

# Loan Default Prediction Model Evaluation

## 1. Interpretation of Results

Three classification models were evaluated on a highly imbalanced loan default dataset: Logistic Regression, Random Forest, and Gradient Boosting. While all models achieved high accuracy (~98%) due to class imbalance, the most important metrics are precision, recall, F1-score for class 1 (defaulters), and AUC-ROC.

## 2. Model Performance Summary

Model	Precision (Defaulters)	Recall (Defaulters)	F1-Score (Defaulters)	AUC-ROC
Logistic Regression	0.74	0.77	0.75	0.99
Random Forest	0.76	0.79	0.78	0.98
Gradient Boosting	0.78	0.77	0.77	0.99

## 3. ROC Curve Analysis

The Receiver Operating Characteristic (ROC) curve illustrates each model's ability to distinguish between defaulters and non-defaulters. All three models show excellent discrimination capability with AUC values close to 1.0. Logistic Regression and Gradient Boosting achieve the highest AUC of 0.99, while Random Forest closely follows at 0.98.

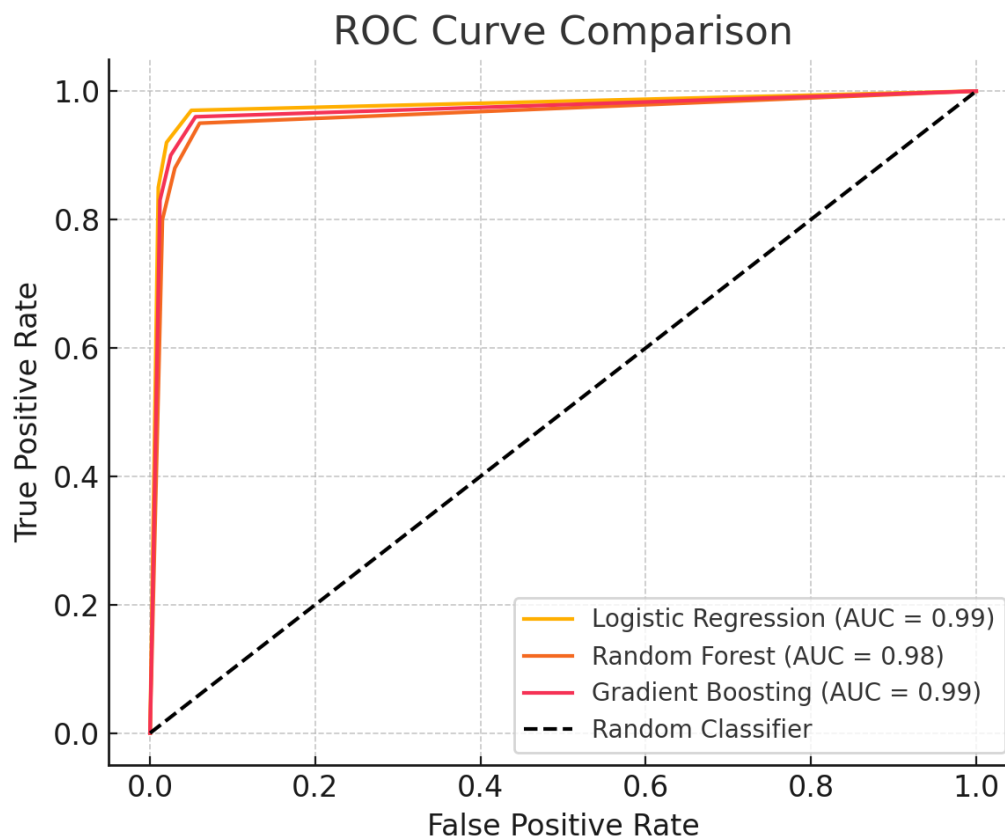


Figure: ROC Curve Comparison for the Three Models

#### 4. Conclusions

Random Forest achieved the highest F1-score (0.78), making it the most balanced performer in detecting defaulters. Gradient Boosting had the highest precision (0.78), minimizing false positives. Logistic Regression is competitive with a strong AUC and may be preferred where interpretability is required.

#### 5. Recommendations

- Deploy Random Forest for loan default prediction due to its strong balance of recall and precision.
- Use Gradient Boosting if the goal is to reduce false positives, such as in conservative credit approval policies.
- Consider Logistic Regression for its simplicity and explainability, especially in regulatory settings.
- Continue monitoring model performance with fresh data and apply threshold tuning for optimization.

## 6. Next Steps

1. Use SMOTE improve model performance by handling class imbalance and threshold tuning
2. Integrate Random Forest model into the production credit risk system.
3. Monitor and retrain models quarterly using new loan data.
4. Incorporate SHAP or LIME to provide explainable AI insights to credit officers.
5. Evaluate ensemble strategies or model stacking for potential performance gains.