Adaptive MNN graph built using local scaling (k\_selector=5).

Found 50 isolated samples (with 0 MNNs).

--------------------------------------------------

Starting comprehensive sample analysis...

Sample Analysis Complete:

-> Identified 79 'SAFE' samples.

-> Identified 40 'BOUNDARY' samples.

-> Identified 17 'OUTLIER' samples.

-> Identified 50 'ISOLATED' samples.

--------------------------------------------------

Calculating density factor (rho) for dynamic parameter tuning...

Density factor calculation complete.

--------------------------------------------------

Applied DYNAMIC weight suppression to 67 outlier/isolated samples based on their density.

Assigned DYNAMIC flipping gain (range [0.7, 0.9]) to 24 majority boundary samples.

Assigned DYNAMIC flipping gain (range [0.05, 0.15]) to 77 majority safe samples.

--------------------------------------------------

--- Starting AdaBoost Training with Dynamic Parameters (V3.1) ---

Iteration 1/50: G-Mean=0.396, Flipped=0 samples

-> Generating visualization for iteration 1...

Iteration 2/50: G-Mean=0.396, Flipped=7 samples

Iteration 3/50: G-Mean=0.754, Flipped=15 samples

Iteration 4/50: G-Mean=0.707, Flipped=17 samples

Iteration 5/50: G-Mean=0.776, Flipped=16 samples

Iteration 6/50: G-Mean=0.729, Flipped=15 samples

Iteration 7/50: G-Mean=0.748, Flipped=15 samples

Iteration 8/50: G-Mean=0.694, Flipped=14 samples

Iteration 9/50: G-Mean=0.790, Flipped=15 samples

Iteration 10/50: G-Mean=0.705, Flipped=14 samples

-> Generating visualization for iteration 10...

Iteration 11/50: G-Mean=0.800, Flipped=11 samples

Iteration 12/50: G-Mean=0.733, Flipped=11 samples

Iteration 13/50: G-Mean=0.787, Flipped=17 samples

Iteration 14/50: G-Mean=0.810, Flipped=14 samples

Iteration 15/50: G-Mean=0.793, Flipped=12 samples

Iteration 16/50: G-Mean=0.793, Flipped=13 samples

Iteration 17/50: G-Mean=0.754, Flipped=18 samples

Iteration 18/50: G-Mean=0.765, Flipped=10 samples

Iteration 19/50: G-Mean=0.813, Flipped=13 samples

Iteration 20/50: G-Mean=0.810, Flipped=11 samples

-> Generating visualization for iteration 20...

Iteration 21/50: G-Mean=0.813, Flipped=12 samples

Iteration 22/50: G-Mean=0.813, Flipped=13 samples

Iteration 23/50: G-Mean=0.813, Flipped=14 samples

Iteration 24/50: G-Mean=0.790, Flipped=14 samples

Iteration 25/50: G-Mean=0.770, Flipped=11 samples

Iteration 26/50: G-Mean=0.773, Flipped=13 samples

Iteration 27/50: G-Mean=0.806, Flipped=11 samples

Iteration 28/50: G-Mean=0.800, Flipped=15 samples

Iteration 29/50: G-Mean=0.803, Flipped=13 samples

Iteration 30/50: G-Mean=0.810, Flipped=14 samples

-> Generating visualization for iteration 30...

Iteration 31/50: G-Mean=0.783, Flipped=17 samples

Iteration 32/50: G-Mean=0.803, Flipped=14 samples

Iteration 33/50: G-Mean=0.813, Flipped=13 samples

Iteration 34/50: G-Mean=0.816, Flipped=14 samples

Iteration 35/50: G-Mean=0.797, Flipped=12 samples

Iteration 36/50: G-Mean=0.819, Flipped=13 samples

Iteration 37/50: G-Mean=0.816, Flipped=15 samples

Iteration 38/50: G-Mean=0.812, Flipped=15 samples

Iteration 39/50: G-Mean=0.816, Flipped=12 samples

Iteration 40/50: G-Mean=0.816, Flipped=14 samples

-> Generating visualization for iteration 40...

Iteration 41/50: G-Mean=0.793, Flipped=16 samples

Iteration 42/50: G-Mean=0.812, Flipped=12 samples

Iteration 43/50: G-Mean=0.790, Flipped=14 samples

Iteration 44/50: G-Mean=0.809, Flipped=13 samples

Iteration 45/50: G-Mean=0.812, Flipped=14 samples

Iteration 46/50: G-Mean=0.821, Flipped=13 samples

Iteration 47/50: G-Mean=0.829, Flipped=15 samples

Iteration 48/50: G-Mean=0.829, Flipped=15 samples

Iteration 49/50: G-Mean=0.812, Flipped=12 samples

Iteration 50/50: G-Mean=0.832, Flipped=12 samples

-> Generating visualization for iteration 50...

--- Performance Metrics on Test Set ---

Accuracy: 0.840

Precision: 0.871

Recall: 0.840

F1-Score: 0.849

G-Mean: 0.834

AUC: 0.897

Performance of models trained on different resampled datasets, evaluated on the original test set.

Accuracy Precision Recall F1 Score G-Mean AUC

Sampler Model

ADASYN AdaBoost 0.802 0.811 0.802 0.806 0.711 0.860

CatBoost 0.778 0.809 0.778 0.789 0.725 0.810

DecisionTree 0.765 0.792 0.765 0.776 0.691 0.700

GBDT 0.815 0.828 0.815 0.820 0.746 0.827

LightGBM 0.840 0.843 0.840 0.841 0.759 0.868

RandomForest 0.753 0.775 0.753 0.762 0.656 0.822

SVC 0.790 0.624 0.790 0.697 0.000 0.799

XGBoost 0.802 0.811 0.802 0.806 0.711 0.824

NearMiss AdaBoost 0.617 0.720 0.617 0.650 0.582 0.710

CatBoost 0.741 0.769 0.741 0.752 0.650 0.723

DecisionTree 0.556 0.745 0.556 0.595 0.603 0.572

GBDT 0.679 0.770 0.679 0.706 0.667 0.747

LightGBM 0.778 0.833 0.778 0.794 0.773 0.758

RandomForest 0.778 0.798 0.778 0.786 0.698 0.780

SVC 0.642 0.743 0.642 0.673 0.621 0.500

XGBoost 0.691 0.723 0.691 0.705 0.561 0.717

Original AdaBoost 0.827 0.823 0.827 0.787 0.481 0.854

CatBoost 0.790 0.762 0.790 0.768 0.521 0.859

DecisionTree 0.802 0.802 0.802 0.802 0.681 0.779

GBDT 0.802 0.775 0.802 0.778 0.525 0.786

LightGBM 0.852 0.841 0.852 0.839 0.670 0.869

RandomForest 0.827 0.823 0.827 0.787 0.481 0.854

SVC 0.790 0.624 0.790 0.697 0.000 0.500

XGBoost 0.790 0.762 0.790 0.768 0.521 0.810

SMOTE AdaBoost 0.790 0.804 0.790 0.796 0.705 0.866

CatBoost 0.778 0.820 0.778 0.792 0.750 0.828

DecisionTree 0.704 0.728 0.704 0.715 0.567 0.602

GBDT 0.827 0.827 0.827 0.827 0.724 0.831

LightGBM 0.815 0.828 0.815 0.820 0.746 0.853

RandomForest 0.790 0.795 0.790 0.792 0.675 0.826

SVC 0.790 0.624 0.790 0.697 0.000 0.813

XGBoost 0.864 0.861 0.864 0.863 0.772 0.838

TomekLinks AdaBoost 0.827 0.815 0.827 0.818 0.659 0.869

CatBoost 0.815 0.798 0.815 0.802 0.616 0.864

DecisionTree 0.728 0.763 0.728 0.742 0.643 0.714

GBDT 0.815 0.804 0.815 0.808 0.653 0.857

LightGBM 0.790 0.769 0.790 0.776 0.566 0.837

RandomForest 0.827 0.809 0.827 0.806 0.580 0.863

SVC 0.778 0.622 0.778 0.691 0.000 0.819

XGBoost 0.840 0.831 0.840 0.834 0.699 0.892