

# Números Binomiais

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# Números Binomiais

## Número Binomial

$$\binom{n}{p} = \frac{n!}{p! \cdot (n-p)!} = C_n^p$$

$$n \geq p, n \in \mathbb{N}, p \in \mathbb{N}$$

## Exemplo

$$\binom{6}{2} = \frac{6!}{2! \cdot (6-2)!}$$

$$\binom{6}{2} = \frac{6 \cdot 5 \cdot 4!}{2 \cdot 1 \cdot 4!} = 15$$

## Exemplos

$$1. \binom{7}{2} = \frac{7!}{2! \cdot 5!} = 21$$

$$2. \binom{6}{5} = \frac{6!}{5! \cdot 1!} = 6$$

$$3. \binom{7}{5} = \frac{7!}{5! \cdot 2!} = 21$$

$$4. \binom{8}{0} = \frac{8!}{0! \cdot 8!} = 1$$

## Consequências

$$1. \binom{n}{0} = 1$$

$$2. \binom{n}{n} = 1$$

$$3. \binom{n}{1} = n$$

$$4. \binom{n}{n-1} = n$$

## Binomiais Complementares

$$\binom{7}{2} = \binom{7}{5} \quad \binom{6}{4} = \binom{6}{2}$$

$$\binom{8}{3} = \binom{8}{5} \quad \binom{5}{1} = \binom{5}{4}$$

$$x = 4 \quad \binom{9}{x} = \binom{9}{4} \quad x + 4 = 9$$

$$x = 5$$

$$S = \{4, 5\}$$

# Números Binomiais

Resolva a equação:

$$2x - 11 = x + 1$$

$$x = \cancel{12}$$

$$\left( \begin{array}{c} 11 \\ 2x-11 \end{array} \right) = \left( \begin{array}{c} 11 \\ x+1 \end{array} \right)$$

$$2x - 11 + x + 1 = 11$$

$$3x = 21$$

$$x = 7 \quad \checkmark$$

$$S = \{7\}$$

# Números Binomiais

## Relação de Stifel

$$1. \binom{7}{5} + \binom{7}{6} = \binom{8}{6}$$

$$2. \binom{10}{2} + \binom{10}{3} = \binom{11}{3}$$

$$3. \binom{5}{4} + \binom{5}{5} = \binom{6}{5}$$

$$4. \binom{81}{44} + \binom{81}{45} = \binom{82}{45}$$

## Relação de Stifel

$$\binom{n}{p} + \binom{n}{p+1} = \binom{n+1}{p+1}$$

### Exemplo

$$\binom{7}{2} + \binom{7}{3} + \binom{8}{4} = \binom{9}{5} \quad (V)$$

$$\binom{8}{3} + \binom{8}{4} = \binom{9}{4}$$

# Números Binomiais

## Triângulo de Pascal

$$\begin{pmatrix} 0 \\ 0 \end{pmatrix}$$
$$\begin{pmatrix} 1 \\ 0 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$
$$\begin{pmatrix} 2 \\ 0 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \end{pmatrix} \begin{pmatrix} 2 \\ 2 \end{pmatrix}$$
$$\begin{pmatrix} 3 \\ 0 \end{pmatrix} \begin{pmatrix} 3 \\ 1 \end{pmatrix} \begin{pmatrix} 3 \\ 2 \end{pmatrix} \begin{pmatrix} 3 \\ 3 \end{pmatrix}$$
$$\begin{pmatrix} 4 \\ 0 \end{pmatrix} \begin{pmatrix} 4 \\ 1 \end{pmatrix} \begin{pmatrix} 4 \\ 2 \end{pmatrix} \begin{pmatrix} 4 \\ 3 \end{pmatrix} \begin{pmatrix} 4 \\ 4 \end{pmatrix}$$

$$1 \rightarrow 2^0$$

$$1 \quad 1 \rightarrow 2^1$$

$$1 \quad 2 \quad 1 \rightarrow 2^2$$

$$1 \quad 3 \quad 3 \quad 1 \rightarrow 2^3$$

$$1 \quad 4 \quad 6 \quad 4 \quad 1 \rightarrow 2^4$$

# Números Binomiais

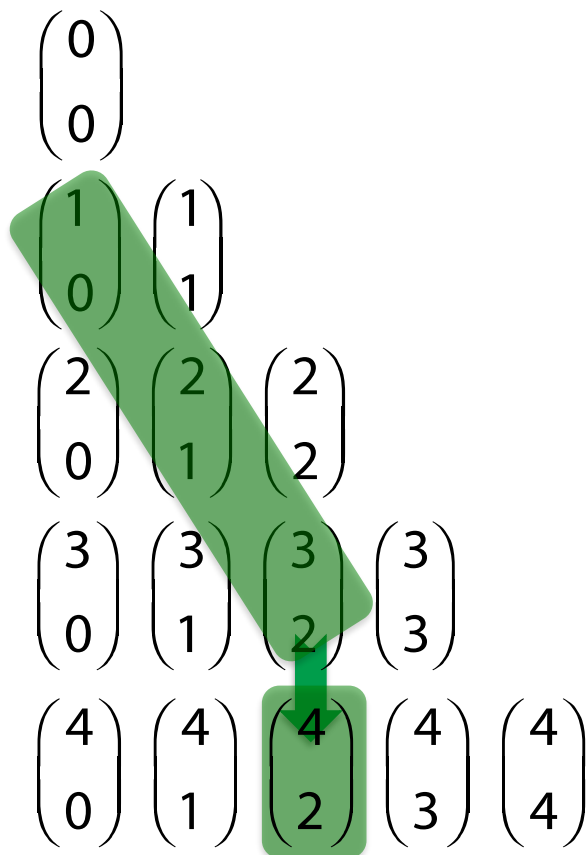
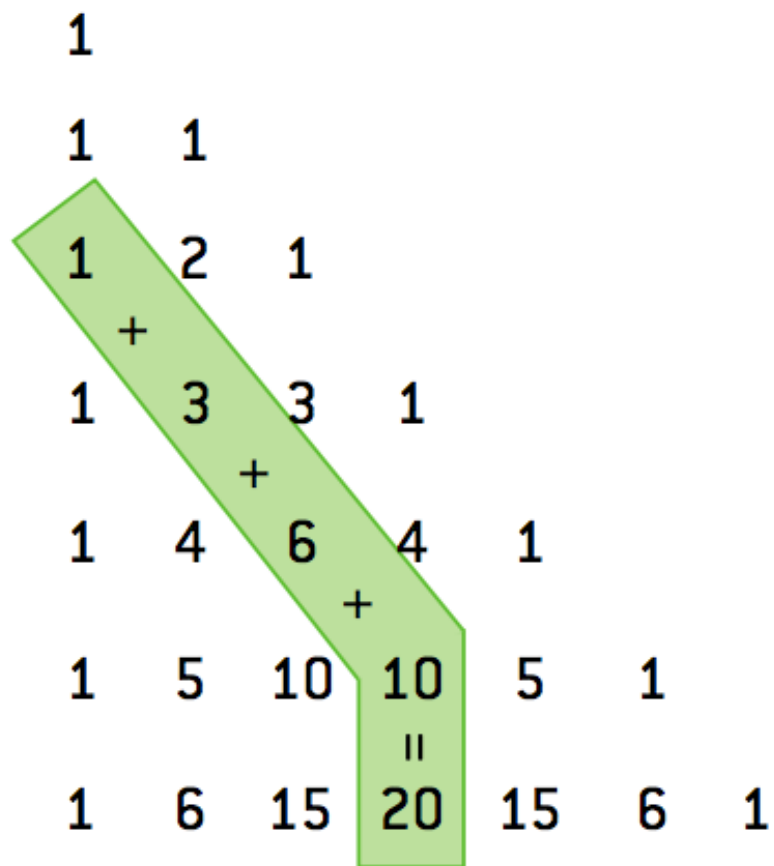
1						
1	1					
1	2	1				
1	3	3	1			
1	4	6	4	1		
1	5	10	10	5	1	

The Pascal's triangle above shows the addition of the two numbers directly above each entry. For example, in the row for n=5, the value 10 is the sum of 4 and 6 from the row above. The numbers 1, 3, 6, 10, 10, 5, 1 are highlighted in green boxes, and the addition 1+3=4 and 3+3=6 are also highlighted.

$\binom{0}{0}$					
$\binom{1}{0}$	$\binom{1}{1}$				
$\binom{2}{0}$	$\binom{2}{1}$	$\binom{2}{2}$			
$\binom{3}{0}$	$\binom{3}{1}$	$\binom{3}{2}$	$\binom{3}{3}$		
$\binom{4}{0}$	$\binom{4}{1}$	$\binom{4}{2}$	$\binom{4}{3}$	$\binom{4}{4}$	

The binomial coefficient table above shows the relationship between the numbers in Pascal's triangle and binomial coefficients. The values  $\binom{4}{1}$  and  $\binom{4}{2}$  are highlighted in green boxes, with a green arrow pointing from  $\binom{4}{1}$  to  $\binom{4}{2}$ , illustrating the relationship between the two numbers in the row n=4.

# Números Binomiais





## Números Binomiais

De quantas formas podemos deixar um castelo aberto, sendo que ele possui 6 portas de entrada e ainda pode-se deixar de uma a todas as portas abertas?

- a) 64
- b) 63**
- c) 248
- d) 254
- e) 256

$$C_6^1 + C_6^2 + C_6^3 + \dots + C_6^6$$

$$\binom{6}{1} + \binom{6}{2} + \binom{6}{3} + \dots + \binom{6}{6}$$

$$2^6 - \binom{6}{0}$$

$$64 - 1$$

$$63$$

# Obrigado

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