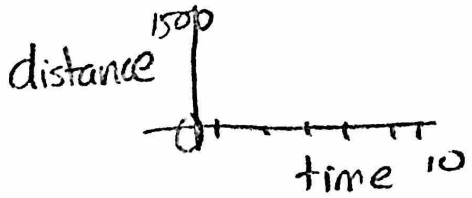
4.1 Direct Variation



Minds-On:

Susan can jog at a steady pace of 150 m/min for the first hour.

a) Create a table showing the distance that Susan jogs in 0 min, 1 min, 2 min, and so on up to 10 min.

Time (min)	Distance (m)
0	0
1	150m
2	300m
3	450m
4	600m
5	750m
6	900 m
7	1050m
8	1200m
9	1350 m
10	1500 m.

b) Identify the independent variable and the dependent variable.

↓ time (min) ↓ distance (m)

c) Graph the relation. You can find printable graph paper online or use Desmos.

d) Describe the shape of the graph. Where does it intersect the y-axis? linear shape, positive strong correlation.
y-axis at (0,0)

e) Write an equation to find the distance, d, in meters, that Susan jogs in t, minutes.

$d = 150t$

f) Use the equation to determine the distance that Susan can jog in 40 min.

$d = 150(40)$
$= 6000\text{ m} = 6\text{ km}$

g) Consider the distance Susan jogged in 2 min. What happens to the distance when the time is doubled? Tripled?

- if double the time we double the distance
- if we triple the time we triple the distance

h) Trish's steady pace jogging is 175 m/min. Develop a similar equation for her distance.

$d = 175t$

i) How much further has Trish ran in 40 min than Susan?

Trish $d = 175(40)$
$= 7000$

Susan $d = 6000$

} 1000 m difference

so Trish runs 1 km further than Susan

MPM1D 4.1 Date:_____

This has been an example of a **direct variation.** The distance varies directly (and only) by time.

Direct variation situations have the following properties:

- They can be written in equation form as $y = mx$, where m is a rate of change
- The graph is a straight line that passes through (or starts) at the origin (0, 0)

Example 1:

Ms. Kuhl travelled 250 km to visit a family member. Assume she was able to maintain a constant speed.

a) After 0.5 hours, her daughter asked "How much longer?". Ms. Kuhl noticed her trip odometer read that they had travelled 43 km. How fast are they travelling?

$$S = \frac{d}{t} = \frac{43\text{ km}}{0.5\text{ h}} = 86\ \frac{\text{km}}{\text{h}}$$

b) How long will the entire trip take at the pace in part a)?

$$86 = \frac{d}{t} \qquad 86(t) = 250 \qquad t = \frac{250}{86} = 2.91\text{ h}.$$

c) How long should Ms. Kuhl estimate the rest of the trip will take?

$2.91 - 0.5 = 2.41$ hours.

Example 2:

Adam works part-time at a local bookstore. He earns $7.50/h.

a) Describe the relationship between his pay, in dollars, and the time, in hours, he works. Use an equation.

direct variation.

Earnings → $E = 7.50h$ ← # of hours

b) Illustrate the relationship using a table of values and a graph.

Hours Worked	Pay
0	0
1	7.50
2	15
3	22.50
4	30

c) One week, Adam works for 9 hours. Find his earnings for that week.

$E = 7.50(9)$
$= \$67.50$

Example 3:

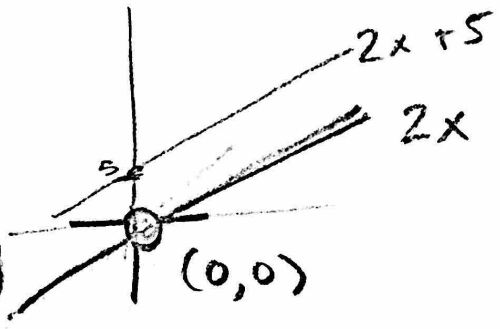
Consider the two equations below.

$y = 2x + 5$ $y = 2x$

Graph them using Desmos. Which is an example of direct variation? How do you know?

not going through (0,0)
not written as
$y = mx$
not direct

goes through (0,0).
is written as $y = mx$
direct



Example 4:

Consider the two equations below.

$y = 2x$ $y = 3x$

Graph them using Desmos. How are they the same? How are they different?

direct

both (0,0)
go
through

both written as
$y = mx$