

Intercept Form—Hot Dogs

Takeru Kobayashi won the 2004 hot-dog-eating contest by eating 53.5 hot dogs in 12 minutes. Your goal is to explore one way of competing with him.

Q1 How many hot dogs would you normally eat in 12 minutes?

Q2 At what rate was Takeru eating hot dogs?

INVESTIGATE

Edit | Preferences (Win); Fathom | Preferences (Mac)

Choose Table | Show Units and Table | Show Formulas. To add cases, select the collection and choose Collection | Add Cases.



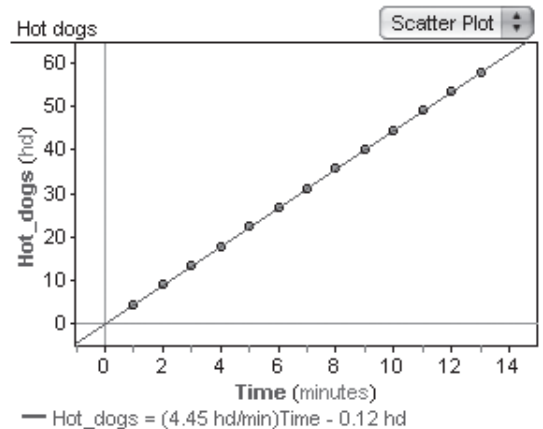
1. Open a new Fathom file. Make sure that the Linear Equation Form is $y = a + bx$ in Preferences.
2. Drag a case table from the shelf and make attributes for *Time* and *Hot_dogs* to represent the number of hot dogs eaten. Add 13 new cases, which will be 13 consecutive minutes of contest time. Make the units for *Time* minutes and the units for the number of *Hot_dogs* eaten hd.
3. As a formula for *Time*, enter *caseIndex*. The term *caseIndex* refers to the numbers in the far left column, which count cases. Make a recursive formula for *Hot_dogs*: $\text{prev}(\text{Hot_dogs}) + 4.46 \text{ hd}$.

Hot dogs		
	Time	Hot_dogs
units	minutes	hd
=	caseIndex	prev(Hot_dogs) + 4.46 hd
1	1 min	4.46 hd
2	2 min	8.92 hd
3	3 min	13.38 hd
4	4 min	17.84 hd
5	5 min	22.3 hd
6	6 min	26.76 hd
7	7 min	31.22 hd
8	8 min	35.68 hd
9	9 min	40.14 hd
10	10 min	44.6 hd
11	11 min	49.06 hd
12	12 min	53.52 hd
13	13 min	57.98 hd

To rotate the line, move the cursor over the line until you get a rotation symbol.



4. Drag a new graph from the shelf. Drag the *Time* attribute to the horizontal axis, then drag the *Hot_dogs* attribute to the vertical axis. The graph turns into a scatter plot. Each dot has two coordinates: (*Time*, *Hot_dogs*). Choose **Graph | Add Movable Line**. Adjust the line so it goes through the data points.



Intercept Form—Hot Dogs

continued

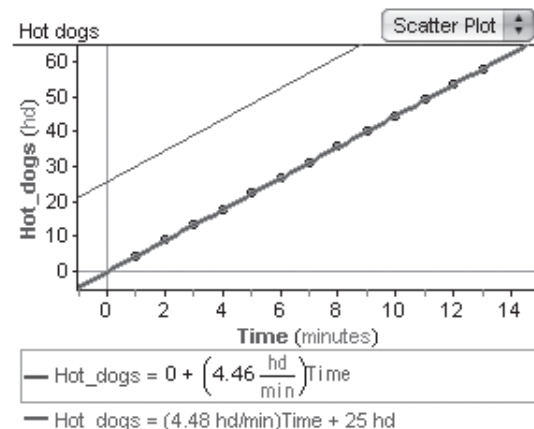
If you click **OK** before you feel that you have a good enough equation, double-click on the formula to return to the formula editor.

5. To determine how many hot dogs Takeru had eaten at any time, you'll plot a fixed line that lies on top of the movable line. Select the graph. From the **Graph** menu, choose **Plot Function**. You'll see the formula editor. The left side of the line's equation, *Hot_dogs*, is already given. Type in the right side of the line's equation and click **Apply**. Be sure to include units.

- Q3** What equation does the line have?
Q4 How does the equation you found in Q3 relate to the recursive formula you entered in step 3 to generate the data points?

6. Drag the movable line out of your way and click on the true line. Drag a red dot along this line. The dot's coordinates are displayed next to it and in the status bar.

- Q5** About how many hot dogs had Takeru eaten after 3.5 minutes?



7. You decide to compete with Takeru. Because you can eat at a speed of only 2.3 hot dogs per minute, you're offered some hot dogs as a head start. Adjust the movable line to reflect your eating rate of 2.3 hot dogs per minute. Then adjust the line, without changing the slope, so you tie Takeru at 12 minutes.

- Q6** What is the equation of your movable line?
Q7 How many hot dogs must you be given as a head start at time 0 in order to tie Takeru?
Q8 How does the equation represent your head start and eating speed?
Q9 Why is this equation said to be in *intercept form*?

Use the up-and-down arrow that appears near the center of the line to move it without changing the slope.



EXPLORE MORE

Make up some additional problems about the hot-dog-eating contest.

Objective: Students will use movable lines on Fathom graphs to understand the slope of a line as a rate of change and as a coefficient in a linear equation. They will see the constant in a linear equation as the y -intercept of the corresponding line and learn about the intercept form of a linear equation.

Student Audience: Algebra 1

Activity Time: 30–40 minutes

Setting: Paired/Individual Activity

Mathematics Prerequisites: Students can read the coefficient of a variable from an equation, understand coordinates of points in the rectangular coordinate system, and understand slope of line as steepness.

Fathom Prerequisites: Students can open a new file; set the linear equation form in **Preferences**; set up attributes and add new cases to a case table; enter units and formulas, including recursive formulas, for attributes; and add a movable line to a scatter plot.

Fathom Skills: Students will use *caseIndex* in formulas, create a scatter plot, plot a function, and trace a function plot with a red dot.

Background: This information was found in March 2005 at sports.espn.go.com/espn/news/story?id=1834236.

Notes: As you check on working students, be alert to potential difficulties if they fail to realize that attributes and units are case sensitive. Ask questions that will help students distinguish between the variable *Hot_dogs*, which refers to the number of hot dogs eaten, and *hd*, the units. You might find it helps some students to lengthen the name of the attribute, or variable, to *Number_hot_dogs_eaten*. You might suggest that students

make a table by hand before they make the Fathom table in step 2. Make sure students realize they can create new units and should click **Yes** to create a new unit named *hd* in step 2. If your students are not familiar with the recursive form of an equation and can't make meaning of the notation, suggest that in step 3 they enter a formula that has meaning for them, such as $Time \cdot 4.46$.

As you visit groups and during discussion, give pairs opportunities to explain their thinking on Q4, Q7, Q8, and Q9. Students benefit from hearing others' explanations.

Q1 Answers will vary considerably.

Q2 $\frac{53.5}{12}$, or 4.46 hot dogs per minute

INVESTIGATE

Q3 Equations should be close to $Hot_dogs = 0 \text{ hd} + (4.46 \text{ hd/min}) \text{ Time}$.

Q4 The coefficient of *time* is the number of *hd/min* in the recursive formula.

Q5 About 15.6 hot dogs

Q6 Equations should be close to $Hot_dogs = 26 \text{ hd} + (2.3 \text{ hd/min}) \text{ Time}$

Q7 Answers will vary around the theoretical value of 26 hot dogs.

Q8 The constant is the line's y -intercept, the head start; the coefficient of *time* is the line's slope, the eating speed or the rate at which hot dogs are consumed.

Q9 The equation begins with the y -intercept. It then adds or subtracts the slope—amount of change in height (the vertical change) per unit—multiplied by the number of units.