Evaluation Metrics using Confusion Matrix

1. **Decision Tree Classification:**

Array = [76, 9]
[8, 41]

True Purchased **76**	False Not Purchased **9**
False Purchased **8**	True Not Purchased **41**

True Purchased = TP = 76
True Not Purchased = TN = 41
False Purchased = FP = 8
False Not Purchased = FN = 9
Total Purchased = TP + FN = 85
Total Not Purchased = TN + FP = 49
Sum of Purchased and Not Purchased = TP+ TN +FP +FN = 134

- **Accuracy:**

Formula: $$\frac{TP + TN}{TP + FP + TN + FN}$$

$$= \frac{76 + 41}{76+8+41+9}$$

$$= \frac{117}{134} = \mathbf{0.87}$$

- **Recall:**

Formula: Purchased = TP/ Total Purchased

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

$$= \frac{76}{76+9}$$

$$= \frac{76}{85} = \mathbf{0.89}$$

Formula: Not Purchased = TN/ Total Not Purchased

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

$$= \frac{41}{41+8}$$

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

- **Precision:**

  Formula: Purchased

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

$$= \frac{76}{76+8}$$

$$= \frac{76}{84} = \mathbf{0.90}$$

  Formula: Not Purchased

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

$$= \frac{41}{41+9}$$

$$= \frac{41}{50} = \mathbf{0.82}$$

- **F1 measure:**

  Formula: Purchased

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

$$= 2* \frac{0.89*0.90}{0.89+0.90}$$

$$= 2* \frac{0.8010}{1.79} = \mathbf{0.90}$$

  Formula: Not Purchased

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

$$= 2* \frac{0.84*0.82}{0.84+0.82}$$

$$= 2* \frac{0.6888}{1.66} = \mathbf{0.83}$$

- **Macro Average:**

  Formula: Precision

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

$$= \frac{0.90+0.82}{2} = \mathbf{0.86}$$

Formula: Recall

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

$$= \frac{0.89+0.84}{2} = \mathbf{0.87}$$

Formula: F1 measure

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

$$= \frac{0.90+0.83}{2} = \mathbf{0.86}$$

- **Weighted Average:**

Formula: Precision

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

$$= 0.90 * \frac{85}{134} + 0.82 * \frac{49}{134}$$

$$= 0.90 * 0.63 + 0.82 * 0.37 = \mathbf{0.87}$$

Formula: Recall

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

$$= 0.89 * \frac{85}{134} + 0.84 * \frac{49}{134}$$

$$= 0.89 * 0.63 + 0.84 * 0.37 = \mathbf{0.87}$$

Formula: F1 measure

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

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

$$= 0.90 * \frac{85}{134} + 0.83 * \frac{49}{134}$$

$$= 0.90 * 0.63 + 0.83 * 0.37 \quad \mathbf{= 0.87}$$