RIVER PARISHES COMMUNITY COLLEGE

MATH 1100: COLLEGE ALGEBRA

LINEAR EQUATIONS AND MODELING

4.2 Modeling with Linear Functions

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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–ntercept, 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 method 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 tt (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

$$C(x) = fixed\ cost + variable\ cost$$

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

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

$P(x)$ 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

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

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

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