

PreCalculus Class Notes: EL - 10 Writing exponential models in the form $y = ae^{kt}$

Exponential Model $y = Ae^{kt}$

Model the population of Earth if in 1976, there were 4.3 billion people and in 1996, there were 5.7 billion people. Use your model to predict the population for 2014.

<http://www.ibiblio.org/lunarbin/worldpop> Population calculator

t	x	P
0	1976	4.3 → A
20	1996	5.7
38	2014	k38

$P = 4.3 e^{kt}$
 $\frac{5.7}{4.3} = \frac{4.3}{4.3} e^{20k}$
 $\ln\left(\frac{5.7}{4.3}\right) = \ln e^{20k}$

$$\frac{\ln\left(\frac{5.7}{4.3}\right)}{20} = k$$

$P = 4.3 e^{k \cdot 38}$
 $P \approx 7.3$

Hard drive storage: In 2000, computer storage cost \$10/gigabyte. In 2010, it costs 6¢ per gigabyte. Predict the cost in 2020.

t	C (\$)
2000	10
2010	.06
2020	?

$C = 10 e^{kt}$
 $.06 = 10 e^{10k}$
 $.006 = e^{10k}$
 $\ln(.006) = 10k$
 $\frac{\ln(.006)}{10} = k$

$C = 10 e^{20k}$
 $= 3.5 \times 10^{-4}$
 $\underbrace{0.00035}_{0.035 \text{ cents}}$
 $1.000 \text{ cent} = 1 \text{ penny}$

Text messages: In 2000, 400,000 text messages were sent in the U.S. In 2010, there were 4.5 billion sent. Predict the number of text messages sent in 2020.

	t	y	billions
2000	0		.0004
2010	10	4.5	
2020	20		

$y = .0004e^{kt}$
 $4.5 = .0004e^{10k}$
 $11250 = e^{10k}$
 $\ln(11250) = 10k$
 $0.9328 \approx \frac{\ln(11250)}{10} = k$

$0,000,400,000$
 $y = .0004e^{20k}$
 $= 50,625 \text{ billion}$
 or
 50.625 trillion

Newspapers: In 2000, there were 1480 daily newspapers in the United States. In 2010, there were 1302. Estimate the number of newspapers being published in 2030. According to your model, when will the last newspaper be published?

	t	N
2000	0	1480
2010	10	1302
2030	30	

$N = 1480e^{kt}$
 $1302 = 1480e^{10k}$
 $\ln\left(\frac{1302}{1480}\right) = 10k$
 $-0.0128 \approx \frac{\ln\left(\frac{1302}{1480}\right)}{10} = k$

$N = 1480e^{30k} \approx 1007.65$
 New York Times or National Enquirer?

$1 = 1480e^{kt}$
 $\frac{1}{1480} = e^{kt}$
 $\ln\left(\frac{1}{1480}\right) = kt$
 $t = \frac{569.67}{k} \approx 57095$
 $\rightarrow 2570$