# Pre-Calculus NOTES
# Applications, specifically Interest

Name: key

Compound Interest Formula: $A = P\left(1+\frac{r}{n}\right)^{nt}$ Continuous Compound Interest Formula: $A = Pe^{rt}$

In this formula, $A$ is the total value of the investment after $t$ years, $P$ is the principal invested, $r$ is the rate of interest (decimal, not percent), and $n$ is the number of times the interest is compounded per year.

Example 2:

a. A total of \$12,000 is invested at an annual interest rate of 9%. Find the balance after 5 years if it is compounded semiannually.

$A = 12000\left(1+\frac{.09}{2}\right)^{2\cdot 5}$ 2× a year

$A \approx \$18635.63$

b. The Iglesias family wants to give the youngest daughter \$20,000 when she is ready for college. They now have \$11,500 to invest. Determine how many years it will take them to achieve their goal given that they invest this amount at 8.3% compounded monthly. (12× a year)

$20000 = 11500\left(1+\frac{.083}{12}\right)^{12t}$

$\frac{40}{23} = \left(1+\frac{.083}{12}\right)^{12t}$

$\log\left(1+\frac{.083}{12}\right)^{\frac{40}{23}} = 12t$

$t = \frac{\log\left(1+\frac{.083}{12}\right)^{\frac{40}{23}}}{12}$

$t \approx 6.7$ years

c. Mrs. Johnson received a bonus equivalent to 10% of her yearly salary and has decided to deposit it in a savings account in which interest is compounded continuously. Her salary is \$38,500 per year and the account pays 7.5% interest. How long will it take to double in value?

bonus: 10% of 38,500 ⇒ \$3850

$7700 = 3850e^{.075t}$

$2 = e^{.075t}$

$\ln 2 = .075t$

$t = \frac{\ln 2}{.075}$

$t \approx 9.2$ years

d. The population in Raleigh-Durham grew from 560,774 in 1980 to 665,400 in 1987. The model for population growth is $P = P_0e^{rt}$, where $P$ is the population after $t$ years, $P_0$ is the original population, and $r$ is the rate of growth of the population per year. Predict the population of Raleigh-Durham in 1995.

$665400 = 560774e^{r\cdot 7}$

$\frac{665400}{560774} = e^{7r}$

$\ln\frac{665400}{560774} = 7r$

$r = \frac{\ln\frac{665400}{560774}}{7}$

$r \approx .024$

or 2.4%

so for 1995

$P = 560774e^{.024\cdot 15}$

$P \approx 803,774$

e. A measles outbreak on many college campuses has necessitated the vaccination of incoming freshmen. To make students aware of this situation, information is printed in newspapers and broadcast on radio and television news. A survey of a sample of the population shows that the number of people $N$ who will have heard the information after $t$ months can be modeled by the equation $N = N_f - N_fe^{-0.16t}$, where $N_f$ is the fixed population. Determine how many months it will take for 12,500 freshmen out of the class of 20,000 to have heard the information.

$12500 = 20000 - 20000e^{-.16t}$

$-7500 = -20000e^{-.16t}$

$.375 = e^{-.16t}$

$\frac{\ln .375}{-.16} = \frac{-.16t}{-.16}$

$t = \frac{\ln .375}{-.16}$

$t \approx 6$

≈ 6 months