Population Growth

Demography Camp

Summer 2013

1 A simple view of demography

Think of a town. At time t, the town's population is X. One year later, the town's population is Y.

- We assume that the population grew at a constant, exponential rate (r).
- $P(t+1) = P(t)e^{rt}$
- $Y = Xe^{rt}$
- To find the growth rate, simply rearrange the equation.
- $\frac{log\left(\frac{P(t+1)}{P(t)}\right)}{t} = r$

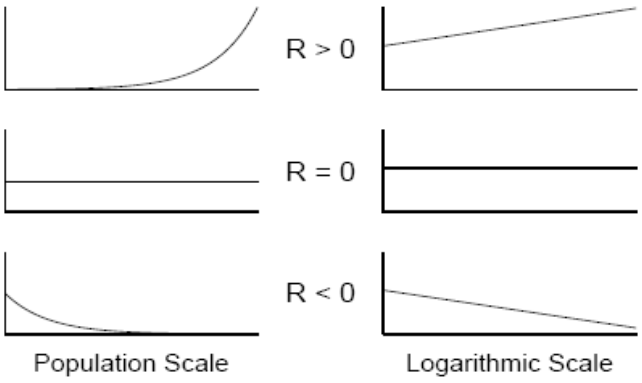

Figure 1: Tragectories of Exponential Growth

1.1 Doubling Time

A common question demographers face is "if the growth rate remains the same, how long will it take for the population to double?"

This is easy to solve:

$$P(t+1) = P(t)e^{rt}$$
$$2 \cdot P(t) = P(t)e^{rt}$$
$$2 = e^{rt}$$
$$\frac{log(2)}{r} = t$$

If r is 2% per year (common in some developing countries), the doubling time is:

$$\frac{log(2)}{.02} = \frac{0.693}{.02} = 34.65\ years$$

2 How do populations change?

Populations can chagne because of four things:

- Births
- Deaths
- Immigration
- Emigration

2.1 The Balancing Equation

$$P(t+n) = P(t) + B(t) - D(t) + I(t) - E(t)$$

2.2 Definitional Notes

- **NATURAL INCREASE** refers to the difference between births and deaths
- A **CLOSED POPULATION** is closed to both immigration and emigration
- An **OPEN POPULATION** is open to immigration and emigration
- In general, we do not deal with numbers individually for immigration and emigration, but instead use **NET MIGRATION**, which is positive if there are more immigrants than emigrants, and negative if there are more emigrants.
  - A closed population has 0 net migration