Naive Bayes Classifier

Complete Example

X_1 = preparation $\{0, 1\}$ X_2 = difficulty $\{0, 1\}$ Y = Result $\{0, 1\}$

X_1	0	0	0	0	0	0	0	1	1	1	1	1	1	1
X_2	0	0	0	1	1	1	1	0	0	0	0	1	1	1
Y	0	0	1	1	0	0	0	0	0	1	1	1	0	0

Inference :

Query 1 : If you have prepared well and the exam was easy, will you get good marks ?

$$P(Y=1 / X_1=1, X_2=0)$$

$$= \frac{P(X_1=1/Y=1) \cdot P(X_2=0/Y=1) \cdot P(Y=1)}{P(X_1=1, X_2=0)}$$

Model Parameters

$P(y)$

y	
0	9/14
1	5/14

$P(x_1/y)$

x_1 \ y	0	1
0	5/9	2/5
1	4/9	3/5

$P(x_2/y)$

x_2 \ y	0	1
0	4/9	3/5
1	5/9	2/5

Conditional Probability Tabel (CPT)

Inference Query 1

$$P(Y=1 / X_1=1, X_2=0)$$

$$= \frac{P(X_1=1/Y=1) \cdot P(X_2=0/Y=1) \cdot P(Y=1)}{P(X_1=1, X_2=0)} \quad (A)$$

← Ignore the denom. for the time being

$$= (3/5)(3/5)(5/14)$$

$$= \frac{45}{350}$$

$$P(Y=0/X_1=1, X_2=0) = P(X_1=1/Y=0) \cdot P(X_2=0/Y=0) \cdot P(Y=0) \quad (B)$$

$$= (4/9)(4/9)(9/14) = \frac{16}{126}$$

if $(45/350) > (16/126)$

$Y = 1$ ✓

else

$Y = 0$

$$P(X_1=1, X_2=0) = P(X_1=1, X_2=0, Y=0) + P(X_1=1, X_2=0, Y=1)$$

$$= P(X_1=1/Y=0) \cdot P(X_2=0/Y=0) \cdot P(Y=0) + P(X_1=1/Y=1) \cdot P(X_2=0/Y=1) \cdot P(Y=1)$$

$$= A + B$$

$$P(Y=1/X_1=1, X_2=0) = \frac{\frac{45}{350}}{\left(\frac{45}{350} + \frac{16}{126}\right)}$$

$$P(Y=0/X_1=1, X_2=0) = \frac{16/126}{45/350 + 16/126}$$

Inference Query 2

$$P(Y=1 / X_1=0,\ X_2=1)$$

$$= P(X_1=0/Y=1) \cdot P(X_2=1/Y=1) \cdot P(Y=1)$$

$$= \underbrace{(2/5)(2/5)(5/14)}_{A+B} \quad \text{— (A)}$$

$$P(Y=0/X_1=0,\ X_2=1)$$

$$= P(X_1=0/Y=0) \cdot P(X_2=1/Y=0) \cdot P(Y=0)$$

$$= \underbrace{(5/9)(5/9)(9/14)}_{A+B} \quad \text{— (B)}$$

$\boxed{Y=0}$ because $P(Y=0/X_1=0, X_2=1) > P(Y=1/X_1=0, X_2=1)$

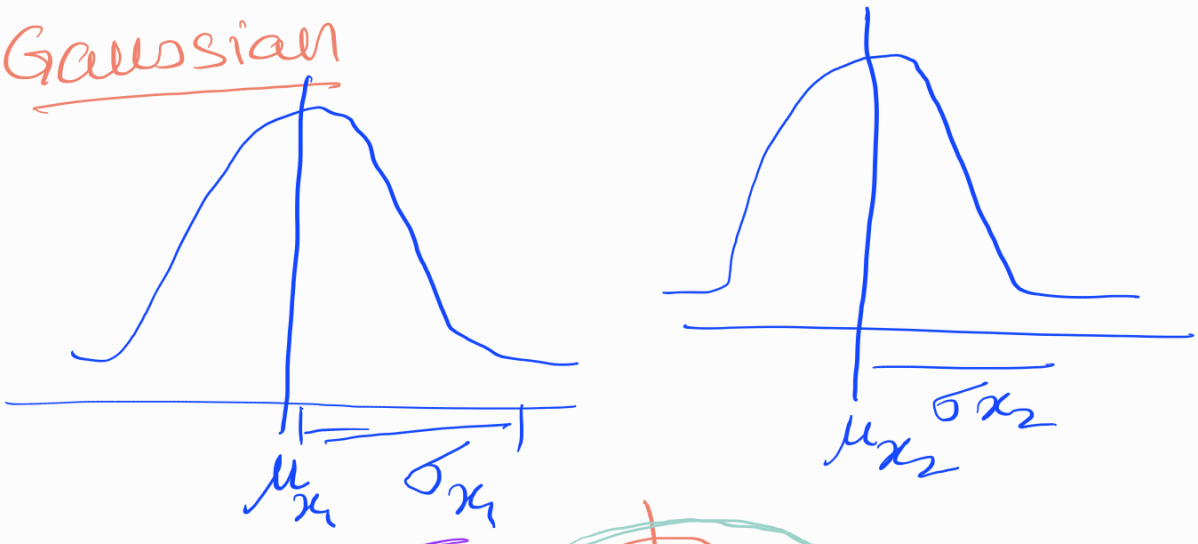
X_1	0.2	0.3	0.4	0.3	0.6	0.8	0.1
X_2	0.1	0.6	0.3	0.7	0.4	0.3	0.5
Y	1	0	1	1	0	1	1

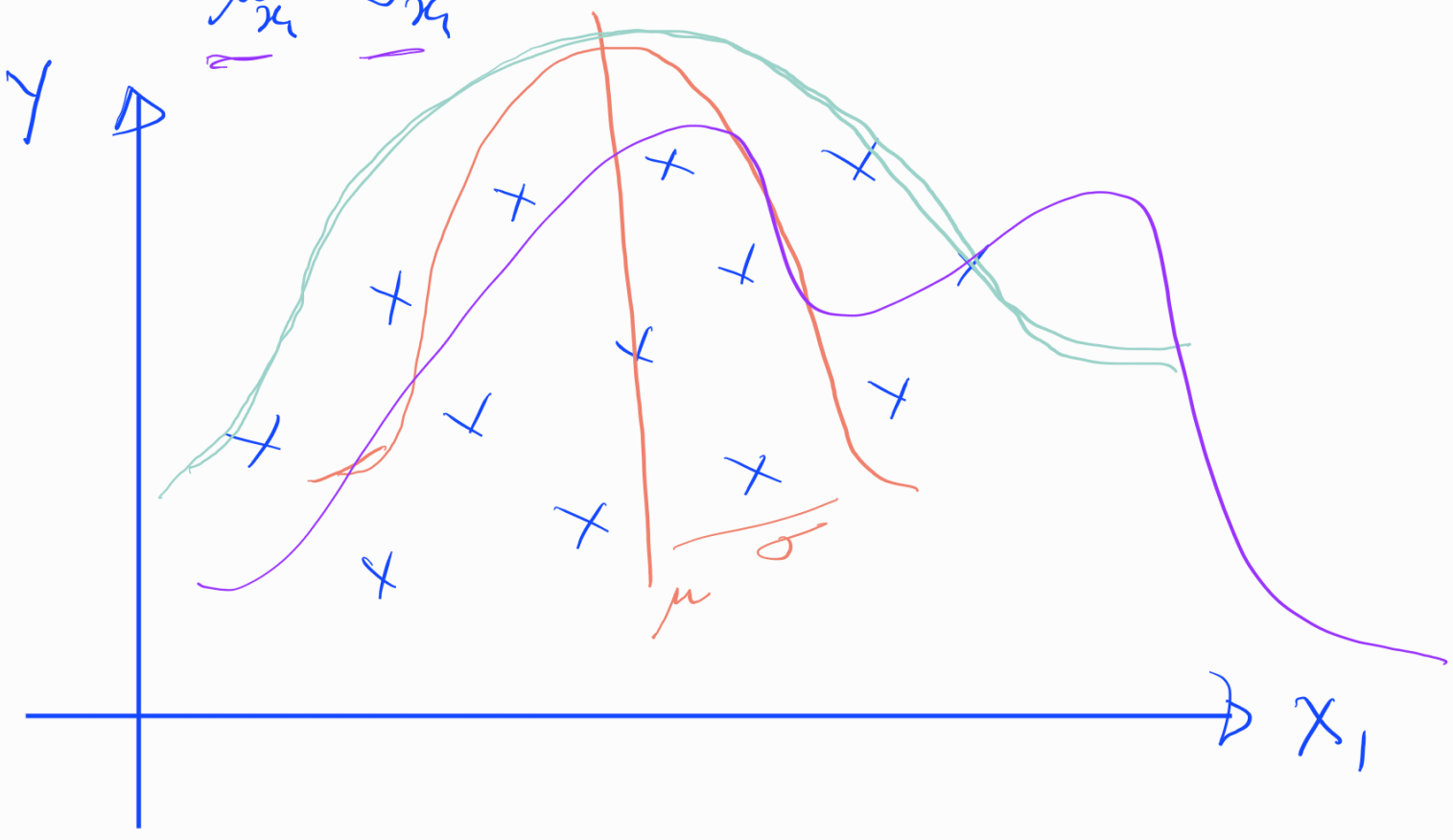
pdf : Assume an underlying distribution like σ_x

$P(x_i/y) = \underbrace{0.2,\ 0.4,\ 0.3,\ 0.8,\ 0.1}$

$P(Y/X_1)$, $P(Y/X_2)$, $P(Y)$

Gaussian





$P(x_1 = 0.6/Y = 1) = \{$