ESM 201 HW 1

Sara Orofino

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# set up for figure captions:
fig_nums <- captioner()
fig_nums("mex_percap", "Mexico's Actual vs. Calculated Per Capita Rate of Change (dN/Ndt). The graph de
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## [1] "Figure 1: Mexico's Actual vs. Calculated Per Capita Rate of Change (dN/Ndt). The graph depicts
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fig_nums("all_percap", "Per Capita for All")
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## [1] "Figure 2: Per Capita for All"
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Question 1 Calculate $\frac{dN}{Ndt}$

a. Describe how annual population are used to calculate $\frac{dN}{Ndt}$

$\frac{dN}{Ndt}$ is the per capita rate of change of the population. Annual population data can be used to calculate the per capita rate of change (r) by taking the natural log of the number of individuals in the population at time t and divide by the number of individuals in the population at time t+1, multiplying it by $\frac{1}{(t+1)-t}$. In this case, the per capita rate of change would be the natural log of the number of individuals in the population in 1964 divided by the number of individuals in the population in 1963. For the difference from 1964 to 1963, the final term $\frac{1}{(t+1)-t}$ would be 1 and is not necessary to include in the equation.

b. Equations for calculating $\frac{dN}{Ndt}$

- Brazil - $r = ln\left(\frac{81972001}{79602001}\right)$
- India - $r = ln\left(\frac{486639001}{476632001}\right)$
- Japan - $r = ln\left(\frac{96959001}{95929001}\right)$
- Mexico - $r = ln\left(\frac{43052001}{41715001}\right)$
- South Korea - $r = ln\left(\frac{27767001}{27138001}\right)$

c. Calcuate $\frac{dN}{Ndt}$ for Mexico for all years 1963-2004

Table 1: Table 1. Calculated vs. Actual Per Capita Rate of Change by Country

Country	Calculated dNNdt	Actual dNNdt
Brazil	0.0293	0.0293
India	0.0208	0.0208
Japan	0.0107	0.0107
Mexico	0.0315	0.0315
South Korea	0.0229	0.0229

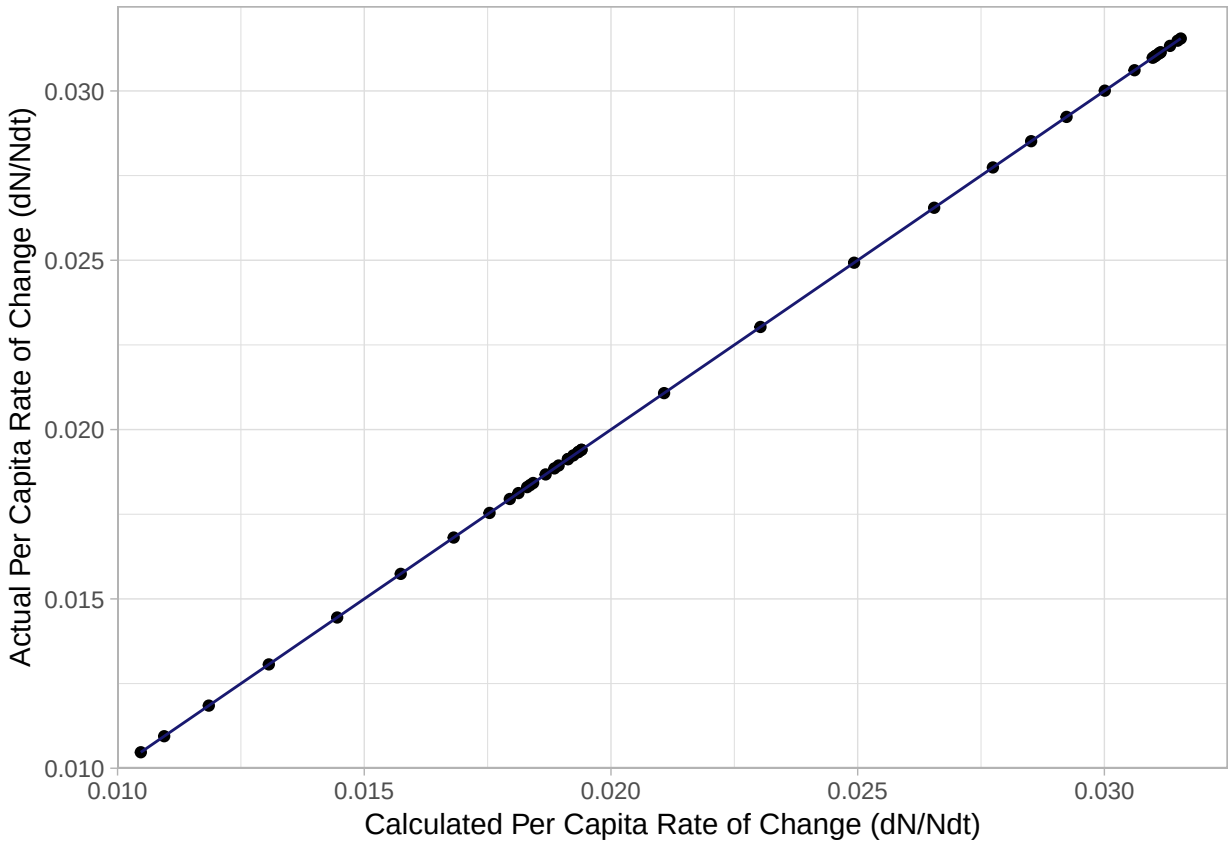
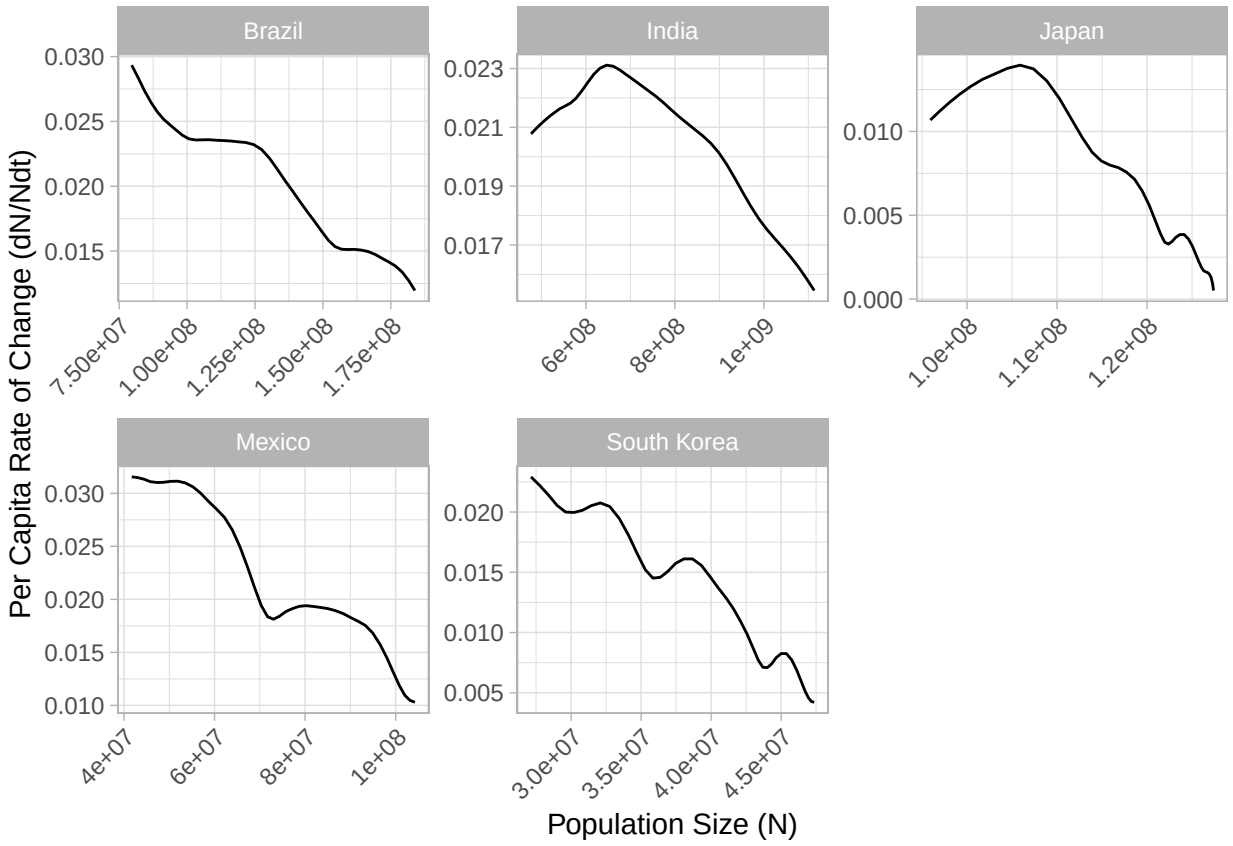


Figure 1: Mexico's Actual vs. Calculated Per Capita Rate of Change (dN/Ndt). The graph depicts the actual vs. calculated per capita rate of change with a one-to-one trendline for Mexico from 1963 to 2003.

Question 2 Graph $\frac{dN}{Ndt}$ vs. $\mathbf{N_t}$

a. For Each Country Plot $\frac{dN}{Ndt}$ vs. $\mathbf{N_t}$

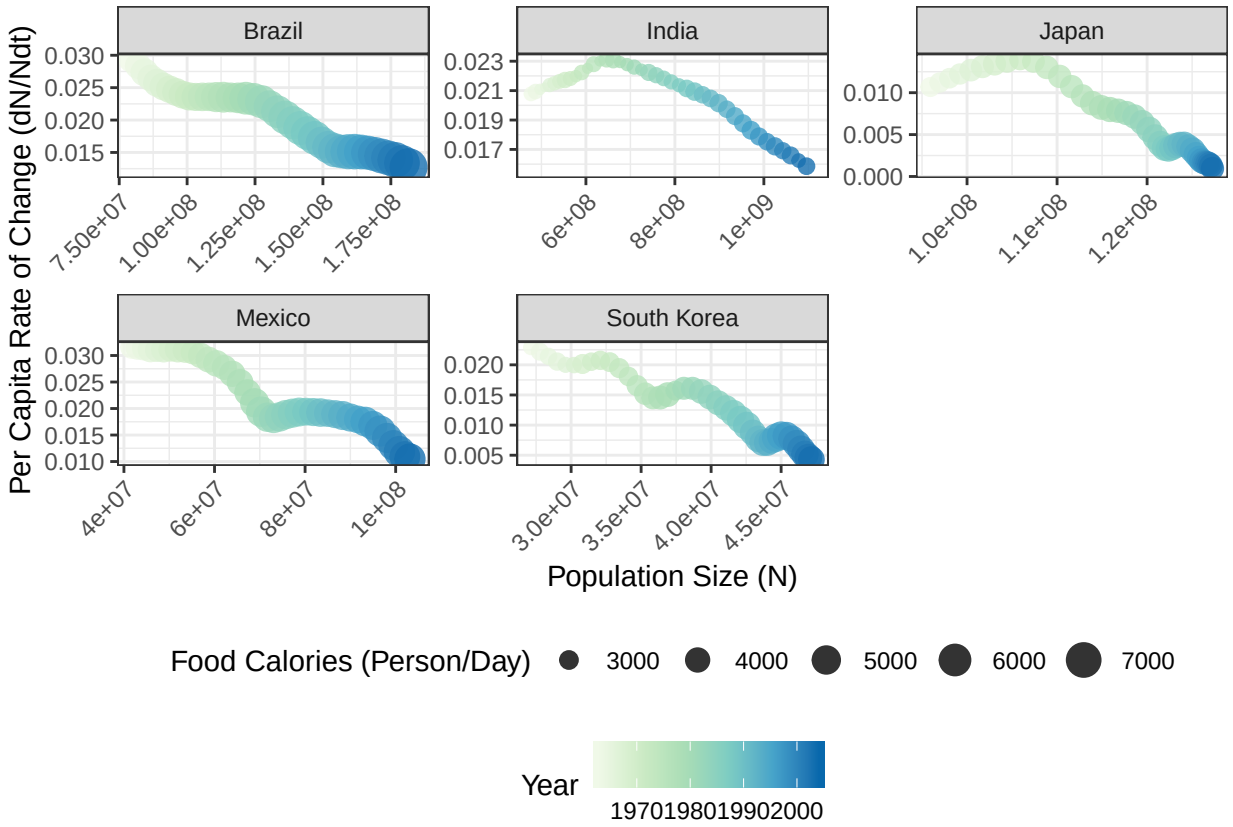


b. Estimating Carrying Capacity

Carrying Capacities:

- **Brazil:**
  $Population = 2.607 * 10^8 - 6.392 * 10^9(\frac{dN}{Ndt})$
  Carrying capacity (K) = population when $\frac{dN}{Ndt} = 0$
  $K = 2.607 * 10^8$
- **South Korea:**
  $Population = 5.282 * 10^7 - 1.054 * 10^9(\frac{dN}{Ndt})$
  Carrying capacity (K) = population when $\frac{dN}{Ndt} = 0$
  $\mathrm{K} = 5.282 * 10^7$

c. Modified Plots



Question 3 What Influences Growth

a. Combined Multiple Linear Regression

Table 2. Combined Regression Results

Dependent variable:

Per Capita Rate of Change (dN/Ndt)

India

-0.01***

(0.001)

Japan

-0.001

(0.002)

Mexico

0.004***

(0.001)

South Korea

0.003*

(0.001)

Years of Education

-0.003***

(0.0002)

Food Calories Per Person Per Day

-0.0000***

(0.0000)

Constant

0.04***

(0.002)

Observations

205

R2

0.95

Adjusted R2

0.95

Residual Std. Error

0.002 (df = 198)

F Statistic

601.34*** (df = 6; 198)

Note:

p<0.1; ***p<0.05;*** p<0.01

Description of Variables:

-

b. Multiple Linear Regression by Country

Table 3. Regression Results by Country

Dependent variable:

Per Capita Rate of Change (dN/Ndt)

Brazil

India

Japan

Mexico

South Korea

(1)

(2)

(3)

(4)

(5)

Years of Education

-0.002***

-0.002***

-0.004***

-0.002***

-0.003***

(0.0003)

(0.0003)

(0.0003)

(0.0003)

(0.0004)

Food Calories Per Person Per Day

-0.0000**

-0.0000

-0.0000**

-0.0000***

-0.0000

(0.0000)

(0.0000)

(0.0000)

(0.0000)

(0.0000)

Constant

0.04***

0.03***

0.05***

0.06***

0.04***

(0.002)

(0.004)

(0.003)

(0.002)

(0.001)

Observations

41

41

41

41

41

R2

0.93

0.62

0.92

0.96

0.95

Adjusted R2

0.92

0.60

0.91

0.96

0.95

Residual Std. Error (df = 38)

0.001

0.001

0.001

0.001

0.001

F Statistic (df = 2; 38)

237.67***

30.80***

204.69***

506.32***

375.38***

Note:

p<0.1; ***p<0.05;*** p<0.01