Bayes' Theorem _week 14_

Bayes' theorem is used to increase accuracy in probability determination by using knowledge of prior events. For example, if you know that the risk of developing health problems increases with age, this can be used to more accurately predict the probability of a person of a known age developing those problems.

$$P(A \mid B) = \frac{P(B \mid A) \cdot P(A)}{P(B)}$$

A, B = events

$P(A|B)$ = probability of A given B is true

$P(B|A)$ = probability of B given A is true

$P(A), P(B)$ = the independent probabilities of A and B

Wikipedia gives the following example: Let $P(\text{User}|Positive)$ mean "the probability that someone is a drug user given that he tests positive". Then we can write:

$$P(\text{User}|Positive) = \frac{P(Positive|\text{User})P(\text{User})}{P(Positive)}$$

$$= \frac{P(Positive|\text{User})P(\text{User})}{P(Positive|\text{User})P(\text{User}) + P(Positive|\text{Non-user})P(\text{Non-user})}$$

$$= \frac{.90 \times .05}{.90 \times .05 + .20 \times 0.95}$$

$$\approx 19\%$$

Even if someone tests positive, the probability they are a drug user is only 19%, because hardly anybody uses marijuana in this group and so most positives are false positives coming from that 95% of the group