

Life Expectancy

Building models is one of the most practical applications of real world mathematics. Predictive models are used everywhere from marketing to medicine. Typically researchers don't argue over the numbers — they argue over whose model is more accurate. One of the most commonly used models is the Linear Model.

Part I: 1800 - 2010

Use the table of life expectancy data by country to calculate lines of best-fit.

Life Expectancy (in years)

Country	1800	1850	1900	1950	2000	2010
Belgium	40.0	42.3	46.6	66.4	77.9	80.0
Burkina Faso	29.2	28.4	29.3	30.6	50.3	55.0
China	32.0	32.1	35.9	39.2	71.3	73.2
Egypt	33.0	36.2	37.8	42.1	69.1	73.0
Ghana	28.0	32.1	34.3	40.2	58.4	63.8
Japan	36.4	37.1	38.6	59.3	81.4	83.2
Mexico	26.9	27.3	27.6	48.5	74.3	76.7
Netherlands	39.9	39.9	48.4	71.5	78.2	80.6
Russia	31.9	31.7	30.5	57.3	65.4	68.5
Saudi Arabia	32.1	34.8	37.2	39.3	71.3	73.7
Sweden	32.2	44.7	52.3	71.1	79.8	81.3
United Kingdom	40.0	42.8	46.3	68.7	78.0	80.0
United States	39.4	44.3	49.2	68.1	76.8	78.3

Calculate a line of best fit to model each of the countries.

Enter the year into a L1 (where 1800 is $t=0$). Type the life expectancy data in L2. Use your calculator to find the equation of the line of best fit and use it to predict the life expectancy in 2050.

Country	1800-2010 Line of Best Fit	2050 Prediction
Belgium		
Burkina Faso		
China		
Egypt		
Ghana		
Japan		
Mexico		
Netherlands		
Russia		
Saudi Arabia		
Sweden		
United Kingdom		
United States		

1. When you graph the lines together, what is the significance of an intersection point?

2. Calculate and interpret the intersection point of the lines between...
 - a. Belgium & Sweden
 - b. Burkina Faso & Ghana
 - c. Mexico & United Kingdom
3. What is the slope of the best-fit line for Russia? Interpret its meaning.
4. What is the y-intercept of the Netherlands? What does this mean?
5. Based on this model, which country would be the first to have an average life expectancy of 100 years old? When would this happen?
6. Are these projections realistic? Why or why not? What does this say about our models? Are they accurate or inaccurate? When would they be accurate?

Part 2: 2000 - 2010

What will happen if only recent data is used? What kind of effect will that have on the model? Use the table of life expectancy data by country to calculate lines of best-fit.

Life Expectancy 2000-2010

Country	2000	2002	2004	2006	2008	2010
Belgium	77.9	78.3	79.1	79.6	79.8	80.0
Burkina Faso	50.3	51.1	52.0	53.0	54.1	55.0
China	71.3	71.9	72.4	72.7	73.1	73.2
Egypt	69.1	70.2	71.2	71.9	72.5	73.0
Ghana	58.4	59.2	60.4	61.7	62.9	63.8
Japan	81.4	82.0	82.4	82.7	82.8	83.2
Mexico	74.3	74.8	75.3	75.8	76.3	76.7
Netherlands	78.2	78.5	79.4	80.0	80.0	80.6
Russia	65.4	65.0	65.3	66.7	67.9	68.5
Saudi Arabia	71.3	71.8	72.3	72.8	73.3	73.7
Sweden	79.8	80.0	80.7	81.0	81.0	81.3
United Kingdom	78.0	78.4	79.1	79.5	79.5	80.0
United States	76.8	76.9	77.5	77.7	77.8	78.3

Calculate a line of best fit to model each of the countries.

Enter the year into a L1 (be consistent with part I. Let $t=0$ represent 1800). Type the life expectancy data in L2. Use your calculator to find the equation of the line of best fit and use it to predict the life expectancy in 2050.

Country	2000-2010 Line of Best Fit	2050 Prediction
Belgium		
Burkina Faso		
China		
Egypt		
Ghana		
Japan		
Mexico		
Netherlands		
Russia		
Saudi Arabia		
Sweden		
United Kingdom		
United States		

1. Are the predictions significantly different from Part I? Which prediction is the most different?

2. Which model do you think will provide more accurate predictions? Why?

3. Calculate and interpret the intersection point of the lines between...
 - a. Belgium & Sweden

 - b. Burkina Faso & Ghana

 - c. Mexico & United Kingdom

 - d. Are these realistic? Why or why not?

4. Based on this model, which country would be the first to have an average life expectancy of 100 years old. When would this happen?

5. What can you conclude based on the time span of the two models and the accuracy of their linear equations?

Part 3: Your Model

Following linear models can be misleading. While some models take on a linear pattern, the reality is we live in a non-linear world. Does the data appear to be more exponential? More quadratic? More quartic? Cubic? Logistic? Rational? This is your chance to make that call — this is your model, but you do have some decisions to make...

Which dataset are you going to use? 1750 – 2000 or 1975 – 2010? _____

Calculate best fit functions to model each of the countries

Enter the year into a L1 (where $t=0$ represents 1800). Type the life expectancy data in L2. Use your calculator to find a regression function that fits your data (looking at the scatter plot will help. Use ZOOMSTAT). Use your model to predict the 2050 population.

Country	Type of Regression	Best Fit Function	2050 Prediction
Belgium			
Burkina Faso			
China			
Egypt			
Ghana			
Japan			
Mexico			
Netherlands			
Russia			

Saudi Arabia			
Sweden			
United Kingdom			
United States			

1. In general, do you think these predictions are more accurate than the linear models? Why or why not?
2. Based on this model, which country would be the first to have an average life expectancy of 100 years old. When would this happen?

The World in 2050

What will life expectancy be like in 2050? Mathematicians and scientists are regularly re-evaluating their prediction and making adjustments to questions like these. Perhaps your model is more accurate!

With the three different predictions from this project, compile them into this table to compare and contrast.

Life Expectancy in 2050

Country	1800 – 2010 Linear Prediction	2000 – 2010 Linear Prediction	Your Model Prediction
Belgium			
Burkina Faso			
China			
Egypt			
Ghana			
Japan			
Mexico			
Netherlands			
Russia			
Saudi Arabia			
Sweden			
United Kingdom			
United States			

1. By the year 2050, which country do you predict will have the most radical change in terms of life expectancy?
2. What are the implications of an increase in life expectancy?
3. Will we reach a maximum age? According to your models, do you have support for your opinion? What will the maximum age be?
4. In your estimation, rank the predictions methods from most to least accurate? Provide reasons for your ranking.
5. How do you think you could have made your model more accurate?