Exponential Growth

$$\frac{dy}{dt} = ky$$

$$\frac{1}{y}\frac{dy}{dt} = k$$

$$\ln|y| = kt + C$$

$$y = e^{kt+C}$$

$$y = e^{kt}e^{C}$$

$$y = Ae^{kt}$$

For $t=0$, $y=y_0$

$$y_0 = Ae^{0}$$

$$\boxed{y = y_0 e^{kt}}$$

$t=0 \quad 1000 \rightarrow (0, 1000)$

$t=12 \quad 2000 \rightarrow (12, 2000)$

$y = y_0 e^{kt}$

$2000 = 1000 e^{12k}$

$2 = e^{12k}$

$\ln 2 = 12k$

$k = \frac{\ln 2}{12}$

$k = \frac{\ln 2}{t}$

$12k \quad k = \frac{\ln 2}{12}$

$y = 1000e^{\frac{\ln 2}{12}t}$

When will the pop. reach 1 million?

For $y = 1000000$ $\frac{\ln 2}{12}t$

$1000000 = 1000e$

$t = 119.589$

$\therefore 119.589$ min.

What will pop be after 3hr?

For $t = 180$

$y = 32768000$ $\therefore 32768000$ bact.

(Ex)

1950 : 50000 (0, 50000)

1980 : 75000 (30, 75000)

2016 : _____ t = 66

$y = y_0 e^{kt}$

$75000 = 50000 e^{30k}$

$k = \frac{\ln \frac{3}{2}}{30}$

$y = 50000 e^{\frac{\ln \frac{3}{2}}{30} t}$

For $t = 66$

$y = 122003.074$

$\therefore$ 122003.074 people

Doubling Time

$2y_0 = y_0 e^{kt}$

$\ln 2 = kt$

$t = \frac{\ln 2}{k}$ or $k = \frac{\ln 2}{t}$

$\frac{70}{5}$ 14 yr.

$\frac{\ln 2}{.05} = \frac{.693}{.05}$

$A = P_0 e^{rt}$

one time

$A = \frac{P_0}{r}\left(e^{rt} - 1\right)$

yearly invest