Rate of Change and Slope

by – Paul Alves

Activity overview

This lesson was designed for the Grade 10 Applied curriculum in Ontario. In that course, students are expected to connect the rate of change of a linear relationship to the slope of a line.

Concepts

Slope of a line; Linear Relations; First Differences; Scatter Plots; Line of Best Fit

Teacher preparation

Students have been introduced to slope and have reviewed how to determine a relation is linear from its various models (i.e numeric, graphical and algebraic).
Student handhelds will need the Nspire file (Rates and Slope) loaded onto each one. Copies of accompanying student worksheet should be distributed to students.

Classroom management tips

It is suggested allowing students to work in pairs for the early part of the activity.

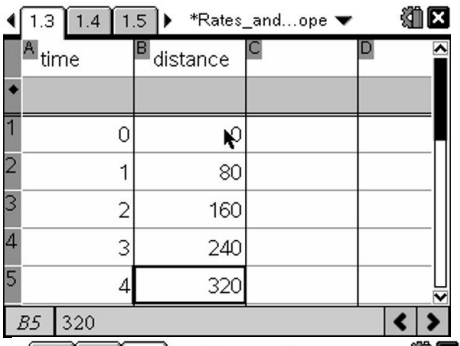
TI-Nspire Applications

Lists and Spreadsheet; Graphs and Geometry

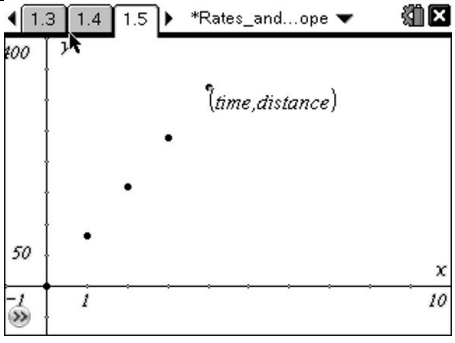
Step-by-step directions

Students are to use accompanying worksheet to guide them and record their answers.

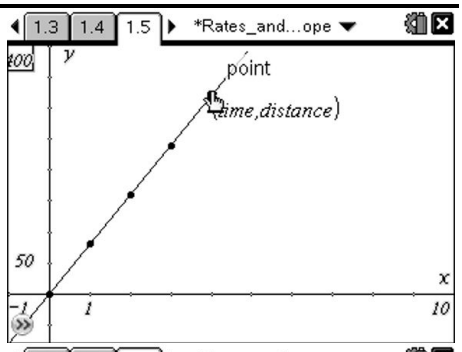
Students are to complete the table on page 1.3 given the context in problem 1. The G1 is the learner's permit to drive a car in Ontario



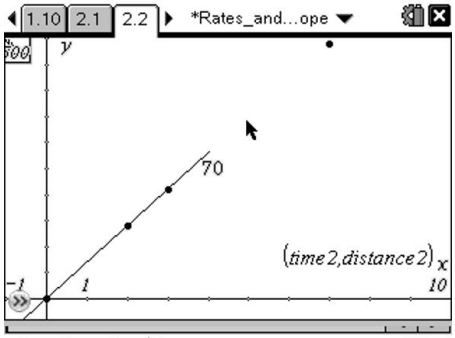
Students are to move to next page and observe the scatter plot that was set up to plot distance vs. time. They are to justify why it is a linear relation given the graph and then move back to page 1.3 and justify the linear relation from the table using first differences.



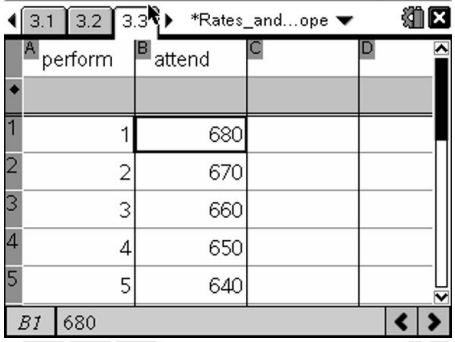
*Students are to then return to page 1.5 and draw the line of best fit using the **Line** tool. They are to then find the slope of their line by using the Slope Measurement tool and confirm that the rate of change (speed) is equal to the slope of the line.*



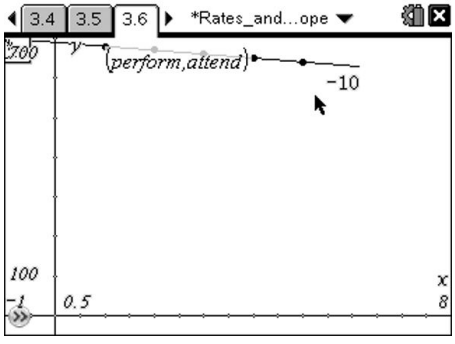
On page 2.2 students are determine the speed of a car given its distance-time scatter plot. They will need to understand that they have to find the slope of the line of best of fit to determine the speed. This should consolidate the concept that the rate of change in a context is the slope of the line.



On page 3.3 students are to fill in the table for the context outlined in problem 3. This context will introduce students to the idea of negative slope and how it is interpreted in context.



As in the previous problems, students will draw the line of best fit for the context and measure the slope of the line. At this point they will observe the negative slope and explain why it is negative and it is interpreted within the context of the problem.



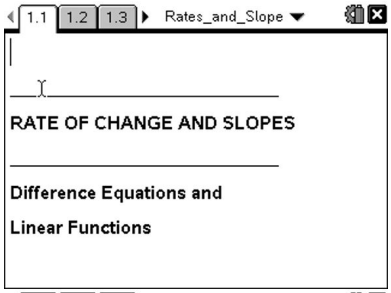
- **Assessment and evaluation**
- *Problem 4 can be used as an opportunity for formative assessment.*

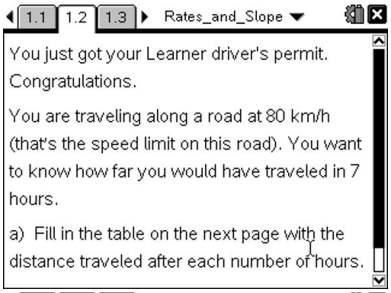
Activity extensions

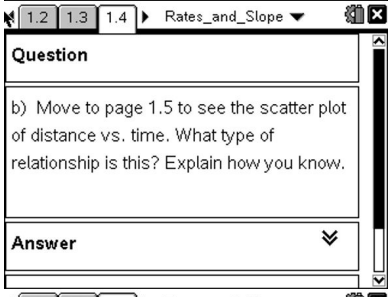
- *An extension can be to look at problem 4 at little closer. Ask students to imagine that the cube is dipped into a can of paint. Students are to determine how many cubes would have 0, 1, 2 and 3 faces with paint on them for a 10X10X10 cube by considering the pattern created when they look at a 3X3X3 cube, 4X4X4 cube and so on.*

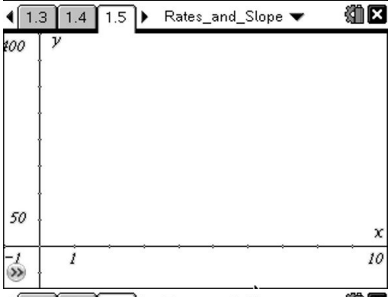
Student TI-Nspire Document

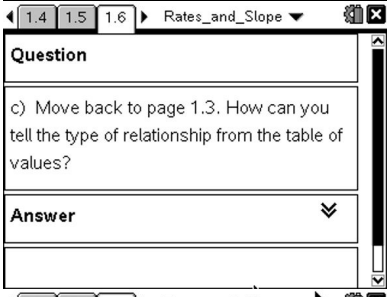
Rates and Slope

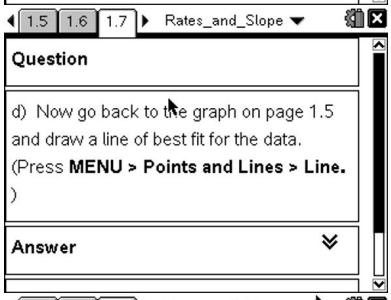


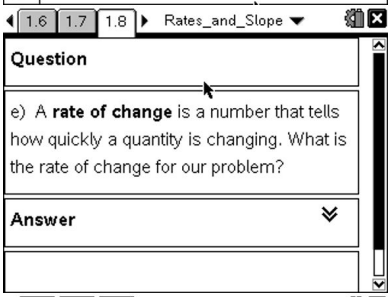


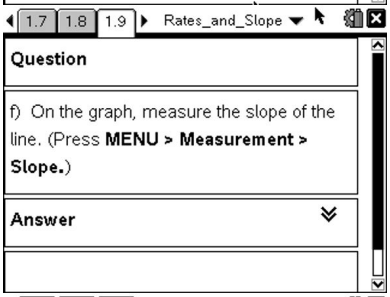


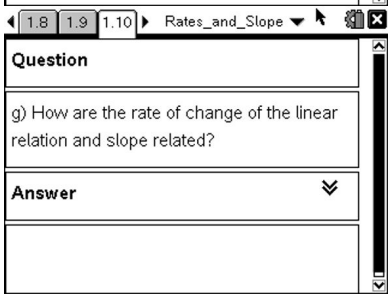


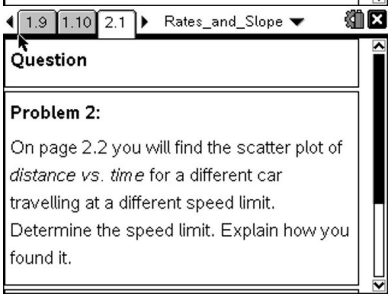


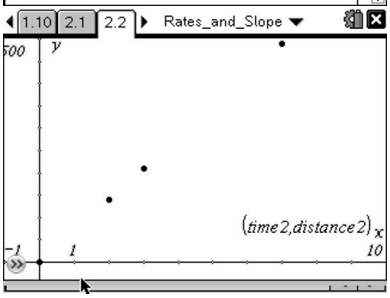


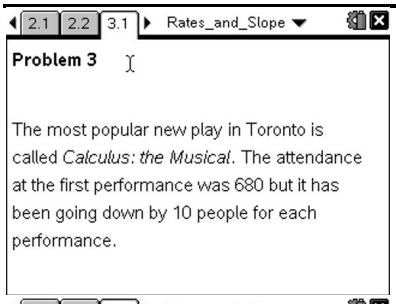


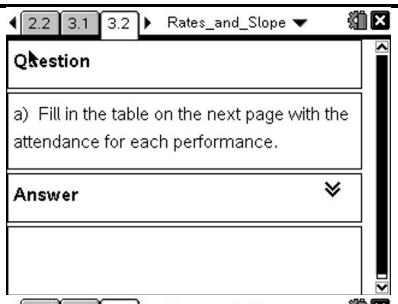


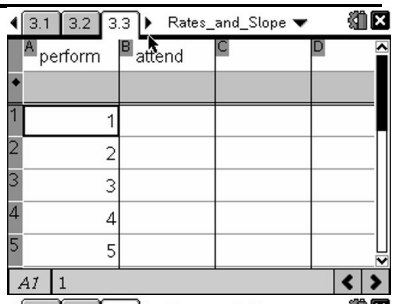


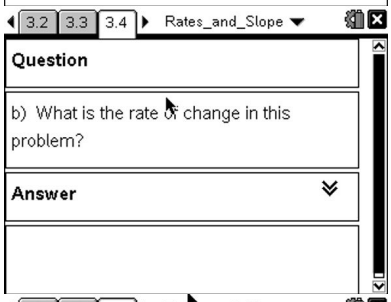


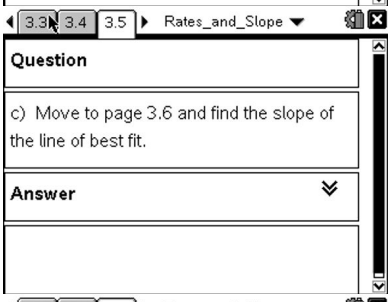


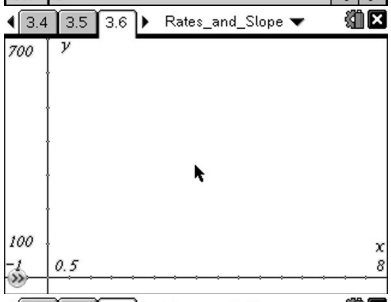

2.1 2.2 3.1 Rates_and_Slope
Problem 3
The most popular new play in Toronto is called *Calculus: the Musical*. The attendance at the first performance was 680 but it has been going down by 10 people for each performance.

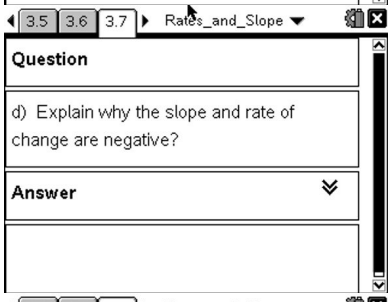

2.2 3.1 3.2 Rates_and_Slope
Question
a) Fill in the table on the next page with the attendance for each performance.
Answer

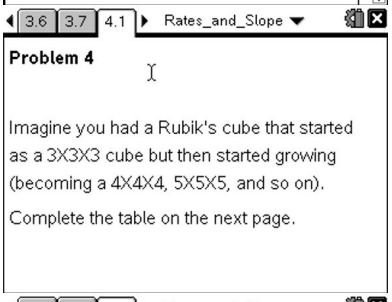

3.1 3.2 3.3 Rates_and_Slope
perform
attend
1
2
3
4
5
A1 1

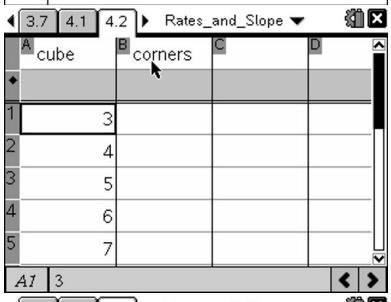

3.2 3.3 3.4 Rates_and_Slope
Question
b) What is the rate of change in this problem?
Answer

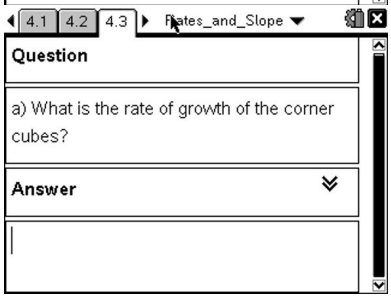

3.3 3.4 3.5 Rates_and_Slope
Question
c) Move to page 3.6 and find the slope of the line of best fit.
Answer

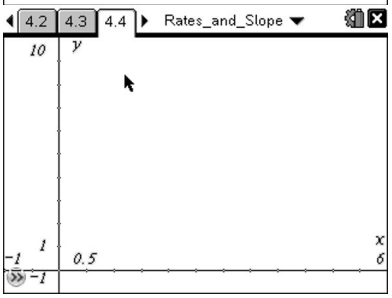

3.4 3.5 3.6 Rates_and_Slope
700
y
100
-1
0.5
x
8

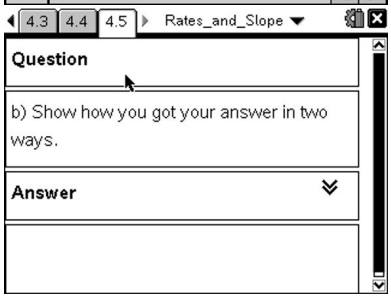

3.5 3.6 3.7 Rates_and_Slope
Question
d) Explain why the slope and rate of change are negative?
Answer


3.6 3.7 4.1 Rates_and_Slope
Problem 4
Imagine you had a Rubik's cube that started as a 3X3X3 cube but then started growing (becoming a 4X4X4, 5X5X5, and so on).
Complete the table on the next page.


3.7 4.1 4.2 Rates_and_Slope
cube
corners
3
4
5
6
7
A1 3


4.1 4.2 4.3 Rates_and_Slope
Question
a) What is the rate of growth of the corner cubes?
Answer


4.2 4.3 4.4 Rates_and_Slope
10
y
-1
1
0.5
x
6
-1


4.3 4.4 4.5 Rates_and_Slope
Question
b) Show how you got your answer in two ways.
Answer

Linear Relations – Rate of Change and Slopes

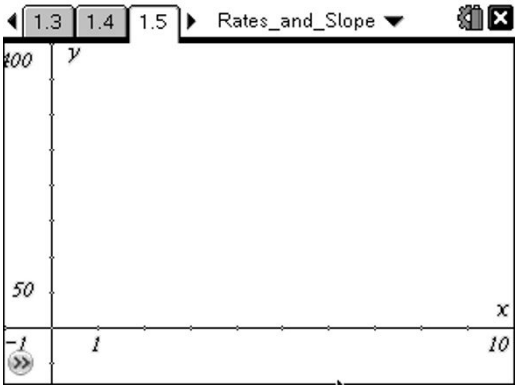
Problem 1: You just got your Learner driver's permit. Congratulations. You are traveling along a road at 80 km/h (that's the speed limit on this road). You want to know how far you would have traveled in 7 hours.

a) Fill in the table on the right and on your calculator with the distance traveled after each number of hours.

b) Move to page 1.5 to see the scatter plot of distance vs. time. What type of relationship is this? Explain how you know.

c) Move back to 1.3. How can you tell the type of relationship from the table of values?

d) Now go back to the graph and draw a line of best fit for the data. (Press MENU > Points and Lines > Line.) Sketch your line on the graph at right.



e) A rate of change is a number that tells how quickly a quantity is changing. What is the rate of change for our problem?

f) On the graph, measure the slope of the line. (Press MENU > Measurement > Slope.)

g) How are the rate of change of the linear relation and slope related?

Problem 2: On page 2.2 you will find the scatter plot of distance vs. time for a different car travelling at a different speed limit. Determine the speed limit. Explain how you found it.

Problem 3: The most popular new play in Toronto is called Calculus: the Musical. The attendance at the first performance was 680 but it has been going down by 10 people for each performance.

a) Fill in the table on the right and on your calculator with the attendance for each performance.

b) What is the rate of change in this problem?

c) Move to page 3.6 and find the slope of the line of best fit.

d) Explain why the slope and rate of change are negative?

Problem 4: Imagine you had a Rubiks cube that started as a 3X3X3 cube but then started growing (becoming a 4X4X4, 5X5X5, and so on). What is the rate of growth of the corner cubes? Show how you got your answer in two ways.