

Binomial coefficients: $\binom{n}{j}$ read as "n choose j"
 defined as $\frac{n!}{j!(n-j)!}$

This is # of ways to pick exactly j out of n items in a row, without regard to the order of picking
 i.e. without noting order of selection.

$\binom{5}{3}$



← 5 items, pick 3

with the order of selection noted, there are $(5)(4)(3)$ ways to pick.



$$(5)(4)(3) = \frac{5!}{2!} = 60$$

also there are $3!$ ways this triple could have been picked



2nd, 3rd, 5th items

so I overcounted by a factor of $3!$ if I want to ignore the order of selection.

So there are really only $\frac{5!}{3!2!} = 10$ ways if we ignore order of selection

- 10 ways:
- 1, 2, 3
 - 1, 2, 4
 - 1, 2, 5
 - 1, 3, 4
 - 1, 3, 5
 - 1, 4, 5
 - 2, 3, 4
 - 2, 3, 5
 - 2, 4, 5
 - 3, 4, 5

without regarding the order of selection
 e.g. without coloring them as you pick them.

So if we have 5 trials, and we want exactly 3 successes, there are $\binom{5}{3} = \frac{5!}{3!2!} = 10$ ways that this could happen.

binomial coefficients play a key role in defining Binomial random variables.