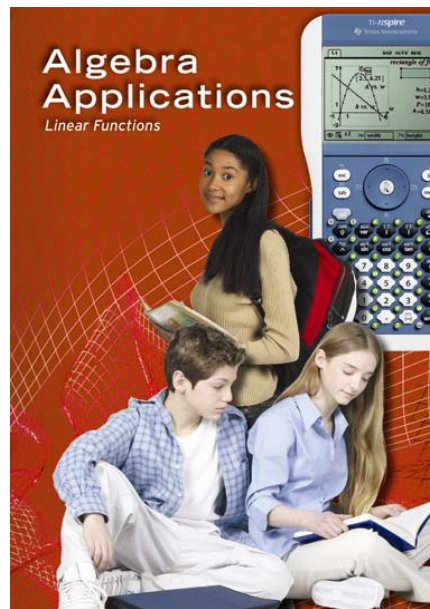




## ALGEBRA APPLICATIONS

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### Linear Functions



# Teacher's Guide

## Series Overview

The *Algebra Applications* series brings real-world, relevant applications of algebra to today's classroom. This series also integrates technology through the use of the Texas Instruments TI-Nspire graphing calculator. The key features of this series include:

- Guided applications that are interdisciplinary and can be done as an in-class group activity.
- All keystrokes are clearly shown.
- Dynamic footage and animations bring math to life.
- Math concepts are developed clearly, making this series an ideal supplement to an Algebra 1 or Algebra 2 class.

## Program Overview





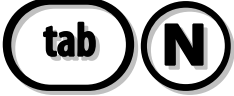




In this episode of *Algebra Applications*, three real-world explorations of linear functions are developed:






























- **Sports.** The relationship between slope and grade in cycling. Go on a tour of Italy through the mountains of Tuscany and apply students' understanding of slope.
- **Oil Exploration.** The potential for oil exploration in the controversial Alaska National Wildlife Refuge (ANWR). A linear regression of oil consumption data over the past 25 years reveals an interesting pattern. How could new oil fields like ANWR help in breaking our dependence on foreign oil?
- **Medicine.** Exercise needs to become a consistent part of everyone's lifestyle. In particular, aerobic exercises, which vigorously exerts the heart, is an important form of exercise. The maximum heart rate from aerobic exercise is a linear function dependent on age. Students are asked to develop a data table based on the function.

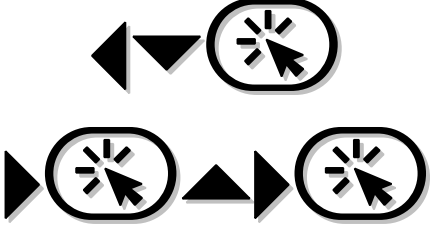
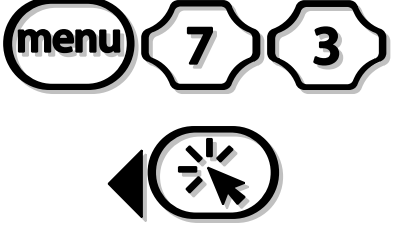

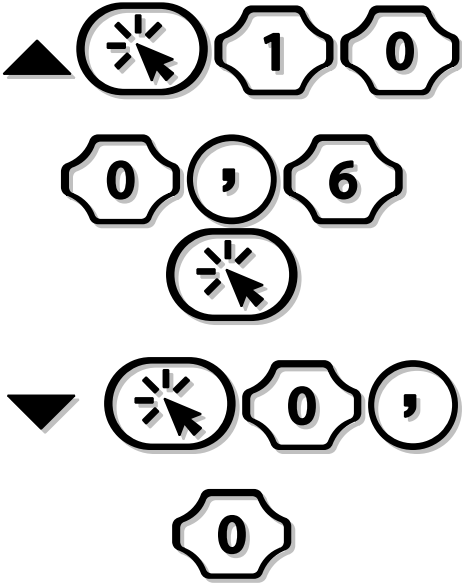
**Concepts explored:** slope, linear regression, slope-intercept form

## Application 1: Cycling

In this application, students explore the concept of the grade of a hill for cycling as an application of slope.

TI- <i>n</i> spire Keystrokes	
Turn on the <i>n</i> spire.	
Press the home key followed by 6, or <b>ctrl N</b> to open a new document.	 OR 
A previous document may be open: if so, a prompt will ask if you wish to save the document. Click to choose “yes” or press tab then click to choose “no.”	 OR 
Select 2 to create a Graphs and Geometry Page.	
Press Ctrl-G to hide the entry line.	
Show the background grid by selecting Menu, 2, and 5.	
Place two points on the grid by selecting Menu, 6, and 1.	

<p>Use the NavPad to move the pointer to the origin and press click to place a point.</p>	
<p>Do the same with a point in the first quadrant.</p>	 
<p>Connect the points with a line by selecting Menu, 6, and 4.</p>	  
<p>Move the pointer so that it is on top of each point and press Click on each point.</p>	  
<p>Change the window settings by clicking and dragging from the upper left to the lower right so that only quadrant 1 is showing.</p>	  
<p>Change the range for the x-axis by moving the pointer over the axis, hold the shift key and press the left button. Choose a max of about 110.</p>	    
<p>Display the coordinates of the points by Menu, 1, and 6. Place the pointer over one of the points and press Click.</p>	    
<p>Move the coordinate display by clicking on it and using the NavPad. Move it to the upper part of the screen.</p>	   
<p>Repeat the previous two steps with the other point.</p>	  

	
<p>Now display the slope of the line by selecting Menu, 7, 3, and clicking on the line.</p>	
<p>Then move the label for the slope to the same area of the screen.</p>	
<p>Change the coordinates of the two points to (0, 0) and (100, 6). Use the NavPad to highlight a pair of coordinates, click on it, and change the values. Repeat with the other set of coordinates.</p> <p>You'll see that the grade is the same as the slope expressed as a percent.</p>	

## Assessment

Complete the following statements.


















1. Slope expressed as a percent is known as \_\_\_\_\_.
2. To find the slope of the line connecting two points use the \_\_\_\_\_.

Find the slope of the line connecting the two points.


3.  $(-1, 10)$  and  $(2, 20)$
4.  $(0, 0)$  and  $(4, -3)$
5.  $(1, 5)$  and  $(-2, 5)$


## Application 2: Oil Exploration


In this part of the program, students graph data and create a linear regression model. The data is for the consumption of oil in the U.S. over a twenty-year period. The goal is to project future usage based on the regression model.

TI-Nspire Keystrokes	
Turn on the <i>Nspire</i> .	
Press the home key followed by 6, or <b>ctrl N</b> to open a new document.	  OR  
A previous document may be open: if so, a prompt will ask if you wish to save the document. Click to choose “yes” or press tab then click to choose “no.”	 OR  
Press 3 to insert the Lists and Spreadsheet application.	
Input the following data into the spreadsheet. Enter the years in column A, pressing enter after each entry; when you're done, use the NavPad to move to column B, where you'll enter the daily oil usage data. The usage data is in thousands of barrels, so each number in the second column represents millions of barrels.	        (Input the data from the first column. Press



Year	Daily usage (in thousands of barrels)
1980	17056
1981	16058
1982	15296
1983	15231
1984	15726
1985	15726
1986	16281
1987	16665
1988	17283
1989	17325
1990	16988
1991	16714
1992	17033
1993	17237
1994	17718
1995	17725
1996	18309
1997	18620
1998	18917
1999	19519
2000	19701
2001	19649
2002	19761
2003	20034
2004	20731
2005	20802
2006	20687
2007	20698

 after each entry.)






(Press  until you reach the top of column B.)


**D A I L Y**  
**U S A G E**


 



(Input the data from the second column.)

Press  after each entry.)

Use the NavPad to move the cursor to the top of column B, beside the letter B. Press the up arrow  once more to select column B. It should now be highlighted. Then, press and hold the SHIFT key while pressing the left arrow . Now both columns should be selected.

(Press  until you reach the top of column B.)






























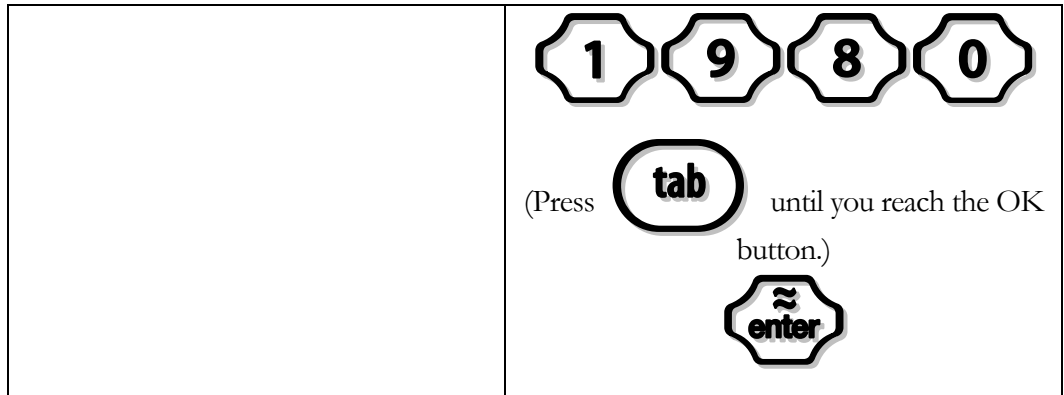
 

Press menu, 4, 1, and 3 to select linear regression. Press tab to move all the way down to OK and press Enter or Click.

**menu** **4** **1** **3**

Your cursor lands on entry one of

<p>column D. To widen the column, press menu, 1, 2, and 1 followed by the right arrow ► a few times until the width is satisfactory. Then press enter.</p>	<p>(Press  until you reach the OK button.) </p>
<p>To plot the data points and the regression line together, press ctrl and I, then 2 to insert a new graph page.</p>	<p> </p>
<p>Press menu, 3, and 4 for scatter plot.</p>	<p>  </p>
<p>Press Enter and the down arrow ▼ to select stat.xreg. Press on the Click button.</p>	<p>  </p>
<p>Press Tab to move to the y variable and likewise select stat.yreg.</p>	<p>   </p>
<p>Select Zoom-Data by pressing menu, 4 and 9.</p>	<p>  </p>
<p>To plot the regression line over the points, press menu, 3 and 1. Press the up arrow ▲ to access f1, and finally press enter.</p>	<p>    </p>
<p>Press Ctrl T for the function table and menu 5 and 3 to change the table start value to 1980. Tab down to select OK.</p>	<p>    </p>



### Assessment

This data table shows the production of oil in Texas from 1980 to 2007. (Source: Energy Information Administration, <http://www.eia.doe.gov/>.)
















Date	Texas Crude Oil Production (Thousand Barrels per Day)
1981	2554
1982	2488
1983	2419
1984	2413
1985	2381
1986	2245
1987	2085
1988	2010
1989	1885
1990	1859
1991	1870
1992	1778
1993	1696
1994	1618
1995	1533
1996	1485
1997	1470
1998	1383
1999	1231
2000	1211
2001	1162
2002	1129
2003	1112
2004	1073


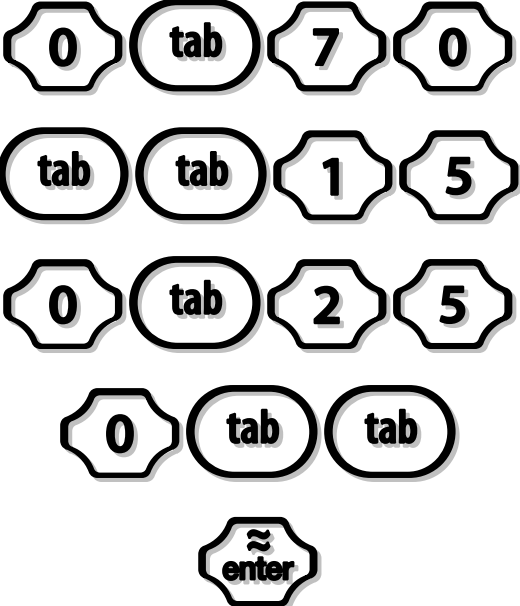




<b>2005</b>	1062
<b>2006</b>	1088
<b>2007</b>	1087

1. Create a linear regression model for the data.
2. What can you conclude from the data, graph, and regression equation?

### Application 3: Exercise

In this application, students analyze a mathematical model for finding the target heart rate for exercise based on a person's age. They will generate an exercise chart of maximum heart rates for people from age 15 to 65.

TI- <i>n</i> spire Keystrokes	
Turn on the <i>n</i> spire.	
Press the home key followed by 6, or <b>ctrl N</b> to open a new document.	  OR  
A previous document may be open: if so, a prompt will ask if you wish to save the document. Click to choose “yes” or press tab then click to choose “no.”	 OR  
Select 2, a graphs and geometry window	
Input the function 220-x.	     

<p>Notice that there is no equation onscreen. This is because the y-intercept, 220, is off the screen.</p> <p>Change the window settings by pressing Menu, 4, and 1.</p>	
<p>Change Xmin to 0 Xmax to 70 Ymin to 150 Ymax to 250</p>	
<p>Now you can see the graph. What we're interested in is generating a data table. To do that click on Ctrl T.</p>	
<p>Change the table settings selecting Menu, 5, and 3.</p>	
<p>Change the table start value to 15 and tab your way to the OK button and click on it.</p>	<p>(Press  until you reach the OK button.)</p> 

Connect your Nspire to your computer and download this file using SmartLink. Open the file using the software version of the Nspire calculator.

Highlight the cells of the table from 15 to 65, for both the x and y values. Once you have highlighted the cells, copy them to the clipboard.

Open a spreadsheet or a word processing program. Paste the cells from the Nspire file into your program.

Add column headings and format your table. Here is a sample table.

Age	Maximum Heart Rate
15	205
16	204
17	203
18	202
19	201
20	200
21	199
22	198
23	197
24	196
25	195
26	194
27	193
28	192
29	191
30	190
31	189
32	188
33	187
34	186
35	185
36	184
37	183
38	182
39	181
40	180
41	179
42	178
43	177
44	176
45	175
46	174
47	173
48	172
49	171
50	170

51	169
52	168
53	167
54	166
55	165
56	164
57	163
58	162
59	161
60	160
61	159
62	158
63	157
64	156
65	155

### Assessment

The maximum heart rate for women is found using this equation.

$$y = 226 - x$$

1. Create a graph of the function.
2. Create an exercise chart for ages 15 to 65.