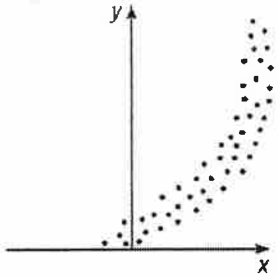
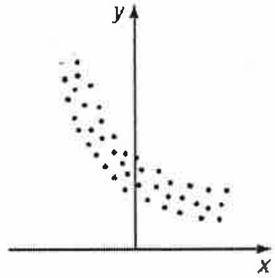
Scatter Plots from Data



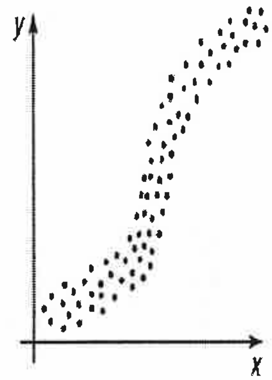
$y = ab^x, a > 0, b > 1$

Exponential



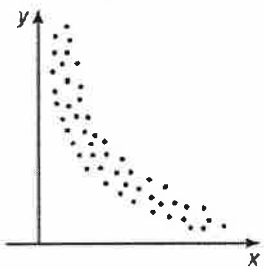
$y = ab^x, 0 < b < 1, a > 0$

Exponential



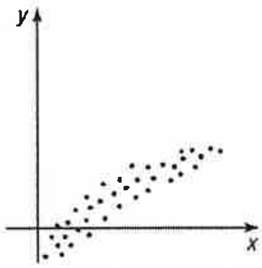
$y = \frac{c}{1 + ae^{-bx}}, a > 0, b > 0, c > 0$

Logistic



$y = a + b \ln x, a > 0, b < 0$

Logarithmic



$y = a + b \ln x, a > 0, b > 0$

Logarithmic

EXAMPLE Fitting an Exponential Function to Data

1. Kathleen is interested in finding a function that explains the growth of cell phone usage in the United States. She gathers data on the number (in millions) of U.S. cell phone subscribers from 1985 through 2005. The data are shown in Table 9.

(a) Using a graphing utility, draw a scatter diagram with year as the independent variable.
(b) Using a graphing utility, fit an exponential function to the data.
(c) Express the function found in part (b) in the form $A = A_0 e^{kt}$.
(d) Graph the exponential function found in part (b) or (c) on the scatter diagram.
(e) Using the solution to part (b) or (c), predict the number of U.S. cell phone subscribers in 2009. $x \approx 25$
(f) Interpret the value of k found in part (c).

input into STAT on calculator

(b) $y = .8650(1.3186)^x$

(c) $A = .8650e^{0.2766t}$

(e) 869.87 million

(f) shows the rate at which subscribers ↑ ea yr. 27.66%

$\ln 1.3186 = \ln e^k$

$\ln 1.3186 = k$

$k \approx .2766$

Year, x	Number of Subscribers (in millions), y
1985 (x = 1)	0.34
1986 (x = 2)	0.68
1987 (x = 3)	1.23
1988 (x = 4)	2.07
1989 (x = 5)	3.51
1990 (x = 6)	5.28
1991 (x = 7)	7.56
1992 (x = 8)	11.03
1993 (x = 9)	16.01
1994 (x = 10)	24.13
1995 (x = 11)	33.76
1996 (x = 12)	44.04
1997 (x = 13)	55.31
1998 (x = 14)	69.21
1999 (x = 15)	86.05
2000 (x = 16)	109.48
2001 (x = 17)	128.37
2002 (x = 18)	140.77
2003 (x = 19)	158.72
2004 (x = 20)	182.14
2005 (x = 21)	207.90
2006 (x = 22)	233.00
2007 (x = 23)	255.40
2008 (x = 24)	270.33

x = 25

EXAMPLE Fitting a Logarithmic Function to Data

2. Jodi, a meteorologist, is interested in finding a function that explains the relation between the height of a weather balloon (in kilometers) and the atmospheric pressure (measured in millimeters of mercury) on the balloon. She collects the data shown in Table 11.

(a) Using a graphing utility, draw a scatter diagram of the data with atmospheric pressure as the independent variable.

(b) It is known that the relation between atmospheric pressure and height follows a logarithmic model. Using a graphing utility, fit a logarithmic function to the data.

(c) Draw the logarithmic function found in part (b) on the scatter diagram.

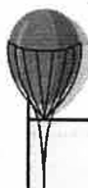
(d) Use the function found in part (b) to predict the height of the weather balloon if the atmospheric pressure is 560 millimeters of mercury.

ln regression

(b) $y = 45.7863 - 6.9025 \ln x$

(d) 2.108 km

put in calculator in STAT



Atmospheric Pressure, *p*	Height, *h*
760	0
740	0.184
725	0.328
700	0.565
650	1.079
630	1.291
600	1.634
580	1.862
550	2.235

on calculator

EXAMPLE Fitting a Logistic Function to Data

3. The data in Table 11 represent the amount of yeast biomass in a culture after *t* hours.

(a) Using a graphing utility, draw a scatter diagram of the data with time as the independent variable.

(b) Using a graphing utility, fit a logistic function to the data.

(c) Using a graphing utility, graph the function found in part (b) on the scatter diagram.

(d) What is the predicted carrying capacity of the culture?

(e) Use the function found in part (b) to predict the population of the culture at $t = 19$ hours.

put in STAT on calculator

(b) $y = \dfrac{663.022}{1 + 71.5763e^{-.547x}}$ (d) $c \approx 663.0$ (e) 661.57

logistic in STAT Calc part of calculator

Time (in hours)	Yeast Biomass	Time (in hours)	Yeast Biomass
0	9.6	10	513.3
1	18.3	11	559.7
2	29.0	12	594.8
3	47.2	13	629.4
4	71.1	14	640.8
5	119.1	15	651.1
6	174.6	16	655.9
7	257.3	17	659.6
8	350.7	18	661.8
9	441.0		