

Calories

Like many people, I am trying to watch what I eat so I don't get even fatter than I am already am. To do that, I have to know how many calories I am consuming each day, and how many calories I burn doing exercise. This example shows how the mathematics of linear equations can be used to create a mathematical model of these situations.

Breakfast and Supper

For breakfast I plan to eat oatmeal (I love oatmeal), so I know exactly what my calories are for breakfast. Because I am eating a pre-made packet, I get the calories from the box and there isn't anything to model with mathematics. Breakfast is easy!

For supper, I have planned a wonderful dinner at a restaurant that includes caloric information in their menu. Again, in this situation there is nothing for me to model with mathematics. Supper is easy!

Lunch

Lunch, on the other hand, is a different matter, since I am constructing my lunch myself. For lunch, I want to eat a sandwich with two slices of bread and peanut butter. I will drink water, so the only calories will come from my sandwich.

Facts:

- Two slices of bread have 200 calories.
- The peanut butter has 50 calories per tablespoon.

What you can do: Draw a graph that expresses the total calories in the sandwich as the amount of peanut butter in the sandwich increases. Describe the shape of the line. The y -intercept is the point where the line intersects the y (or vertical) axes. What is the physical meaning of the y -intercept in your graph? The slope of a straight line is given by the rise over the run. What is the physical meaning of the slope in your graph?

An interesting question: What if I wanted two sandwiches and drank water. What would the graph look like for this case? How is different from the previous graph you drew? How is it the same?

What you can do: Find an algebraic relationship between the amount of peanut butter used and the calories in one sandwich.

A good question: If I have budgeted 650 calories for lunch, what is the maximum amount of peanut butter I can use on my sandwich?

Another good question: What if I decided to have a soda with lunch instead of water? The soda has 12.5 calories per ounce. Can you modify the algebraic equation you found earlier to include the calories from the number of ounces of soda I drink as well?

Question: If I decide to have a 10 ounces of soda and one sandwich for my lunch, how much peanut butter can I use to still stay below 650 calories total?

Physical Exercise

Another important factor if I want to lose weight is how many calories I can burn off using exercise.

Facts:

- I have an elliptical machine at home, and it tells me that I burn roughly 12 calories for each minute I am strenuously working out on it.

What you can do: Draw a graph that expresses the total calories burned on the elliptical as the time spent working out increases. What is the physical meaning of the y -intercept in your graph? What is the physical meaning of the slope in your graph?

What you can do: Find an algebraic relationship between the amount of time spent working out on the elliptical machine and the calories burned.

A good question: I ate waaaaay too much for lunch. I went 530 calories over the amount I had budgeted to eat. How long will I need to work strenuously on the elliptical to burn off those extra 530 calories?

Another good question: I work out during *Law & Order* in the evening, which is 1 hour long. How many calories will I burn in that time?

To think about: Are there some aspects of the graph and algebraic relationship that don't seem to represent the physical reality? What we have done is construct a *mathematical model*, and most of the time the model doesn't perfectly represent reality. What changes would you make to the graph to represent reality more accurately?

What we have accomplished

Mathematical models take facts and create some way of determine other facts. In this worksheet, you took some basic facts about calories and used them to create graph and algebraic equations that allowed you to answer some sophisticated questions.

The models you created for lunch were very accurate, and well described by the linear relationships you found.

The models you created for exercise are probably not as close a relationship to the physical reality, since the underlying relationships are not linear in this case. However, the linear models are still useful, and help us answer questions. If you wanted more accurate models for calories burned during exercise, you could gather more facts and try to find lines that fit those points better than the linear model we used.