HACETTEPE UNIVERSITY INSTITUTE OF POPULATION STUDIES (HUIPS)

DEM 601 Introduction to Demographic Analysis

Lecture 3 handout

TOPIC
Population Change

SESSION
8 October 2026

NAME

> **The shape of the lecture, not a substitute for it.** Every heading is a slide, in the order it is shown, with the formulas it carries and the terms it defines.

Opening

WHERE WE ARE **Setting the numbers in motion**

Components of Change

COMPONENTS **Closing the equation on a real year**

COMPONENTS **The same equation, as rates**

Growth rate Everything that moved the number

Rate of natural increase Births minus deaths

Net migration rate Arrivals minus departures

MEASURES **Absolute change**

$$\Delta P = P_t - P_0$$

THE WORLD **People added each year**

Sketch the shape, and label the axes

THE WORLD **Twelve thousand years, one corner**

Sketch the shape, and label the axes

MEASURES **Percentage change**

$$\%\Delta P = \frac{P_t - P_0}{P_0} \times 100$$

MEASURES **The same percentage, twice**

YOUR TURN **Which one grew faster?**

THE ANSWER **The same change, in half the time**

Growth Rates

GROWTH **Two counts, and a guess about the middle**

Arithmetic a constant number

Geometric a constant ratio, once a year

Exponential a constant ratio, always

GROWTH **Arithmetic growth**

$$P_n = P_0 + \big(n \times (r \times P_0)\big)$$

$$r = \frac{P_n - P_0}{n} \div P_0 \times 100$$

GROWTH **Geometric growth**

$$P_n = P_0 \times (1 + r)^n$$

$$r = \sqrt[n]{\frac{P_n}{P_0}} - 1$$

GROWTH **Exponential growth**

$$P_n = P_0 \times e^{r \times n}$$

$$r = \frac{\ln(P_n / P_0)}{n}$$

$$r(t) = \lim_{\Delta t \to 0} \frac{\Delta N(t)}{N(t)\,\Delta t} = \frac{\frac{dN(t)}{dt}}{N(t)} = \frac{d\ln[N(t)]}{dt}$$

GROWTH **Nothing grows exponentially for ever**

Sketch the shape, and label the axes

GROWTH **Running the formula forwards**

$$P_n = P_0 \times e^{r \times n}$$

GROWTH **Where the world actually is**

Sketch the shape, and label the axes

GROWTH **The world and Türkiye**

Sketch the shape, and label the axes

GROWTH **One country, eighty-one answers**

Sketch the shape, and label the axes

GROWTH **Every country, one year**

Sketch the shape, and label the axes

GROWTH **The same year, without migration**

Sketch the shape, and label the axes

YOUR TURN **Find your own population**

THE ANSWER **Türkiye, on the two maps**

Doubling Time

DOUBLING **How long until twice as many?**

$$2P_0 = P_0 \times e^{r \times n}$$

$$\ln(2) = r \times n$$

$$n = \frac{\ln(2)}{r}$$

DOUBLING **A statement about today**

Sketch the shape, and label the axes

DOUBLING **What the UN actually publishes**

Sketch the shape, and label the axes

YOUR TURN **Double Türkiye**

THE ANSWER **Türkiye, doubled**

Replacement and Momentum

REPLACEMENT **Standing still is work**

$$\text{Population Turnover} = \text{Losses} + \text{Gross Growth}$$

Sketch the shape, and label the axes

REPLACEMENT **A little more than two**

MOMENTUM **Below replacement, still growing**

Sketch the shape, and label the axes

MOMENTUM **Türkiye, step by step**

Fertility fell children per woman, below replacement, and it has been falling for decades

Births still beat deaths Natural increase a year, from many potential mothers and comparatively few old people

The population grows Median age , and of the country is not yet 15

YOUR TURN **Thirty years from now**

MOMENTUM **How much is already decided**

Sketch the shape, and label the axes

CLOSING **What you can do now**