Exponential Growth
$$A = P(1 + r)^t$$

Exponential Decay
$$A = P(1 - r)^t$$

$A =$ Amount you have at a certain time
$P =$ The initial amount (how much you had at the start)
$r =$ Rate of change (remember to turn percents into decimals, so 5% $= .05$)
$t =$ Time

Example of Exponential Growth

The population of Whoville County in 1998 was 29,270.  That's the year the Grinch and Horton (the elephant) built a Dr. Seuss theme park.  Since 1998, the county's population has increased by a rate of 8% per year.

Write a model equation to determine Whoville County's population:

1.  Since the population is increasing, we will use exponential growth.

$$A = P(1 + r)^t$$

2.  Substitute the values we know (initial amount = 29,270 and rate of change= 0.08 because 8% is .08 as a decimal).

$$A = 29{,}270(1 + .08)^t$$
$$\mathbf{A = 29{,}270(1.08)^t}$$
$$[t \text{ will be the number of years since 1998}]$$

Use the model to estimate the population of Whoville County in 2005.

1.  Calculate $t$.  It will be 7 years.

2.  Substitute 7 for $t$ in the model equation we made.
$$A = 29{,}270(1.08)^t$$
$$A = 29{,}270(1.08)^7$$

3.  Use a calculator to find the amount.  Start with the exponent.
$$A = 29{,}270(1.08)^7$$
$$A = 29{,}270(1.71382426877952)$$
$$\mathbf{A \approx 50{,}164}$$

The population of Whoville County was about 50,164 in 2005.

Example of Exponential Decay

The population of Smellsbad County in 2002 was 87,272.  That's the year everyone noticed a nasty odor throughout the county and people started to move away.  Since 2002, the county's population has decreased by a rate of 6% per year.

Write a model equation to determine Smellsbad County's population:

1. Since the population is decreasing, we will use exponential decay.

$$A = P(1 - r)^t$$

2. Substitute the values we know (initial amount = 87,272 and rate of change= 0.06 because 6% is .06 as a decimal).

$$A = 87{,}272(1 - .06)^t$$
$$A = 87{,}272(0.94)^t$$
$$[t \text{ will be the number of years since 2002}]$$

Use the model to estimate the population of Smellsbad County in 2007.

1. Calculate $t$.  It will be 5 years.

2. Substitute 5 for $t$ in the model equation we made.

$$A = 29{,}270(1.08)^t$$
$$A = 87{,}272(0.94)^5$$

3. Use a calculator to find the amount.  Start with the exponent.

$$A = 87{,}272(0.94)^5$$
$$A = 87{,}272(0.7339040224)$$
$$A \approx 64{,}049$$

The population of Smellsbad County was about 64,049 in 2007.