

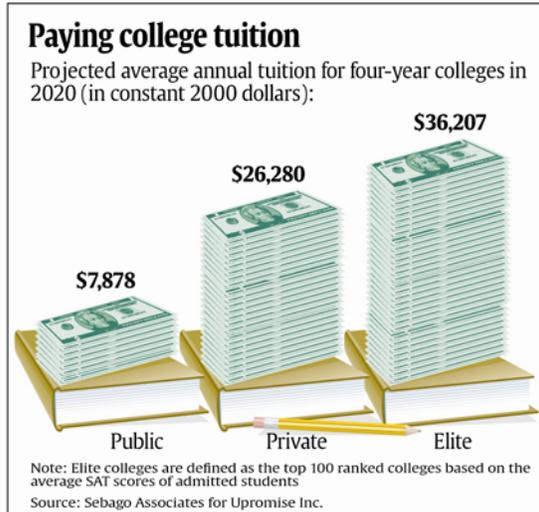


Activity 10:

Paying college tuition

by: Bob Tower - Revised from *Math TODAY: Paying college tuition* by Brenda Perkins for USA TODAY.

USA TODAY Snapshots®



By Karen Sloan and Marcy E. Mullins, USA TODAY

Activity Overview:

Students will write exponential equations based on the percent of increase of college costs and will graph and interpret these equations. Students will then use an inflationary equation based on the USA TODAY Snapshot, "Paying college tuition" to project college costs using another factor which affects future expenditures pertaining to higher education.

Concepts:

- Calculating percent of change
- Understanding exponential equations:
 - writing exponential equations
 - finding x - and y -intercepts
 - graphing and interpreting exponential equations

Activity at a Glance:

- Grade level: 9-12
- Subject: Algebra
- Estimated time: 50 minutes

Materials:

- TI-Navigator™ system
- TI-83 Plus family and TI-84 Plus family of graphing calculators

Recommended:

- Multimedia Projector
- TI Keyboards

Prerequisites:

Students should know how to:

- calculate percent of change
- write, graph, and calculate using exponential equations
- graph and use tables on the graphing calculator

TI | **navigator.**

For use with the TI-Navigator™
Classroom Learning System



Student Objectives:

- Calculate the percent of change
- Write exponential equations in the form $y = a(b)^x$, given a and b
- Use the exponential equations to analyze and make predictions
- Graph exponential functions

Background:

As students approach the end of their compulsory education, their sights are set on college. Scholarships, financial aid, decisions between private versus public universities, and 2-year versus 4-year degree institutions are all factors affecting the ultimate cost of a post-secondary education.

The USA TODAY articles, “Grants more than offset soaring university tuition” and “Public universities raise tuition, fees — and ire” and the USA TODAY Snapshot, “Paying college tuition” present another aspect students may not be aware of — the effect that inflation and a slow economy might play in the ultimate cost of their degree.

This activity presents a real-life application of exponential equations, one that the majority of students will find pertinent to their immediate future. It offers a timely lesson in reading and understanding data presented in a graphical, as well as written format.

Preparation:

- Download the activity files to your computer: Teacher Edition, Student Edition, Transparency, Activity Center Settings, Lists, and LearningCheck™ Assessment. (See Appendix B for a list of the files.)
- Make copies of the Student Edition for your class. Students can refer to the Student Edition during the activity and use it to record their work.
- Set up your TI-Navigator system and make sure you are familiar with the following functions: Send to Class, Collect from Class, Screen Capture, Quick Poll, Activity Center, LearningCheck Assessment, and Class Analysis.
- Students will need a TI-83 Plus or TI-84 Plus graphing calculator, either working in pairs or individually.
- Recommendations:
 - Multimedia Projector for sharing the Activity Center, Quick Polls, and Screen Captures with your students
 - TI Keyboards for students to easily answer the LearningCheck assessment questions

Data Source:

Sebago Associates for Upromise Inc.

Activity Extensions:

- Use in-state costs and have students create a map graph to analyze college costs by national regions.
- Have students investigate the tuition and other fees of a college of their choice. Calculate the cost of attending for four years. Finally, have them develop a budget and a method of paying for this college tuition.
- Using the inflationary equation, have students draw a financial picture of the year 2020. Have them project food, entertainment, housing, and transportation costs. To round out the activity, have them fill in their personal information or have them describe a typical Wednesday with all details of their day.

Curriculum Connections:

- Social Studies/Economics
- Business
- Career Planning

**Teacher:****Student:****Classroom Management Tips:**

- You may use the transparency for a class discussion before the students start working. This will give the students a better understanding of how to read the graphic and retrieve data.
- Remind students to carefully read all parts of the graphic before they start collecting data.
- Students can work individually or in small groups on this activity. Working in groups is especially helpful as they learn the various features of the calculator.
- Review calculating the percent of change. The average percent of change can be easily calculated by using the average costs of the two school years. Some students will calculate the mathematical average by entering all of the data they calculated from the chart. The two methods should yield the same result, but there is a greater possibility of error using the calculated data due to the number of pieces of data.
- The independent variable is years since 2001. This makes calculations easier because of the smaller numbers and gives a point of reference for discussion purposes.

Activity Step-by-Step:

The following steps represent a suggested TI-Navigator classroom procedure to answer the focus questions.

1. Send to Class – send college cost data lists to class
2. Calculator – calculate percent change based on the data lists
3. Screen Capture – check student understanding
4. Activity Center – enter an exponential equation, predicting the cost of college per year for a university of the students' choice
5. Activity Center – enter an exponential equation, predicting the cost of college using the average cost and percent of increase
6. Activity Center – enter an exponential equation, showing a 6% change year over year for in-state students
7. Quick Poll – Multiple Choice, which variable in the exponential model $y = ab^x$ would explain the differences in the graphs of the functions – A) a , B) b , or C) x ?

Focus Questions:

- How much will you/your parents pay for your college education? Project the cost to the year you expect to graduate.
- Should state government fund the larger portion of increases in tuition and other college costs?
- Will the difference in total costs of public, private, and out-of-state universities determine where you go to college?

Teacher:

8. Calculator – using the cost for an elite college, calculate the cost in 2020 dollars if inflation remains on the average 3.5% a year
9. Quick Poll – Open Response, what is the annual cost in 2020 for an elite college in 2020 dollars?
10. Activity Center – enter two exponential equations, predicting the cost of a public college and a private college in 2020 dollars
11. LearningCheck Reading Comprehension – answer the reading comprehension questions and discuss the results with your class to check for understanding

See below for details on each of these steps.

Student:**STEP 1 – SEND TO CLASS**

1. After students have logged into TI-Navigator, send the “Paying college tuition” data (MT10L1.8xl, MT10L2.8xl, MT10L3.8xl, and MT10L4.8xl) to the class using **Force send to students now**.
The data in L1 and L2 represent in-state tuition for the 2001-2002 and 2002-2003 school years respectively. L3 and L4 represent out-of-state tuition for the 2001-2002 and 2002-2003 school years respectively.
2. Instruct your students to exit the TI-Navigator system when you are ready to go to the next step.

1. Press [APPS], select NavNet, and login.
2. Wait for the teacher transfer – the data is downloaded in four lists, L1, L2, L3, and L4.
3. Once the data is downloaded, press BACK ([ZOOM]) and then [4] to EXIT APP.

**STEP 2 – CALCULATOR**

1. Instruct your students to determine the percent change based on the data lists.

1. Press [STAT] and choose Edit.
2. Use the arrow keys to highlight L3.
3. Press [2nd] [INS] and enter PC1 to represent percent change from 2001-02 to 2002-03.
4. Enter $(L2) \div (L1) \times 100$ and press [ENTER].
5. Record the amounts on the Student Edition for later reference.

Teacher:

Student:



STEP 3 – SCREEN CAPTURE

- Use **Screen Capture** to check student understanding.
The entries in the list editor represent the percent change starting at the top of the university list for in-state students.
- Instruct your students to return to TI-Navigator when you are ready to go to the next step.

L1	L2	FC1	# 2
7202	7590	5	
8880	9370	6	
8186	8350	2	
8610	9151	6	
7872	8072	3	
12120	13497	11	
11455	12014	5	

L2(1)=7590

- Press **PRGM**, select GONAVNET and press **ENTER**.



STEP 4 – ACTIVITY CENTER

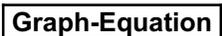
- In Activity Center, use **Load Activity Settings** to load MT_Tuition.act.
- Press **Start Activity** to begin.
- Instruct your students to enter an exponential equation, predicting the cost of college per year for a university of the students' choice.
- Select the **Graph-Equation** tab.
Note: *The window may need to be adjusted to view student graphs. Make the necessary changes so that every student's equation and graph will appear.*
- As equations appear, discuss the following with your class to check for understanding:
 - Equations that are particularly interesting or ambitious
 - Equations that have common errors**NOTE:** Select **Pause Activity** to have a class discussion. Select **Resume Activity** to continue.
Sample discussion questions:
 - What would have to happen for the graph to decrease from left to right?
 - What do you know about exponential growth (your equation for STEP 4) equations?
- Press **Stop Activity** when you are ready to go to the next step.

- From the TI-Navigator home screen press **1** Activity Center.
- When prompted, enter the exponential equation.
- Press **PLOT (WINDOW)** to graph the function on the calculator.
- Press **SEND (Y=)** to submit the equation.

Teacher:

Student:

**STEP 5 – ACTIVITY CENTER**

1. In Activity Center, select **Edit** from the toolbar and choose **Clear Activity Data**.
2. Press  to begin.
3. Instruct your students to enter an exponential equation, predicting the cost of college using the average cost and percent of increase.
4. Select the  tab.
5. Enter the regression model to fit the data.
6. As equations appear, discuss the following with your class to check for understanding:
 - Equations that are particularly interesting or ambitious
 - Equations that have common errors

NOTE: Select  to have a class discussion. Select  to continue.

Sample discussion questions:

 - How did your exponential graph compare with the model using average cost?
 - What is the growth rate? What is the growth factor?
7. Press  when you are ready to go to the next step.

1. When prompted, enter the exponential equation.
2. Press PLOT () to graph the function on the calculator.
3. Press SEND () to submit the equation.

**STEP 6 – ACTIVITY CENTER**

1. In Activity Center, select **Edit** from the toolbar and choose **Clear Activity Data**.
2. Press  to begin.
3. Instruct your students to enter an exponential equation, showing a 6% change year over year for average in-state students.
4. Select the **Graph-Equation** tab.
5. Enter the regression model to fit the data.
6. As equations appear, discuss the following with your class to check for understanding:
 - Equations that are particularly interesting or ambitious
 - Equations that have common errors

NOTE: Select  to have a class discussion. Select  to continue.

1. When prompted, enter your exponential equation.
2. Press PLOT () to graph your function on the calculator.
3. Press SEND () to submit your equation.

Teacher:Sample discussion questions:

- How did the different models compare?
- Is it possible for this exponential model to have an x -intercept? y -intercept?

7. Press  when you are ready to go to the next step.

Student:**STEP 7 – QUICK POLL**

1. From the pull-down menu select **Multiple Choice A Thru C** and check **Resubmit** so that students may change their answers.
2. Press  when you are ready to start.
3. Instruct the class to answer this question:

Q. Which variable in the exponential model $y = ab^x$ would explain the differences in the graphs of the functions?

- A) a
B) b
C) x

A. B) b

4. Discuss with your class to check for understanding.
NOTE: Select  to have a class discussion. Select  to continue.
5. Press  when you are ready to go to the next step.
6. Instruct your students to exit the TI-Navigator system when you are ready to go to the next step.

1. Mark answer A, B, or C and press SEND (.
2. Resubmit answer as needed during the class discussion.

3. Press  [QUIT] to return to the TI-Navigator home screen.
4. Press  to EXIT APP.

**STEP 8 – CALCULATOR**

1. Instruct your students to use the cost for an elite college and calculate the cost in 2020 dollars if inflation remains on the average 3.5% a year.
NOTE: Students will find the information about the elite college in the USA TODAY Snapshot, "Paying college tuition."
2. Instruct your students to return to TI-Navigator when you are ready to go to the next step.

1. Using the data in the USA TODAY Snapshot, "Paying college tuition," calculate the cost in 2020 dollars if inflation remains on the average 3.5% a year.
2. Press , select GONAVNET and press .

Teacher:

Student:

**STEP 9 – QUICK POLL**

- From the pull-down menu select **Open Response** and check **Resubmit** so that students may change their answers.
- Press **Start Poll** when you are ready to start.
- Instruct the class to answer this question:

Q. What is the annual cost in 2020 for an elite college in 2020 dollars?

A. \$72,044
- Discuss with your class to check for understanding.

NOTE: Select **Pause Poll** to have a class discussion, then select **Resume Poll** to continue
- Press **Stop Poll** when you are ready to go to the next step.

- Input answer and press SEND ($\boxed{Y=}$).
- Resubmit answer as needed during the class discussion.

**STEP 10 – ACTIVITY CENTER**

- In Activity Center, select **Edit** from the toolbar and choose **Clear Activity Data**.
- Press **Start Activity** to begin.
- Instruct your students to enter two exponential equations, predicting the cost of a public college and a private college in 2020 dollars.
- Select the **Graph-Equation** tab.
- Enter the regression model to fit the data.
- As equations appear, discuss the following with your class to check for understanding:
 - Equations that are particularly interesting or ambitious
 - Equations that have common errors

NOTE: Select **Pause Activity** to have a class discussion. Select **Resume Activity** to continue.

Sample discussion questions:

 - How do the two graphs compare over time?
 - According to the models, is it possible to have an x-intercept?
 - According to the models, is it possible to have a y-intercept?
- Press **Stop Activity** when you are ready to go to the next step.

- Find the information about the public and private colleges in the USA TODAY Snapshot.
- Press \boxed{T} Activity Center.
- When prompted, enter the exponential equation for average cost.
- Press PLOT (\boxed{WINDOW}) to graph the function on the calculator.
- Press SEND ($\boxed{Y=}$) to submit the equation.

Teacher:

Student:

**STEP 11 – LEARNINGCHECK****READING COMPREHENSION**

1. Using  **Send to Class**, distribute the LearningCheck assessment file Tuition.edc to your students using **Force send to students now**.
2. Prompt the students to open the  LearningCheck assignment and answer the following questions regarding the USA TODAY article, “Public universities raise tuition, fees — and ire.”
 - Q. What is the primary factor for the current increase of college/university costs?**
 - A. Cuts in state funding
 - Q. Although most colleges and universities have kept increases to single digits, which universities show some of the larger increases?**
 - A. University of Kansas at 21%, Texas A&M at 26%, and the University of South Carolina at 27%.
 - Q. Why is increased enrollment putting a strain on college and university budgets?**
 - A. 1) The revenue gained is merely funds lost to state cuts rather than additional value.
2) The largest share is low-income students, many of them minorities and the first in their families to aspire to college.
3) Many of these students will need financial aid and basic skill remediation, two more budget drainers.
 - Q. Even with the substantial increases in tuition and fees, why does the article propose that a public college or university education is still a bargain?**
 - A. State schools are still a bargain compared to tuition at private universities.
 - Q. What is the University of Kansas doing with a portion of their tuition increase?**
 - A. The University of Kansas is investing \$1.5 million, or about 20% of the revenue raised by the undergraduate tuition increase, into need-based aid.

1. Press BACK (**ZOOM**) to go to the TI-Navigator home screen.
2. From the TI-Navigator home screen press **2** Network Apps.
3. Select LearnChk.
4. Select the Tuition assignment and follow the prompts to answer the questions.

NOTE: It is recommended that students use TI Keyboards to answer reading comprehension questions. If you don't have TI Keyboards, these questions are in the Student Edition and can be answered in writing.



Teacher:

Student:

Q. What is another factor adding to the increase in college and university enrollments?

A. Enrollments have increased in part due to the economy. Many people who have lost their jobs are going back to school.

Q. What are some of the other ways colleges and universities have increased income without general tuition hikes?

A. Purdue and Indiana University are charging a one-time-only \$1,000 new student fee. The University of Illinois is adding a similar \$1000 surcharge. Some universities are charging higher tuitions for upper-level students due to their increased usage of high-tech facilities.

“Grants more than offset soaring university tuition”

Q. Explain what the article means when it states: “For most students, it’s a lot cheaper to go to a four-year public university today than it was just six years ago.”

A. This is because tuition has been supplemented in recent years with tax breaks and grants. Few people pay full price.

Q. Why supplement tuition with tax breaks and grants? Why not just charge less for tuition?

A. According to James Garland, president of Miami University in Oxford, Ohio, the high price makes students realize the value of their education.

3. Select  **Class Analysis** and make sure all of the students have completed the assignment.

4. Select  **Collect From Class**.

NOTE: Before collecting the answers, we recommend that you check these options:

- **Delete Answer File from Device after Collect**
- **Delete Assignment File from Device after Collect**

5. Using  **Class Results Slide Show**, discuss the results with your class to check for understanding.