

# Digits Lesson 7-3/7-4

## Linear & Nonlinear Functions

2/21/2020

Goal: I will be able to **recognize linear and nonlinear functions**

Tool Bag  
Formulas, equations, Vocabulary, etc.

Here's How... Notes & Examples

**Linear Functions**

a function that has a constant rate of change

Plot Points  
1.  $((1,5), (2,7), (3,9), (4,11))$   
2.  $((0,0), (1,1), (2,4), (3,9))$

Do they go in a straight line?  
1. Yes. Linear  
2. No. Nonlinear

Rate of Change (slope)  
 $\frac{\text{rise}}{\text{run}} = \frac{\text{vertical}}{\text{horizontal}} = \frac{\Delta Y}{\Delta X}$   
 $\Delta = \text{delta} = \text{change}$

Linear Function from a Table

Input (x)	Output (y)
1	5
2	8
3	11
4	14
5	17

Is it a function? Yes. One input one output

Rate of Change  
 $\frac{\Delta Y}{\Delta X} = \frac{3}{1} = \frac{3}{1} = \frac{3}{1} = \frac{3}{1}$   
Since they are equal, it IS linear

Input (x)	Output (y)
0	0
3	1
6	3
9	6
12	10

Is it a function? Yes.

Rate of Change  
 $\frac{\Delta Y}{\Delta X} = \frac{1}{3} = \frac{2}{3}$   
Not equal Nonlinear

Example

Which of the following are linear functions?

Input (x)	Output (y)
2	0
2	2
4	4
6	6
6	12

$\frac{\Delta Y}{\Delta X} = \frac{3}{2} = \frac{3}{2} = \frac{3}{2}$   
Equal. Linear

Input (x)	Output (y)
0	1
1	2
2	4
3	7
3	8

$\frac{\Delta Y}{\Delta X} = \frac{2}{1} = \frac{3}{1}$  Not equal. Nonlinear

Input (x)	Output (y)
0	0
3	1
3	3
3	9
3	6

$\frac{\Delta Y}{\Delta X} = \frac{1}{3} = \frac{2}{3}$  Not equal, nonlinear

If it is linear, what is the rate of change?

Nonlinear Functions

a function that does NOT have a constant rate of change.

Examples

Which of the following are nonlinear functions?

Linear - constant rate of change  
 $\frac{\Delta Y}{\Delta X} = \frac{1}{2} = \frac{1}{2}$  Not equal Nonlinear

Not equal Not linear  
 $\frac{\Delta Y}{\Delta X} = \frac{-1}{1} = \frac{1}{1}$

Which of the following are nonlinear functions?

Input	Output
1	-8
2	-16
3	-24
4	-32
5	-40

$\frac{\Delta Y}{\Delta X} = \frac{-8}{1} = \frac{-8}{1} = \frac{-8}{1}$   
Linear

Input	Output
1	1.5
2	2.5
3	5.5
4	8.5
5	10.5

$\frac{\Delta Y}{\Delta X} = \frac{1}{1} = \frac{3}{1}$  Not equal Nonlinear

Input	Output
1	1
2	3
3	6
4	10
5	15

$\frac{\Delta Y}{\Delta X} = \frac{2}{1} = \frac{3}{1}$  Not equal Nonlinear

You Try

Suppose there are 20 rabbits on an island and that rabbit population can triple every 6 months.

a. Make a table to determine the rabbit population after 2 years.

Time (yrs)	Rabbits
0	20
1/2	60
1	180
1 1/2	540
2	1080
2 1/2	3240
3	~ 10,000
3 1/2	30,000
4	90,000
4 1/2	270,000
5	810,000

b. Is the relationship linear or nonlinear?  
 $\frac{\Delta Y}{\Delta X} = \frac{40}{1/2} = \frac{120}{1/2}$  Not equal Nonlinear

c. Using the table, when would you expect the population to be 1,000,000?  
 $\approx 5 \text{ years}$

800,000  
24,000,000