

# Math 1030 #16a

## Exponential Modeling

### Exponential Functions

An Exponential Function is one in which the *relative growth rate* is constant.

Consider this example:

#### **EX 1:**

One of the top five fastest growing small towns in the USA is Heber, Utah which had a population of 20,000 in 2007. The population grows by 15% each year.

Population after 1 year =  $20,000 \times 1.15 =$

Population after 2 years =  $(20,000 \times 1.15) \times (1.15)$

Population after 3 years =  $20,000 \times 1.15 \times 1.15 \times 1.15$

Population after  $t$  years = initial population  $\times 1.15^t$

What is the population of Heber in 2014?

Can we write a general equation for this function?

Exponential functions grow (or decay) by the same relative amount per unit of time.

For any quantity  $Q$  growing exponentially with a fractional growth rate  $r$ ,

$$Q = Q_0(l + r)^t$$

where

$Q$  = value of the exponentially growing quantity at time  $t$ .

$Q_0$  = initial value of the quantity (at  $t = 0$ )

$r$  = fractional growth rate (which may be positive or negative)

$t$  = time

### **EX 2:**

The number of restaurants in a city is growing according to this equation, beginning in the year 2010.  $Q = 500(1.03)^t$ .

a) What is the rate of growth?

b) How many restaurants were there in the year 2010?

c) How many restaurants will there be in 2020?

**EX 3:**

The population of Cook Islands has been decreasing. The rate of decrease is 3% each year. In 2012 there were 11,000 people on the Islands.

a) Write an equation for the decline in population.

b) At this rate, what will the population be in 2025?