

ES 160 Lab

Survivorship and Demography

From Joseph Balczon

Environmental scientists are interested in describing, understanding and explaining the distribution and abundance of organisms. To do this, one must understand the processes that affect the survival and reproduction of an organism. Ultimately, however, any environmental factor may affect the survival (or death) of an organism. People that study the processes of birth, death and migration of individuals in populations, or the ways that populations change with time, are called demographers. **Demography** investigates trends in populations, many of which change during the course of an individual's lifetime [such as age-specific birth rates (**fecundity**) or age-specific death rates (**survivorship**)], or change with longer periods of time (for example, from generation to generation, as our technology advances).

People exhibit many of these changes in fecundity and survivorship. (Specialized demographers who work for insurance companies study these changes and their findings influence your insurance rates.) A particularly rich source for their statistics is from public records offices which yield access to detailed information such as cause of death, etc. Another way to obtain information about changes in survivorship is to collect information from cemetery gravestones. Collecting information regarding date of birth, date of death and sex of the individual allows us to plot changes in survivorship of members of a **cohort** (members of a population born at the same time) with time. Accumulated age-specific information is often presented in **life tables**. From life tables we can generate a **survivorship curve**. A survivorship curve is simply a graphical representation of the chance that an individual will survive from birth to any particular age. In other words, it is a curve that plots percent survival (which starts at 100%, and ends at 0%) versus time ($t=0$ at the start and ends at the age of death of the last person in the cohort). Often, we can design hypotheses regarding the reasons that we see changes in survivorship of people born in different time periods.

Challenge: We will go to several local cemeteries and collect information regarding the birth date, death date and sex of human individuals. You must collect as many data points as possible, and you must be careful NOT to duplicate each other's work by counting gravesites more than once.

If we cut the verbiage, this cemetery demography exercise will:

- (1) demonstrates the use and value of life table analysis,
- (2) uses data that can be readily collected,
- (3) produces results (patterns of human survivorship) that are of direct interest to most students, and
- (4) lets you answer questions you raise yourself.

You can, for example, make various survivorship comparisons - males vs. females, early vs. late 19th century, urban vs. rural locations, northern vs. southern regions - as well as examine the

change in survivorship patterns over time and the impact of major episodes of mortality (e.g., the Civil War).

While the details of life table analysis are available in various locations, one clear explanation is found in the book *Experiments to Teach Ecology*, published in 1993 by the Education Committee of the Ecological Society of America and available from the ESA national office, Washington, DC. This book contains an exercise titled "Cemetery Demography" which was submitted by Nancy Flood, Univ. Toronto, and tested and presented by Charles Horn, Newberry College. A cemetery exercise was also published in R. Brewer & M.T. McCann, 1982, *Laboratory and Field Manual of Ecology*, Saunders College Publishing.

Local cemeteries are an excellent place to study human demography. Etched in the gravestones are the dates of birth and death of the person below, at least in most cases. From these data, we can calculate death rates and draw survivorship curves. By comparing survivorship curves for different periods of time we may look for historical trends in demography over the decades. Also, different cemeteries may represent different socio-economic cross-sections of the population, and comparing data among cemeteries may reveal different patterns of mortality.

Over the last few centuries, advances in health care and large-scale global political conflict have left rather opposing marks on the demographics of our population. Two major time intervals stand out: before 1950 and from 1950 to the present. Firstly, the time interval before 1950 includes the industrial revolution, the ravaging effects of polio, infection and other presently curable diseases, as well as World Wars I and II. Following 1950, numerous vaccines and antibiotics were widely used and, with the exception of the Korean, Vietnam, and Gulf Wars (not to mention a few other incidents...), this has been an era of relative peace in North America. What are your predictions about how the demographics of the Pennsylvania human population have changed during these two time periods?

In order to study the demography of the entire human population that once lived in Pennsylvania, we would have to study all of the local cemeteries and assume that no one emigrated from the area and was buried elsewhere. Neither is likely. We only have a few hours, and many deceased residents of Pennsylvania were buried, or otherwise, elsewhere. Thus for now, we will assume that the cemeteries we will visit are representative of all humans in this area, although we should be aware of these sorts of biases in the data.

Hypotheses. What Types of Survivorship Curves Might We See? (Note the data available for post 1950 is not extensive so these are intended to be used for illustrative purposes only.)

Q1 - In general, what are your predictions about death rates of people before or after 1950?

Now let's try to predict some of the specifics:

Q2 - For infants of both sexes, would you expect infant mortality to be higher or lower before or after 1950? Why?

Q3 - For females ages 20-50 (reproductive and working ages), would you expect females before or after 1950 to have a higher death rate? Why?

Q4 - For males ages 20-50 (reproductive and working ages), would you expect males before or after 1950 to have a higher death rate? Why?

Q5 - For females ages 50-80, would you expect females before or after 1950 to have a higher death rate? Why?

Q6 - For males ages 50-80, would you expect males before or after 1950 to have a higher death rate? Why?

Q7 - Given what you said above for the causes of mortality for males and females, which sex would you predict has a higher death rate for...

...for the time period before 1950?

...for the time period after 1950?

Now that you have made your predictions, you are ready to go out and collect the data to test them.