The binomial theorem

$$(p+q)^0 = 1$$

$$(p+q)^1 = p+q$$

$$(p+q)^2 = p^2 + 2pq + q^2$$

$$(p+q)^3 = p^3 + 3p^2q + 3pq^2 + q^3$$

$$(p+q)^4 = p^4 + 4p^3q + 6p^2q^2 + 4pq^3 + q^4$$

The binomial theorem

$$(p+q)^0 = 1 = \binom{0}{0}p^0q^0$$

$$(p+q)^1 = p+q = \binom{1}{1}p^1q^{1-1} + \binom{1}{0}p^0q^{1-0}$$

$$(p+q)^2 = p^2 + 2pq + q^2 = \binom{2}{2}p^2q^{2-2} + \binom{2}{1}p^1q^{2-1} + \binom{2}{0}p^0q^{2-0}$$

$$(p+q)^3 = p^3 + 3p^2q + 3pq^2 + q^3 = \binom{3}{3}p^3q^{3-3} + \binom{3}{2}p^2q^{3-2} + \binom{3}{3}p^1q^{3-1} + \binom{3}{0}p^0q^{3-0}$$

$$\begin{aligned}(p+q)^4 &= p^4 + 4p^3q + 6p^2q^2 + 4pq^3 + q^4 \\ &= \binom{4}{4}p^4q^{4-4} + \binom{4}{3}p^3q^{4-3} + \binom{4}{2}p^2q^{4-2} + \binom{4}{1}p^1q^{4-1} + \binom{4}{0}p^0q^{4-0}\end{aligned}$$

The binomial theorem

$$(p+q)^0 = 1 = \binom{0}{0}p^0q^0$$

$$(p+q)^1 = p+q = \binom{1}{1}p^1q^{1-1} + \binom{1}{0}p^0q^{1-0}$$

$$(p+q)^2 = p^2+2pq+q^2 = \binom{2}{2}p^2q^{2-2} + \binom{2}{1}p^1q^{2-1} + \binom{2}{0}p^0q^{2-0}$$

$$(p+q)^3 = p^3+3p^2q+3pq^2+q^3 = \binom{3}{3}p^3q^{3-3} + \binom{3}{2}p^2q^{3-2} + \binom{3}{3}p^1q^{3-1} + \binom{3}{0}p^0q^{3-0}$$

$$\begin{aligned}(p+q)^4 &= p^4+4p^3q+6p^2q^2+4pq^3+q^4 \\ &= \binom{4}{4}p^4q^{4-4} + \binom{4}{3}p^3q^{4-3} + \binom{4}{2}p^2q^{4-2} + \binom{4}{1}p^1q^{4-1} + \binom{4}{0}p^0q^{4-0}\end{aligned}$$

$$(p+q)^n = \binom{n}{n}p^n + \binom{n}{n-1}p^{n-1}q + \cdots + \binom{n}{1}pq^{n-1} + \binom{n}{0}q^n = \sum_{k=0}^{n}\binom{n}{k}p^kq^{n-k}$$