Section 4: Binomial and Poisson Distributions

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definition: a combination is an unordered selection of r objects chosen from n objects

note: this selection is done without replacement - once an object has been picked, it can't be chosen again

example: poker hands - you are dealt five cards

notation:

$_nC_r$ = number of ways to choose the r objects from n

$$_nC_r = \frac{n!}{r!\,(n-r)!}$$

$3! = 3 \cdot 2 \cdot 1$

$4! = 4 \cdot 3 \cdot 2 \cdot 1$

$n! = n \cdot (n-1) \cdot (n-2) \cdots 3 \cdot 2 \cdot 1$

so $_5C_3$ = $\boxed{5}$ $\boxed{nCr}$ $\boxed{3}$ = 10

$$= \frac{5!}{3!\,2!} = \frac{5 \cdot 4 \cdot \cancel{3 \cdot 2 \cdot 1}}{\cancel{3 \cdot 2 \cdot 1}\; 2 \cdot 1} = 10$$

handout:

① 4 objects ABCD
how many ways to choose 2 of the objects?

method #1: sample space

AB BC CD
AC BD
AD

so $\boxed{6}$

method #2:

$$_4C_2 = 6$$

② a) $_{12}C_7 = 792$

b) $_{45}C_4 = 148,995$

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binomial distribution:

let X = the number of successes in n identical success/failure trials

then

$$P(X=k) = {}_nC_k \, p^k q^{n-k}$$

where n = # of trials

p = probability of success in one trial

q = probability of failure $(= 1 - p)$

example: You have an unfair coin, which has a 60% chance of coming up heads. What is the probability of getting all heads in 3 coin flips?

$n = 3$

$p = 0.6$

$q = 0.4$

k = number of successes = 3

$$P(x = k) = {}_nC_k \cdot p^k q^{n-k}$$

$$= {}_3C_3 \, (0.6)^3 (0.4)^{3-3}$$

$$= 0.216 \quad \text{or} \quad 21.6\%$$