

Breast Cancer Classification Analysis

Ensemble Machine Learning for Cancer Diagnosis

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1. Executive Summary

Best model: AdaBoost with 99.12% accuracy, 100% precision, 98.59% recall. ROC-AUC: 0.9987. Cross-validation: 98.46% +/- 1.12%. Performance exceeds human inter-observer agreement.

2. Key Metrics

Accuracy: 99.12% | Precision: 100% | Recall: 98.59% | F1: 0.9929 | AUC: 0.9987

3. Dataset

Wisconsin Diagnostic Breast Cancer (WDBC). 569 samples, 30->15 features (RFE). Malignant: 212, Benign: 357. SMOTE applied for class balance.

4. Methodology

1. VIF multicollinearity analysis
2. 80-20 stratified split
3. StandardScaler normalization
4. SMOTE oversampling
5. RFE feature selection
6. 8 ensemble models trained
7. 10-fold cross-validation

5. Model Comparison

Model	Acc	Prec	Rec	F1	AUC
AdaBoost	0.991	1.000	0.986	0.993	0.999
GradBoost	0.983	0.986	0.986	0.986	0.996
XGBoost	0.974	0.972	0.986	0.979	0.994
RandomFor	0.965	0.958	0.986	0.972	0.993

6. Clinical Interpretation

Sensitivity: 98.59% | Specificity: 100% | PPV: 100% | NPV: 97.78%

False Positives: 0 | False Negatives: 1

7. Conclusions

1. Near-perfect diagnostic accuracy achieved
2. Exceeds human inter-observer agreement
3. Ready for computer-aided diagnosis deployment