5.2 Partial Variation

Part 1: DO IT NOW

The Keg Restaurant charges $100 to reserve a private dining room plus $40 per person.

a) Write an equation to show the relationship between the cost of the reservation and the number of people attending.

$$y = 40x + 100$$

y is cost
x is # of people.

b) What is different about this equation and the equation of a direct variation $(y = mx)$?

There is an additional cost added.

c) How much will it cost to reserve the room if

i) An extended family of 25 want to have dinner to celebrate a recent birth of twins?

$$y = 40(25) + 100$$
$$y = 1000 + 100 \qquad \text{It would cost \$1100.}$$
$$y = 1100$$

ii) The Pittsburgh Penguins want to celebrate their 2009 Cup Victory. There are 24 players and 6 coaches attending the celebration.

$$y = 40(30) + 100$$
$$y = 1200 + 100 \qquad \text{It would cost \$1300}$$
$$y = 1300$$

Part 2: Recall properties of direct variations

A direct variation is a relationship between two variables in which one variable is a constant multiple of the other.

Model a direct variation in an equation: $y = mx$

Constant of variation is defined as: $m = rate\ of\ change = \frac{\Delta y}{\Delta x}$

Direct variations are linear relations that always pass through which point on the Cartesian coordinate grid? The origin (0,0)

Part 3: Compare direct variations to partial variations

The Tesla electrical company charges $25 per hour to do electrical work plus a fee of $50 for the estimate on the proposed work. AC-DC electrical charges $50 per hour. Write equations to model each relationship. Let x represent the number of hours and let y represent the total cost.

Tesla Electric company:

$$y = 25x + 50$$

AC-DC electrical:

$$y = 50x$$

Use the equations to create tables to organize the data for 0 to 4 hours.

Tesla electric company:

Hours (h)	Cost ($)
0	50
1	75
2	100
3	125
4	150

AC-DC electrical:

Hours (h)	Cost ($)
0	0
1	50
2	100
3	150
4	200

Which relation is a direct variation and how do you know?

AC-DC is a direct variation because its initial value is 0.

The graph of AC-DC would pass through the origin.

Now graph the data for both companies on the same Cartesian coordinate grid.
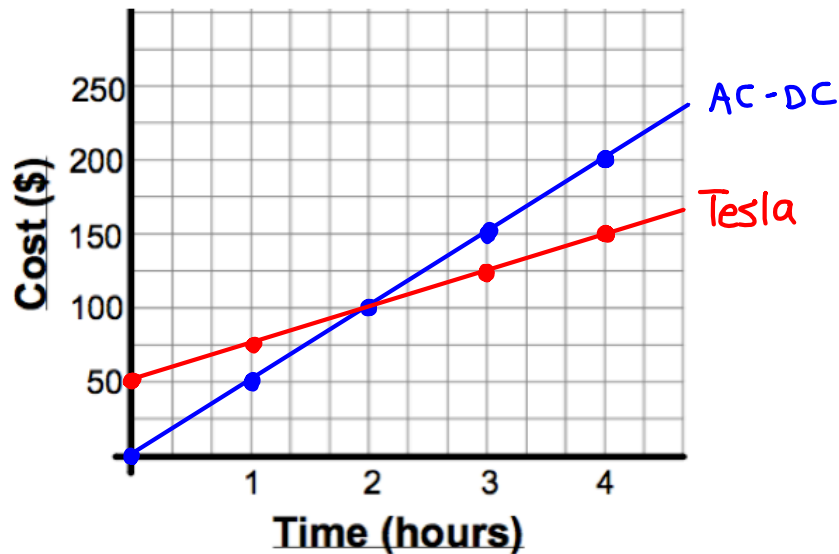
Looking at the **graph or the table**, we should use ___TESLA___ for 3 hours of electrical work. Does this company always offer the best deal? Explain.

Tesla only offers a better deal if the work takes longer than 2 hours.

What is different about the two relations?

Tesla is a PARTIAL variation (initial cost ≠ 0)

AC-DC is a DIRECT variation (initial cost = 0)

A **PARTIAL VARIATION** is a relationship between two variables in which the dependent variable is the sum of a constant number and a constant multiple of the independent variable.

In general, the graph of a **partial variation** has the following properties:

- it is a straight line which <u>does not</u> pass through the origin (0,0)
- the equation of a partial variation is always in the form $y = mx + b$
- 'b' is the initial value (y-intercept, fixed cost)
- 'm' is the constant of variation (rate of change, variable cost)

Part 4: Working with Partial Variation

a) Complete the following chart given that y varies partially with x (you may need to determine the constant of variation)

x	y
0	6
1	9
2	12
3	15
4	18
7	27

Δx (from 0 to 1), Δy (from 6 to 9)

b) What is the initial value of 'y' (y-intercept)?

when $x=0$; $y=?$

$$b = 6$$

c) What is the constant of variation (rate of change)?

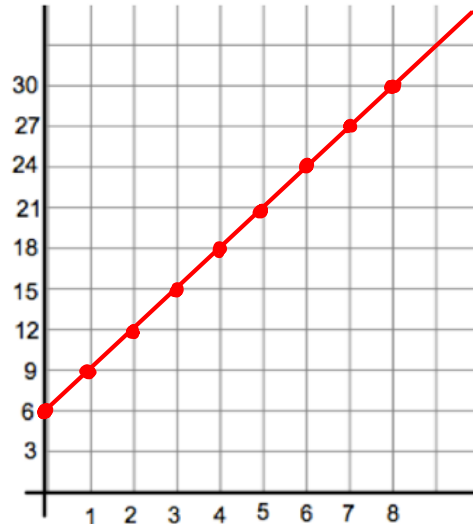$$m = \frac{\Delta y}{\Delta x} = \frac{9-6}{1-0} = \frac{3}{1} = 3$$

Remember: $m = \frac{\Delta y}{\Delta x}$

$$m = 3$$

d) Write an equation relating y and x in the form $y = mx + b$

$$y = 3x + 6$$

e) Graph the relation

Part 5: Application of Partial Variation

A school is planning an awards banquet. The cost of renting the banquet facility and hiring serving staff is $675. There is an additional cost of $12 per person for the meal.

a) Identify the fixed cost (initial value; b) and the variable cost (constant of variation; m)

$$m = 12$$
$$b = 675$$

b) Write an equation to represent this relationship in the form $y = mx + b$

$$y = 12x + 675$$

COST

# of People

c) Use your equation to determine the total cost if 500 people attend the banquet.

$$y = 12x + 675$$

$$y = 12(500) + 675$$

$$y = 6675$$

It would cos $6 675.

Consolidate:

Direct variation			Partial variation		
Table	Graph	Equation	Table	Graph	Equation
Has (0,0) as the initial value	Passes through the origin	$y = mx$	Has an initial value other than zero	Crosses the dependent axis (y-axis) at an initial value other than 0	$y = mx + b$
Create an example:	Create an example:	Create an example:	Create an example:	Create an example:	Create an example:

Direct variation Table:

x	y
0	0
1	2
2	4
3	6

Direct variation Equation: $y = 2x$

Partial variation Table:

x	y
0	1
1	3
2	5
3	7

Partial variation Equation: $y = 2x + 1$