Objective: Identify a function from a table

Concept

Average Rate of Change for a Function

$$\frac{\Delta y}{\Delta x} = \frac{\Delta f(x)}{\Delta x} = \frac{change\ (difference)\ in\ the\ y\ values}{change\ (difference)\ in\ the\ x\ values}$$

$$\frac{\Delta f(x)}{\Delta x} = \frac{f(x_2) - f(x_1)}{x_2 - x_1} \text{ for the interval } [x_1, x_2]$$

Objective: Identify a function from a table

Concept

An **exponential function** has a **constant growth factor (a factor greater than 1) or a constant decay factor (a positive factor less than 1)**.

To calculate the growth factor or decay factor, divide consecutive y values. Divide the y value with the greater x value by the y value with the smaller x value.

Exponential Growth Function

constant growth factor = $2 > 1$

x	$f(x)$
1	1
2	2
3	4
4	8
5	16
6	32

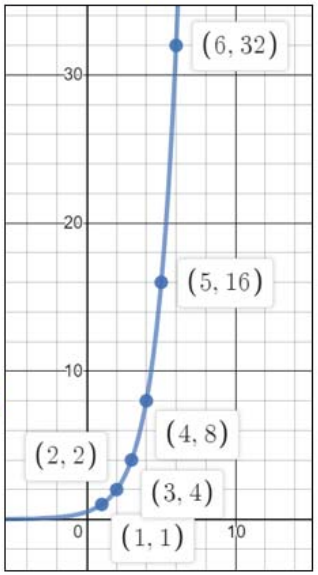
$\frac{2}{1} = 2$

$\frac{4}{2} = 2$

$\frac{8}{4} = 2$

$\frac{16}{8} = 2$

$\frac{32}{16} = 2$



Objective: Identify a function from a table

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An **exponential function** has a **constant growth factor (a factor greater than 1) or a constant decay factor (a positive factor less than 1)**.

To calculate the growth factor or decay factor, divide consecutive y values. Divide the y value with the greater x value by the y value with the smaller x value.

Exponential Decay Function

constant decay factor = $\frac{1}{2} < 1$

x	$f(x)$
1	32
2	16
3	8
4	4
5	2
6	1

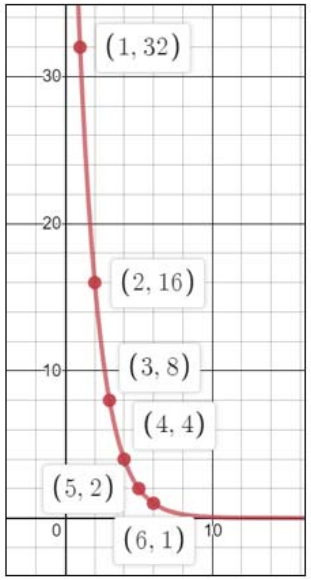
$\frac{16}{32} = \frac{1}{2}$

$\frac{8}{16} = \frac{1}{2}$

$\frac{4}{8} = \frac{1}{2}$

$\frac{2}{4} = \frac{1}{2}$

$\frac{1}{2} = \frac{1}{2}$



Objective: Identify a function from a table

Concept

A **linear function** has a **constant "first" average rate of change. This is the slope of the line** and is also what we refer to as just the average rate of change.

Linear Function

1st average rate of change = 2

x	$f(x)$
1	6
2	8
3	10
4	12
5	14
6	16

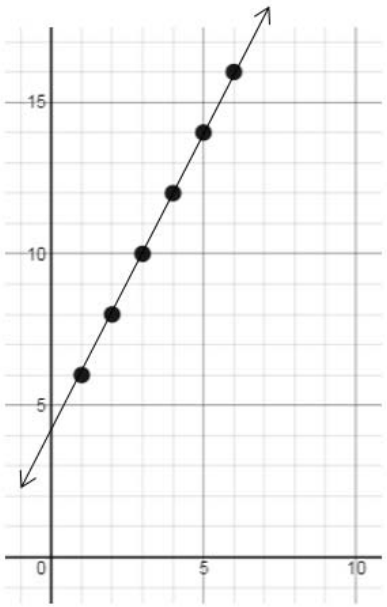
$$\frac{8-6}{2-1}=2$$

$$\frac{10-8}{3-2}=2$$

$$\frac{12-10}{4-3}=2$$

$$\frac{14-12}{5-4}=2$$

$$\frac{16-14}{6-5}=2$$



Objective: Identify a function from a table

Concept

A **quadratic function** has a **constant second average rate of change.**

Quadratic Function

x	$f(x)$
1	6
2	9
3	15
4	24
5	36
6	51

first avg. rate of change varies

Second average rate of change = 3

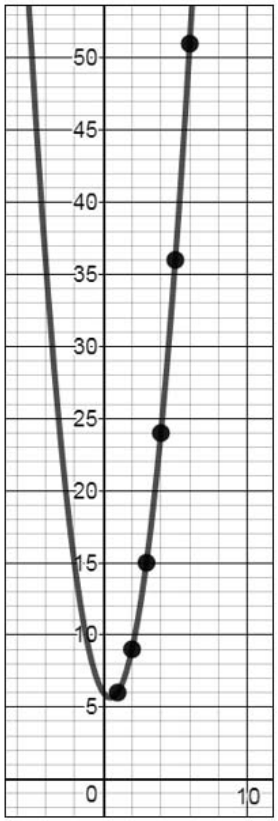
$\frac{9-6}{2-1} = 3$ > $6 - 3 = 3$

$\frac{15-9}{3-2} = 6$ > $9 - 6 = 3$

$\frac{24-15}{4-3} = 9$ > $12 - 9 = 3$

$\frac{36-24}{5-4} = 12$ > $15 - 12 = 3$

$\frac{51-36}{6-5} = 15$



Objective: Identify a function from a table

Procedure to Identify a Function from a Table

1. **Check for a constant growth factor or constant decay factor.** If there is one, **the function is exponential**. If there isn't one, go on to step 2.
2. **Check for a constant "first" average rate of change.** If there is one, **the function is linear**. If there isn't one, go on to step 3.
3. **Check for a constant second average rate of change.** If there is one, **the function is quadratic**. **If there isn't one, the function is something other than exponential, linear, or quadratic.**

Objective: Identify a function from a table

Ex) Determine if the function is linear, exponential, quadratic, or none of these. Explain your reasoning.

x	$f(x)$
4	0.25
5	1
6	1.25
7	1
8	0.25
9	-1

① growth/decay factor

$\frac{1}{.25} = \frac{1}{\frac{1}{4}} = 1 \cdot 4 = 4$

$\frac{1.25}{1} = 1.25$

$4 \neq 1.25$

not exponential

② 1st AROC

$\frac{\Delta y}{\Delta x}$

$\frac{1-.25}{5-4} = .75$

$\frac{1.25-1}{6-5} = .25$

$\frac{1-1.25}{7-6} = -.25$

$\frac{.25-1}{8-7} = -.75$

$\frac{-1-.25}{9-8} = -1.25$

③ 2nd AROC

$0.25-0.75 = -.5$

$-.25-.25 = -.5$

$-.75-(-.25) = -.5$

$-1.25-(-.75) = -.5$

constant ↓ quadratic

④ conclusion

The function is quadratic because the second average rate of change is constant.

Objective: Identify a function from a table

Ex) Determine if the function is linear, exponential, quadratic, or none of these. Explain your reasoning.

x	$f(x)$
0	81
1	27
2	9
3	3
4	1
5	$\frac{1}{3}$

① growth/decay factor

$\frac{27}{81} = \frac{1}{3}$

$\frac{9}{27} = \frac{1}{3}$

$\frac{3}{9} = \frac{1}{3}$

$\frac{1}{3}$

$\frac{\frac{1}{3}}{1} = \frac{1}{3}$

constant → exponential decay

$\frac{1}{3} < 1$

② The function is exponential decay because it has a constant decay factor.

Objective: Identify a function from a table

Ex) Determine if the function is linear, exponential, quadratic, or none of these. Explain your reasoning.

x	$f(x)$
2	1
3	8
4	27
5	64
6	125

① growth/decay factor

$\frac{8}{1} = 8 \neq$

$\frac{27}{8} = 3\frac{3}{8}$

② 1st AROC

$\frac{8-1}{3-2} = 7$

$\frac{27-8}{4-3} = 19$

$\frac{64-27}{5-4} = 37$

$\frac{125-64}{6-5} = 61$

③ 2nd AROC

$19-7 = 12 \neq$

$37-19 = 18$

none of these

④ The function is not exponential, linear, or quadratic because it has no constant growth or decay factor and no constant first or second average rate of change.

Objective: Identify a function from a table

Ex) Determine if the function is linear, exponential, quadratic, or none of these. Explain your reasoning.

x	$f(x)$
10	80
11	74
12	68
13	62
14	56
15	50

① growth/decay factor

$\frac{74}{80} = 0.925 \neq \frac{68}{74} = 0.\overline{918}$

② 1st AROC

$\frac{74-80}{11-10} = -6$

$\frac{68-74}{12-11} = -6$

$\frac{62-68}{13-12} = -6$

$\frac{56-62}{14-13} = -6$

$\frac{50-56}{15-14} = -6$

constant ↓ linear

③ The function is linear because the first average rate of change is constant.