CEMETERY DEMOGRAPHY

ESA lab

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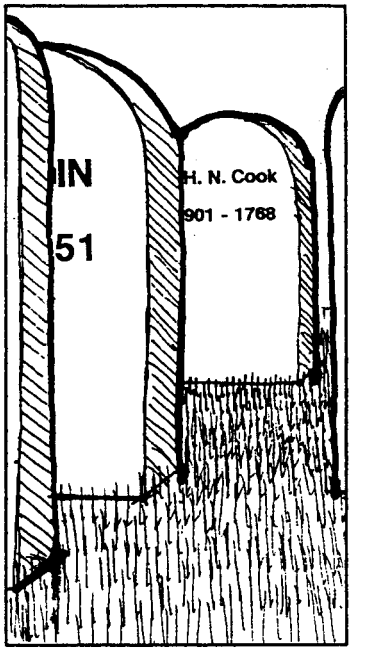
INTRODUCTION

As the United States has progressed through the industrial revolution over the last 150 years, changes in the life-styles of citizens have been reflected in their age at death. Factors such as diseases and accidents have changed in their relative impacts. One way to study these changes in human demographic patterns is to visit a local cemetery and collect data recorded on tombstones.



By collecting information on the year of death for all individuals of the same age class (a cohort) you can produce a graphical representation of their survivorship. For this exercise a cohort will include all of the individuals born during the same decade.

For the numerous species studied, the curves usually fit one of three general shapes (Figure 1). Human survivorship typically fits a type 1 curve. Especially interesting through is that slight, but distinct, differences can be seen when curves from separate communities are compared, or when cohorts from different decades for a single community are compared, as you will do during this lab.

LABORATORY OBJECTIVES

conceptual

1. Compare and explain the differences in the survivorship curves for at least two cohorts in a community with respect to local or national history.
2. Speculate on future changes in demography, based on current community changes

FIGURE 1. Three types of survivorship curves: Type 1 shows low initial mortality and many individuals living to old age. Type 2 shows a steady death rate. Type 3 shows high initial mortality with few individuals living to old age.

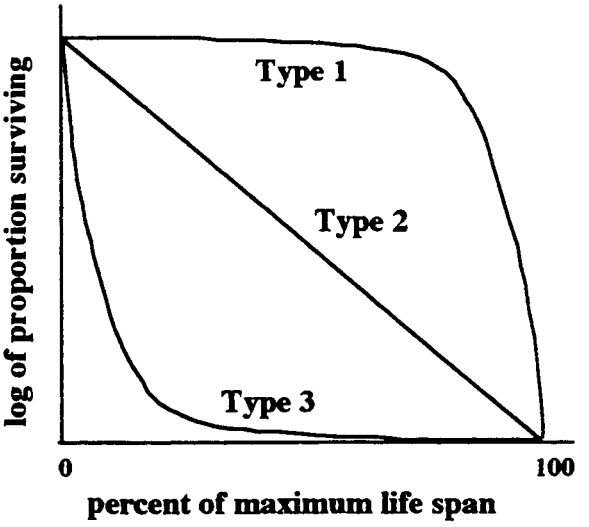
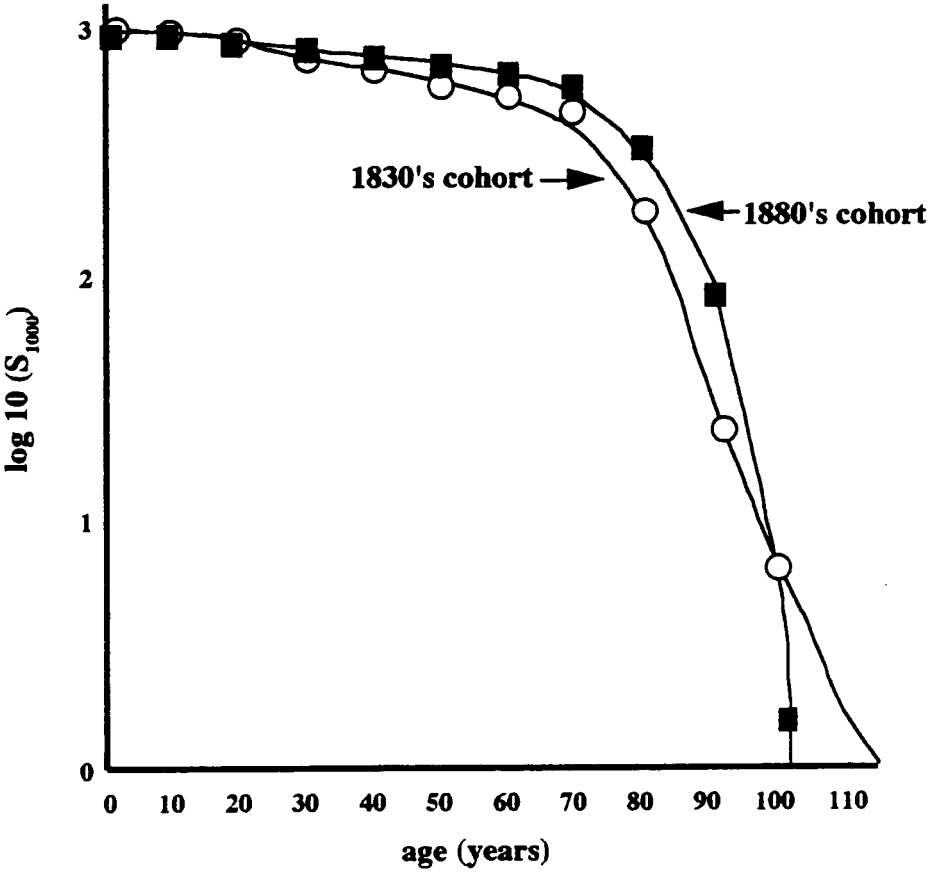


FIGURE 2. Survivorship curves for the decades of the 1830's and 1880's in Newberry, South Carolina.



3. Collect age data and calculate survivorship for at least two cohorts in a community. Graph these data to show a survivorship curve for each decade you studied.

procedural

MATERIALS AND METHODS

1. Select at least two specific cohorts (defined as a decade for this study) in a cemetery in your community. Because you will be following all individuals born during these decades, you must choose two that date prior to the 1890's. Why?

select two cohorts

2. Record birth year and death year for each individual in Table 1. You need data for AT LEAST 100 individuals. Your instructor may ask you to collect more data or to distinguish between males and females.

record data

DATA ANALYSIS

1. For each individual calculate the age at death (Table 1).

calculate age at death

2. Summarize the data in Table 2. Note data are clustered into age classes (first column) of ten year intervals. For the 0-9 age class, count all of the individuals which died at an age of 9 or less. Continue to record the number of deaths for each of the age classes. The number of deaths for an age class is commonly abbreviated as "d_x". When you reach the bottom of the column, determine the total number of deaths and record this number in the indicated space. This number should equal the total number of tombstones you counted for that decade.

summarize the data (d_x)

3. The third column is for survivorship data (l_x) and the calculations of these data are cumulative. Begin by placing a zero (0) in the lowest box of the column. To determine the number for the next box up add to the zero the number for the number of deaths (d_x) that appears in the column to the left and one row up. Continue this process of adding on the number to the left and one row up to determine the data for each row of the suvivorship column. When you reach the top you should have the total number of tombstones that you originally counted. (See Table 3 for an example of data determined in this manner.)

calculate survivorship (l_x)

4. Standardize the survivorship data to per 1000 (S_{1000}) to allow you to compare data from the two decades. Use the equation on the following page to make the necessary calculations.

standardize the data

survivorship per 1000 = total tombstones counted x 1000

To check your calculations for correctness, the top line should be 1000 and the bottom line zero.

determine logarathims

5. To standardize your data for graphing, calculate the logarithm to the base ten (10) of each number in the "survivorship per 1000" column. Once again to check your calculations, the number in the top row should be 3 and bottom line will produce an error (log 0 is undefined) on your calculator. For this number just put "0".

graph your data

6. Plot your data with the x-axis representing time and the y-axis representing the log of the proportion of individuals surviving. Use graph paper or the space provided following Table 2. Compare your data with Figures 1 and 2.

QUESTIONS

1. Do the curves for the different decades differ from one another? If so, what might have caused the differences?

Questions continued after graph of your data.

2. How do your graphs compare with Figure 1, survivorship curves for different types of populations and with Figure 2, survivorship curves for Newberry, South Carolina. Can you explain any differences?

3. How would your data have been altered if your cemetery had closed in 1965 rather than being open to the present day?

TABLE 1: Cemetery data sheet. ***Reproduce this page as needed.***

# OF INDIV.	BIRTH YEAR	DEATH YEAR	AGE AT DEATH	SEX	# OF INDIV.	BIRTH YEAR	DEATH YEAR	AGE AT DEATH	SEX
1					26				
2					27				
3					28				
4					29				
5					30				
6					31				
7					32				
8					33				
9					34				
10					35				
11					36				
12					37				
13					38				
14					39				
15					40				
16					41				
17					42				
18					43				
19					44				
20					45				
21					46				
22					47				
23					48				
24					49				
25					50				

SEE THE FOLLOWING PAGE FOR INDIVIDUALS #51-100.

TABLE 1, continued: Cemetery data sheet. Reproduce this page as needed.

# OF INDIV.	BIRTH YEAR	DEATH YEAR	AGE AT DEATH	SEX	# OF INDIV.	BIRTH YEAR	DEATH YEAR	AGE AT DEATH	SEX
51					76				
52					77				
53					78				
54					79				
55					80				
56					81				
57					82				
58					83				
59					84				
60					85				
61					86				
62					87				
63					88				
64					89				
65					90				
66					91				
67					92				
68					93				
69					94				
70					95				
71					96				
72					97				
73					98				
74					99				
75					100				

SEE THE PREVIOUS PAGE FOR INDIVIDUALS # 1-50

TABLE 2. Data calculations for survivorship curve. ***Make copies of chart as needed.***

STUDENTS NAMES _____
CEMETERY _____
DECADE _____

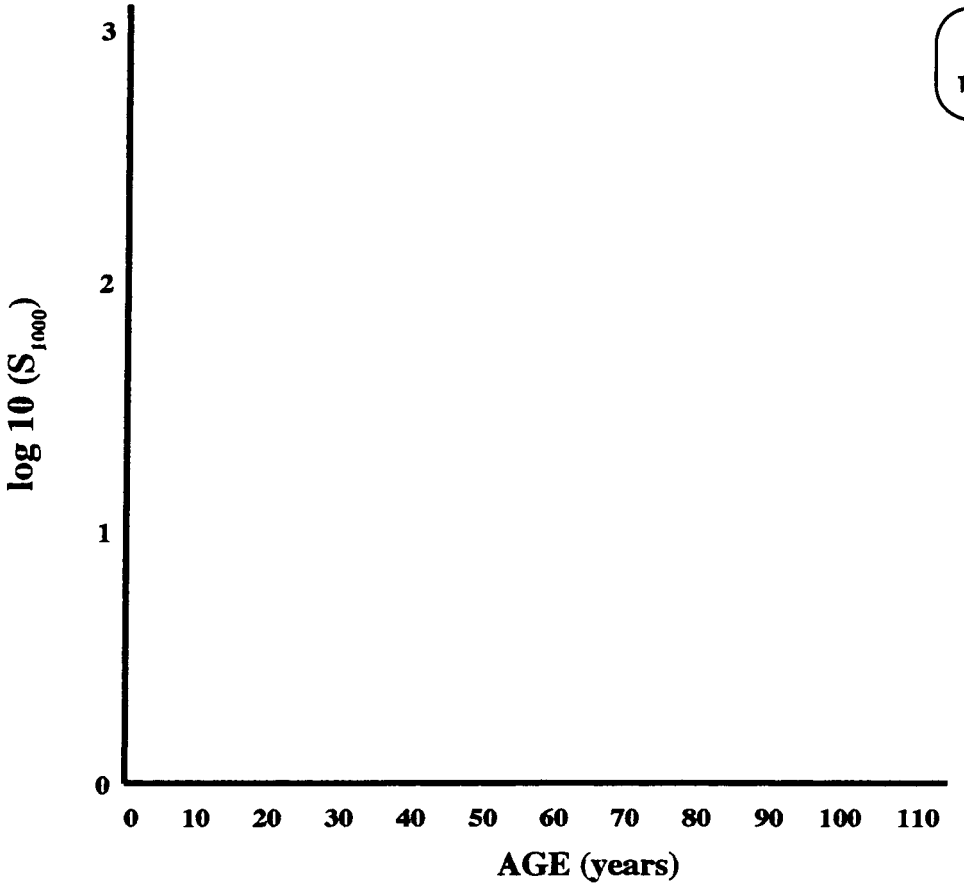
AGE CLASS YEARS	#DEATHS IN CLASS (d_x)	#SURVIVING FROM BIRTH (l_x)	SURVIVORSHIP PER 1000 $\cdot$ (S_{1000})	LOG_{10} (S_{1000})
0-9				
10-19				
20-29				
30-39				
40-49				
50-59				
60-69				
70-79				
80-89				
90-99				
100-109				
110 +				

TABLE 3. Example of survivorship table summarizing data collected for the 1830's cohort from a cemetery in Newberry, South Carolina.

AGE CLASS YEARS	#DEATHS IN CLASS (d_x)	#SURVIVING FROM BIRTH (l_x)	SURVIVORSHIP PER 1000 (S_{1000})	LOG_{10} (S_{1000})
0-9	8	160	1000	3.00
10-19	7	152	950	2.98
20-29	13	145	906	2.96
30-39	9	132	825	2.92
40-49	13	123	769	2.89
50-59	21	110	688	2.84
60-69	23	89	556	2.75
70-79	39	66	413	2.62
80-89	22	27	169	2.23
90-99	4	5	31	1.49
100-109	1	1	6	0.78
110 +	0	0	0	"0"

GRAPH OF YOUR DATA FROM TABLE 2

Compare your results with those in Figure 1.



4. One problem with studying survivorship curves is that a birth cohort must be followed through until the death of the last individual. How would a 1940's survivorship curve be altered from those of the 1800's?

questions continued

5. Speculate about the future if:
   a) Aids continues to increase and no cure is found.
   b) Medical advances continue and most diseases and infant mortality are eliminated.
   c) Environmental problems get worse and pollution related diseases increase.

6. What type of assumptions did you (and all ecologists) need to make in order to develop the survivorship curves for your town?

REFERENCES

Condran, G. and E. Crimmins. 1980. Mortality differentials between rural and urban areas of states in the northeastern United States 1890-1900. Journal of Historical Geography 6 (2): 179-202.

Dethlefsen, E. S. and K. Jensen. 1977. Social commentary from the cemetery. Natural History 86(6) 32-39.

Gwatkin, D. R. and S. K. Brandel. 1982. Life expectancy and population growth in the third world. Scientific American 246 (5): 57-65.

Kuntz. S. 1984. Mortality change in America, 1620-1920. Human Biology 56: 559-582.

Mahler, H. 1980. People. Scientific American 243 (3): 67-77.

NOTES TO THE INSTRUCTOR

SUPPLEMENTARY INFORMATION

Cemeteries are interesting in themselves because they reflect social change and attitudes toward death. Cemeteries of the Revolutionary Way era, such as some in Boston, have gravestones decorated with grinning skulls and cross-bones and stressed man's inevitable fate. Cemeteries were muddy and unkept, reinforcing the grim message. By the late 1700's death was viewed more as a release from earthly suffering. White marble, a symbol of purity, became common for grave markers, which were shaped like headboards of beds. Gravestone size indicated age of the deceased.

In the 1830's cemeteries were run by towns rather than by churches, and it became necessary to buy plots. Grave markers became more ornate, and for wealthy families, mausoleums were in vogue. By the late 1800's, family memorials had a central marker for the head of the family (an adult male), with smaller stones around it, representing family members. At this time one of five women died during childbirth and many children died before the age of five. Thus death in the immediate family was frequent. Because cemeteries held those recently deceased individuals, families often made weekend excursions to the cemetery and took along picnic lunches. The atmosphere of cemeteries reflected that social pattern; cemeteries were groomed for a park-like effect.

During this century the husband and wife had equal and side-by-side markers, stressing the marital bond, rather than the supremacy of the father. By the 1950's, gravestones were simple, modest, wedge-shaped markers, reflecting modern man's denial of death.

ADDITIONAL CALCULATIONS

You may want your students to calculate life expectancy at any time during life for one or more of the decades under investigation. This value (e_x) is mathematically calculated in several steps.

EDITOR'S NOTE

There are diverse opinions among ecologists as to the appropriateness of using demographic procedures,that were developed for natural populations of other animals and plants, on human populations . If this exercise is viewed as an interesting way to introduce the topic of demography your students then can discuss the differences between the demography of humans and other types of organisms, using Figure 1 as a guide.