

Chapter 7 Project: Human Population and Migration

Name _____ Name _____

In this project, you will access population data for various countries, and make predictions about how those populations will grow. The data are found at the U.S. Census Bureau's International Data Base web site. Follow the directions carefully below.

(1) Go to <http://www.census.gov/ipc/www/idb/index.php>

You should see the web page which is displayed below. If you do not, see your instructor immediately for additional help.

U.S. Census Bureau
International Data Base (IDB)

Country Rankings
Largest countries for any year, 1950 to 2050.

World Population Information
Global population trends, links to historical population estimates, population clocks, and estimates of population, births, and deaths occurring each year, day, hour, or second.

Enter the database
Data Access
Find tabular data for countries and regions as well as demographic indicators, population pyramids and source information for countries.
Data updated December 2009 - [Release notes](#)

Methodology
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Related Sites
Links to other international products and services

(2) Select **Data Access**. Change the country to **Ireland**. Be sure that the year **2010** is selected, then press **Submit**. Now select the **Tables** tab in orange. You should see the web page below.

U.S. Census Bureau
International Data Base (IDB)

Demographic Indicators **Tables** Population Pyramids Source Information

Table: Total Midyear Population

| Year | Population |
|------|------------|
| 2010 | 4,250,163 |

Source: U.S. Census Bureau, International Data Base.

Download Total Midyear Population: Ireland table as: [Excel](#) | [CSV](#)

Now go to the next page of this project to record results and make a few calculations.

1. IRELAND (year 2010) Record and compute the following:

- a) Record the
- Total Midyear Population**
- of Ireland for year 2010.

Ireland's 2010 population = _____

After recording the population, go to the top pull-down menu to change the table output. Select **Crude Birth and Death, Net Migration, and Growth Rates**. Be sure that you are still viewing data for Ireland in year 2010.

- b)
- Record the birth rate:**
- births per 1,000 = _____

Write the birth rate in decimal form and in percent form:

Birth Rate = _____ = _____ %

- c)
- Record the death rate:**
- deaths per 1,000 = _____

Write the death rate in decimal form and in percent form:

Death Rate = _____ = _____ %

- d)
- Compute:**
- Natural Growth Rate = birth rate – death rate. Write the answer in both decimal and percent form.

Natural Growth Rate = _____ = _____ %

Check to see that your answer matches the printout in the data base column "Rate of Natural Increase (Percent)." Does it?

- e)
- Record the net migration rate:**
- Net migrants per 1,000 = _____

Write the net migration rate in decimal form and in percent form:

Net Migration Rate = _____ = _____ %

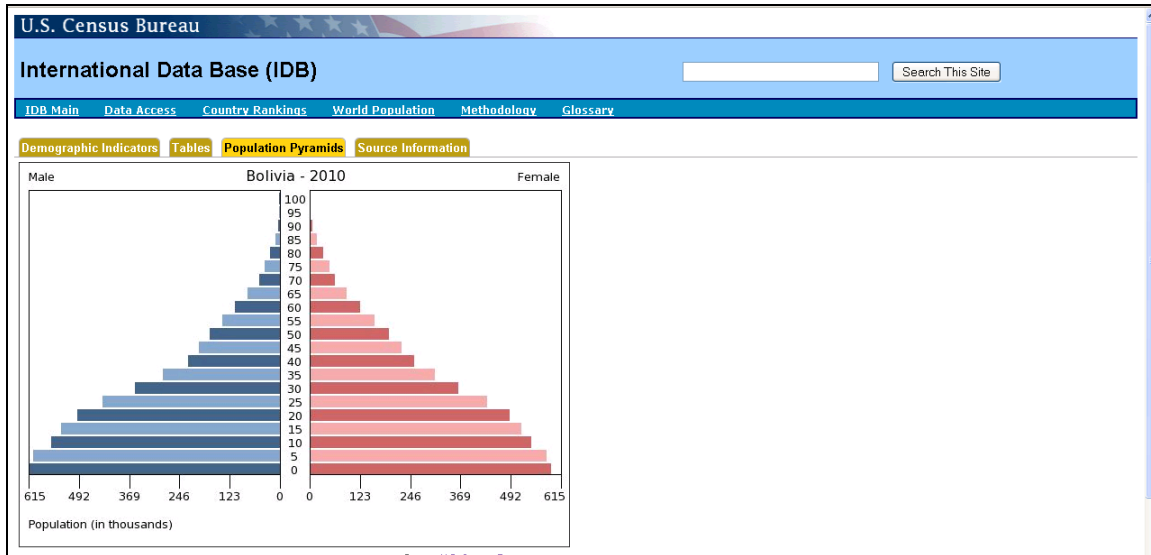
- f)
- Compute:**
- Using the information from above, compute Ireland's growth rate using the formula: Growth Rate = Natural Growth Rate + Net Migration Rate. Write the answer in both decimal and percent form.

Growth Rate = _____ = _____ %

Check to see that your answer matches the printout in the data base column "Growth Rate (Percent)." Does it?

2. Population Pyramids

At the top of the web site, click the Population Pyramids tab. Change the country to **Bolivia**, again select year **2010**, and press **Submit**. See below.



a) To see how Bolivia's population pyramid might change over time, **select the years 2010, 2015, 2020, 2025, etc. until you reach 2050**. You will need to hold down the CTRL key as you click each of these years. Then press **Submit**. The database will display the population pyramids for these years, one above the other. Above the pyramids, you will find Animation Controls. Press the play button to view the animation.

What is the most significant aspect of change in the *overall population structure* for Bolivia?

b) Make a quick sketch of Bolivia's population pyramids in years 2010, 2030, and 2050, paying attention to general shape only. Label years.

3. Country of Choice Find a country whose year 2010 population pyramid resembles that of Bolivia in 2010 (the first pyramid you sketched earlier) **AND** whose year 2010 net migration rate is negative (< 0). *Hint: first find a similar population pyramid, then check if the net migration rate is negative using the Tables tab accessed previously. If the net migration rate is zero or positive, choose another country!*

Your country : _____ **Print** your country's population pyramid for the year 2010 and attach it to the project.

For your country of choice, use the Tables tab to record and compute the following information for your country in year 2010.

a) **Record the birth rate:** births per 1,000 = _____

Write the birth rate in decimal form and in percent form: _____ = _____%

b) **Record the death rate:** deaths per 1,000 = _____

Write the death rate in decimal and percent forms: _____ = _____%

c) **Compute:** Natural Growth Rate = birth rate – death rate. Write your answer in both decimal and percent form.

Natural Growth Rate = _____ = _____%

Check to see that your answer matches the data base. Does it?

d) **Record the net migration rate:** Net migrants per 1,000 = _____

Write this rate in decimal and percent forms: _____ = _____%

e) **Compute:** Growth Rate = Natural Growth Rate + Net Migration Rate. Write the answer in both decimal and percent form.

Growth Rate = _____ = _____%

Check to see that your answer matches the data base. Does it?

f) Now switch tables to obtain the **Total Midyear Population** for your country of choice. Select the years from **2010 to 2050**, jumping **every 5 years**. Print the results.

4. Interpreting Rates

Explain in your own words the terms **natural growth rate**, **net migration rate**, and **growth rate**. Then explain how they relate to one another.

5. Exponential modeling of Ireland's population

In this section we will use the population growth rate (natural growth rate plus migration rate) in a simple exponential model of future population.

a) Let $p(n)$ represent the population, and n the number of years elapsed since 2010. Assume the population grows according to the growth rate calculated on the Ireland worksheet (page 2). Write the difference equation relating $p(n)$ to $p(n-1)$; also write the initial condition.

b) Write the solution equation.

c) Complete the table below to predict Ireland's population through the year 2050 using your exponential model. Use either the difference equation and initial condition or the solution equation. Round population values to the nearest 1 person.

| Country: Ireland | | | | | | |
|-------------------------|----------|--|--|-------------|----------|--|
| year | n | exponential equation's predicted population | | year | n | exponential equation's predicted population |
| 2010 | 0 | | | 2035 | 25 | |
| 2015 | 5 | | | 2040 | 30 | |
| 2020 | 10 | | | 2045 | 35 | |
| 2025 | 15 | | | 2050 | 40 | |
| 2030 | 20 | | | | | |

6. The Affine Model of Ireland's Population

In this section you will split the population growth into its two constituent parts: natural growth and net migration.

a) It is often the case that a country's government allows only a fixed number of net migrants. The net number of migrants is equal to the net migration rate times total population. Compute Ireland's net migration in the year 2010.

In your own words, explain what your answer represents.

b) Assume that net migration is fixed at the year 2010 number. Using this number and the *natural* growth rate, write the difference equation relating $p(n)$ to $p(n-1)$. Also state the initial condition.

c) Complete the table below to predict Ireland's population through the year 2050 using your affine model. Round to the nearest 1 person.

| Country: Ireland | | | | | | |
|-------------------------|----------|--|--|-------------|----------|--|
| year | n | affine difference equation predicted population | | year | n | affine difference equation predicted population |
| 2010 | 0 | | | 2035 | 25 | |
| 2015 | 5 | | | 2040 | 30 | |
| 2020 | 10 | | | 2045 | 35 | |
| 2025 | 15 | | | 2050 | 40 | |
| 2030 | 20 | | | | | |

7. Model Comparisons for Ireland

The U.S. Census has a model that predicts country population values for future years. Their model is more sophisticated than the exponential or affine models that you derived. The population projections for Ireland, based on their model, are given below.

| Country: Ireland | | | | | | |
|------------------|----|---------------------------------------|--|------|----|---------------------------------------|
| year | n | Census Bureau predicted population | | year | n | Census Bureau predicted population |
| 2010 | 0 | 4,250,163 | | 2035 | 25 | 5,120,827 |
| 2015 | 5 | 4,475,804 | | 2040 | 30 | 5,237,010 |
| 2020 | 10 | 4,674,148 | | 2045 | 35 | 5,330,728 |
| 2025 | 15 | 4,842,255 | | 2050 | 40 | 5,396,215 |
| 2030 | 20 | 4,988,732 | | | | |

a) Plot the population predictions for Ireland based on 3 models: Census Bureau, your exponential difference equation, and your affine difference equation. Connect each with a smooth curve. *Use a full piece of graph paper and label each of the graphs.*

b) Compare the exponential and affine equations for Ireland. Also compare the predicted values over the 40-year period from 2010 to 2050.

c) The affine model and the Census model give vastly different predictions. By what percent does the affine model exceed that of the Census model after 10 years? After 40 years?

d) As you can see, the affine and Census Bureau models predict very different population values in the year 2050 ($n = 40$). Let's assume that the Census prediction is more reliable. Modify the constants in your affine difference equation so that its population prediction in 2050 is close (within 1,000 people) to that of the Census model. Write your modified affine difference equation below.

8. Affine Population Model for your Country of Choice

a) Compute Net Migration for your country in the year 2010. Interpret your answer.

b) Assume that net migration is fixed at the year 2010 value. Using this value and the *natural* growth rate, write the affine difference equation relating $p(n)$ to $p(n-1)$. Also state the initial condition.

c) Complete the table below to predict your Choice Country's population until the year 2050 using your affine model. Round to the nearest 1 person.

| Country of Choice: | | | | | | |
|---------------------------|----------|--|--|-------------|----------|--|
| year | n | affine difference equation predicted population | | year | n | affine difference equation predicted population |
| 2010 | 0 | | | 2035 | 25 | |
| 2015 | 5 | | | 2040 | 30 | |
| 2020 | 10 | | | 2045 | 35 | |
| 2025 | 15 | | | 2050 | 40 | |
| 2030 | 20 | | | | | |

9. Analysis of your Country of Choice!

- a) Plot population predictions for the U.S. Census model (the data that you printed out) and your affine model. Connect each with a smooth curve. *Use a full piece of graph paper and label each graph.*
- b) Your affine model assumes that the natural growth rate and net migration will remain constant in the future. The U.S. Census data are derived using different assumptions and equations. Often these equations involve population growth rates which decrease over time. Pick two social or environmental conditions (i.e. variables) that are *likely* to slow your Choice Country's population growth rate in the future. Explain briefly how these two conditions might affect the natural growth rate or the migration rate.

