

The Dirty Dawg Salon

ID: 12090

Time required
25 minutes

Activity Overview

In this activity, students will work through a scenario of a business venture involving washing dogs. They will translate fixed and variable costs to a cost function and make a decision about how much to charge to wash per dog. When the break-even point is found, students must interpret it to answer the question.

Topic: Systems of Equations

- *Break-even point (intersection of two lines)*
- *Interpreting cost, income, and profit*

Teacher Preparation and Notes

- *Students must be able to solve a linear system by substitution.*
- *Students will utilize the **Hide/Show** tool to reveal an ordered pair that labels the point of intersection.*
- *It would be helpful for students to know how to answer multiple choice questions by clicking on the choices.*
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter “12090” in the quick search box.***

Associated Materials

- *Alg1Week18_DogWash.tns*
- *Alg1Week18_DogWash_Soln.tns*
- *Alg1Week18_DogWash_worksheet_TINspire.tns*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *Getting Started with the TI-Navigator System: Show Me The Money (TI-84 Plus family with TI-Navigator) — 5607*
- *Solving Linear Systems by Graphing, Substitution, or Elimination (TI-Navigator) — 6425*
- *Linear Systems: Using Graphs and Tables (TI-84 Plus family) — 4423*
- *All On The Line (TI-Nspire technology) — 11928*
- *Intersecting the Solution (TI-Nspire technology) — 11517*

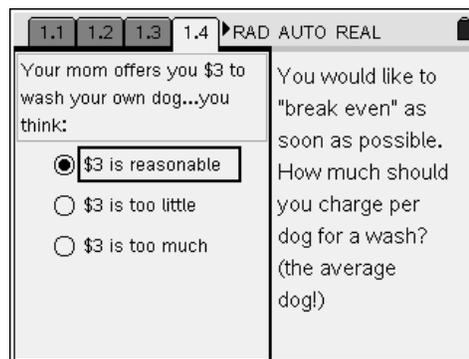
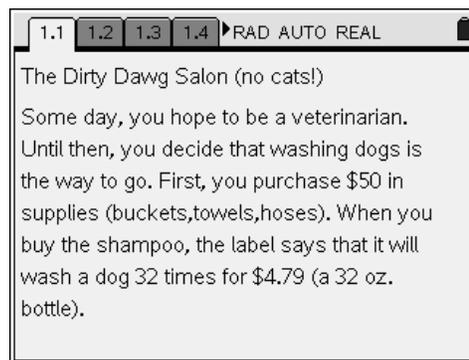
Part 1 – Setting up the problem

The first concept introduced here is the idea of a fixed cost (\$50) in the purchase of supplies. You may wish to discuss start up costs for a business. Next, the idea of a unit price is introduced. Help the students to divide the total cost \$4.79 by the number of washes (approximately 32) per bottle.

Pages 1.2 and 1.3 ask the student to choose expressions that represent the unit cost and the Cost function.

Page 1.4 provides an opportunity to discuss what might go into the decision of how much to charge for a service. The students could take the \$50 fixed costs and divide it by several different prices to determine an approximate break-even point.

For example, if you charge \$2 per dog wash, it will take about 25 dogs, whereas charging \$5 per wash will speed up the profits. If the students think that a parent would give a “reasonable” figure, they might agree with the mom’s offer. Have students explain why they think the price is too little or too much if they disagree with \$3.

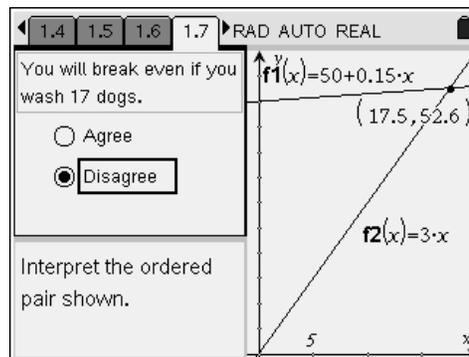
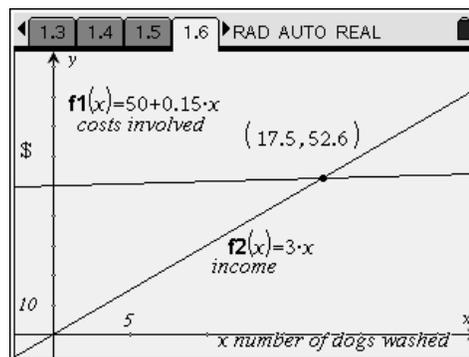


Part 2 – Finding the break even point

Page 1.5 summarizes what the student knows so far before showing the graphic representation. The **Hide/Show** tool from the Actions menu will reveal the coordinates of the point of intersection on the graph.

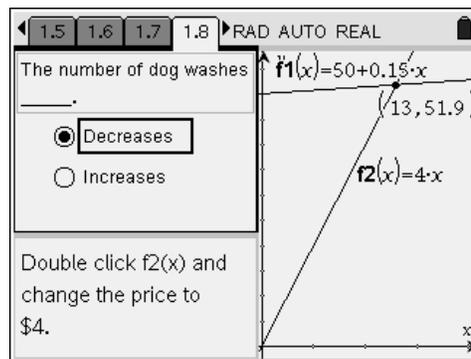
On page 1.7, it is important to discuss the meaning of the ordered pair (17.5, 52.6). Be sure that students understand that 17.5 can not be a number of dogs washed and that the money collected and the cost are both approximately \$52.60. This is also an opportunity for students to calculate by hand washing 17 dogs and 18 dogs and then compare the answers.

In the student document, there is work space for the students to solve the system by substitution with $f_2(x) = 3x$. This helps the student to see how the ordered pair is found, and that it represents the solution to the linear system of constraints.



Part 3 – Really thinking about the business now

Students are now asked to solve the algebraic system with the altered price $f_2(x) = 4x$. This will highlight the different solutions to the break-even point based on the price charged per dog wash.



The spreadsheet provides a different representation for the students to see how their costs and money change depending on how many dogs are washed. Students are able to calculate several different values in the table because the functions are already placed in the gray formula cells.

A	B	C
dogs	cost	income
	=f1(dogs)	=f2(dogs)
3	10	51.5
4	13	51.95
5	14	52.1
6	15	52.25
7	20	53.
A7	20	

Part 4 – Calculating the profit

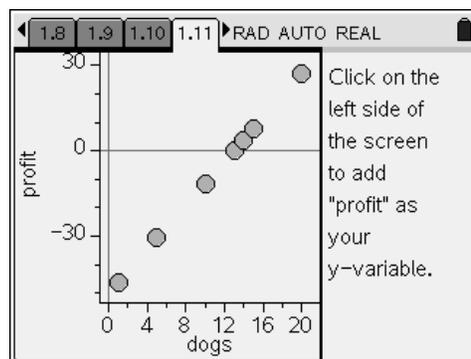
On page 1.10, students are to use a spreadsheet to calculate profit more easily. They need to move the cursor to the gray cell in Column B and type **=income – cost**. (money and cost are the titles of the columns on page 1.9)

You may also wish to teach students how to use the **var** button (var), so they can avoid misspelling a variable name. The calculations in Column B will confirm the answers students found by hand on the worksheet. They can also use this spreadsheet to calculate some additional values for numbers of dog washes, and how much profit (or loss) would result.

A	B
dogs	profit
	*ome-cost
1	1
2	5
3	10
4	13
5	14
B	*ofit:=income-cost

On page 1.11, a *Data & Statistics* page is ready to plot profit vs. dogs. Students need to click on the left side of the graph where a box will appear. The variable to select is **profit**. Then students are to analyze what information the scatter plot is presenting.

The extension questions on the worksheet allow students to investigate the problem further.



Solutions – student worksheet

1. Answers may vary. Sample answer:
2. $C(x) = 0.15x + 50$
3. Answers may vary. Sample answer: Seems reasonable because the cost of the shampoo per dog is very low.
4. (17.5, 52.6)
5. The intersection point means that 17.5 dogs have to be washed to earn \$52.60.
6. $0.15x + 50 = 3x$ $y = 3 \cdot 17.54$
 $-2.85x = -50$ $y = 52.63$
 $x = 17.54$
7. Yes, a profit will be made before more shampoo needs to be bought because any washes above 17.5 will earn profit and 17.5 is less than 32.
8. The intersection point decreases.
9. $0.15x + 50 = 4x$ $y = 4 \cdot 12.99$
 $-3.85x = -50$ $y = 51.96$
 $x = 12.99$
10. When charging \$4 per wash, 13 washes: $52 - 51.95 = \$0.05$; 14 washes: $56 - 52.1 = \$3.90$; 15 washes: $60 - 52.25 = \$7.75$; 20 washes: $80 - 53 = \$27$
11. Answers may vary.
12. The scatter plot is a line starting below the horizontal axis and ending above the horizontal axis.
13. These points represent not enough dogs washed in order to produce a profit.
This point is the break-even point.
Here is where you will begin to make a profit.

Extension

- If, on the average, the student business owner still maintains the \$4 charge, the profits will be about the same.
- Fixed costs would rise, making it harder to make a profit. Perhaps a per-dog fee could be paid to the hired worker.
- If the shampoo price increases, profits will decrease. If the shampoo price decreases, profits will increase.
- When charging \$4 per wash, $P(x) = 2.85x - 50$.