Linear Functions

Objective:
Students will write an equation for a given problem situation and investigate the relationships for these situations using tables and graphs.

Connections to Previous Learning:
Students should be able to write an equation, understand input and output, and graph on a coordinate plane.

Connection to AP:
AP Calculus topic of analysis of functions

Time Frame:
75 minutes

Materials:
Worksheet, calculators (optional)

Teacher Notes:
Introduce the problem situation to the whole group. Ask some questions about the three choices of companies. For example, when would you want to order from Folders R Us? (when you are ordering just a few folders). When would Folders 'N More be the company of choice? (when you are ordering large quantities of folders).

After completing the table that shows the printing price, you may want the students to use graphing calculators to verify their answers. Divide the class into two groups. Have half of them use the statistics capabilities by entering the number of folders into a list (List 1), enter the equation for Folders R Us into a second list (List 2), enter the equation for Folders Etc. into a third list (List 3), and enter the equation for Folders 'N More into a fourth list (List 4). Have them check their answers with the calculator-generated values. Have the other half of the class use the table building capabilities by entering each equation into Y=. Have them change table setup to ask for the independent variable. This will allow them to enter the same numbers that were on the worksheet. By doing this, they will be able to easily compare their answers with the calculator-generated values.

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The band booster club at your middle school is trying to raise money to help pay for a band trip to Fiesta Texas. They have decided to have several fund raising projects throughout the school year. The first fund raiser is selling folders that have the school name and mascot on them. Several companies have sent them pricing information for producing these folders. One company, Folders R Us, said that they would charge forty cents for each folder produced. Another company, Folders Etc. said that they would charge twenty cents for each folder, but would also charge a $20 set-up fee. A third company, Folders 'N More, said that they would charge only fifteen cents a folder with a $50 set-up fee.

1. Complete the following table showing the printing price for each company. Include the process that you used to find this amount.

Number of Folders Printed	Folders R Us	Folders Etc.	Folders 'N More
50			
75			
100			
150			
200			
250			
300			
350			
400			
500			
600			
750			
1000			
n			

2. Write a sentence and equation for the cost of the folders from Folders R Us.

3.   Write a sentence and equation for the cost of the folders from Folders Etc.

4.   Write a sentence and equation for the cost of the folders from Folders 'N More.

5.   As the number of folders increase, what happens to the cost? What would a graph representing the costs for each company look like?

6.   If the band boosters club only has $80 to spend, how many folders could they purchase from each company?

   a)   Which company offers the best deal?

   b)   What is the equation for this company?

   c)   What does *n* equal for this amount? Explain in words what *n* represents.

7.   If the band boosters club only has $30 to spend, how many folders could they purchase from each company?

   a)   Which company offers the best deal?

   b)   What is the equation for this company?

   c)   What does *n* equal for this amount? Explain in words what *n* represents.

8. Folders Etc. has some financial problems and goes out of business. The band booster club has to decide between Folders R Us and Folders 'N More.

   a) Write a sentence that tells when Folders R Us offers the better deal for the purchase of these folders.

   b) Write a sentence that tells when Folders 'N More offers the better deal for the purchase of these folders.

9. a) Is there a point where the two companies, Folders R Us and Folders 'N More, charge the same amount for the same number of folders?

   b) If so, what is that charge?

   c) Write an equation that represents the point where these two companies charge the same amount for the same number of folders.

   d) Sketch a graph for both of these companies. Choose an appropriate scale for both axes. Remember to label your axes.
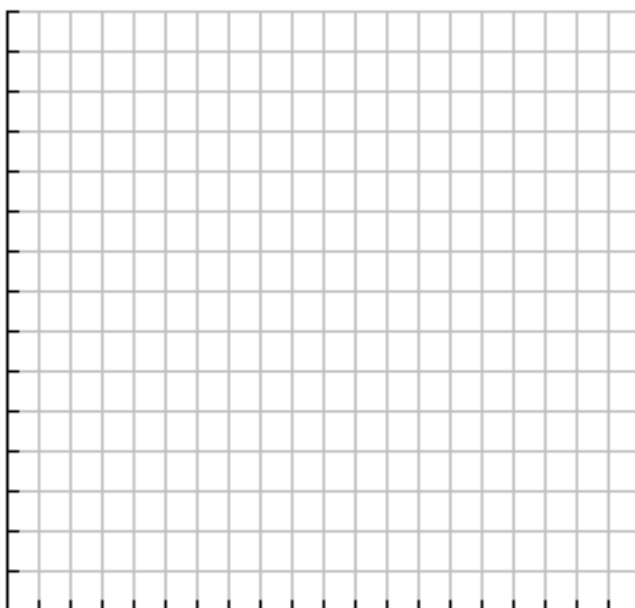
10. Folders R Us really wants the band boosters to buy folders from them. They make a counter offer to try to get the contract. If the band boosters will buy one thousand folders from them, they will decrease their original offer by fifty percent.

   a) What would this new equation be?

   b) How much would 1000 folders cost now?

   c) How does this cost compare to Folders 'N More?

11. Since there are seven hundred fifty students at your school, the band boosters club decides to order only 500 folders. They would like to make a profit of $200 on the sale of these folders. Write a paragraph telling which company, Folders R Us or Folders 'N More, they should buy from and why. (Since they are only buying 500 folders, Folders R Us will charge their original price.) Explain what their cost will be for each folder based on the company you choose. Determine a reasonable price for them to charge for these folders to insure a profit of $200. Justify your answer.

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Answers:

1. As shown in following table:

Number of Folders Printed	Folders R Us	Folders Etc.	Folders 'N More
50	.40 (50) = 20	20.+ .20 (50) = 30	50 + .15(50) = 57.50
75	.40 (75)= 30	20.+ .20 (75) = 35	50 + .15(75) = 61.25
100	.40 (100) = 40	20.+ .20 (100) = 40	50 + .15(100) = 65
150	.40 (150) = 60	20.+ .20 (150) = 50	50 + .15(150) = 72.50
200	.40 (200) = 80	20.+ .20 (200) = 60	50 + .15(200) = 80
250	.40 (250) = 100	20.+ .20 (250) = 70	50 + .15(250) = 87.50
300	.40 (300) = 120	20.+ .20 (300) = 80	50 + .15(300) = 95
350	.40 (350) = 140	20.+ .20 (350) = 90	50 + .15(350) = 102.50
400	.40 (400) = 160	20.+ .20 (400) = 100	50 + .15(400) = 110
500	.40 (500) = 200	20.+ .20 (500) = 120	50 + .15(500) = 125
600	.40 (600) = 240	20.+ .20 (600) = 140	50 + .15(600) = 140
750	.40 (750) = 300	20.+ .20 (750) = 170	50 + .15(750) = 162.50
1000	.40 (1000) = 400	20.+ .20 (1000) = 220	50 + .15(1000) = 200
n	.40n	20 + .20n	50 + .15n

2. The cost of the printing of the folders from Folders R Us is forty cents for each folder. $C = .40n$

3. The cost of the printing of the folders from Folders Etc. is $20 plus 20 cents for each folder. $C = 20 + .20n$

4. The cost of the printing of the folders from Folders 'N More is $50 plus 15 cents for each folder. $C = 50 + .15n$

5. As the number of folders increases, the cost increases. All three graphs would go up but at different rates. The graphs are straight lines. The graph for Folders R Us would go up faster than the other two graphs.

6. Folders R Us—200 folders; Folders Etc.—300 folders; Folders 'N More—200 folders

    a) Folders Etc.

    b) $80 = 20 + .20n$
        Students should write the equations then look for the answer in the table. They do not need to solve the equation.

    c) $n = 300$. This represents 300 folders that the band boosters would buy from Folders Etc.

7. Folders R Us—75 folders; Folders Etc.—50 folders; Folders 'N More—none since set up fee alone is $50.

    a) Folders R Us

    b) $30 = .40n$

    c) $n = 75$. This represents 75 folders that the band boosters would buy from Folders R Us. Again, students should write the equation then look for the answer in the table. They do not need to solve the equation. It is important that students see equations in a real world context and understand how to solve them using a table.

8. Answers are:

    a) Folders R Us offers the better deal for $n < 200$. There is no difference for $n = 200$.

    b) Folders 'N More offers the better deal for $n > 200$.

9. Answers are:

    a) Yes

    b) When $n = 200$, the cost is $80 for either company.

    c) $40n = 50 + .15n$

    d) See graph next page.

10. Answers are:

 a) $C = .20x$
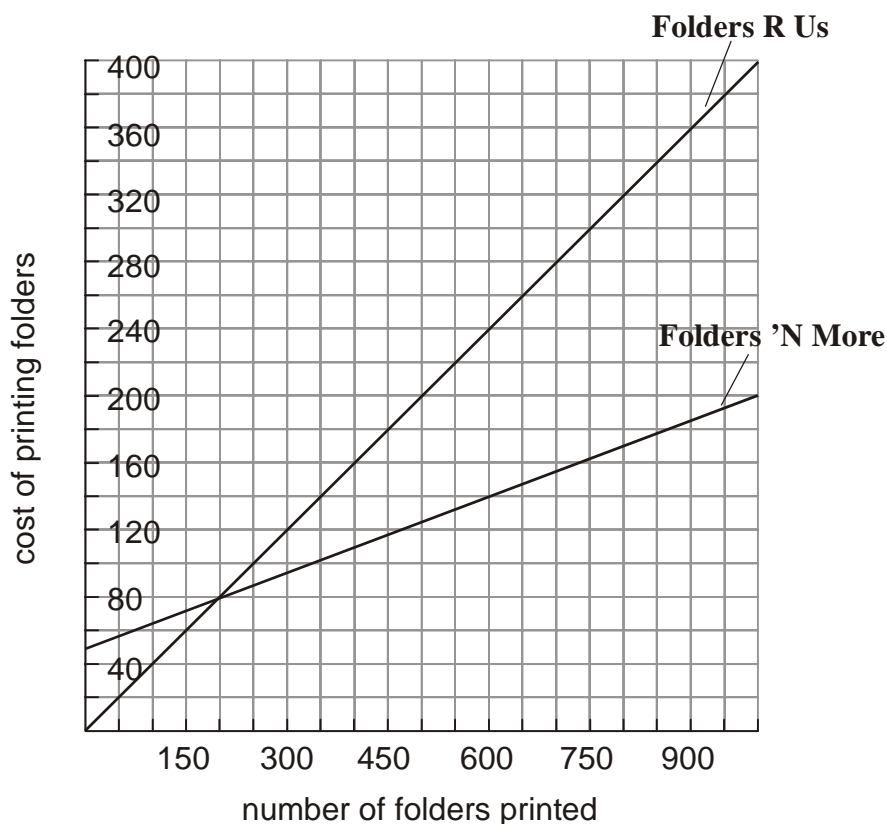
 b) $C = .20(1000) = 200$

 c) The cost for either company is the same ($200).

11. Answers will vary. Here is a sample response:

 If the band boosters are going to order 500 folders, they should buy them from Folders 'N More. For 500 folders, the cost is $125 from Folders 'N More and $200 from Folders R Us. The cost for each folder from Folders 'N More is twenty-five cents. This cost is found by dividing $125 by 500 folders. So to make a profit of $200 they need to sell the folders for at least 65 cents each. At 65 cents each, they would collect $325. They have to pay Folders 'N More $125 so they would have $200 left. It is reasonable to charge 65 cents for a folder with a school's name and mascot on it.