2.14 Logarithmic Function Context and Data Modeling

2.14 Notes

QUICK REVIEW

Remember that logarithmic functions have independent values that increase proportionally while the dependent values increase at a constant rate.

Independent - x	1	3	9	27	81
Dependent - $f(x)$	3	5	7	9	11

*The amount the proportional values increase of the independent values would also be the base.

Ex 1: At the end of the school year, the classroom gets really warm! As the number of students increases so does the temperature. Mr. Bean took some data last May!

# of Students	2	4	8	16
Temperature	67	69	71	73

What's a regression equation to model the situation:

According to the model, what is the temperature if there are 35 students?

According to the model, how many students are there when the temperature reaches 85 degrees?

Ex 2: Mr. Kelly loves to wake up and have a fresh cup of coffee. He likes his coffee to cool down a bit though before drinking it. He makes a table of values to help him find an appropriate model. He sets his data up so that the time (in minutes) is a function of the temperature (in degrees).

Temp (T)	95	90.6	86.5	82	78	75
Time (M)	0	3	6	9	12	15

Find a regression equation to model the equation:

How long will it take for Mr. Kelly's morning coffee to be 70 degrees?

Ex 3: People measure loudness in terms of decibels using the following function, where $D(I)$ is the decibel level, I is the intensity of the sound and 10^{-12} is the intensity of the quietest sound a human can hear.

$$D(I) = 10 \log\left(\frac{I}{10^{-12}}\right)$$

What's the intensity of the sound of the school fire alarm if it registers as 100 decibels?

Ex 4: Mr. Brust wants to save for a new Lamborghini. He currently has $50,000 in an account that pays interest continuously and will need $300,000 in total. If he leaves his money in the account for 12 years and does not add anything, what interest rate would he need to achieve his goal?

Use the equation below where $A(t)$ is the current amount of money, P is the principal (starting value), r is the interest rate and t is the time in years.

$$A(t) = Pe^{rt}$$

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AP Precalculus

2.14 Practice

Calculator Active. Use the data provided to find a regression equation and answer the questions.

1. Mr. Bean started learning Chinese in hopes of translating all his videos one year. He created some data to find a model for the number of days studying as a function of the number of words he learned that day.

# of Words Learned	10	32	79	197	400
# of Days Studying	1	6	10	14	17

a. What is a logarithmic regression equation that could model this situation?

b. How many days would it take for Mr. Bean to learn 1,000 words?

c. How many words would he learn if he studied for 2 months (60 days)?

2. Mr. Sullivan recently decided (with the help from his doctor) that he needed to start a diet. Each week he collects data on the amount of weight he loses that week. He wants to find a regression equation that models the pounds lost on a particular week as a function of the week number.

Week #	1	2	6	9
Pounds lost that week	9.5	8.5	6.5	5.5

a. What's a logarithmic regression equation that could model this situation?

b. Which week number will Mr. Sullivan lose 2 pounds?

c. How many pounds will Mr. Sullivan lose during the 12th week?

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3. The latest and greatest new tech firm, Math Geek Tech, is about to go public on the Stock Exchange. The market guys at Math Geek Tech want to create a regression model that shows the stock price (in dollars) as a function of the number of days on the market.

Days on Market	1	3	4	7
Stock Prices ($)	112	15.5	160.5	180.1

a. What's a logarithmic regression equation that could model this situation?

b. How many days will it take for the stock price to be $250?

c. What would the stock price be after the first two weeks on the market (14 days)?

4. People can use the formula below to determine future population $N(t)$ of cities. N_0 represents the initial population, r is the rate of population growth, and t is the time in years.

$$N(t) = N_0 e^{rt}$$

a. What is the population of Cleveland, Ohio in 10 years if there are currently 275,000 people, with a population growth rate of 2.5%.

b. What growth rate would Cleveland, Ohio need to achieve a population of 400,000 people in 20 years?

5. Forensics often use Newton's Law of Cooling to determine the elapsed time since a person has died. The formula is $t = -10 \ln\left(\frac{T-R}{98.6-R}\right)$, where T stands for the body's temperature in degrees Fahrenheit, R is the temperature of the room and t is the elapsed time since death in hours.

a. How many hours elapsed if the temperature of the room was 75° and the body's temp was 85°?

b. Suppose a body was found 5 hours after death (neighbor heard thud) in a room that was 65°. What was the temperature of the body when it was found?

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6. The table presents values for a function f at selected values of x. A logarithmic regression is used to model the data. What is the value of $f(4.5)$?

x	$f(x)$
1	44.9
3	37.9
7	32.4
9	30.7

(A)   35.225   (B)   34.987   (C)   54.639   (D)   54.012