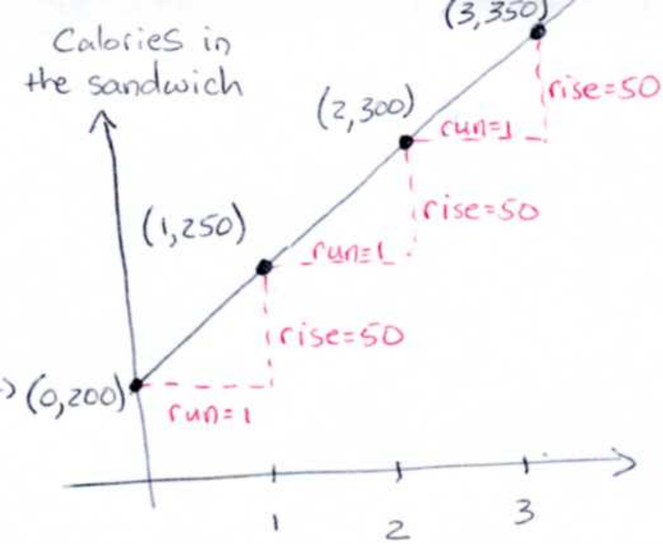
Lunch



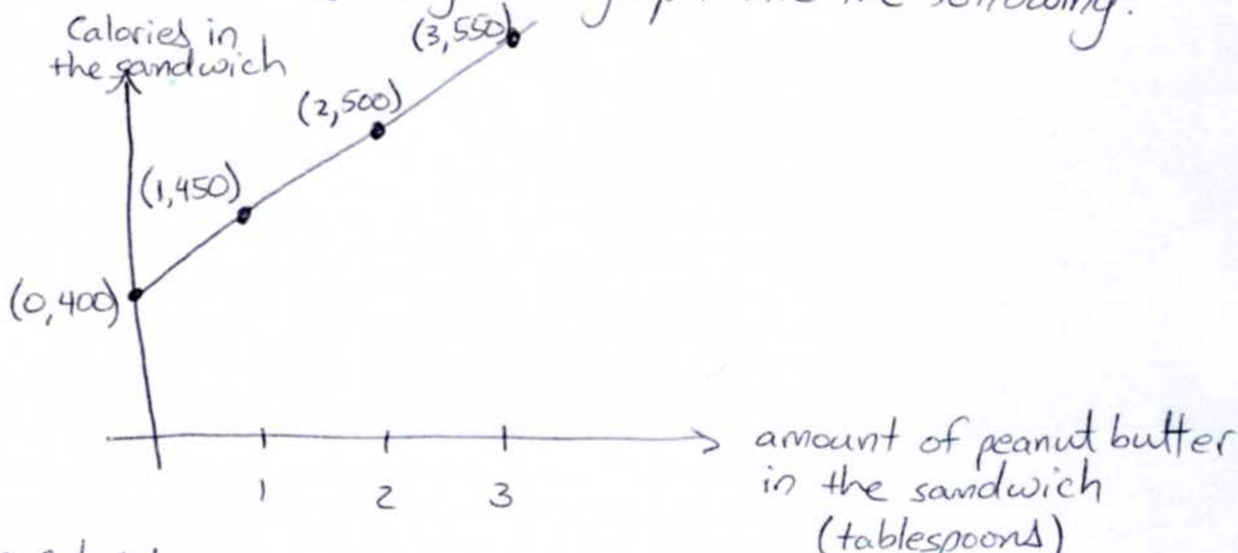
This is the y-intercept.

if we put no peanut butter on the sandwich, the only calories are from the bread!

The graph looks like a straight line.

The slope (which is given by the $\frac{\text{rise}}{\text{run}}$ and is drawn in red on the graph) is $\frac{50}{1} = 50$, which tells us that whenever we increase the amount of peanut butter in our sandwich by 1 tablespoon, we increase the calories by 50.

If I eat two sandwiches I get a graph like the following:



The entire graph is the same as above except it is shifted up 200 Calories.
This makes the y-intercept different, but the slope is the same.

Lunch continued

To get an algebraic relationship that describes the graph, we can use <u>variables</u> to represent the axes. We do this mainly to avoid writing a long phrase over and over.

Let x = amount of peanut butter in the sandwich, in units of tablespoons

y = the calories in the sandwich

From the graphs we drew earlier, we know the relationship between x & y is linear, so

$$y = mx + b.$$

and we need to determine m & b. From the first graph (one sandwich) we know

$$m = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{50}{1} = 50$$

$$b = y\text{-intercept} = 200.$$

So the algebraic relationship is

$$y = 50x + 200.$$

Lunch
the conclusion

If I budgeted 650 calories for lunch, then the amount of peanut butter I can use is found from solving

$$650 = 50x + 200 \qquad (\text{set } y = 650)$$

for x.

$$\Rightarrow 450 = 50x$$
$$9 = x$$

So I could use 9 tablespoons of peanut butter. Yum!

If I include the soda - well, that's something new, so I need a new variable to describe it.

Let

z = amount of soda drank, in ounces.

The calories added to lunch if I drink z ounces of soda is $12.5z$ (12.5 calories per ounce).

The algebraic relationship is now

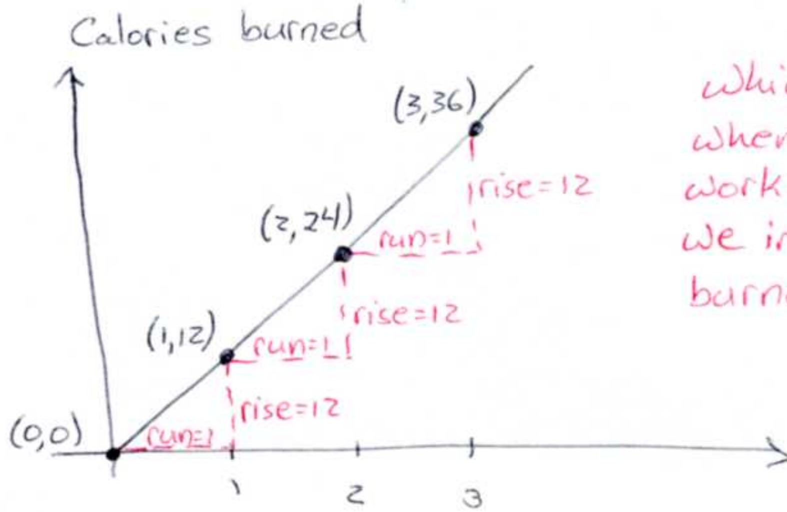
$$y = 50x + 200 + 12.5z.$$

Now, if I have 10 ounces of soda and one sandwich and want to stay below 650 calories total I solve

$$650 = 50x + 200 + 12.5(10)$$
$$325 = 50x$$
$$6.5 = x$$

to find out I can use 6.5 tablespoons of peanut butter.

Physical Exercise



Time spent working out. (in minutes)

The slope is $\frac{rise}{run} = \frac{12}{1} = 12$, which tells us that whenever we increase workout time by 1 minute we increase the calories burned by 12 calories.

The y-intercept is at the origin in this case, because I don't burn any calories until I start to work out.

To get an algebraic relationship we need to define some variables.

Let x = time spent working out (in minutes)
y = calories burned.

From the graph we see a linear relationship between x and y, so

$$y = mx + b,$$

and we need to determine m and b.

$$m = \text{slope} = \frac{rise}{run} = \frac{12}{1} = 12$$
$$b = y\text{-intercept} = 0$$

So the algebraic relationship is $y = 12x$.

Physical Exercise
continued

If I need to burn 530 calories, I need to work out for

$$530 = 12x \qquad \text{(set } y = 530\text{)}$$

$$44.166 = x$$

about $x = 42$ minutes.

During Law & Order, which is 1 hr = 60 minutes long, I will burn

$$y = 12(60) \qquad \text{(set } x = 60\text{)}$$

$$= 720$$

720 calories. Note how important it is to use the correct units!

Physical Exercise continued

The graph drew earlier assumed you worked out at the same pace throughout your workout, which probably isn't true. You probably start off a bit slower, and burn fewer than 12 calories per minute.

You also probably also have a cooldown, where you burn fewer than 12 calories per minute. The middle of your workout you probably do maintain a steady pace and burn 12 calories per minute.

Here's a more accurate mathematical model for working out on an elliptical:

Note: to work out the algebraic formula of this graph requires quite a bit of work!