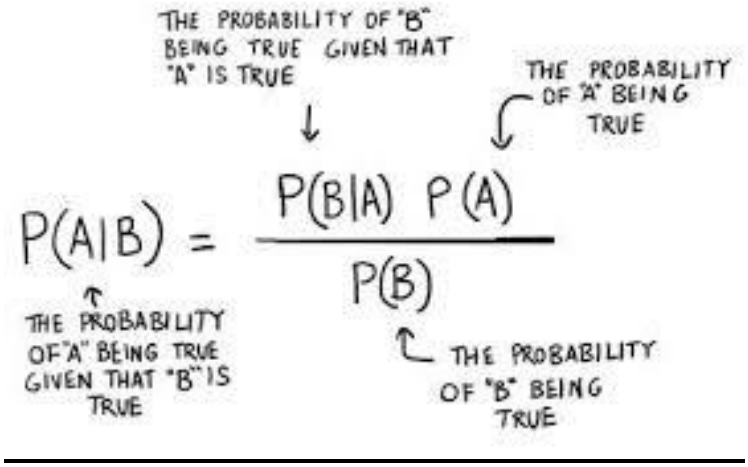
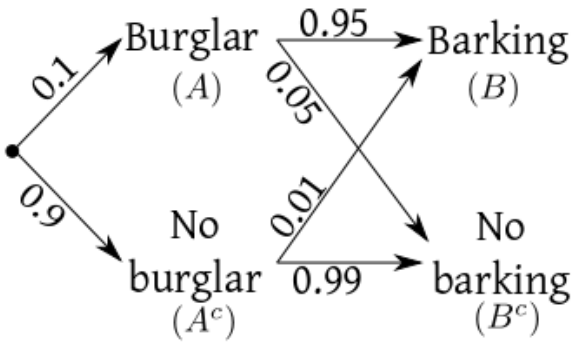
PRT - Ex-3

Bayes Theorem Basics



Examples



- **Medical Diagnosis**
  - suppose we know from statistical data that flu causes fever in 80% of cases, approximately 1 in 10,000 people have flu at a given time, and approximately 1 out of every 50 people is suffering from fever:

    Pr(*fever* | *flu*) = 0.8 Pr(*flu*) = 0.0001 Pr(*fever*) = 0.02

  - Given a patient with fever, does she have flu? Answer by applying Bayes' rule:

    Pr(*flu* | *fever*) = [Pr(*fever* | *flu*) . Pr(*flu*)] / Pr(*fever*)

    = 0.8 x 0.0001 / 0.02 = 0.004

Application of Bayes Theorem - Exercises

1. ***Chocolate Problem:***

   Suppose a Chocolate manufacturing company is sending 40% of the Chocolates to Stores-A and 60% of the Chocolates to Stores-B. After a day Stores-A reports that 7% of the Chocolates delivered are defective and Stores-B reports that 5% of Chocolates delivered are defective.

   a) *Find the probability that Chocolates sent to Stores-A and it is defective.*
      Ans) *P(Chocolate to A and it is defective)*
      P(A)P(D|A) = 0.4(0.07) = 0.028

   b) *Find the probability that a product is sent to company A and it is not defective.*
      Ans) *P(Chocolate to A and not defective)*
      P(A)P(D'|A) = 0.4(0.93) = 0.372

   c) *Find the probability that a product is sent to company B and it is defective.*
      Ans) *P(Chocolate to B and defective)*
      P(B)P(D|B) = 0.6(0.05) = 0.03

   d) *Find the probability that a product is sent to company B and it is not defective.*
      Ans) *P(Chocolate to B and not defective)*
      P(B)P(D'|B) = 0.6(0.95) = 0.57

2. **Faculty Problem:**

A Department in an university has rated 80% of its faculty as satisfactory (S) and 20% as unsatisfactory (S'). On seeing their resume, it showed that 75% of the satisfactory faculty had previous work experience (E) in teaching, while 20% of the unsatisfactory faculty had no teaching experience (E') in the profession.

If a faculty who has had previous work experience is hired, what is the approximate empirical probability that this faculty will be an unsatisfactory employee?

Ans) $P(S'|E) = \frac{P(S') * P(E|S')}{P(S') * P(E|S') + P(S) * P(E|S)} = \frac{0.2 * 0.8}{0.2 * 0.8 + 0.8 * 0.75} = 0.2105$

OR

	S	**S'**	**TOTAL**
E	600	160	760
E'	200	40	240
TOTAL	800	200	**1000**

Ans) $P(S'|E) = \frac{160}{760} = 0.2105$

3. **Driver Problem:**

Suppose a survey of 1000 drivers in a metropolitan area during a 3-year period was taken. The following results were found.

Age Group	18-25	26-39	40-55	55+	
0-1 Accidents	100	150	250	75	575
2-3 Accidents	150	25	125	25	325
3+ accidents	50	25	25	0	100
Totals	300	200	400	100	1000

Suppose we randomly select a driver from the group. What is the probability that the driver,

a) Is in the 26-39 age group, given they have more than 3 accidents.
Ans) 25/100=0.25

b) Had 2-3 accidents, given they are in the 18-25 age group.
Ans) 150/300=0.5

c) Had 0-1 accidents, given they are in the 40-55 age group.
Ans) 250/400=0.625

d) Is in the 40-55 age group, given they had 0-1 accidents
Ans) 250/575=0.435