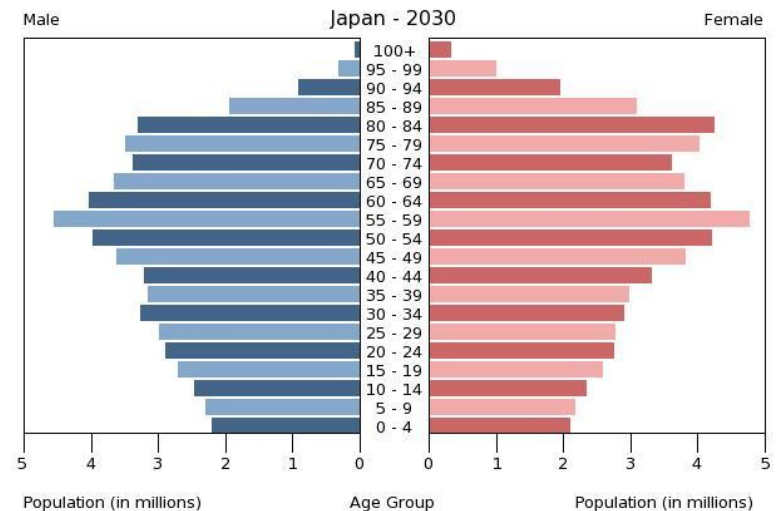
Standardized Crude Death Rates

If one knows age-specific deaths rates for two areas, and the age-sex structure of those areas, one can calculate a standardized crude death rate.

By applying the age-sex structure of one country to the age-specific death rates of the other.



Source: U.S. Census Bureau, International Database.
<http://www.census.gov/population/international/data/idb/region.php?N=%20Results%20&T=12&A=separate&RT=0&Y=1995&R=-1&C=LA>



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<http://www.census.gov/population/international/data/idb/region.php?N=%20Results%20&T=12&A=separate&RT=0&Y=2030&R=-1&C=JA>

Age-Specific Central Death Rates

Like the crude death rate, age-specific central death rates are calculated by dividing those dying at a particular age by the population at risk.

Rate	Numerator	Denominator
Infant death rate	Deaths age 0	Midyear population age 0
Child death rate	Deaths ages 1-4	Midyear population ages 1-4
Death rate 5-9	Deaths ages 5-9	Midyear population ages 5-9
Death rate ages x to $x+4$	Deaths ages x to $x+4$	Midyear population ages x to $x+4$
Death rate ages 80+	Deaths ages 80+	Midyear population ages 80+

Age-Specific Death Rates – The General Formula

Age-specific central death rates M_x are calculated as the number of deaths in a particular age group per 1,000 population in the same age group:

$$D_x/P_x$$

Age-specific death rates are calculated as the number of deaths in a particular age group per 1,000 population in the same age group.

In symbols:

$${}_nM_x^t = \frac{{}_nD_x^t}{{}_nP_x^t} \times 1,000$$

Where:

${}_nM_x^t$ is the age-specific death rate between ages x and $x+n$ for year t ;

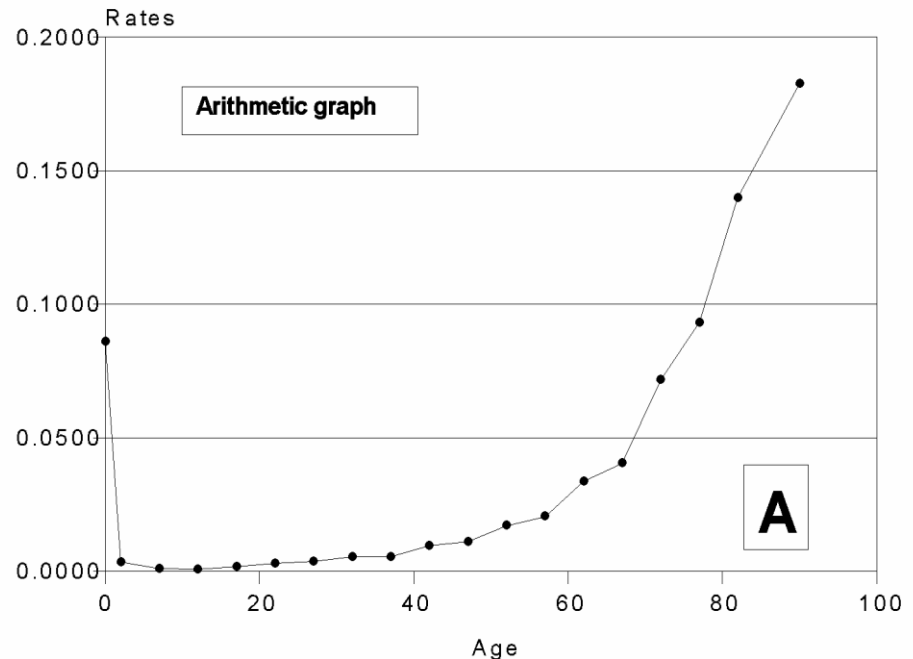
${}_nD_x^t$ is the number of deaths between ages x and $x+n$ for year t ; and

${}_nP_x^t$ is the population between ages x and $x+n$ for year t .

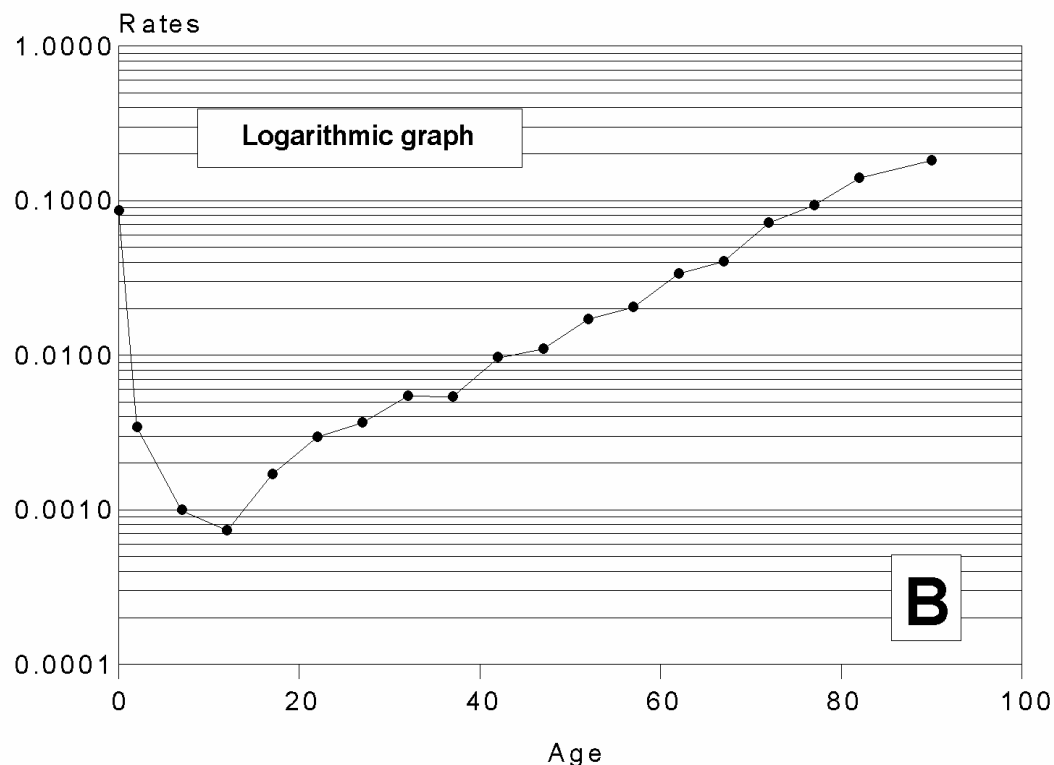
Age-Specific Death Rates – The J-Shape Pattern

The typical mortality M_x patterns has a J-shape.

That is, mortality is high among infants and young children, after which it declines rapidly, reaching its lower level in the teen and young adult years. At progressively older adult ages, mortality tends to rise.

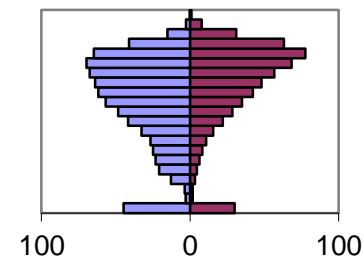


Age-Specific Death Rates – Logarithmic Scale



M_x

Remember this?



Exercises

- **Compute crude death rates**
- **Compute age-specific central death rates (nM_x)**
- **Plotting age-specific central death rates (compare linear vs. semi-log plots)**