**Is Population Growth Linear?**

|  |  |
| --- | --- |
| **Year** | **Population (in billions)** |
| 1804 | 1 |
| 1850 | 1.2 |
| 1900 | 1.6 |
| 1927 | 2 |
| 1950 | 2.55 |
| 1955 | 2.78 |
| 1960 | 3.04 |
| 1965 | 3.35 |
| 1970 | 3.71 |
| 1975 | 4.09 |
| 1980 | 4.45 |
| 1985 | 4.85 |
| 1990 | 5.28 |
| 1995 | 5.7 |
| 2000 | 6.1 |
| 2005 | 6.48 |
| 2008 | 6.71 |
| 2010 | 6.87 |

Since the 1960’s, the world population has grown rapidly. During this same time period, world food production has also increased. There are many reasons why people have been able to produce more crops. Farmers rotate crops more efficiently causing crop yields to expand. New and improved fertilizers and chemical pesticides allow farmers to grow more crops on the same amount of land. In dry, arid regions, large irrigation systems convert land to farmland. Also, farmers use genetically altered crops that greatly increase crop yields.

Crop yields are increasing but so is the world population. Scientists need to know if one quantity is growing much faster than the other. What could happen if the world population is growing much faster than the amount of food produced?

Let’s begin by exploring the growth in the world population. The table on the right gives year and population data for a sample of years from 1804

to 2010.

**Question:** **Are the population vs. year data linear?**

There are several ways to investigate this question. We will look at patterns in the graph, patterns in the table, the linear regression line, and its correlation coefficient. This will allow us to explain why we think the

data are linear or not linear.

1. Make a graph of the data on the coordinate axes below.



1. Describe any patterns you see. What does your graph tell you about the linearity of the data?
2. Find average rates of change between the given pairs of points in the table. The first pair is done for you.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Difference in year (∆*x*)** | **Year** | **Population in billions** | **Difference in population in billions (∆*y*)** | **Average rate of change (∆*y*/∆*x*)** |
| 1850 – 1804 = 46 | 1804 | 1 | 1.2 – 1 = 0.2 | 0.2/46 =0.00043 |
| 1850 | 1.2 |
|  | 1900 | 1.6 |  |  |
| 1927 | 2 |
|  | 1950 | 2.55 |  |  |
| 1955 | 2.78 |
|  | 1960 | 3.04 |  |  |
| 1965 | 3.35 |
|  | 1970 | 3.71 |  |  |
| 1975 | 4.09 |
|  | 1980 | 4.45 |  |  |
| 1985 | 4.85 |
|  | 1990 | 5.28 |  |  |
| 1995 | 5.7 |
|  | 2000 | 6.1 |  |  |
| 2005 | 6.48 |
|  | 2008 | 6.71 |  |  |
| 2010 | 6.87 |

1. Describe any patterns you see in the average rates of change column of the table. What do those patterns tell you about the linearity of the data?
2. Enter the data in your calculator and find the linear regression line and its correlation coefficient.

Regression equation:

Correlation Coefficient: *r* =

1. What does the correlation coefficient tell you about the linearity of the data?
2. Compare your answers and ideas with those of the rest of the class. Do you agree? Did you or anyone else change their minds? Explain why or why not.