

# **A CALIBRATED AND INTERPRETABLE ENSEMBLE FRAMEWORK**

*for Reliable Diabetes Risk Prediction*

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## **Model Overview**

This report presents a Calibrated and Interpretable Ensemble Framework (CIEF) for reliable diabetes risk prediction using the Pima Indians Diabetes dataset.

The model integrates Support Vector Machine (SVM), XGBoost, and Logistic Regression, calibrated via Isotonic Regression to ensure reliable probability estimates and interpretability.

Dataset: Pima Indians Diabetes (768 samples, 8 features)

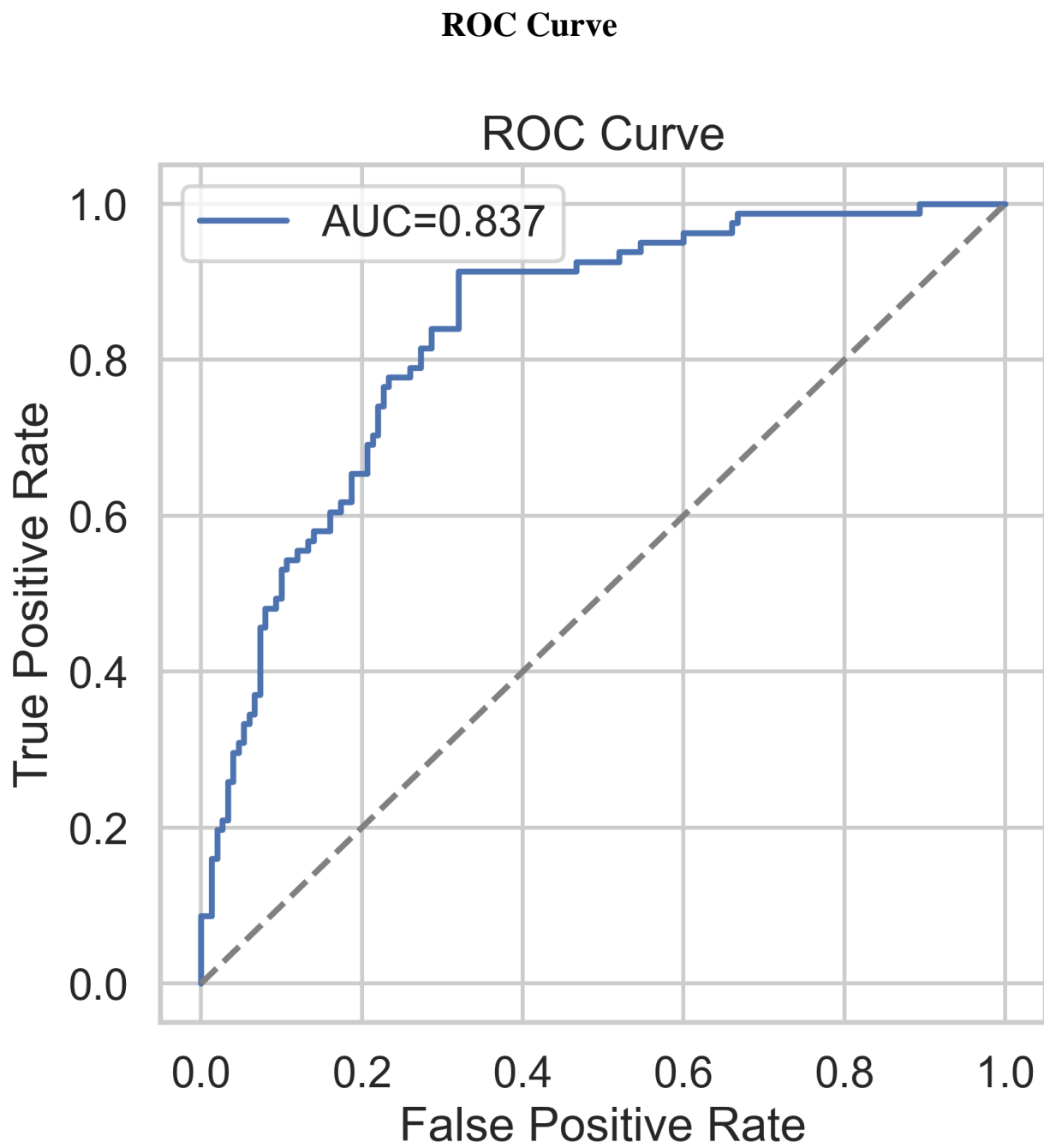
Split: 70% training, 20% calibration, 30% testing

Calibration Method: Isotonic Regression

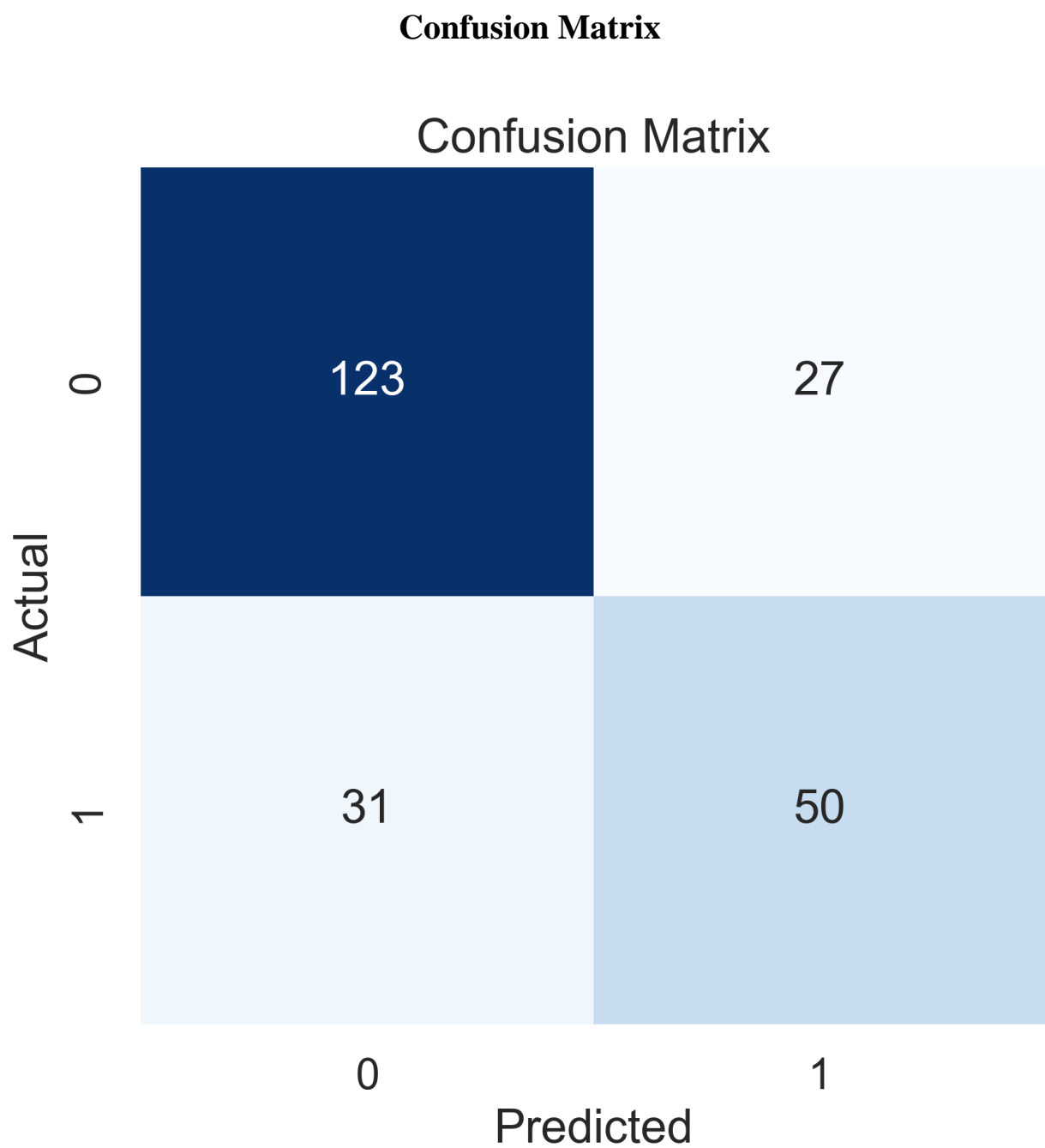
Evaluation Metrics: Accuracy, ROC-AUC, PR-AUC, F1-score, and Brier Score.

## Performance Summary

Accuracy	: 0.7489
Precision	: 0.6494
Recall	: 0.6173
F1	: 0.6329
Roc_auc	: 0.8368
Brier	: 0.1606
Pr_auc	: 0.7198



*Figure 1. ROC Curve showing model discrimination.*



*Figure 2. Confusion Matrix of predicted vs actual outcomes.*

### Precision-Recall Curve

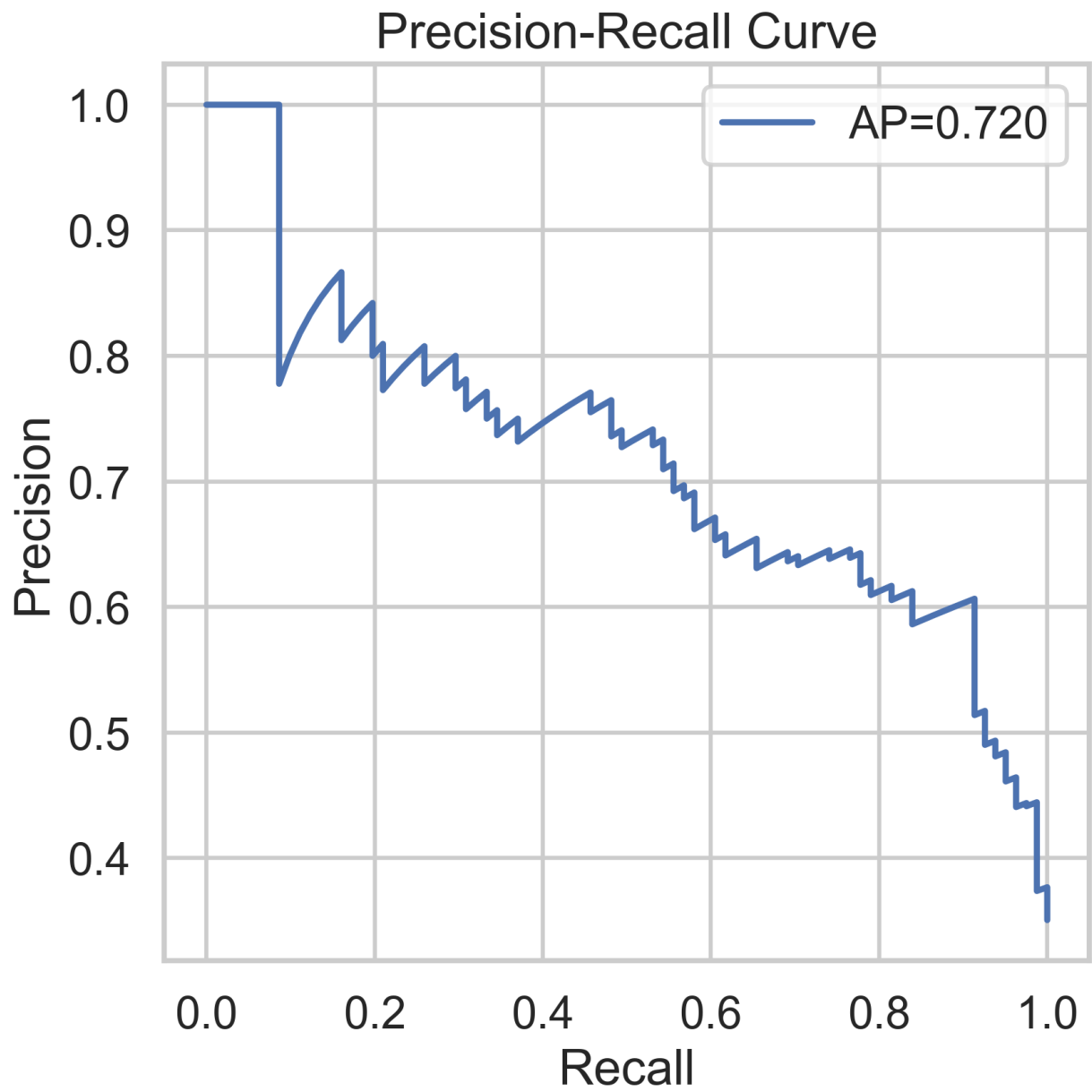


Figure 3. Precision-Recall Curve illustrating sensitivity trade-offs.

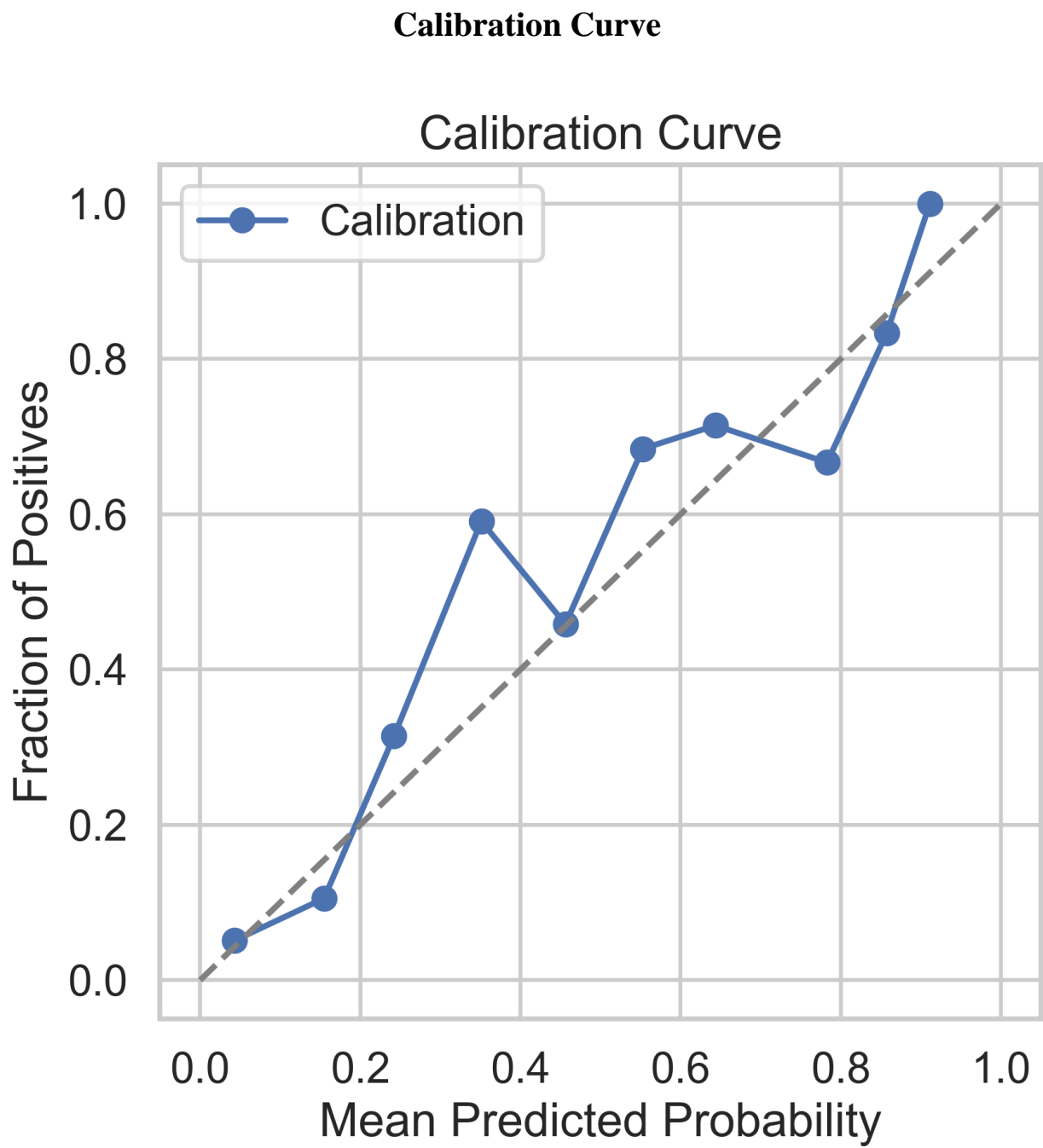


Figure 4. Calibration Curve showing reliability of predicted probabilities.

## Probability Distribution

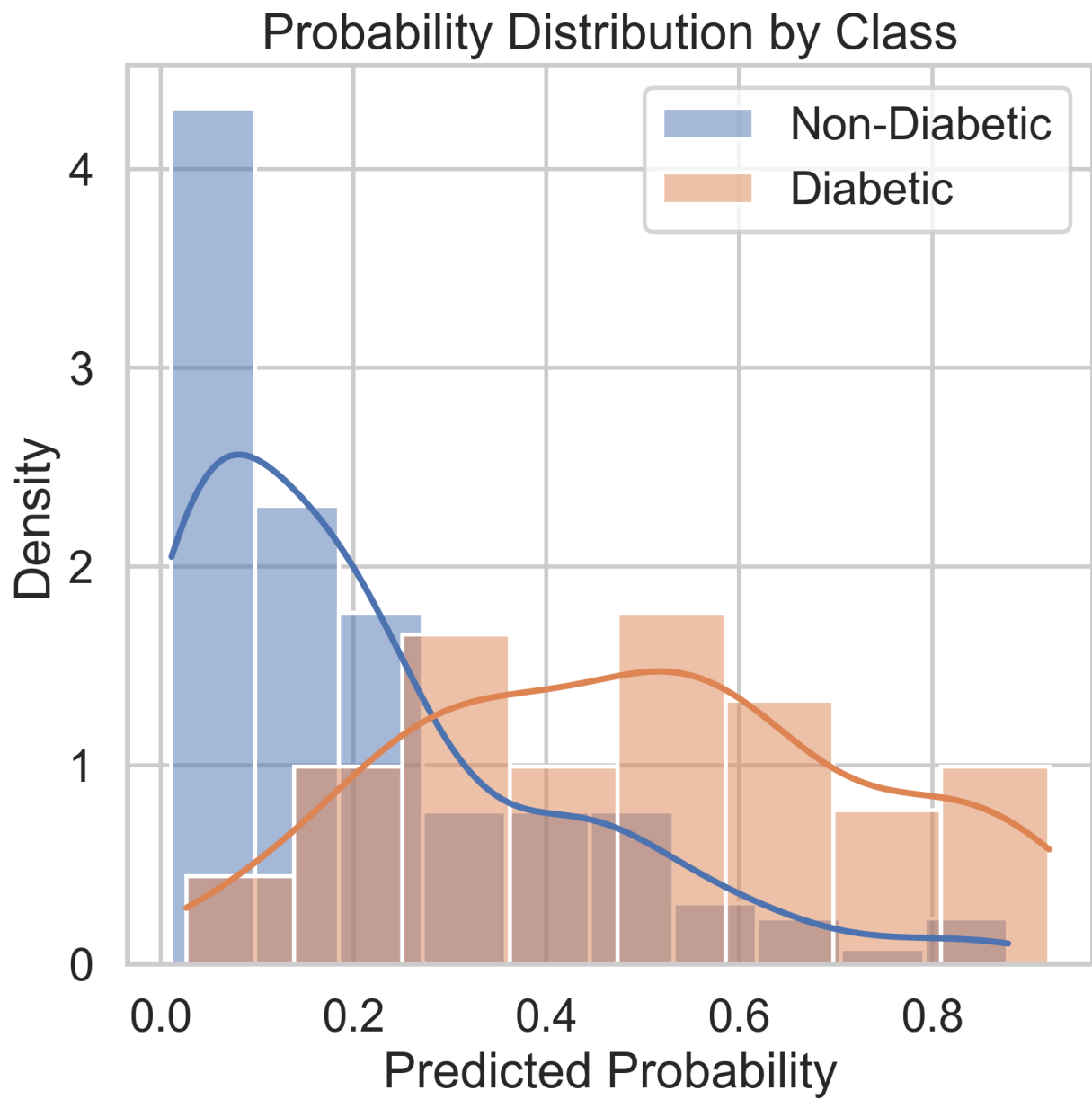


Figure 5. Probability distribution by predicted class.



## **SHAP-Based Interpretability**

SHAP (SHapley Additive ExPlanations) is applied to measure how each clinical feature influences model predictions.

Global SHAP plots highlight overall feature importance, identifying Glucose, BMI, and Diabetes Pedigree Function as the strongest predictors.

Local SHAP force plots visualize how patient-specific characteristics drive individual risk probabilities, enhancing transparency and supporting clinical reasoning.

## Global SHAP Summary

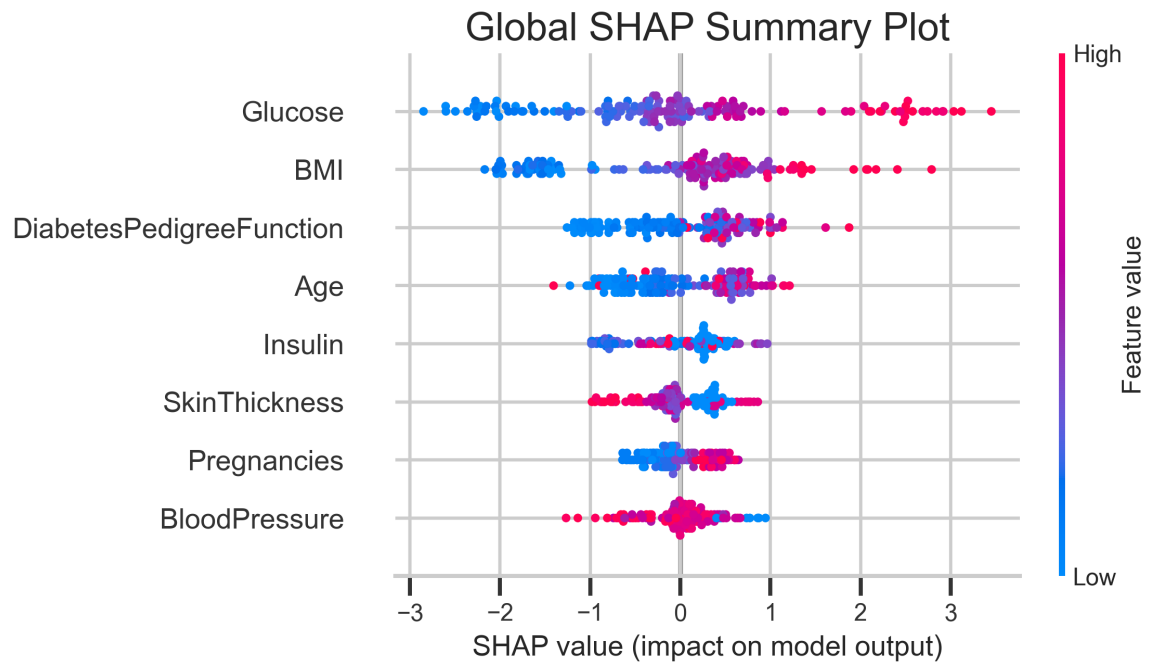


Figure 6. Global SHAP summary showing overall feature impact across all patients.

# Local SHAP Force Plot

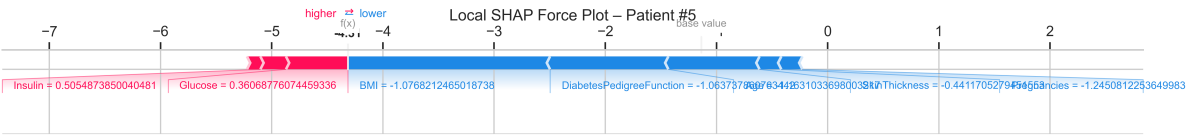


Figure 7. SHAP Force Plot for an individual patient, illustrating feature contributions.

## **Clinical Summary and Relevance**

The ensemble achieved an accuracy of 0.749, ROC-AUC of 0.837, PR-AUC of 0.720, and Brier Score of 0.161, indicating well-calibrated predictions.

Clinically, the CIEF framework provides a transparent, reliable, and interpretable AI-based assessment of diabetes risk, suitable for integration in healthcare decision support systems.