

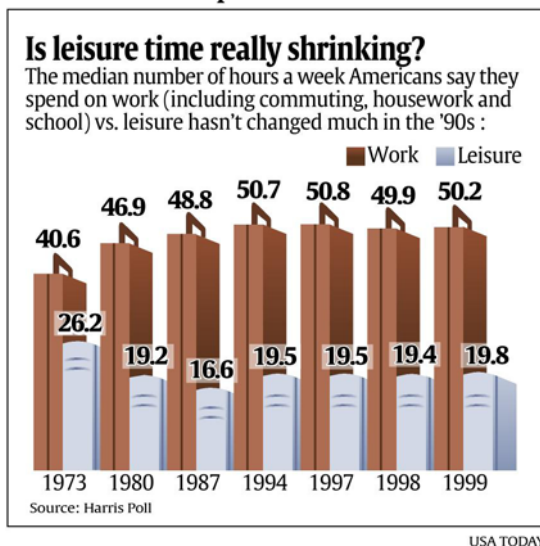


Activity 8:

Is leisure time really shrinking?

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USA TODAY Snapshots



Activity Overview:

Students will have the opportunity to organize data from the USA TODAY Snapshot, "Is leisure time really shrinking?" into two scatter plots and determine the quadratic model for each scatter plot. Students will need to explore the graphs and determine if these graphs intersect. Students will learn the concept of extrapolation by expanding the viewing window to find the intersection. Students will also practice calculating percent increase or decrease by comparing the predicted value with the listed value through percent of error.

Concepts:

- Reading and interpreting graphs
- Modeling data with quadratic functions
- Solving non-linear systems of equations
- Determining percent change

Activity at a Glance:

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

Materials:

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

Recommended:

- USA TODAY Newspapers
- Multimedia Projector
- TI Keyboards

Prerequisites:

Students should:

- be familiar with solving systems of equations
- be familiar with the regression capabilities of the calculator
- have prior knowledge about quadratics and what the vertex represents graphically

TI | **navigator**

For use with the TI-Navigator™
Classroom Learning System



Student Objectives:

- Create two scatter plots from the data
- Explore quadratic regression models for the scatter plots
- Find the intersection for the system of quadratic equations
- Find the vertex of a quadratic model
- Calculate the percent error between two values for one of the data sets

Background:

This activity will give students the opportunity to explore solutions to problems by solving a system of quadratic equations. Students will explain the trend in the data by using a scatter plot of the data from the USA TODAY Snapshot, "Is leisure time really shrinking?". When the quadratic regression model is determined, the vertex of the model will be used to answer questions. Finally, students will be asked to compare a value predicted using the model to the actual value listed in the USA TODAY Snapshot, and determine the percent error between the two values.

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 to easily answer LearningCheck assessment questions

Data Source:

Harris Poll

Activity Extensions:

- Have students explore the Life section of the USA TODAY to find activities, books, and movies that may interest them. Have them make a list of two or three new activities, books, or movies that they would be interested in pursuing to expand and make the best of their leisure time.
- Facilitate a class discussion of what constitutes "leisure time" and the value of and challenges in achieving a balanced quality of life. Then have students read and research the USA TODAY to find the different ways in which people approach leisure time -- some may volunteer, some may play sports, some may invest in the stock market, some may travel, etc.
- Have students conduct a poll in your community to determine the current number of hours per week that adults spend on work and leisure. Have them create a USA TODAY-type Snapshot based on their data (using the type of work as a category instead of year). Have students note the number of people who completed the poll.

Curriculum Connections:

- Health and Physical Education
- Business Education

Teacher:**Students:****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.
- 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.
- This activity provides students with the opportunity to learn how to analyze data numerically, graphically, and symbolically. Allow students to discuss with each other the trends, and then have them write their own response to the question about trends.

Activity Step-by-Step:

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

1. Send to Class – send leisure time data files to class
2. Calculator – use the data to create two scatter plots and two quadratic regression models; create L4 to determine the trend in difference between work and leisure time and describe the trend
3. Screen Capture – check student understanding
4. Quick Poll – Multiple Choice, the trend in the difference between work and leisure is – a) increasing always, b) increasing then decreasing, or c) decreasing always?
5. Activity Center – explore student regression models
6. Quick Poll – Multiple Choice, in the quadratic model, $y = a(x - h)^2 + k$, what does the positive value for a indicate about the graph – a) It opens up, b) It opens down, or c) It is linear?
7. Calculator – determine the intersection (in the future) of the two regression models (Y1 and Y2) and record the year
8. Quick Poll – Open Response, during which year (past 1999) is the amount of time spent by Americans on leisure expected to be equal to the amount of time spent on work?
9. LearningCheck Assessment – answer the focus questions and discuss the results with your class to check for understanding

See below for details on each of these steps.

Focus Questions:

- Describe the trend in the difference between work and leisure time for the period shown in the USA TODAY Snapshot, “Is leisure time really shrinking?”.
- Will there be a time when the number of hours spent by Americans on leisure will equal the number of hours spent on work? If yes, predict when this will happen.
- Using the mathematical model, predict the year when the maximum time was spent on work and determine the percent error in the prediction as compared to the value listed in the USA TODAY Snapshot for that year.

Teacher:

Students:

**STEP 1 – SEND TO CLASS**

1. After students have logged into TI-Navigator, send the “Is leisure time really shrinking?” data (MT08L1.8xl, MT08L2.8xl, and MT08L3.8xl) to the class using **Force send to students now**.

The data represents the median number of hours a week spent by Americans on work vs. leisure from 1973 to 1999.

2. Instruct your students to exit TI-Navigator 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 three lists, L1, L2, and L3.
3. Once the data is downloaded, press **BACK** (**[ZOOM]**) and then **[4]** to **EXIT APP**.

**STEP 2 – CALCULATOR**

1. Prompt the class to create two scatter plots and two quadratic regression models (Y1 and Y2).
2. Instruct your students to use their calculators to create L4 to show the difference between L2 and L3 to determine the trend in the difference between work and leisure time.
3. Prompt students to describe the trend in the data in L4.

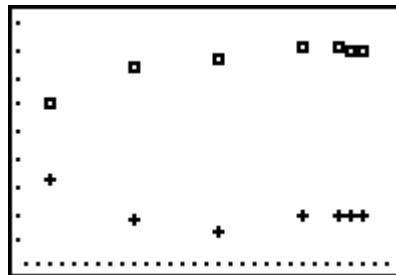
1. Press **[2nd]** **[Y=]** and adjust the settings for both scatter plots, L2 vs. L1 and L3 vs. L1.
2. Press **[WINDOW]** and set the appropriate window values for the data.
3. Press **[GRAPH]**.
4. Press **[ENTER]** and highlight L4.
5. Enter **[2nd]** **[L2]** **[–]** **[L3]** and press **[ENTER]** to calculate the difference between the data points.

**STEP 3 – SCREEN CAPTURE**

1. Use **Screen Capture** to check student understanding.

The scatter plot should look like the image on the right. If not, this is an opportunity to discuss appropriate independent and dependent variables for this problem.

2. Instruct your students to return to the TI-Navigator system when you are ready to go to the next step.




1. Press **[PRGM]**, select **GONAVNET** and press **[ENTER]**.

Teacher:

Students:

**STEP 4 – QUICK POLL**

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




Q. The trend in the difference between work and leisure time is:

A) increasing always.

B) increasing then decreasing.


C) decreasing always.

A. B) increasing then decreasing.
- Discuss with your class to check for understanding.



NOTE: Select  to have a class discussion, then select  to continue.
- Press  when you are ready to go on to the next step.

- Mark the answer A, B, or C and press SEND ($\overline{Y=}$).
- Resubmit answer as needed during the class discussion.

**STEP 5 – ACTIVITY CENTER**

- In Activity Center, use **Load Activity Settings** to load MT_Leisure.act.
- Press  to begin.
- Instruct your students to enter an equation in vertex form that would represent a vertical shift of the given equation.

Note: If students increase the vertical more than 10 units the window settings will need to be changed.
- As submissions appear, discuss the following with your class to check for understanding:
 - Submissions that are particularly interesting or ambitious
 - Submissions that have common errors

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

Sample discussion questions:

 - What does the vertical shift do to the vertex?
 - What does the vertical shift do to the axis of symmetry?
 - What would a vertical shift mean about the data

- Press BACK (\overline{ZOOM}) to go to the TI-Navigator home screen.
 - From the TI-Navigator home screen press $\overline{1}$ Activity Center.
 - When prompted, enter the equation in $Y2=$ and press SEND ($\overline{Y=}$).
- OPTION: Press PLOT (@) to view the graph of the equations before sending.

Teacher:

in this problem situation?

5. Press **Stop Activity** when you are ready to continue.
6. Press **Edit** and select **Clear Activity Data**.
7. Press **Start Activity** to begin.
8. Instruct your students to enter an equation in vertex form that would represent a horizontal shift of the given equation.
Note: A horizontal shift of more than ± 40 will require changing the window settings to see the graph.
9. As submissions appear, discuss the following with your class to check for understanding:
 - Submissions that are particularly interesting or ambitious
 - Submissions that have common errors

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

Sample discussion questions:

 - What does the horizontal shift do to the vertex? axis of symmetry?
 - What would a horizontal shift mean about the data in this problem situation?
10. Press **Stop Activity** when you are ready to go to the next step.

Students:**STEP 6 – 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 **Start Poll** when you are ready to start.
3. Instruct the class to answer this question:

Q. In the quadratic model, $y = a(x - h)^2 + k$, what does the positive value for a indicate about the graph?

A) It opens up.
B) It opens down.
C) It is linear.

A. A) It opens up.
4. Discuss with your class to check for understanding.
NOTE: Select **Pause Poll** to have a class discussion, then select **Resume Poll** to continue.
5. Press **Stop Poll** when you are ready to go on to

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

Teacher:

- the next step.
- Instruct your students to exit TI-Navigator when you are ready to go to the next step.

Students:

- Press **[4]** to EXIT APP.

**STEP 7 – CALCULATOR**

- Instruct your students to use their calculators to determine the intersection (in the future) of the two regression models (Y1 and Y2) and record the year.
- Instruct your students to return to TI-Navigator when you are ready to go to the next step.

- Press **[2nd]** **[TRACE]** **[5]** **[ENTER]** **[ENTER]** **[ENTER]** to find the intersection of the two graphs.
- Record your answer on the student sheet.
- Press **[PRGM]**, select GONAVNET and press **[ENTER]**.

**STEP 8 – 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. During which year (past 1999) is the amount of time spent by Americans on leisure expected to be equal to the amount of time spent on work?

A. During 2015
- 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 on to the next step.




- Input answer and press SEND (**[Y=]**).
- Resubmit answer as needed during the class discussion.

**STEP 9 –
LEARNINGCHECK ASSESSMENT**

- Using **[📧 Send to Class]**, distribute the LearningCheck assessment file Leisure.edc to your students using **Force send to students now**.
- Prompt them to open the **[📄 LearningCheck]** assignment and answer the following questions:

- Press BACK (**[ZOOM]**) to go to the TI-Navigator home screen.
- Press **[2]** Network Apps.
- Select LearnChk.

**Teacher:**

- Q. Describe the trend in the difference between work and leisure time for the period shown in the USA TODAY Snapshot, “Is leisure time really shrinking?”.**
- A. The difference between hours spent at work and hours spent on leisure time increased from 1973 through 1987. There is a decrease in the difference between hours at work and at leisure from 1987 to 1994 with a slight increase between 1994 and 1997. Then the general trend is that the difference gets smaller from 1997 through 1999.
- Q. Will there be a time when the number of hours spent by Americans on leisure will equal the number of hours spent on work? If yes, predict when this will happen.**
- A. The scatter plots appear to be quadratic during this time period. The intersection of the two quadratic models would place the year at 2015 when equal amounts of time will be spent on leisure and work.
- Q. Using the mathematical model, predict the year when the maximum time was spent on work and determine the percent change in the prediction as compared to the value listed in the USA TODAY Snapshot for that year.**
- A. The maximum number of hours spent on work according to the regression model was during 1994. The number of hours spent on work each week was predicted to be 50.6 for that year. The value listed in the Snapshot is 50.7, which means that the predicted value is underestimated by 0.2%.
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.

Students:

4. Select the Leisure assignment and follow the prompts to answer the questions.

NOTE: TI Keyboards may be used to answer the questions.