

Human lifespan demographics



A&S300-002 Jim Lund

Sanrock, Life-Span, 8e. Copyright © 1997. McGraw-Hill Companies, Inc. All Rights Reserved.

TABLE 1.1 Human Life Expectancy

Time Period	Average Life Expectancy (in years)
Prehistoric times	18
Ancient Greece	20
Middle Ages, England	33
1620, Massachusetts Bay Colony	35
19th century, England	41
1900, USA	47
1915, USA	54
1954, USA	70
1992, USA	75

Definitions

- * Gerontology: the study of the aging process (biological, sociological, and historical).
- * Geriatrics: the branch of medicine that deals with health care for the elderly.
- * Demography: the statistical study of human populations.

Definitions

- * Cellular senescence: a phenomenon where isolated cells demonstrate a limited ability to divide in culture. Also, the end state before death.
- * Mean Longevity: average longevity of a population. $\text{Sum of ages at death} / \# \text{ of individuals}$.
- * Maximum longevity: age at death of the longest-lived number of a population.

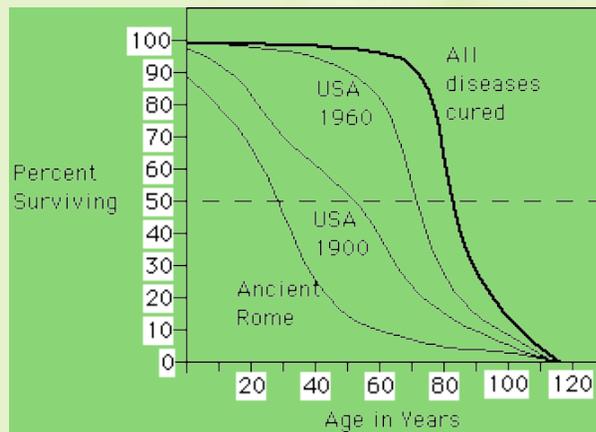
Human lifespan

- * Mean Longevity in the US (2005):
 - ♣ Males, 75.2 yrs.
 - ♣ Females, 80.4 yrs.
- * Maximum longevity (verified):
 - ♣ Jeanne Clament who died in 1997 at age 122

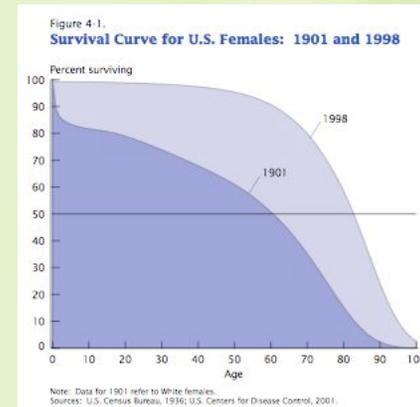
Reports of longevity are often exaggerated

- * Caucasus, Georgia, Armenia, and Azerbaijan
 - ♣ Shirali Muslimov, claimed 168 yrs
 - ♣ No documentation
- * Karakoram Mountains, Pakistan
 - ♣ Hunza region, claim very long ls
 - ♣ No documentation
- * village of Vilcabamba, southern Ecuador
 - ♣ Many claim ages in the 120's
 - ♣ Poor docs, similar names

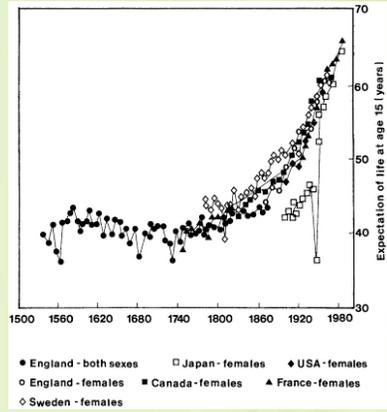
Human lifespan demographics.



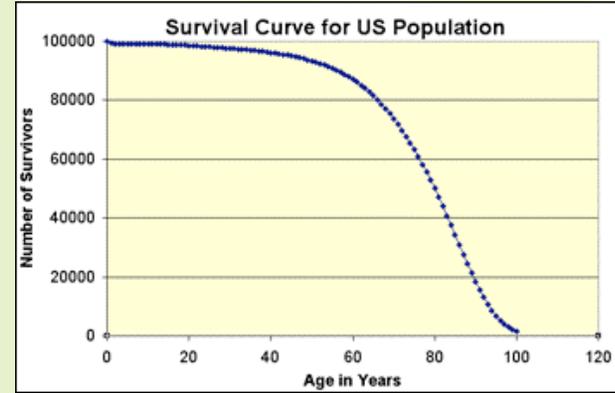
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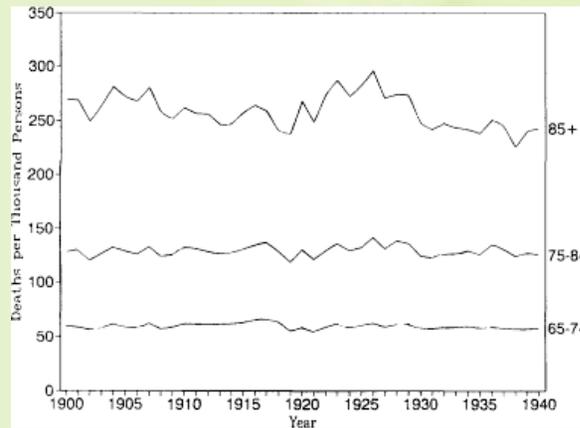
Lifespan increases (at 15 years of age, excluding childhood mortality)



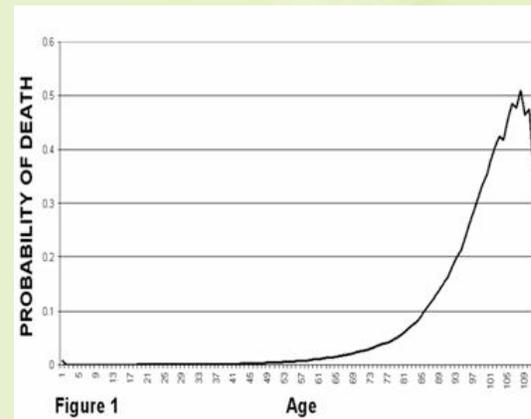
US survival curve



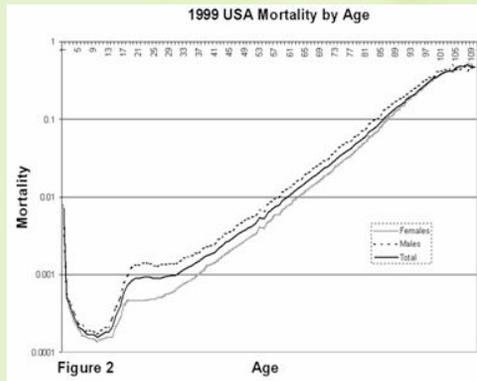
Death rates of US railroad workers



Mortality rate increases with age



Log mortality is linear



Mortality increases exponentially!

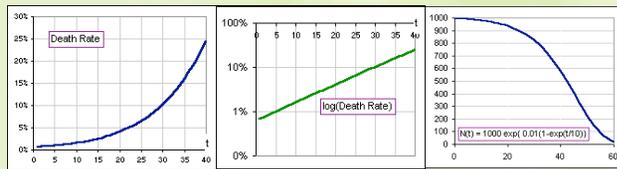
Mathematical description of lifespan

1825, Benjamin Gompertz showed that the mortality rate increases exponential rate as age increases:

$$\text{mortality}(t) = Ne^{bt}$$

$$\% \text{ survival} = e^{(C/k)(1 - e^{kn})}$$

Gompertz survival statistics



Mortality

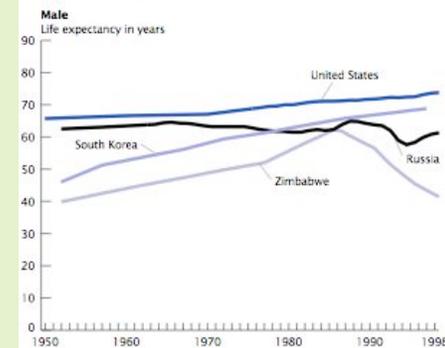
log(Mortality)

% survival

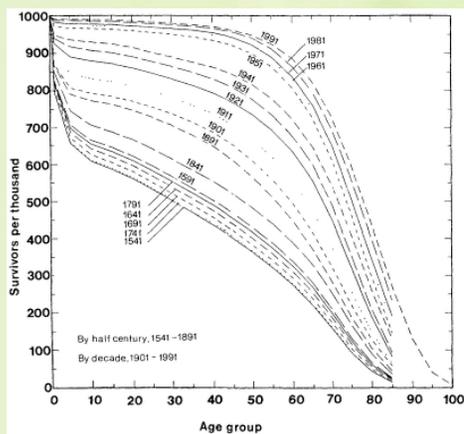
$$\% \text{ survival} = e^{(C/k)(1 - e^{kn})}$$

Increasing life expectancy

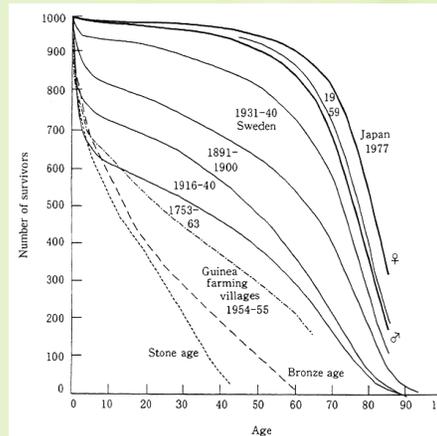
Figure 3-3.
Life Expectancy at Birth in Four Countries: 1950 to 1998



Squaring the survival curve



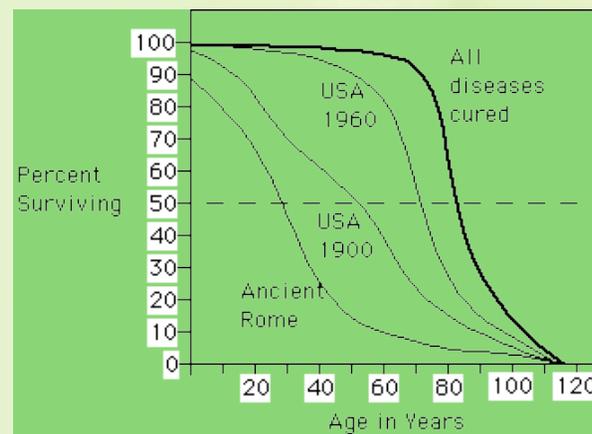
Survival increases in Japan

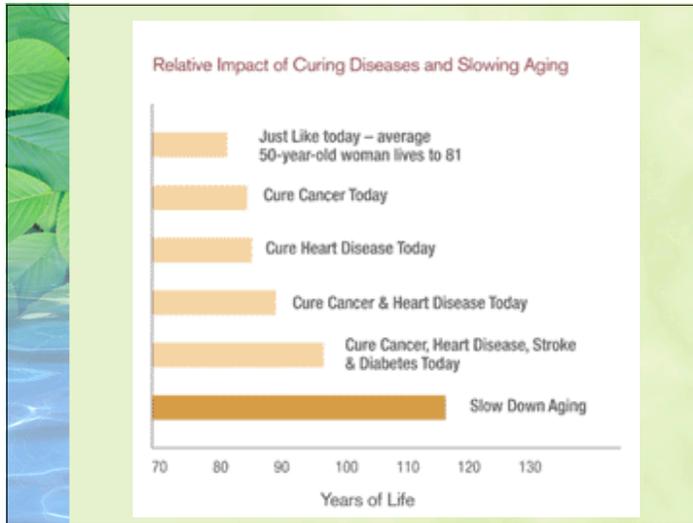


Main causes of death

Cause of Death (USA 2005 Data)	Percent
Heart Disease	27
Cancer	23
Cerebrovascular Disease s	6
Lower Respiratory Disease (asthma, COPD)	5
Accident	5
Diabetes	3
Alzheimer's Disease	3
Influenza and Pneumonia	3
Kidney disease	2
Other	23

Human lifespan demographics.





Future medical advances?

Different estimates:

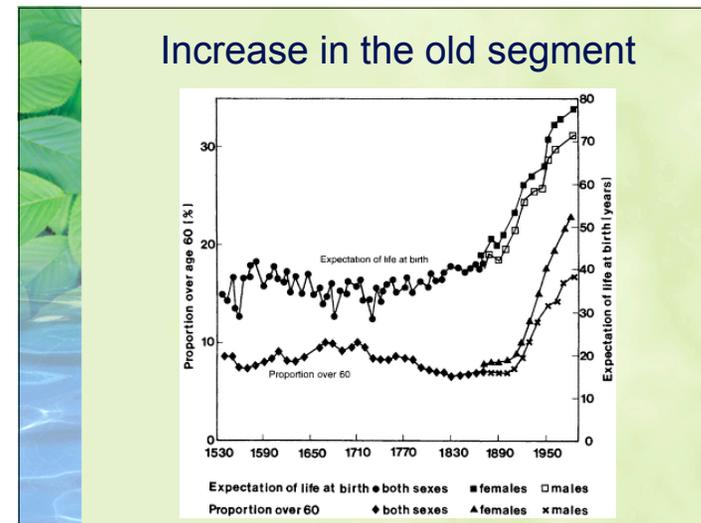
For instance, if diabetes, all cardiovascular diseases, and all forms of cancer were eliminated today, life expectancy at birth in the United States would rise to about 90 years, from the present 78.

Cure all disease → mean lifespan of 85 yrs

Cure all disease → perhaps add 15 years to human life expectancy.

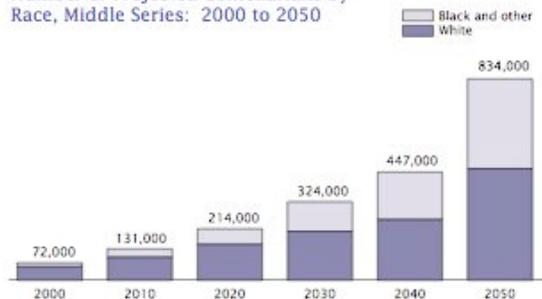
Consequences of increased longevity

- Changes in population structure
 - Increases in the old segment
 - Dramatic increases in the oldest segment
- Increased incidence of diseases of aging.
- The number of persons age 65 or older stands at 34.9 million (12.7%). Will increase to 70 million by 2030.
- The fastest growing population segment is age 75 and older
- 4.3% of those 65 or older live in institutional settings. Increases to 19% for those 85 and older



Increases in centenarian numbers

Figure 1.
Number of Projected Centenarians by
Race, Middle Series: 2000 to 2050



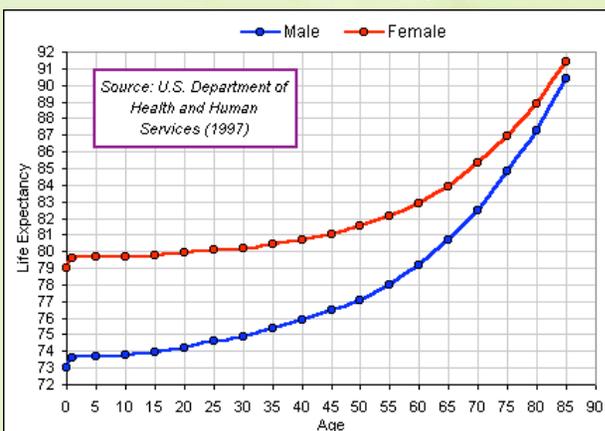
Source: Day, J. C., 1996, Population Projections of the United States by Age, Sex, Race, and Hispanic Origin: 1995 to 2050, U.S. Bureau of the Census, Current Population Reports, P25-1130, U.S. Government Printing Office, Washington, DC.

Life expectancy

- Expected survival at a particular age.
- For example:
 - Mean lifespan of US females: 79 years.
 - Expected ls of US females 20 yrs old: 83 yrs.
 - Expected ls of US females 85 yrs old: 91 yrs
 - Expected ls of US females 90 yrs old: 94 yrs.

Life expectancy at birth = mean lifespan
At older ages life expectancy > mean lifespan

Life expectancy



Source: U.S. Department of
Health and Human
Services (1997)

Rank Order of Major Conditions, occurring in 10% or more of cancer patient sample, 55 yrs+

Condition	Percent
Hypertension	42.9
Heart-related conditions	39.1
Arthritis	34.9
Gastrointestinal problems	31.0
Anemia	22.6
Eye problems	19.0
Urinary tract	18.0
Previous cancers	15.4
Gallbladder problems	14.9
Chronic obstructive pulmonary disease	14.5
Diabetes	12.8
Fracture	10.8
Gland disorders	10.6

Yancik, 1997 Cancer v80, p1273-83