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World Population Dynamics: Modeling Involving Polynomial Functions [Mathematics]

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World Population Dynamics: Modeling involving Polynomial Functions

Introduction: Do you think the world population size has increased dramatically in recent years? If so, why are we experiencing such an increase? In the following assignment you will learn about trends in world population growth. You will be able to develop a mathematical model using which you can make the predictions about the future population size.

In the second part of the assignment you will explore trends in population growth of the USA in the last decade as well as world population growth rates. In addition you will be asked to predict the future USA population size through next few years. You will be able to gather information by conducting your own research and compare results of your analysis with the actual population size found online.

At the end of the assignment you will reflect on key questions such as: will human population grow forever? What causes change in the population size? What is the impact human population growth on the environment? How does fertility, death rate or a country's economic factors effect the dynamics population? What are the consequences of increasing in population size?

Through this assignment, you will be learning mathematical skills such as building linear equations, graphing straight lines using two points, finding rate of change or slope of line & interpreting the values. Using technology such as excel or a graphing calculator you will be able to make scatter plots and find the equation of the trend line.

Part 1-

Use MAPLE software to answer the questions. Label each graph and axes. Use the title, legend, thickness, and color commands in MAPLE to make graphs readable, Check your answers using a graphing utility or algebraically.

The table gives the population of the world for every ten years from 1950 (in millions of people):

Year	Population (in millions)
1950	2525.2
1960	3018.3
1970	3682.5
1980	4439.6
1990	5309.7
2000	6126.6
2010	6929.7

Source: http://esa.un.org/unpd/wpp/DVD/

Use the above chart to answer the following questions

1. Write each data value as an ordered pair (x, y) where x represents a year and y represents world population in millions for that year. List domain and range.

2. Make a scatter plot of the data to graph each pair of points (x, y) on the same set of coordinate axes, choose x as independent variable and y as dependent variable. What trend do you observe from the graph?

3. Compute slope for every pair of points. Are the slopes same? Interpret one value of the slope.

4. Find a linear function (a straight line) that models the data in the table.

5. Use the equation you found in question#4 to predict the world population in 1975, 1985, 1995 2005, and 2015. Round your answers to millions. Use the chart below to record your answers.

6. Using the same scattered plot that you found in question-2 above, Find a cubic function (a third degree polynomial) that models the data.

7. Use the cubic function that you found in question#6 to predict the world population in 1975, 1985, 1995 2005, and 2015. Round your answers to millions. Use the chart below to record your answers.

8. Search the appropriate database online or your campus library to find the actual world population in 1975, 1985, 1995, 2005 and 2015.

Year	1975	1985	1995	2005	2015
Predicted population using linear model (in Millions) $f(t) =$ _____					
Predicted population using cubic model (in Millions) $g(t) =$ _____					
Actual population (in Millions)					

9. Compare the actual population with your predictions using each model. Are your predictions higher or lower than the actual population? Could you explain why? Cite the source for the information you obtained.

10. Based on your summary of results in the chart, which model do you think is appropriate? Linear or cubic? Explain

11. Do you think we can use any one of the models to predict the future world population for the year 2090? Why or why not?

Part 2- Research on your own about the USA population trend

1. Search the appropriate database online or your campus library to find the population of the USA every 10 years starting from the year 1975 to 2015. Calculate how much the population size has increased over the decades from 1975.

2. Make a scatter plot of the data points that you have found using Maple.

3. Build a linear and a cubic model on the same set of axes that fits the data. List the two functions you found.

4. Use each of the models that you found in question 3 above to predict the population of the USA in 2016. Are your predictions higher or lower than the one you found on internet? Could you explain why?

5. Which model do you think is appropriate to predict the population of USA?

6. How do the trends for USA population compare with the world population over the years? Are they similar or different? Explain (Hint: compare the rate of change in population per year. Notice that rate of change in population per year using a linear model is the slope of the trend line)

7. Write a paragraph about the dynamics of population for the world. What could be some of the possible parameters that correlate to the change in the population size? Reflect on what did you learn by doing this activity?

Directions:

- Create a word document. Type in your answers below each question
- You can paste into a word document the graphs and equations obtained in MAPLE
- If you plan to submit a hand written copy of your work, please write legible and follow question-answer format. Make sure to label each question. Graphs and equations must be obtained using Maple.

- Staple a copy of assignment questions together with your answer sheets & do not forget to write your name on the front page.
- To answer question #7 in part2, please visit appropriate websites to gather information & synthesize it in your own words.