Based on this likelihood table, we will calculate conditional probabilities as below

Frequency Table		Buy		
		Yes	No	
Day	Weekday	9	2	11
	Weekend	7	1	8
	Holiday	8	3	11
		24	6	30

Likelihood Table		Buy		
		Yes	No	
Day	Weekday	9/24	2/6	11/30
	Weekend	7/24	1/6	8/30
	Holiday	8/24	3/6	11/30
		24/30	6/30	

P(B) = **P(Weekday)** = 11/30 = 0.367

P(A) = **P(No Buy)** = 6/30 = 0.2

P(B|A) = **P(Weekday | No Buy)** = 2/6 = 0.33

P (A|B) = **P (No Buy | Weekday)**
= P(Weekday| No Buy) * P(No Buy) / P(Weekday)
= (0.33 * 0.2) / 0.367 = 0.179

Based on this likelihood table, we will calculate conditional probabilities as below

Frequency Table		Buy: Yes	Buy: No	
Day	Weekday	9	2	11
	Weekend	7	1	8
	Holiday	8	3	11
		24	6	30

Likelihood Table		Buy: Yes	Buy: No	
Day	Weekday	9/24	2/6	11/30
	Weekend	7/24	1/6	8/30
	Holiday	8/24	3/6	11/30
		24/30	6/30	

P(B) = **P(Weekday)** = 11/30 = 0.367

P(A) = **P(Buy)** = 24/30 = 0.8

P(B|A) = **P(Weekday | Buy)** = 2/6 = 0.375

If A equals Buy, then

P (A|B) = **P (Buy | Weekday)**

= P(Weekday| Buy) * P(Buy) / P(Weekday)

= (0.375 * 0.8) / 0.367 = 0.817

As the **Probability(Buy | Weekday)** is more than **Probability(No Buy | Weekday)**, we can conclude that a customer will most likely buy the product on a Weekday

Similarly, we can find the likelihood of occurrence of an event involving all three variables

WE HAVE THE FREQUENCY TABLES OF ALL THE THREE INDEPENDENT VARIABLES. WE WILL NOW CONSTRUCT LIKELIHOOD TABLES FOR ALL THE THREE

Frequency Table		Buy	
		Yes	No
Day	Weekday	3	7
	Weekend	8	2
	Holiday	9	1

Likelihood Table		Buy		
		Yes	No	
Day	Weekday	9/24	2/6	11/30
	Weekend	7/24	1/6	8/30
	Holiday	8/24	3/6	11/30
		24/30	6/30	

Likelihood Tables

Likelihood Table		Buy: Yes	Buy: No	
Day	Weekday	9/24	2/6	11/30
	Weekend	7/24	1/6	8/30
	Holiday	8/24	3/6	11/30
		24/30	6/30	

Frequency Table		Buy: Yes	Buy: No	
Discount	Yes	19/24	1/6	20/30
	No	5/24	5/6	10/30
		24/30	6/30	

Frequency Table		Buy: Yes	Buy: No	
Free Delivery	Yes	21/24	2/6	23/30
	No	3/24	4/6	7/30
		24/30	6/30	

Calculating Conditional Probability of purchase on the following combination of day, discount and free delivery:

Where B equals:

- Day = Holiday
- Discount = Yes
- Free Delivery = Yes

Let A = No Buy

P (A|B) = P (No Buy | Discount = Yes, Free Delivery = Yes, Day = Holiday)

$$= \frac{P(\text{Discount = Yes} \mid \text{No}) * P(\text{Free Delivery = Yes} \mid \text{No}) * P(\text{Day = Holiday} \mid \text{No}) * P(\text{No Buy})}{P(\text{Discount=Yes}) * P(\text{Free Delivery=Yes}) * P(\text{Day=Holiday})}$$

$$= \frac{(1/6) * (2/6) * (3/6) * (6/30)}{(20/30) * (23/30) * (11/30)}$$

= 0.178

Likelihood Tables

Likelihood Table		Buy: Yes	Buy: No	
Day	Weekday	9/24	2/6	11/30
	Weekend	7/24	1/6	8/30
	Holiday	8/24	3/6	11/30
		24/30	6/30	

Frequency Table		Buy: Yes	Buy: No	
Discount	Yes	19/24	1/6	20/30
	No	5/24	5/6	10/30
		24/30	6/30	

Frequency Table		Buy: Yes	Buy: No	
Free Delivery	Yes	21/24	2/6	23/30
	No	3/24	4/6	7/30
		24/30	6/30	

Calculating Conditional Probability of purchase on the following combination of day, discount and free delivery:

Where B equals:

- Day = Holiday
- Discount = Yes
- Free Delivery = Yes

Let A = Buy

P (A|B) = P (Yes Buy | Discount = Yes, Free Delivery = Yes, Day = Holiday)

$$= \frac{P(\text{Discount} = \text{Yes} \mid \text{Yes}) * P(\text{Free Delivery} = \text{Yes} \mid \text{Yes}) * P(\text{Day} = \text{Holiday} \mid \text{Yes}) * P(\text{Yes Buy})}{P(\text{Discount}=\text{Yes}) * P(\text{Free Delivery}=\text{Yes}) * P(\text{Day}=\text{Holiday})}$$

$$= \frac{(19/24) * (21/24) * (8/24) * (24/30)}{(20/30) * (23/30) * (11/30)}$$

$$= 0.986$$

PROBABILITY OF PURCHASE = 0.986
PROBABILITY OF NO PURCHASE = 0.178

FINALLY, WE HAVE CONDITIONAL PROBABILITIES OF PURCHASE ON THIS DAY!

LET US NOW NORMALIZE THESE PROBABILITIES TO GET THE LIKELIHOOD OF THE EVENTS

SUM OF PROBABILITIES
= 0.986 + 0.178 = 1.164

LIKELIHOOD OF **PURCHASE**
= 0.986 / 1.164 = **84.71 %**

LIKELIHOOD OF **NO PURCHASE**
= 0.178 / 1.164 = **15.29 %**

PROBABILITY OF PURCHASE = 0.986
PROBABILITY OF NO PURCHASE = 0.178

AS **84.71%** IS GREATER THAN **15.29%**, WE CAN CONCLUDE THAT AN AVERAGE CUSTOMER WILL **BUY** ON A **HOLIDAY WITH DISCOUNT AND FREE DELIVERY**

Example 2

From the dataset we have obtained, we will populate frequency tables for each of the attribute

Frequency Table		Play	
		Yes	No
Sunny	Yes	3	4
	No	6	1

Frequency Table		Play	
		Yes	No
Windy	Yes	6	2
	No	3	3

Frequency Table		Play	
		Yes	No
Season	Summer	3	2
	Monsoon	4	0
	Winter	2	3

For each of the frequency tables, we will find the likelihoods for each of the cases

Here, *c = Play* and *x = Variables like Season, Sunny & Windy*.

Frequency Table		Play	
		Yes	No
Season	Summer	3	2
	Monsoon	4	0
	Winter	2	3

Likelihood Table		Play		
		Yes	No	
Season	Summer	3/9	2/5	5/14
	Monsoon	4/9	0/5	4/14
	Winter	2/9	3/5	5/14
		9/14	5/14	

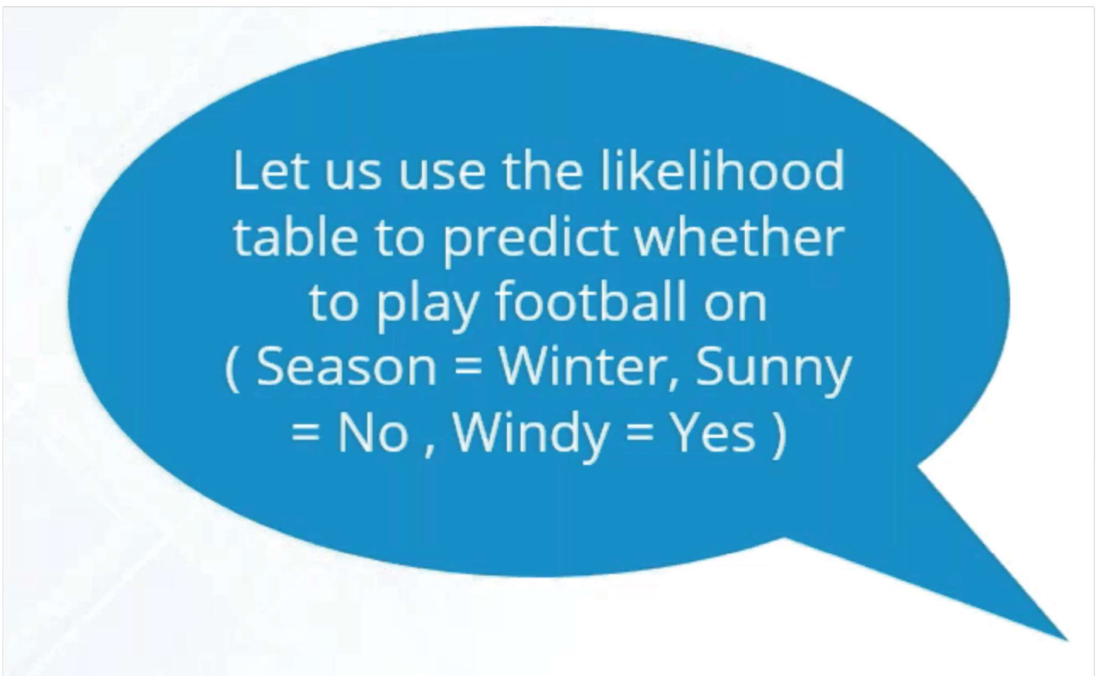
P(x | c) = P(Summer | Yes) = 3/9 = 0.33

P(x) = P(Summer) = 5/14 = 0.36

P(c) = P(Yes) = 9/14 = 0.64

Likelihood of 'Yes' given Summer is:

P(c | x) = P(Yes | Summer) = P(Summer | Yes)* P(Yes) / P(Summer) = (0.33 x 0.64) /0.36 = 0.60

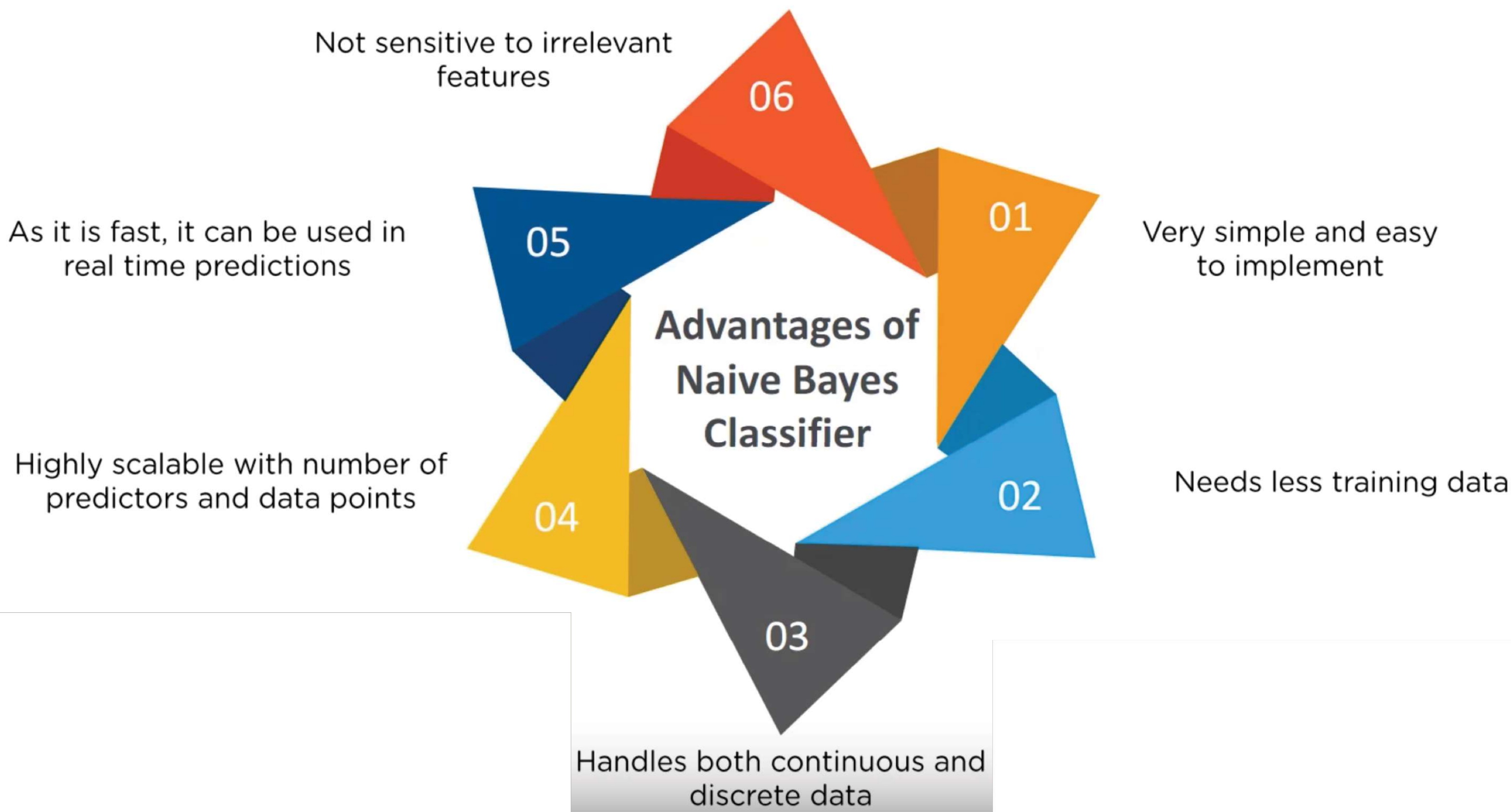

Let us use the likelihood table to predict whether to play football on (Season = Winter, Sunny = No , Windy = Yes)

$$P(c \mid x) = P(\text{Play} = \text{Yes} \mid \text{Winter}, \text{Sunny} = \text{No}, \text{Windy} = \text{Yes})$$

$$= \frac{P(\text{Winter} \mid \text{Yes}) * P(\text{Sunny} = \text{No} \mid \text{Yes}) * P(\text{Windy} = \text{Yes} \mid \text{Yes}) * P(\text{Yes})}{P(\text{Winter}) * P(\text{Sunny} = \text{No}) * P(\text{Windy} = \text{Yes})}$$

$$= (2/9) * (6/9) * (6/9) * (9/14) \;/\; (5/14) * (7/14) * (8/14) = 0.6223$$

Since the probability is greater than 0.5, we should play football on that day.


Advantages of Naive Bayes Classifier
01
Very simple and easy to implement
02
Needs less training data
03
Handles both continuous and discrete data
04
Highly scalable with number of predictors and data points
05
As it is fast, it can be used in real time predictions
06
Not sensitive to irrelevant features