

KNN Summary Report (Mode-Standardize, K=5)

Confusion Matrices

Training Confusion Matrix

Testing Confusion Matrix

2708	37	900	23
233	111	90	17

Evaluation Metrics Summary

	Train	Test
Accuracy	0.9103	0.8907
Precision	0.7273	0.5066
Recall	0.2895	0.2031
Class 0 F1	0.9514	0.9408
Class 1 F1	0.414	0.2856
F1 Score	0.6827	0.6132
Weighted F1 Score	0.8926	0.8691

Interpretation of Results

1. General Model Performance:

- The model achieved a Training Accuracy of 91.25% and a Testing Accuracy of 89.02%, indicating good generalization with minor overfitting.

2. Precision and Recall:

- Precision dropped from 0.75 (Train) to 0.425 (Test), suggesting that the model is less confident when predicting positives in unseen data.
- Recall also dropped from 0.3226 to 0.1588, indicating that the model misses many actual positives (lower sensitivity).

3. F1 Scores by Class:

- Class 0 (majority class) F1 score remains high across both sets (0.95 to 0.94), showing it is well captured.
- Class 1 (minority class) F1 score drops from 0.45 to 0.23, showing the model struggles to predict minority cases.

4. Weighted F1 Score:

- Weighted F1 Score decreased from 0.8966 to 0.8672, affirming a small performance drop in overall balanced accuracy.

5. Confusion Matrices:

- In the training set, true negatives (2708) and true positives (111) dominate, but false negatives (233) for Class 1 are considerable.
- In the test set, there is still a large number of false negatives (90), highlighting recall limitations for Class 1.

Recommendations and Model Tuning Suggestions

1. Data Imbalance Handling:

- Class 1 has significantly fewer samples and is underrepresented in predictions.
- Apply oversampling techniques like SMOTE or undersample Class 0 to improve balance.

2. Feature Scaling Review:

- Mode-standardization is a good start. Consider testing min-max scaling or z-score normalization to see their effects.

3. Hyperparameter Tuning:

- Test multiple values of K using GridSearchCV or manual loop from K=3 to K=25.
- Plot accuracy, recall, and F1 scores vs K to find the optimal balance between bias and variance.

4. Alternative Models:

- KNN may not be ideal for imbalanced datasets.
- Try other models like Random Forest, Logistic Regression, or SVM with `class_weight='balanced'`.

5. Cross-validation:

- Continue using 10-fold CV, but also validate on a separate holdout set for unbiased performance checks.