

Permutations, no repetition

If n and r are integers with $0 \leq r \leq n$, then $P(n, r) = \frac{n!}{(n-r)!}$.

permutation formula, ORDER MATTERS (i.e. ways to sort 5 of 10 students in a line)

Permutations, repetition

The number of r -permutations of a set of n objects with repetition allowed is n^r .

very easy, just use product rule as shown

Combinations, no repetition

The number of r -combinations of a set with n elements, where n is a nonnegative integer and r is an integer with $0 \leq r \leq n$, equals

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

combination formula, ORDER does NOT matter (i.e committee of 3 out of 5 students)

Combinations, repetition

There are $C(n+r-1, r) = C(n+r-1, n-1)$ r -combinations from a set with n elements when repetition of elements is allowed.

Bars and stars! Order does not matter, ways to select bills/fruit and place in a container

C/P Quick table

TABLE 1 Combinations and Permutations With and Without Repetition.		
Type	Repetition Allowed?	Formula
r -permutations	No	$\frac{n!}{(n-r)!}$
r -combinations	No	$\frac{n!}{r!(n-r)!}$
r -permutations	Yes	n^r
r -combinations	Yes	$\frac{(n+r-1)!}{r!(n-1)!}$

quick reference

Binomial Theorem

THE BINOMIAL THEOREM Let x and y be variables, and let n be a nonnegative integer. Then

$$(x+y)^n = \sum_{j=0}^n \binom{n}{j} x^{n-j} y^j = \binom{n}{0} x^n + \binom{n}{1} x^{n-1} y + \cdots + \binom{n}{n-1} x y^{n-1} + \binom{n}{n} y^n.$$

binomial theorem... coefficient is a Combination.

Pascal's identity

PASCAL'S IDENTITY Let n and k be positive integers with $n \geq k$. Then

$$\binom{n+1}{k} = \binom{n}{k} + \binom{n}{k-1}$$

binomial coefficients, a recursive definition

Probability of union of 2 events

Let E_1 and E_2 be events in the sample space S . Then

$$p(E_1 \cup E_2) = p(E_1) + p(E_2) - p(E_1 \cap E_2).$$

useful for proving things

Conditional Probability

Let E and F be events with $p(F) > 0$. The conditional probability of E given F , denoted by $p(E | F)$, is defined as

$$p(E | F) = \frac{p(E \cap F)}{p(F)}$$

probability of E given F E|F

Definition of independent event

The events E and F are independent if and only if $p(E \cap F) = p(E)p(F)$.

use for proofs

Pigeonhole Principle

THE GENERALIZED PIGEONHOLE PRINCIPLE If N objects are placed into k boxes, then there is at least one box containing at least $\lceil N/k \rceil$ objects.

if k is a positive integer and $k+1$ or more objects are placed into boxes, at least 1 box has 2+ objects

Bernoulli trials probability of success

The probability of exactly k successes in n independent Bernoulli trials, with probability of success p and probability of failure $q = 1 - p$, is

$$C(n, k) p^k q^{n-k}$$

Baye's theorem

BAYES' THEOREM Suppose that E and F are events from a sample space S such that $p(E) \neq 0$ and $p(F) \neq 0$. Then

$$p(F | E) = \frac{p(E | F)p(F)}{p(E | F)p(F) + p(E | \bar{F})p(\bar{F})}$$

calculate probability of i.e diseases/diagnosis, probability of spam...

Finite probability

If S is a finite nonempty sample space of equally likely outcomes, and E is an event, that is, a subset of S , then the probability of E is $p(E) = \frac{|E|}{|S|}$.

event over sample space. event is a subset of sample space

Compliment of probability event

Let E be an event in a sample space S . The probability of the event $\bar{E} = S - E$, the complementary event of E , is given by
 $p(\bar{E}) = 1 - p(E)$.

technique to calculate some probabilities

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