

Calculus II

Guess sequence formula, part 1

Todor Milev

2019

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has **numerator** ?

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has **numerator** ?

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has **numerator** ?

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has **numerator** ?

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has **numerator** ?

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has **numerator** ?

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has **numerator ?**

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.

$$n - 1$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.

$$n - 1$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator ?

$$n - 1$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator ?

$$n - 1$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator ?

$$n - 1$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator ?

$$n - 1$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator ?

$$n - 1$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator ?

$$n - 1$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator 2^n .

$$\frac{n - 1}{2^n}$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator 2^n .
- The signs of the terms alternate between positive and negative.

$$\frac{n-1}{2^n}$$

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator 2^n .
- The signs of the terms alternate between positive and negative.
- We take this into account by multiplying by $(-1)^n$.

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

Example (Sequences via f-las: guess f-la from terms)

Find a formula for the general term a_n of the sequence

$$\left(0, \frac{1}{4}, -\frac{2}{8}, \frac{3}{16}, -\frac{4}{32}, \frac{5}{64}, \dots\right)$$

$$a_1 = 0, a_2 = \frac{1}{4}, a_3 = -\frac{2}{8}, a_4 = \frac{3}{16}, a_5 = -\frac{4}{32}, a_6 = \frac{5}{64},$$

- The numerators start at 0 and go up by one with each term.
- The n^{th} term has numerator $n - 1$.
- The denominators start at 2 and double with each term.
- The n^{th} term has denominator 2^n .
- The signs of the terms alternate between positive and negative.
- We take this into account by multiplying by $(-1)^n$.

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