

## Evaluation Metrics using Confusion Matrix

### 1. Navie Bayes Classification: (GaussianNB)

Array = [80, 5]  
[8, 41]

True Purchased <b>80</b>	False Not Purchased <b>5</b>
False Purchased <b>8</b>	True Not Purchased <b>41</b>

True Purchased = TP = 80

True Not Purchased = TN = 41

False Purchased = FP = 8

False Not Purchased = FN = 5

Total Purchased = TP + FN = 85

Total Not Purchased = TN + FP = 49

Sum of Purchased and Not Purchased = TP+ TN +FP +FN = 134

- **Accuracy:**

$$\begin{aligned}\text{Formula: } & \frac{TP + TN}{TP + FP + TN + FN} \\ &= \frac{80 + 41}{80+8+41+5} \\ &= \frac{121}{134} = \mathbf{0.90}\end{aligned}$$

- **Recall:**

Formula: Purchased = TP/ Total Purchased

$$\begin{aligned}&= \frac{TP}{TP + FN} \\ &= \frac{80}{80+5} \\ &= \frac{80}{85} = \mathbf{0.94}\end{aligned}$$

Formula: Not Purchased = TN/ Total Not Purchased

$$\begin{aligned}&= \frac{TN}{TN + FP} \\ &= \frac{41}{8+41}\end{aligned}$$

$$= \frac{41}{49} = 0.84$$

- **Precision:**

Formula: Purchased

$$= \frac{TP}{TP + FP}$$

$$= \frac{80}{80+8}$$

$$= \frac{80}{88} = 0.91$$

Formula: Not Purchased

$$= \frac{TN}{TN + FN}$$

$$= \frac{41}{41+5}$$

$$= \frac{41}{46} = 0.89$$

- **F1 measure:**

Formula: Purchased

$$= 2 * \frac{\text{Recall} * \text{Precision}}{\text{Recall} + \text{Precision}}$$

$$= 2 * \frac{0.94 * 0.91}{0.94 + 0.91}$$

$$= 2 * \frac{0.8554}{1.85} = 0.92$$

Formula: Not Purchased

$$= 2 * \frac{\text{Recall} * \text{Precision}}{\text{Recall} + \text{Precision}}$$

$$= 2 * \frac{0.84 * 0.89}{0.84 + 0.89}$$

$$= 2 * \frac{0.7476}{1.73} = 0.86$$

- **Macro Average:**

Formula: Precision

$$= \frac{\text{Precision Purchased} + \text{Precision Not Purchased}}{2}$$

$$= \frac{0.91+0.89}{2} = \mathbf{0.90}$$

Formula: Recall

$$= \frac{\text{Recall Purchased} + \text{Recall Not Purchased}}{2}$$

$$= \frac{0.94+0.84}{2} = \mathbf{0.89}$$

Formula: F1 measure

$$= \frac{\text{F1 measure Purchased} + \text{F1 measure Not Purchased}}{2}$$

$$= \frac{0.92+0.86}{2} = \mathbf{0.89}$$

- **Weighted Average:**

Formula: Precision

$$= \text{Precision Purchased} * \frac{\text{Total Purchased}}{\text{Sum of Purchased \& Not Purchased}}$$

$$+ \text{Precision Not Purchased} * \frac{\text{Total Not Purchased}}{\text{Sum of Purchased \& Not Purchased}}$$

$$= 0.91 * \frac{85}{134} + 0.89 * \frac{49}{134}$$

$$= 0.91 * 0.63 + 0.89 * 0.37 = \mathbf{0.90}$$

Formula: Recall

$$= \text{Recall Purchased} * \frac{\text{Total Purchased}}{\text{Sum of Purchased \& Not Purchased}}$$

$$+ \text{Recall Not Purchased} * \frac{\text{Total Not Purchased}}{\text{Sum of Purchased \& Not Purchased}}$$

$$= 0.94 * \frac{85}{134} + 0.84 * \frac{49}{134}$$

$$= 0.94 * 0.63 + 0.84 * 0.37 = \mathbf{0.90}$$

Formula: F1 measure

$$= \text{F1 measure Purchased} * \frac{\text{Total Purchased}}{\text{Sum of Purchased \& Not Purchased}}$$

$$+ \text{F1 measure Not Purchased} * \frac{\text{Total Not Purchased}}{\text{Sum of Purchased \& Not Purchased}}$$

$$= 0.92 * \frac{85}{134} + 0.86 * \frac{49}{134}$$

$$= 0.92 * 0.63 + 0.86 * 0.37 = \mathbf{0.90}$$