

## Data Modeling with Exponential functions.

Linear data

$x$	$y$	$y \text{ diff}$
1	7	7
2	14	7
3	21	7
4	28	7
5	35	7
:	:	

$$\text{slope} = 7$$

Exponential data

$x$	$y$	$\text{+ ratio}$
1	7	7
2	14	$14/7 = 2$
3	28	$28/14 = 2$
4	56	$56/28 = 2$
5	112	$112/56 = 2$

$$\text{base} = 2$$

$$y = a \cdot 2^x$$

$$\text{when } x = 1, y = 7$$

$$7 = a \cdot 2 \Rightarrow a = 7/2$$

$$\Rightarrow \boxed{y = \left(\frac{7}{2}\right) \cdot 2^x}$$

$$x = 2 \Rightarrow y = \frac{7}{2} \cdot 2^2 = 14$$

Example :

x	Time in months	0	1	2	3	4	5
y	Contaminant level difference	64	45.44	32.26	22.91	16.26	11.55

(a) Use exponential function to model the data ( $y$  is an exp. function of  $x$ )

(b) Use the model to estimate  $y$  when  $x$  is 7

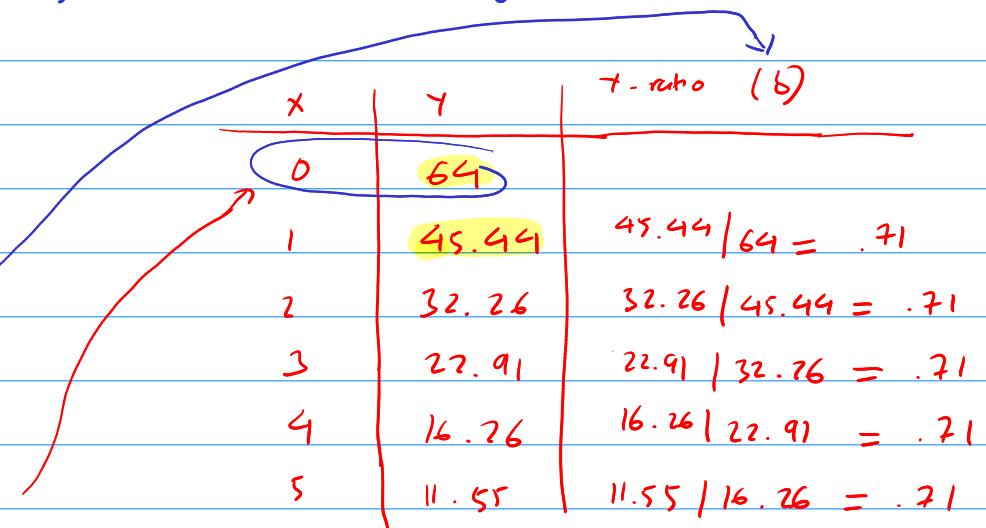
Exponential Model:

$$y = a \cdot b^x$$

$$\Rightarrow y = a \cdot (.71)^x$$

To find  $a$  set

$$x=0 \text{ and } y=64$$



$$64 = a \cdot (.71)^0$$

$$\Rightarrow 64 = a \Rightarrow a = 64$$

The model is 
$$y = 64 \cdot (.71)^x$$

(b)  $x=7 \rightarrow y = 64 \cdot (.71)^7 = 5.82$

## Assignment 7

The salinity of a saltwater aquarium is being raised to a target value of 32 parts per thousand of dissolved solids in the tank. The table below shows the difference  $D$  between the target salinity and the current salinity  $S$  after  $t$  hours. Both  $D$  and  $S$  are measured in parts per thousand.

$t = \text{time in hours}$	0	1	2	3	4
$D = \text{salinity difference}$	32	25.60	20.48	16.38	13.11

- ① Make a model of  $D$  as an exponential function of  $t$ . Find a formula that gives the salinity  $S$  as a function of  $t$ .

- ② Use the model to estimate  $D$  when  $t = 9$

Notice : Show all your work to get to the answer. ( set up the equation to find  $a, b$  ).