MATH 1311

Section 4.3

Modelling Exponential Data

To model exponential data, the first thing you must do is to confirm that the information given is actually exponential.

This will be done in a method similar to how linear data was determined.

Since this is a method that is multiplication-based, you must divide to determine if it is an exponential function.

Consider the following example of bank savings:

Time in months	0	1	2	3	4
Savings balance	$3500.00	$3542.00	$3584.50	$3627.52	$3671.05

First, confirm that all values in the independent variable are evenly spaced. Once this is confirmed, calculate the ratios of consecutive values of the dependent variable.

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First, confirm that all values in the independent variable are evenly spaced. Once this is confirmed, calculate the ratios of consecutive values of the dependent variable.

Time increment	From 0 to 1	From 1 to 2	From 2 to 3	From 3 to 4
Ratios of *B*	$\frac{3542.00}{3500.00} = 1.012$	$\frac{3584.50}{3542.00} = 1.012$	$\frac{3627.52}{3584.50} = 1.012$	$\frac{3671.05}{3627.52} = 1.012$

You'll notice that the ratios are all the same. This means that the data is exponential.

Creating a function from exponential data:

To find an exponential equation, you must determine the initial value and the growth/decay factor (base value).

Time in months	0	1	2	3	4
Savings balance	$3500.00	$3542.00	$3584.50	$3627.52	$3671.05

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Ratios of *B*	$\frac{3542.00}{3500.00} = 1.012$	$\frac{3584.50}{3542.00} = 1.012$	$\frac{3627.52}{3584.50} = 1.012$	$\frac{3671.05}{3627.52} = 1.012$

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Initial Value (found when t = 0)

Base Value (Ratio of consecutive values)

Time increment	From 0 to 1	From 1 to 2	From 2 to 3	From 3 to 4
Ratios of *B*	$\frac{3542.00}{3500.00} = 1.012$	$\frac{3584.50}{3542.00} = 1.012$	$\frac{3627.52}{3584.50} = 1.012$	$\frac{3671.05}{3627.52} = 1.012$

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Savings balance	$3500.00	$3542.00	$3584.50	$3627.52	$3671.05

The exponential function would be:
$b(t) = 3500 \times 1.012^t$

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Ratios of *B*	$\frac{3542.00}{3500.00} = 1.012$	$\frac{3584.50}{3542.00} = 1.012$	$\frac{3627.52}{3584.50} = 1.012$	$\frac{3671.05}{3627.52} = 1.012$

The following data is information on the number of bacterial cells in a colony based on hours after an antiseptic was applied:

time (hours)	0	1	2	3	4	5
Population (cells)	12500	10625	9031	7677	6525	5546

Is the model exponential?

What is the initial value?

What is the growth factor?

What is the function?

How long before the population is under 500 cells?

If table values are not sequential:

The following table shows the width of a tree taken in 6 month intervals.

time(months)	0	6	12	18	24	30
width (inches)	4.00	6.00	9.00	13.50	20.25	30.38

Is the model exponential?

What is the initial value?

What is the growth factor?

What is the exponent?

If the initial value is not given:

The following shows the population of fruit flies (in thousands) measures in days after garbage was left out.

time(days)	2	4	6	8	10	12
Flies (thousands)	12.00	21.60	38.88	69.98	125.97	226.75

If the initial value is not given:

The following shows the population of fruit flies (in thousands) measures in days after garbage was left out.

time(days)	2	4	6	8	10	12
Flies (thousands)	12.00	21.60	38.88	69.98	125.97	226.75

You can determine that the function is exponential with a growth rate of 1.8.

So, the function is $f(t) = a \times 1.8^{t/2}$

To find the a-value, plug in any point from the table, *for t and f(t),* and solve for the a-value. This would be your initial value.

If the initial value is not given:

The following shows the population of fruit flies (in thousands) measures in days after garbage was left out.

time(days)	2	4	6	8	10	12
Flies (thousands)	12.00	21.60	38.88	69.98	125.97	226.75

$f(t) = a \times 1.8^{t/2}$

$12 = a \times 1.8^{2/2}$

$12 = a \times 1.8^{1}$

$6.67 = a$

So the function is: $f(t) = 6.67 \times 1.8^{t/2}$

The amount of trees in a certain lot of pasture is given by the following:

time(months)	0	3	6	9	12	15
trees hundreds	45.00	49.50	54.45	59.90	65.88	72.47

1. Is this model exponential?
2. Determine the initial value.
3. Determine the growth factor.
4. Determine the exponent.
5. Determine the function.

The amount of trees in a certain lot of pasture is given by the following:

time(months)	0	3	6	9	12	15
trees hundreds	45.00	49.50	54.45	59.90	65.88	72.47

6. Determine the number of trees after 8 months.

7. Determine the number of trees after 2 years.

8. How long will it take for the pasture to have 120 trees?