## **Linear Models**

A linear depreciation/appreciation model, refereed to a straight line depreciation/appreciation model is a model that gives the book value of an asset t years after it has been purchased or priced where the value of the asset changes at a constant rate.

The rate of change in the model is equal to the slope of the linear model and the initial value is equal the y intercept of the model. If we use the variable v to indicate the book value of the asset at time t and r to be the rate of depreciation/Appreciation, then the model can be represented by the equation:

$$v = rt + v_0$$

Example. Mira purchased a truck for her delivery services that is eligible for tax deduction based on a constant rate depreciation at 2,200 per year for 10 years. If the truck costs \$25,000 find the following.

a. The book value of the truck t yeas later.

b. How long will it take the truck to have a book value of \$14,000.

Solution

a. v = -2,200t + 25,000

the negative coefficient of t indicates a decreasing value of the truck.

b. substitute the given value v = 13,000 and solve for the corresponding t value.

$$14,000 = -2,200t + 25,000$$
  

$$11,00 = -2,2000t$$
  

$$t = 11,000 \div (-2,200)$$
  

$$t = 5$$

The boo value of the truck will be \$14,000 5 years after the time of purchase.

Problems

1. You are given the dollar value of a product in 2010 and the rate at which the value of the product is expected to change during the next 5 years. Use this information to write a a linear appreciation/depreciation model that gives the dollar value V of the product in terms of the number of years t.

Use t = 0 to represent the year 2010.

a. Value = $$15,000$ rate of decrease = $$2,000$ per year ( <i>depreciation model</i> )
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- b. Value = 30,000 rate of increase = \$1,200 per year *(appreciation model*)
- 2. Repeat problem 1 with the year t = 10 represents 2010.

## **Exponential Depreciation/Appreciation Models**.

## **Exponential Models**

An exponential depreciation/appreciation model is model that gives the book value of an asset t years after its has been purchased or priced where the value of the object changes at a constant percent rate.

The book value of an asset that has an original cost C and depreciate/appreciates at a constant percent rate r is given by the exponential model

$$v(t) = C(1+r)^t$$

Where r the term < 0 (1 + r) < 1 in the case of depreciation and (1 + r) > 1 in the case of appreciation.

**Example**. A milling machine is to be depreciated at a constant percent rate of 25% per annum over 12 year period. If the book value of the machine at the time of purchase \$45,000 find the following

- a. The book value the machine as t years later.
- b. The book value of the machine 5 years later?
- c. The number of years in service until its book value reduce to \$22,500.

Solution:

a. 
$$v(t) = 45,000(0.75)^{t}$$

b. 
$$v(t) = 45,000(0.75)^5 = \$10,679$$

c. 
$$45,000(0.75)^{t} = 22,500$$
  
 $(0.75)^{t} = \frac{22,500}{45,000}$   
 $\ln((0.75)^{t} = \ln\left(\frac{1}{2}\right)$   
 $t = 2.4$  years

Problem.

- 1. A shipping company plans to depreciate one of its new delivery trucks that costs \$65,000 down to its salvage value of \$12,800 over a period of 10 years.
- a. Write a constant percent depreciation model for the truck as a function of time t from the time of purchase. You need to show that the constant percent rate of depreciation is approximately 15%
- b. Find the book value of the truck after 3 yeas.
- 2. Mr Smith purchased a split widow bug for \$35,000 and hopes to sell it 10 years later as part of an investment for \$50,000. If he assumes constant percent rate of appreciation, find the rate of appreciation Mr smith used to forecast the price of the bug. In the event Mr Smith decides to retain the bug for 15 years, compute Mr Smith's profit from his investment before taxes.