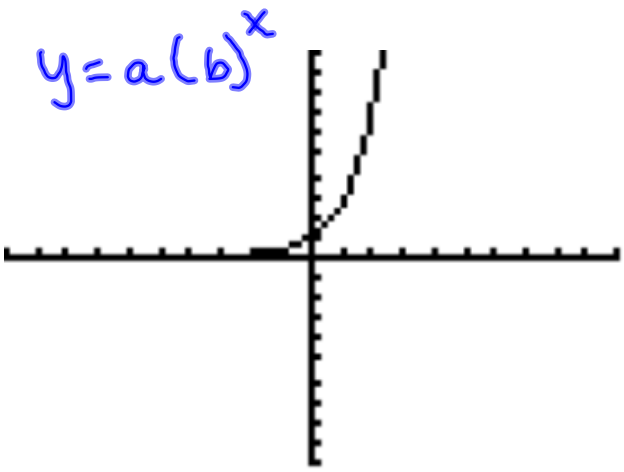
# 5.5 Exponential and Logarithmic Models


CALVIN! YOU'RE GOING TO BE LATE FOR SCHOOL! GET UP!
CALVIN, IT'S ALMOST 7:30! ARE YOU UP??
I'M COMING.
WATTERSON
SEE? I TOLD YOU IT WOULDN'T WORK!
OF COURSE NOT, DUMMY! YOU DIDN'T PUT ON ANY PANTS!

# Exponential Growth

$y = ae^{bx}$, $b > 0$



Estimates of the world population (in millions) from 1995 to 2004 are shown in the table. Determine when the world population will reach 6.8 billion.

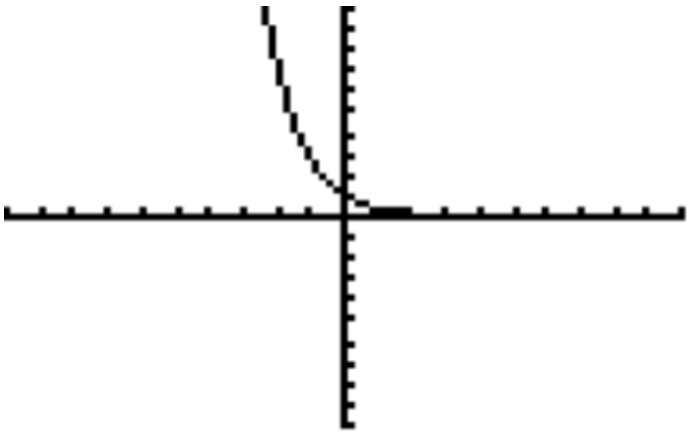
2013

| Year | Population (P) |
|---|---|
| 1995 | 5685 |
| 1996 | 5764 |
| 1997 | 5844 |
| 1998 | 5923 |
| 1999 | 6002 |

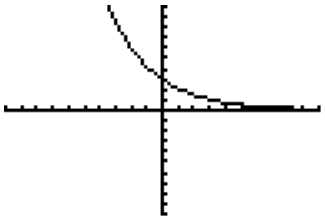
| Year | Population (P) |
|---|---|
| 2000 | 6079 |
| 2001 | 6154 |
| 2002 | 6228 |
| 2003 | 6302 |
| 2004 | 6376 |

# Exponential Decay

$y = ae^{-bx}$ , $b > 0$



Find the exponential model that fits the given graph.



| X | Y1 |
|---|---|
| -4 | 12 |
| -3 | 8.4853 |
| -2 | 6 |
| -1 | 4.2426 |
| 0 | 3 |
| 1 | 2.1213 |
| 2 | 1.5 |

X= -4

$y = a(e)^{-bx}$

$y = 3(e)^{-.35x}$

(0, 3)

(2, 1.5)

$3 = a(e)^{-b(0)}$

$a = 3$

$1.5 = 3(e)^{-b(2)}$

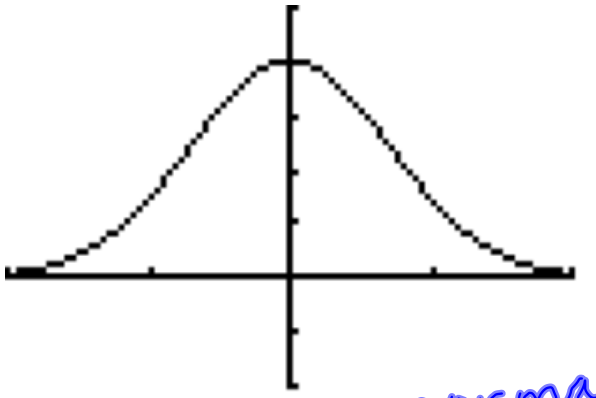
$.5 = e^{-2b}$

$\ln .5$

$b = .35$

# Gaussian Model

$$y = ae^{(-(x-b)^2)/c}$$



I'm not normal curve

In 2002, the SAT math scores for college-bound seniors roughly followed the normal distributin:

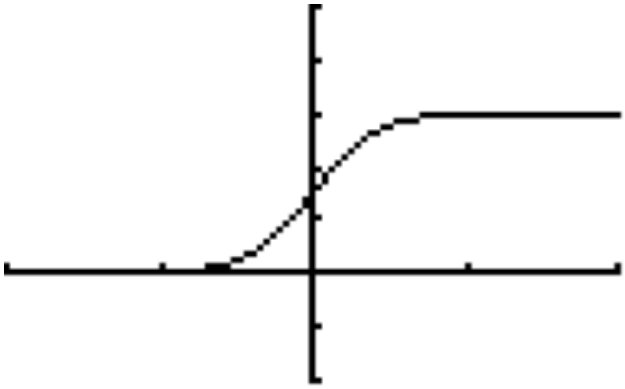
$y = .0035e^{(-(x-516)^2)/25,992}$,

$200 \leq x \leq 800$, where x is the SAT score for math.

Estimate the average SAT score.

# Logistic Growth model

$$y = \frac{a}{1 + be^{-rx}}$$



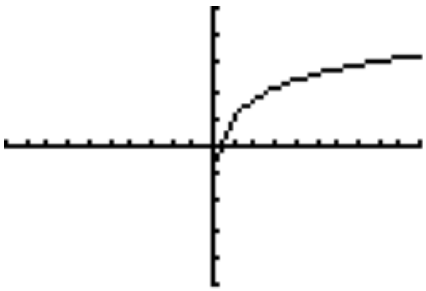
On a college campus of 5000 students, one student returns from vacation with a contagious flu virus. The spread of the virus is modeled by:

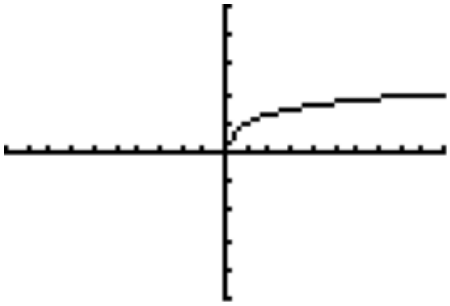
$$y = \frac{5000}{1 + 4999e^{-.8t}}$$

where y is the total number infected after t days. How many students are infected after 5 days?

# Logarithmic models

$y = a + b \ln x$, $y = a + b \log x$





On the Richter scale, the magnitude R of an earthquake of intensity I is given by:

$$R = \log_{10} \frac{I}{I_o}$$

where $I_o = 1$ is the minimum intensity used for comparison.

Find the intensity of an earthquake that measured 8.4 on the Richter scale.