Bayes Thm

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

$$P(D|T) = P(T|D)\cdot\frac{P(D)}{P(T)}$$

$P(D) = 10^{-5}$

Test: T event that you test
E positive.

$$P(D|T) = \frac{P(T|D)\cdot P(D)}{P(T|D)\cdot P(D) + P(T|\bar{D})\cdot P(\bar{D})}$$

$P(T|D) = .99$

$P(T|\bar{D}) = .005$

26-7
27-1

$$P(D|T) = \frac{.99 \times 10^{-5}}{.99 \times 10^{-5} + .005 \times (1 - 10^{-5})}$$

$$\sim \frac{1}{1 + 500} \sim .002$$

$$P(D|\bar{T}) \to 10^{-7}$$

Proof

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

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

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

SPAM Filtering

1000 messages

700 SPAM B

300 Good G

w "viagra"

.25 $\quad p(w) = \dfrac{\#\text{ of msgs in B with word } w}{|B|}$

.01 $\quad q(w) = $ ditto for G

E event that new msg contains w

S . . . - - . . . - is spam

$$P(S|E) = \frac{P(E|S)\cdot \cancel{P(S)}}{P(E|S)\cdot \cancel{P(S)} + P(E|\bar{S})\cdot \cancel{P(\bar{S})}}$$

Assume $P(S) = P(\bar{S}) = .5$

$$\approx \frac{p(w)}{p(w)+q(w)} = \frac{.25}{.25+.01}$$

3.3

2^{nd} word v

Assuming v + w are independent

$$\longrightarrow \frac{p(w)\cdot p(v)}{p(w)\cdot p(v) + q(w)\cdot q(v)}$$

Random Variable is function from sample space to $\mathbb{R}$

X is # of heads in 3 trials

Y is sum of 2 dice

Z is max of 2 dice

Distribution of X

$\{(r, \text{Prob}(X=r))\}$

	1	2	3	4	5	6
1	1	2			5	6
2	2	2			5	6
3					5	6
4					5	6
5	5	5	5	5	5	6
6	6	6	6	6	6	6

$(6, 11/36)$

$(5, 9/36)$

Expected value

$$E(X) = \sum_{s \in S} p(s) \cdot X(s)$$