**📘 Final Report – Food Delivery Classification Models**

**✅ Reporting and Insights**

**🔹 Model Comparison: Naive Bayes vs KNN vs Decision Tree**

We evaluated three classification models using performance metrics such as accuracy, precision, recall, and F1-score. Below is the detailed comparison.

**📊 Naive Bayes Classifier**

| **Metric** | **Value** |
| --- | --- |
| Accuracy | **98.33%** |
| Precision | 0.93 (class 0), 1.00 (class 1) |
| Recall | 1.00 (class 0), 0.98 (class 1) |
| F1 Score | 0.97 (class 0), 0.99 (class 1) |

**Confusion Matrix**:

[[14 0]

[ 1 45]]

✅ **Highlights**:

* Highest accuracy and balance across all metrics.
* Excellent at predicting both classes.
* Only 1 misclassification.

**📊 K-Nearest Nighbour (KNN) – *k = 9***

| **Metric** | **Value** |
| --- | --- |
| Accuracy | **96.67%** |
| Precision | 1.00 |
| Recall | 95.65% |
| F1 Score | 97.78% |

**Confusion Matrix**:

[[14 0]

[ 2 44]]

✅ **Highlights**:

* Very high precision (no false positives).
* Slight drop in recall due to 2 false negatives.
* Very strong overall performance, sensitive to choice of k.

**📊 Decision Tree Classifier**

| **Metric** | **Value** |
| --- | --- |
| Accuracy | **76.67%** |
| Precision | 0.7667 |
| Recall | 100.00% |
| F1 Score | 86.79% |

**Confusion Matrix**:

[[ 0 14]

[ 0 46]]

⚠️ **Concerns**:

* **Completely failed** to classify class 0.
* **Recall = 100%** because it predicted all instances as class 1.
* Biased and **not generalizing well** for imbalanced classes.

**📈 Visual Results to Include in Notebook**

* ✅ Confusion Matrix heatmaps (for all 3 models).
* ✅ ROC Curves for Naive Bayes and KNN.
* ❌ Decision Tree not suitable for ROC due to poor performance.

**💡 Actionable Insights**

**🔍 Strengths and Weaknesses of Each Model:**

| **Model** | **Strengths** | **Weaknesses** |
| --- | --- | --- |
| **Naive Bayes** | Fast, simple, highly accurate, interpretable | Assumes feature independence (may not hold) |
| **KNN (k=9)** | High precision, non-parametric | Slower with large datasets, sensitive to k |
| **Decision Tree** | Interpretable, easy to visualize | Severe overfitting, class bias |

**✅ Recommended Model:**

🟢 **Naive Bayes** is recommended because:

* It gives **the best accuracy (98.33%)**.
* **Low error rate**, especially important in critical decisions.
* **Balanced classification** across both classes.
* Interpretable and lightweight, suitable for deployment.

🟡 **KNN** is a good backup option if dataset changes, but slower in real-time use.

🔴 **Decision Tree** should be avoided in current form due to biased predictions.

**📝 Final Summary Table**

| **Model** | **Accuracy** | **Precision** | **Recall** | **F1 Score** | **Recommendation** |
| --- | --- | --- | --- | --- | --- |
| **Naive Bayes** | 98.33% | 0.93/1.00 | 1.00/0.98 | 0.97/0.99 | ✅ Best overall |
| **KNN (k=9)** | 96.67% | 1.00 | 95.65% | 97.78% | 👍 Strong second |
| **Decision Tree** | 76.67% | 0.7667 | 100% | 86.79% | ❌ Not suitable |