#flo #inclass

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1 | **probability**

1.1 | **intro**

given a sample space, a **probabilty map** P is a function from subsets of Ω to [0,1] where $P(\Omega)$ = 1

can imagine a bunch of disjoint sets, $A_1, A_2, A_3,$ ect. then the prob

$$P(U_{i=0}^{\infty}A_i) = \sum_{i=1}^{\infty} P(A_i)$$

where all A_j are disjoint.

note: Ω and the empty set are disjoint $P(A^c)$ means a complement, or every outcome not in A, is just $1 - P(A)$.

1.2 | **inclusion / exclusion**

overlapping sets, A and B counting formula, P(A union B) = P(A) + P(B) - P(A intersect B) #extract

if we have three, $P(a \cup b \cup c) = P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C) - P(A \cap C) + P(A \cap B \cap C)$

demotmot's problem? de montmort.

$A_i = i^{th}$ card has the number i on it $P(winning) = P(A_1 \cup A_2 \cup \ldots A_n) = \sum P(A_i) - \sum P(A_i \cap A_j) + \sum P(A_i \cap A_j \cap A_k)$ .... ?? goes to 1-1/e

this is called a derangment > In combinatorial mathematics, a derangement is a permutation of the elements of a set, such that no element appears in its original position. In other words, a derangement is a permutation that has no fixed points. -wiki

1.3 | **independence**

if we flip a coin and then roll a die, P(2H) = P(H) P(2) = 1/2 * 1/6 = 1/12

2 events A and B are independent if $P(a \cap B) = P(A) * P(B)$

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conditional probability! def $P(A|B) = \frac{P(A \cap B)}{P(B)}$ $P(A|B)P(B) = P(B|A)P(A) = P(A$ and $B)$

this is basically bayes theorem:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

which is also written as:

$$P(A|B) = \frac{P(B|A)P(A)}{P(BandA) + P(BandA^C)} = \frac{P(B|A)P(A)}{P(B|A) * P(A) + P(B|A^c) * A^c}$$

but don't memorize it in this way.

1.4 | example

- disease, occurs 1 in a 1000 people
  - 98% right when person has the disease
  - 90% of being right when they don't have it
  - but, we have 100% accuracy if we do an unpleasant test, which we wan't to avoid
- screen test comes back positive. what is the prob that you have the disease?
  - P(disease | positive test)

	positive	negative
disease	.98/1000	0.02/1000
no disease	.1 * 999/1000	.9 * 999/1000

as marginal is 1/1000 -> 999/1000

so, $P(d|p) = \frac{P(\text{dispease and positive})}{P(positive)}$

we have two ways to test positive, so we can add them. this yields around 1%.

this is called, switching conditioning. so don't panic about positive tests until you know what is going on about them!