

RIVER PARISHES COMMUNITY COLLEGE

MATH 1100: COLLEGE ALGEBRA

LINEAR EQUATIONS AND MODELING

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## 4.2 Modeling with Linear Functions

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*Semester*  
Spring 2021

*Department*  
Physical Science: MATH

January 4, 2021

## Learning Objectives

In this section, you will learn:

- ♣ Build linear models from verbal descriptions.
- ♣ Model a set of data with a linear function.

## 1 Introduction : Linear Models

A linear model is an equation that describes the relationship between two quantities that has constant rate of change (slope).

We represent linear relationships graphically with straight lines. A linear model is usually described by two features: the slope, often called the growth factor or rate of change, and the  $y$ -intercept, often called the initial value. Given the slope  $m$  and the  $y$ -intercept  $b$ , the linear model can be written as a linear function  $y = mx + b$

Note: When we build a linear model, we usually start with the big data set. There are various methods to find a linear model of such big data set. One common method is called **Linear regression**. You can also check the accuracy of your model comparing with the values predicted by the model and actual values.

## 2 Examples

### 1. Example 1

The population of Ascension Parish, Louisiana in 2010 was 107,886. In 2015, the population rose to 119,374. How much population does linear model predict 2020?

Year	Population
2010	107,886
2015	119,374
2020	?

### 2. Example 2

The position  $y$  (in kilometers) of a car at time  $t$  (in hours) is given by  $y = 80t + 300$ . How far does the car travel in one hour?

### 3. Example 3

You are choosing between two different cell phone plans. Plan 1, charges a rate of 25 cents per minute. Plan 2 charges a monthly fee of \$49.95 plus 11 cents per minute. If  $x$  is the number of minutes used and  $y$  total cost in Dollars.

Write an equation to represent the total cost (in dollars) of each plan.

What is the minimum number of minutes you would have to use in a month in order for the second plan to be preferable?

### 4. Example 4

Combinations of linear equations.

Linear equations can be added together, multiplied or divided.

A simple example of addition of linear equations

Let  $x$  be the number of items produced and sold

$C(x)$  is a cost function given by

$$C(x) = \text{fixed cost} + \text{variable cost}$$

$R(x)$  is a revenue function given by

$$R(x) = \text{selling price times number of items sold}$$

$P(x)$  is a profit function given by revenue less cost

$$P(x) = R(x) - C(x)$$

Data:

A company receives \$45 for each unit of output sold. It has a variable cost of \$25 per item and a fixed cost of \$1600. What is its profit if it sells:

(a) 75 items,

(b) 150 items, and (c) 200 items?

$$R(x) = 45x \quad C(x) = 1600 + 25x$$

$$P(x) = 45x - (1600 + 25x) = 20x - 1600$$

If

$$x = 75, P(75) = 20(75) - 1600 = -100, \text{ a loss}$$

$$x = 150, P(150) = 20(150) - 1600 = 1400$$

$$x = 200, P(200) = 20(200) - 1600 = 2400$$