

Unit 7: Discrete Functions  
Geometric Sequences

Ex. Find the next three terms in each sequence:

(a) 2, 4, 8, 16, ... 32, 64, 128

$\xrightarrow{\times 2} \xrightarrow{\times 2} \xrightarrow{\times 2}$

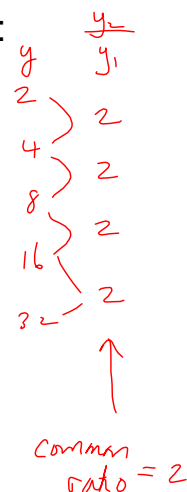
(b) 1, -2, 4, -8, ... 16, -32, 64

$\xrightarrow{\times (-2)} \xrightarrow{\times (-2)}$

(c) 27, 9, 3, 1, ...  $\frac{1}{3}, \frac{1}{9}, \frac{1}{27}$

$\xrightarrow{\div 3} \xrightarrow{\div 3} \xrightarrow{\div 3}$

$\xrightarrow{\times \frac{1}{3}} \xrightarrow{\times \frac{1}{3}} \xrightarrow{\times \frac{1}{3}}$



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Ex. For the sequence 5, 10, 20, 40, ... 80, 160, 320, 640

- (a) find the 8<sup>th</sup> term.
- (b) write an expression for the n<sup>th</sup> term.
- (c) where would you find 5120 in the sequence?

recall: arithmetic sequence  $t_n = a + (n-1)d$   
 start   # of steps   step

(b)  $t_1 = 5 \xrightarrow{\times 2} t_2 = 10 = 5(2)$   
 $t_3 = 20 = 5(2)(2) = 5(2)^2$   
 $t_4 = 40 = 5(2)(2)(2) = 5(2)^3$

$t_n = 5(2)^{n-1}$

(c)  $t_n = 5120, n = ?$

$\frac{5120}{5} = \frac{5(2)^{n-1}}{5}$

$1024 = 2^{n-1}$

$2^{10} = 2^{n-1}$

$\Rightarrow 10 = n-1$

$n = 11$

$\therefore 5120$  is term number 11.

- 2 1
- 4 2
- 8 3
- 16 4
- 32 5
- 64 6
- 128 7
- 256 8
- 512 9
- 1024 10

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A geometric sequence occurs when there is a common ratio ( $r$ ) between consecutive terms.

The first term,  $t_1$ , or  $f(1)$ , is  $a$ .

In general, the sequence is:

$$a, ar^1, ar^2, ar^3, \dots$$

$t_1 \quad t_2 \quad t_3 \quad t_4$

The  $n^{\text{th}}$  term is:

$$t_n = ar^{n-1} \quad \text{or} \quad f(n) = ar^{n-1}$$

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Ex. Is each sequence geometric? If so, state the common ratio.

(a)  $2, -8, 32, -128, \dots$

$$\frac{t_2}{t_1} = \frac{-8}{2} = -4 \quad \frac{t_3}{t_2} = \frac{32}{-8} = -4 \quad \frac{t_4}{t_3} = \frac{-128}{32} = -4$$

(b)  $x, 2x, 3x, 4x, \dots$

$$\frac{t_2}{t_1} = \frac{2x}{x} = 2 \quad \frac{t_3}{t_2} = \frac{3x}{2x} = \frac{3}{2} \quad 2 \neq \frac{3}{2}$$

$\checkmark$  geometric,  $r = -4$   
 $\times$  not geometric

(c)  $x^7, x^{14}, x^{28}, x^{56}, \dots$

$$\frac{t_2}{t_1} = \frac{x^{14}}{x^7} = x^7 \quad \frac{t_3}{t_2} = \frac{x^{28}}{x^{14}} = x^{14} \quad \times \text{ not geo.}$$

(d)  $2x^7, 4x^{10}, 8x^{13}, 16x^{16}, \dots$

$$\frac{t_2}{t_1} = \frac{4x^{10}}{2x^7} = 2x^3 \quad \frac{t_3}{t_2} = \frac{8x^{13}}{4x^{10}} = 2x^3 \quad \frac{16x^{16}}{8x^{13}} = 2x^3$$

$\checkmark$  geo  
 $r = 2x^3$

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Ex. Given  $t_5 = 1875$  and  $t_7 = 46875$ , find  $t_n$  (geometric).

$$t_n = ar^{n-1}$$

$$1875 = ar^{4} \quad \textcircled{1}$$

$$46875 = ar^6 \quad \textcircled{2}$$

$$\textcircled{1} \Rightarrow a = \frac{1875}{r^4}$$

$$1875 = ar^4 \quad \textcircled{1}$$

Sub  $a$  into  $\textcircled{2}$

$$\textcircled{2} \div \textcircled{1} \quad 25 = r^2$$

$$r = \pm 5$$

$$46875 = \left(\frac{1875}{r^4}\right)r^6$$

$$\frac{46875}{1875} = \frac{1875r^2}{1875}$$

$$25 = r^2$$

$$r = 5$$

$$r = -5$$

$$\textcircled{1} \quad 1875 = a(5)^4$$

$$1875 = a(625)$$

$$a = 3$$

$$1875 = a(-5)^4$$

$$1875 = a(625)$$

$$a = 3$$

$$\therefore t_n = 3(5)^{n-1}$$

OR

$$t_n = 3(-5)^{n-1}$$

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Assigned Work:

p.452 # [1-4][basics], 5-7(adf), 9, 13, 18

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