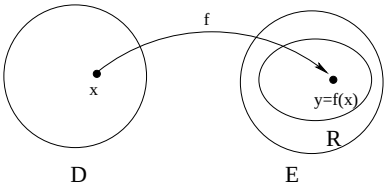
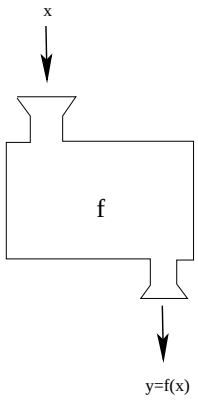
Math 229
Linear Modeling
05/29/2008

Definitions:
A **mathematical model** is an attempt to describe some real-world phenomenon using the language of mathematics. A common tool used in mathematical modeling is using a *function*.
Informally, a **function** is a rule that assigns exactly one output to any given input. The set of all possible inputs is the **domain** of the function. The set of all possible outputs is the **range** of the function.
More formally, a function f from a domain set D to a set E is a correspondence that assigns to each element x of D exactly one element y of E. We call x the **argument** of f and y the **value** of f at x. The **range** of f is the subset R of E consisting of all y values that corresponding to an x in the domain D.





A **linear function** is a function of the form $f(x) = mx + b$. A **linear model** is a linear function that is used to describe a real-world phenomenon.
Examples:

1. Suppose that you are the owner of a music store. Your wholesale supplier sells you CD's for \$5 apiece. It costs you \$1000 a month to rent your store space, plus \$500 a month in utilities and \$500 a month to pay part time employees to help run the store. Suppose you decide to charge \$12 for each CD you sell.

   (a) Find a linear function $C(x)$ that models your monthly costs if you stock x new CDs each month.

   (b) Find a linear function $R(x)$ that models your revenue is you sell x CDs each month.

   (c) Find a linear function $P(x)$ that gives your monthly profit assuming that you stock and sell x CDs each month.

   (d) How many CDs must you sell in order to turn a profit?

(e) Suppose that market research has show you that you will sell 300 CD each month if you charge \$12 each month, but if you decrease our price to \$10, you can sell 400 CDs each month. Would it be worthwhile to lower your price?

(f) Assuming that demand is linear, find a linear model relating p, the price charged per CD in dollars to x, the number of CDs sold each month.

(g) What price should you charge is you want to sell 500 CDs each month?

(h) What is the meaning of the p-intercept of this linear model?

2. Suppose you buy a car for \$15,000. Five years later, its blue book value is \$8,000.

(a) Find a linear model that show the depreciation of the car's value as a function of time in year since its initial purchase.

(b) How much will the car be worth 2 years after you bought it?

(c) When will the car be worthless?