Exploring Rates of Change Worksheet

Part 1: Text Messaging

The cost for text messaging varies from company to company and from plan to plan. A plan that suits one person may not be beneficial to another. Explore the pricing and the rate of change in each of the following plans.

A. Unlimited plan
B. Pay-per-use plan
C. Plan with 750 messages

Use the Plan Description to complete the tables (see the example below) and to plot the data points on the grid to the right of each table. Connect the points with appropriate line(s).

Example: A plan with 300 text messages

Plan Description: $5.99 per month with 300 text messages; additional fee of $.05 for each message over the 300 limit

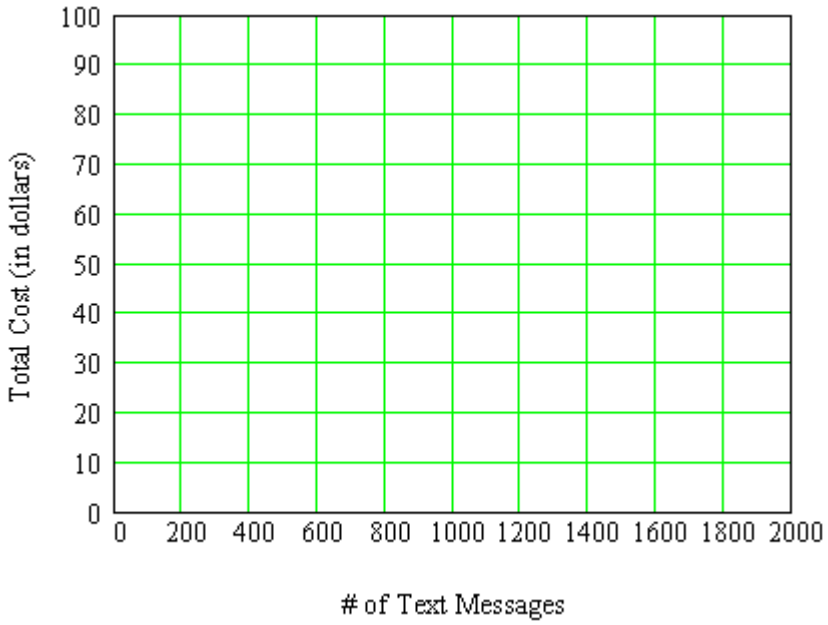
To create ordered pairs to graph the relationship, cost was calculated for messages in increments of 200, beginning with zero. The values in the Total Cost column are calculated based on the Plan Description.

# of Text Messages	Total Cost	Calculations
0	$5.99	Monthly charge
200	$5.99	Monthly charge (200 of the first 300 messages of the plan)
400	$10.99	Monthly charge (includes first 300 messages), plus remaining 100 messages at .05/message = $5.00.
600	$20.99	Monthly charge (includes first 300 messages), plus remaining 300 messages at .05/message = $15.00.
800	$30.99	Monthly charge (includes first 300 messages), plus remaining 500 messages at .05/message = $25.00.
1000	$40.99	Monthly charge (includes first 300 messages), plus remaining 700 messages at .05/message = $35.00.

A. **Unlimited Plan**

Plan Description: $24.99 per month, regardless of the number of text messages

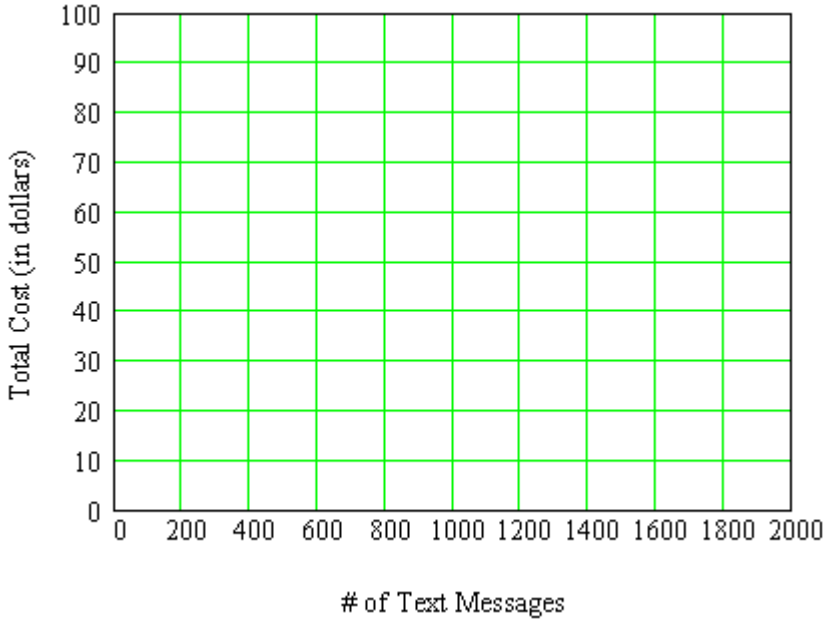
# of Text Messages	Total Cost
0	
200	
400	
600	
800	
1000	
1200	
1400	
1600	
1800	
2000	



B. **Pay-Per-Use Plan**

Plan Description: $.05 per text message, billed monthly

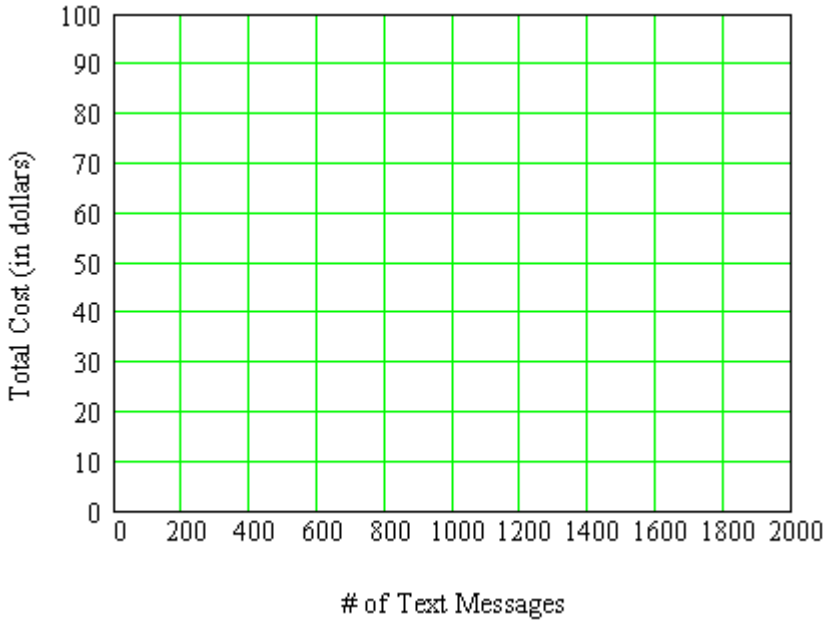
# of Text Messages	Total Cost
0	
200	
400	
600	
800	
1000	
1200	
1400	
1600	
1800	
2000	



C. **750 Included Plan**

Plan Description: $9.99 per month with 750 text messages; an additional fee of $.05 for each message over the 750 limit

# of Text Messages	Total Cost
0	
200	
400	
600	
750	
800	
1000	
1200	
1400	
1600	
1800	
2000	



1. Calculate the slope of the line for each plan. Explain the meaning of the slope in terms of number of text messages and total cost in dollars.

   Plan A:

   Plan B:

   Plan C:

2. Determine the *y*-intercept and state what the intercept represents for each plan.

   Plan A:

   Plan B:

Plan C:

3. Compare your graphs for Plan A and Plan B. How can you interpret any ordered pair on the graph of Plan A? Plan B? Describe how do the two plans differ.

4. In these plans, the rate of change of the total cost is the rate at which the total cost increases with each additional text message. Use this definition to complete each sentence.

   a. For plan A, as the number of text messages sent increases, the rate of change in the _____ remains the same at _____.
   b. For plan B, for each message sent, the rate of change in the _____is _____.
   c. For plan C, after the first 750 messages, the rate of change in the total cost is _____.

   What is another term that we use to describe rate of change?

5. Using the data and your graphs, write an equation to describe the relationship between the number of text messages and the cost for each plan. Note for Plan C: write two equations for the total cost; the first from 0 to 750 messages and the second for 750 messages and higher.

   Plan A:

   Plan B:

   Plan C:

6. Using the equations above, determine which plan will be the most cost-effective for the number of text messages below. List the cheapest plan and its cost.

   100 messages:

   500 messages:

   1500 messages:

7. Alma has purchased an Alltel cellular phone and must decide which text messaging plan to add. Examine the graphs and equations. Advise Alma on her choices by explaining, in writing, which plan is best for a certain number of text messages. (Hint: Displaying all three graphs on one grid may also be helpful.)

Part 2: Moving Truck Rentals

Truck rental costs vary according to the size of the truck, the miles driven, and, sometimes, the cost of the gasoline. In the following problems, the cost is dependent upon the size of the truck and the miles driven while using the truck. In each problem, use the Explanation of the Charges to complete the tables (see the example below) and plot the data points on the grid to the right of each table. Connect the points with appropriate line(s).

Example: 17' Truck

Explanation of the Charges: $29.95 for truck rental; an additional fee of $.79 per mile

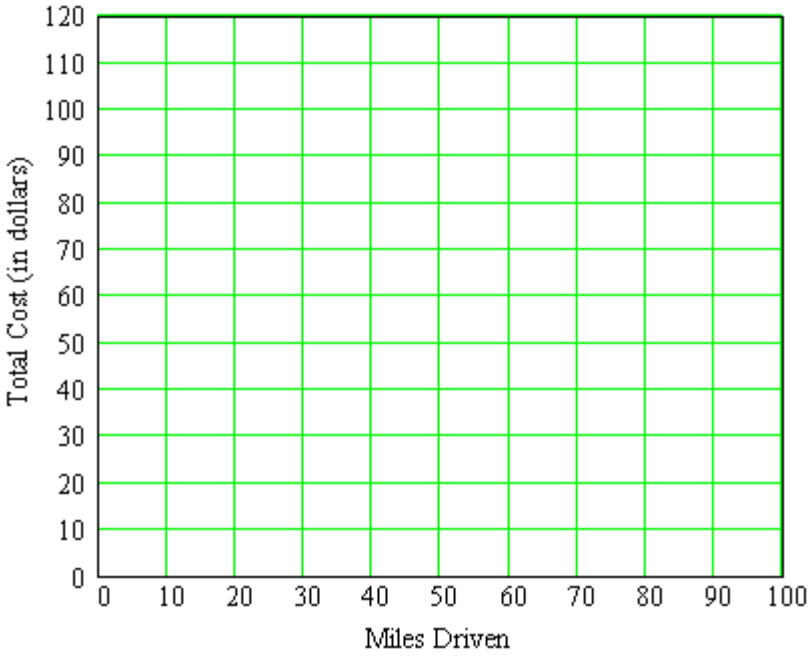
To create ordered pairs to graph the relationship, the cost was calculated for miles driven in increments of 10, beginning with zero, plus the rental charge.

Miles	Total Cost	Calculations
0	$29.95	Truck rental charge
10	$37.85	Rental charge plus 10 miles at $.79/mile ($7.90)
20	$45.75	Rental charge plus 20 miles at $.79/mile ($15.80)
30	$53.65	Rental charge plus 30 miles at $.79/mile ($23.70)
40	$61.55	Rental charge plus 40 miles at $.79/mile ($31.60)

A. **24' Truck**

Explanation of Charges: $39.95 to rent the truck; an additional $.79 per mile

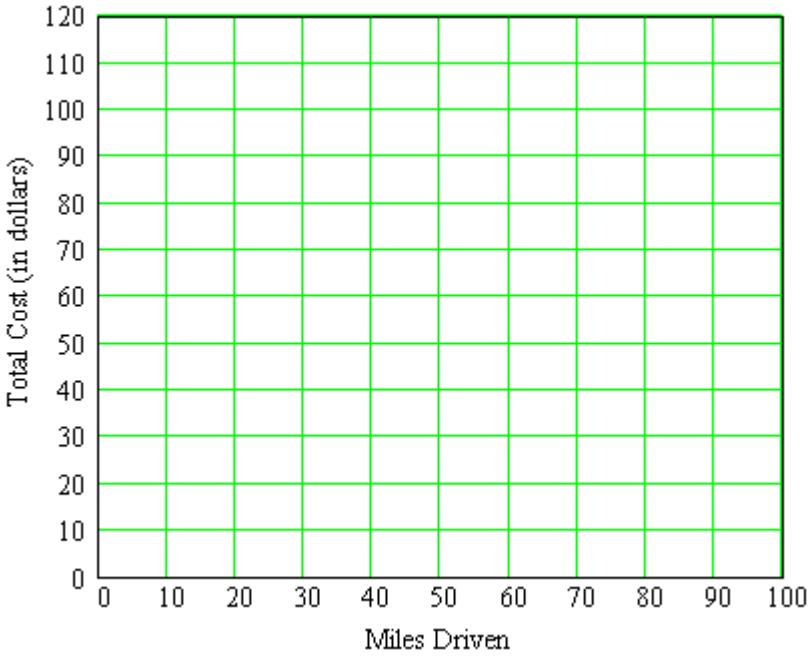
Miles	Total Cost
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	



B. **10' Truck**

Explanation of Charges: $19.95 to rent the truck; an additional $.79 per mile

Miles	Total Cost
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	



8. From the data points and your graph, determine the slope of the line for the 24" truck rental. For the 10" truck rental. Interpret the slope.

   24" Truck Rental:
   10" Truck Rental:
   Interpretation:

9. Determine the *y*-intercept for both rentals. Interpret the *y*-intercept.

   24" Truck Rental:
   10" Truck Rental:
   Interpretation:

10. Write an equation in slope-intercept form to describe the data for each rental

    24" Truck Rental:
    10" Truck Rental:

11. Use the definition for rate of change from Part 1, problem 4 to complete a similar definition for the rate of change in this truck rental example.

    The rate of change of the total cost for truck rental is the rate at which the _____ _____

with each additional _____.

12. What is the only cost difference between renting the two different size trucks?

13. You plan to move from a 3-bedroom apartment to a new apartment 10-miles away. Would it be cheaper to rent the larger truck and make one trip (from the old apartment to the new apartment) or rent the smaller truck and make several trips (to the new apartment, back home, back to the new apartment)? Show your calculations.

14. Consider the same options from the scenario presented in problem 10, but suppose the move is 30 miles across town instead of 10. Which rental would be cheaper? Show your calculations.

Summary Questions

15. If the rate of change were much greater in these scenarios (text messages and truck rental), what obvious difference would you expect to see in the graphs? Explain.

16. Describe at least two real-world examples where rate of change could be represented by a negative slope.