

Texas Instruments Activity #7

Title: Managing the National Debt

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Estimated Time: 40-50 Minutes

NCTM Standards:

Connections Standard – Recognize and apply mathematics in contexts outside of mathematics. Use representations to model and interpret physical, social and mathematical phenomena.

Problem Solving Standard – Solve problems that arise in mathematics and other contexts.

Algebra Standard – Understand patterns, relations, and functions. Approximate and interpret rates of change from graphical and numerical data. Understand and compare the properties of classes of functions.

Topics in Calculus:

Applications of Derivatives, Differential Equations

Overview:

In this activity, the students will predict the national debt by using logistic growth. The students will find the current national debt and use it to make their predictions. There is an optional section, which will allow the students to predict the national population and then compare the amount of debt per person now with the future amount of debt per person.

Supplies: TI-89 Graphing Calculator, Computer with Internet Access

Name: _____ Date: _____

MANAGING THE NATIONAL DEBT

In this activity, you will predict the United States National Debt using logistic growth and your TI-89 graphing calculator. Thomas Jefferson wrote, "I place economy among the first and most important of republican virtues, and *public debt as the greatest of dangers to be feared.*" Be that as it may, the nation is now in very deep debt. How much debt? Today we are going to determine, or predict the national debt in years to come.



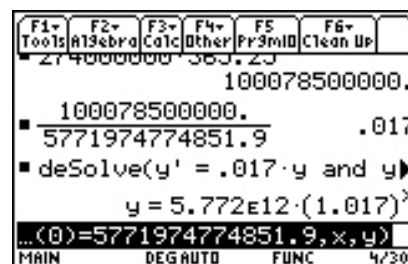
STEP ONE: To begin, you will need to visit http://www.brillig.com/debt_clock/, and find the current national debt. Write it here: _____. Then enter the value into the TI-89 and press **[ENTER]**. Write the scientific form here: _____.

STEP TWO: From the website, find the average daily increase in the national debt. This number is located underneath the total debt. Write it here: _____.

STEP THREE: To determine the average amount of money that the debt grows each year, multiply the figure from **STEP TWO** by the number of days in each year. (Use $365\frac{1}{4}$ days for each year, to account for leap years.) Write this value here: _____.

STEP FOUR: Now, divide the results from **STEP THREE** by the results from **STEP TWO**. (Use the \odot key to highlight previous calculations and press **[ENTER]** to select the calculation.) Write the result here: _____. This is called the *growth rate constant*.

STEP FIVE: Now, set up the differential equation to find the national debt in terms of x and y . The equation is $y' = (\text{growth rate constant}) \cdot y$ with the initial condition $y(0) = \text{current debt}$. Press **[F3]**, select **deSolve(** (and press **[ENTER]**). Then enter the first equation followed by **[CATALOG]** and, and then enter the initial condition followed by **[,]** **[X]** **[Y]** **[,]** **[ENTER]**.



STEP SIX: Now, save the solution in the Y=Editor. Press **[CATALOG]**, select Define and press **[ENTER]**. Then enter $y1=$ and press \odot **[ENTER]**. Press \blacktriangledown **[Y=]** and press **[F2]** and select A:ZoomFit. The graph will appear.

STEP SEVEN: Press **[F3]** to trace the function and determine the following:

1. The national debt when you are 30 years old: _____.
2. The national debt when you are 60 years old: _____.
3. The national debt in 100 years is: _____.

Does the national debt increase or decrease over the years? How can you tell? _____

PART TWO (*Optional*)

On the website, directly under the total national debt, there is a current U.S. population and the amount of money per individual when the total is divided among each man, women, and child.

STEP ONE: Go to <http://www.census.gov/population/www/estimates/uspop.html> to find the current population information. Write the current population here: _____.
Then, find the average yearly increase of the U.S. population: _____.

STEP TWO: Complete **STEP TWO** through **STEP SEVEN** on the previous page using the population information from **STEP ONE** (directly above). Use the space below to write any information you may need to complete the steps.

1. What will the population be in the United States when you are 30 years old? _____.
2. Using your answer from question one on the first page and question one above, what is the amount each citizen would be responsible for paying? _____.
3. How does this answer compare to the amount of debt per person now? (Greater, Less, Equal) This information is available on the debt website. _____.
4. How can the amount of debt per person decrease? List all possibilities and explain each. _____

5. In groups of two or three, create a plan to reduce the national debt. Find an equation in which x amount of dollars is deducted per year. Then figure out when the principle will first be paid. (Use the information on the website if you need help.) Explain the equation, how it works and how the equation varies from real life. _____

Equation: _____

The principle will first be paid: _____

The debt will be completely paid off by: _____

Explanation of Equation: _____
