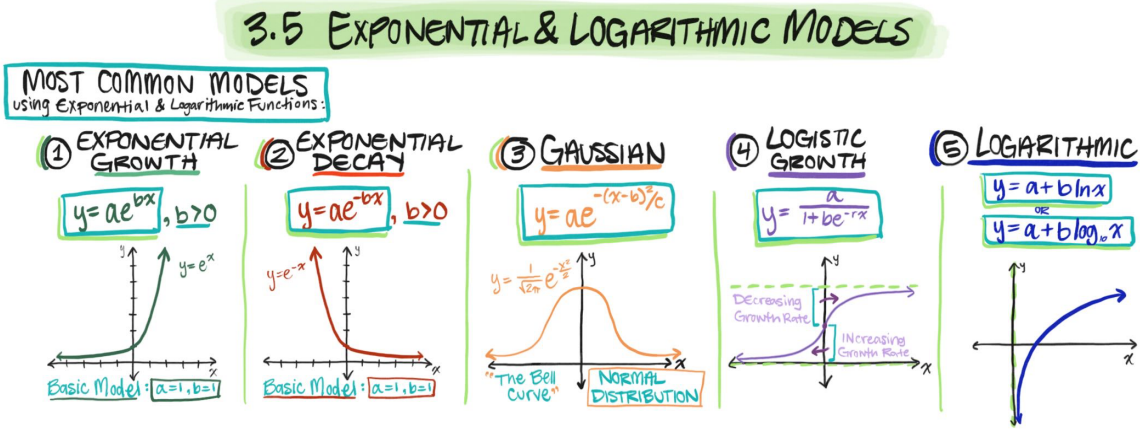
3.5 Exponential & Logarithmic Models

Objective: Today we will use nonlinear functions to model data.

Warm-up: Solve for x, and check for extraneous solutions.

$$\log_5 x + \log_5 (x - 8) = \log_{125} 729$$

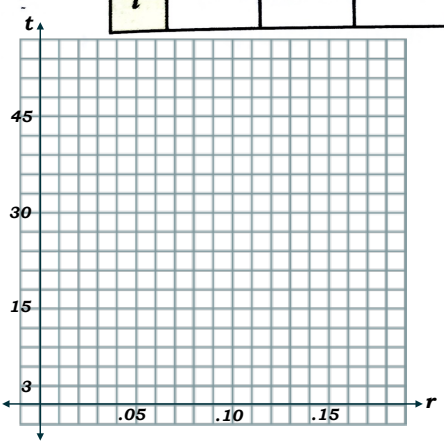


Using a Compound Interest Formula In Exercises 13–20, complete the table for a savings account in which interest is compounded continuously.

	Initial Investment	*Annual % Rate*	*Time to Double*	*Amount After 10 Years*
14.	$2000	1.5%		
16.	$1000		12 years	

22. Tripling an Investment Complete the table for the time t (in years) necessary for P dollars to triple when interest is compounded annually at rate r. Create a scatter plot of the data.

r	2%	4%	6%	8%	10%	12%
t						



36. Demography The populations P (in thousands) of Raleigh, North Carolina from 2000 through 2008 can be modeled by $P = 289.81e^{kt}$, where t is the year, with $t = 0$ corresponding to 2000. In 2006, the population was 363,000. (Source: U.S. Census Bureau)

(a) Find the value of k for the model. Round your result to four decimal places.

(b) Use your model to predict the population in 2015.

44. Biology The number Y of yeast organisms in a culture is given by the model

$$Y = \frac{663}{1 + 72e^{-0.547t}}, \quad 0 \le t \le 18$$

where t represents the time (in hours). See margin.

(a) Use a graphing utility to graph the model.

(b) Use the model to predict the populations for the 19th hour and the 30th hour.

(c) According to this model, what is the limiting value of the population?

(d) Why do you think this population of yeast follows a logistic growth model instead of an exponential growth model?

3.6 Nonlinear Models

Objective: Today we will use nonlinear functions to model data.

Checkpoint: If you invest P dollars in an account at an annual rate of 5.17%. How long would it take for your money to QUADruple if it compounds annually?

3.6 NONLINEAR MODELS

FINDING the "BEST-FITTING" MODEL

1. CREATE a SCATTER PLOT
2. Find the desired REGRESSIONS
3. RECORD ⓐ the Regression Equations & ⓑ the R^2-values (to 3 decimal places)

NOTE: Highest R^2-value gives the "Best-Fitting" Model

ON TI-83 → TI-84+ Calculators:

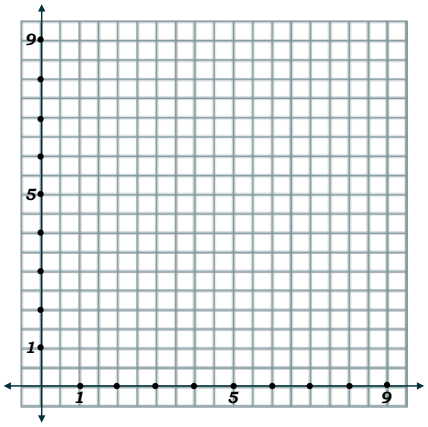
STAT → CALC

4: LinReg (ax+b) ← Linear
9: LnReg ← Logarithmic
0: ExpReg ← Exponential
A: PwrReg ← Power
B: Logistic ← Logistic

Select the desired Regression

Classifying Scatter Plots **In Exercises 13–18, use a graphing utility to create a scatter plot of the data. Decide whether the data could best be modeled by a linear model, an exponential model, or a logarithmic model.**

18. (1, 5.0), (1.5, 6.0), (2, 6.4), (4, 7.8), (6, 8.6), (8, 9.0)



32. MODELING DATA

The table shows the annual amounts A (in billions of dollars) spent in the U.S. by the cruise lines and passengers of the North American cruise industry from 2003 through 2008. (Source: Cruise Lines International Association) See margin.

Year	Amount, A
2003	12.92
2004	14.70
2005	16.18
2006	17.64
2007	18.70
2008	19.07

(a) Use the *regression* feature of a graphing utility to find a linear model, an exponential model, and a logarithmic model for the data. Let t represent the year, with $t = 3$ corresponding to 2003.

(b) Use the graphing utility to graph each model with the data. Use the graphs to determine which model best fits the data.

(c) Use the model you chose in part (b) to predict the amount spent in 2009. Is the amount reasonable?