EECS 203 Exam 2 Cheat Sheet

by Kalbi via cheatography.com/19660/cs/2790/

Permutations, no repetition

If n and r are integers with $0 \le r \le n$, 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 $0 \le r \le n$, 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

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

binomial theorem... coefficient is a Combination.

Pascal's identity

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

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

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 $p(E \mid F)$, is defined as

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

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

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

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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

$$p(F \mid E) = \frac{p(E \mid F)p(F)}{p(E \mid F)p(F) + p(E \mid \overline{F})p(\overline{F})}.$$

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 $\overline{E} = S - E$, the complementary event of E, is given by

$$p(\overline{E}) = 1 - p(E).$$

technique to calculate some probabilities