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A Machine Learning-Powered Decision Tool to Predict the Risk of Knee Arthroplasty in Patients with Osteoarthritis Using Plain Radiographs and Routine Clinical Data

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Financial Disclosure Statement

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- None to declare

Introduction

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- Osteoarthritis (OA) stands as the most prevalent degenerative joint condition, profoundly affecting patients' mobility and quality of life while also imposing a considerable economic burden worldwide.

- As the global population ages and obesity rates increase, the incidence of OA is on the rise, leading to an anticipated surge in the demand for knee arthroplasty (KA).

- Although KA is highly effective, predicting which patients will require this surgery remains a significant challenge in clinical practice. Accurate prediction tools are needed to better inform treatment decisions and optimise patient outcomes.

Objectives

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This study aimed to develop a practical machine learning (ML)-powered decision tool to accurately KA risk using a combination of routine clinical data and data from plain radiographs.

Dataset

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- Data of 4,796 patients (12,813 knees) were retrieved from the Osteoarthritis Initiative (OAI) dataset, who were followed for at least five years.

- A wide range of 52 demographic and clinical variables (such as age, body mass index, functional scores, and 12-Item Short Form Survey) and plain radiographic features (including Kellgren-Lawrence (K-L) grade and Osteoarthritis Research Society International [OARSI] grades) were selected.

Preprocessing and Development

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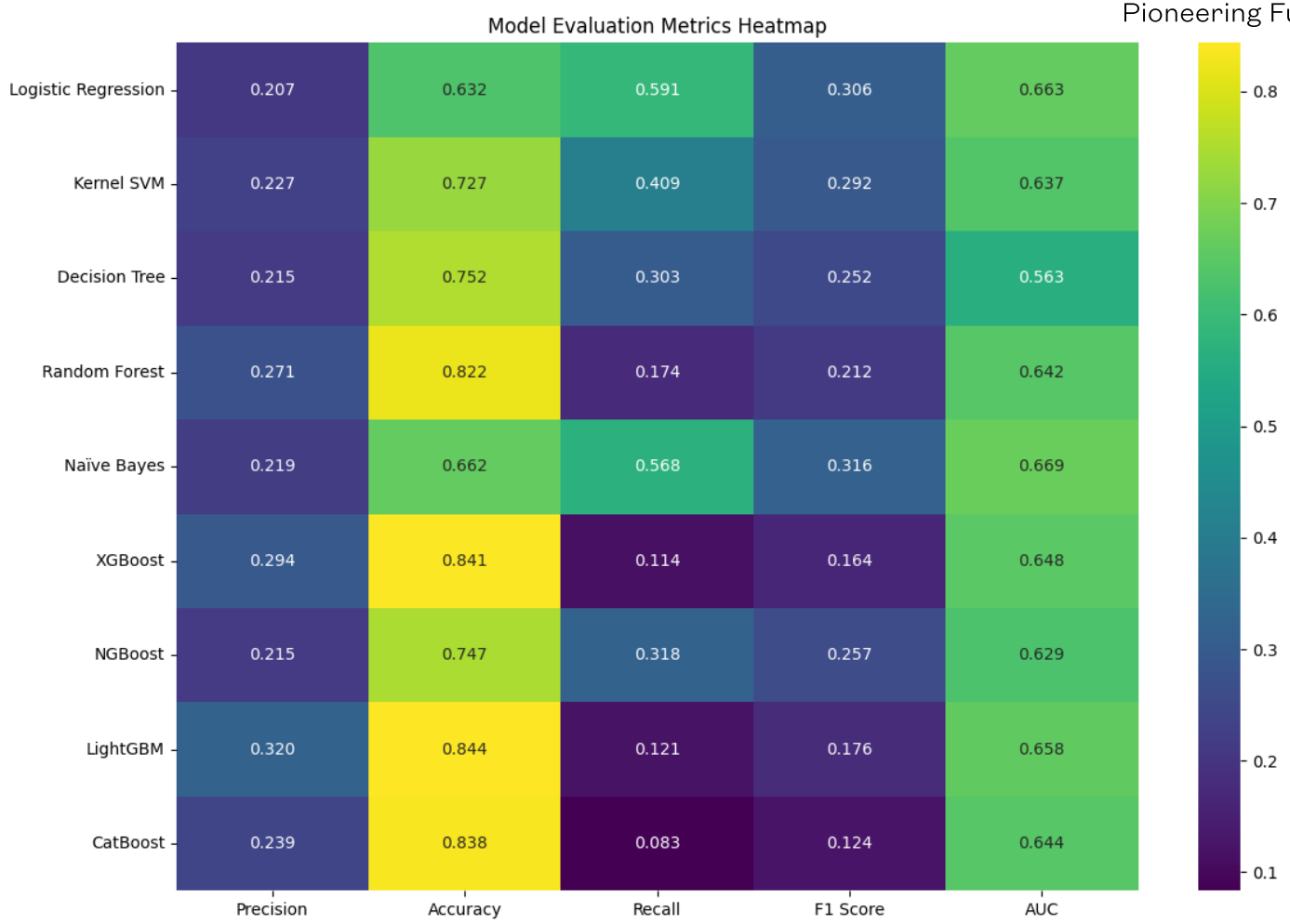
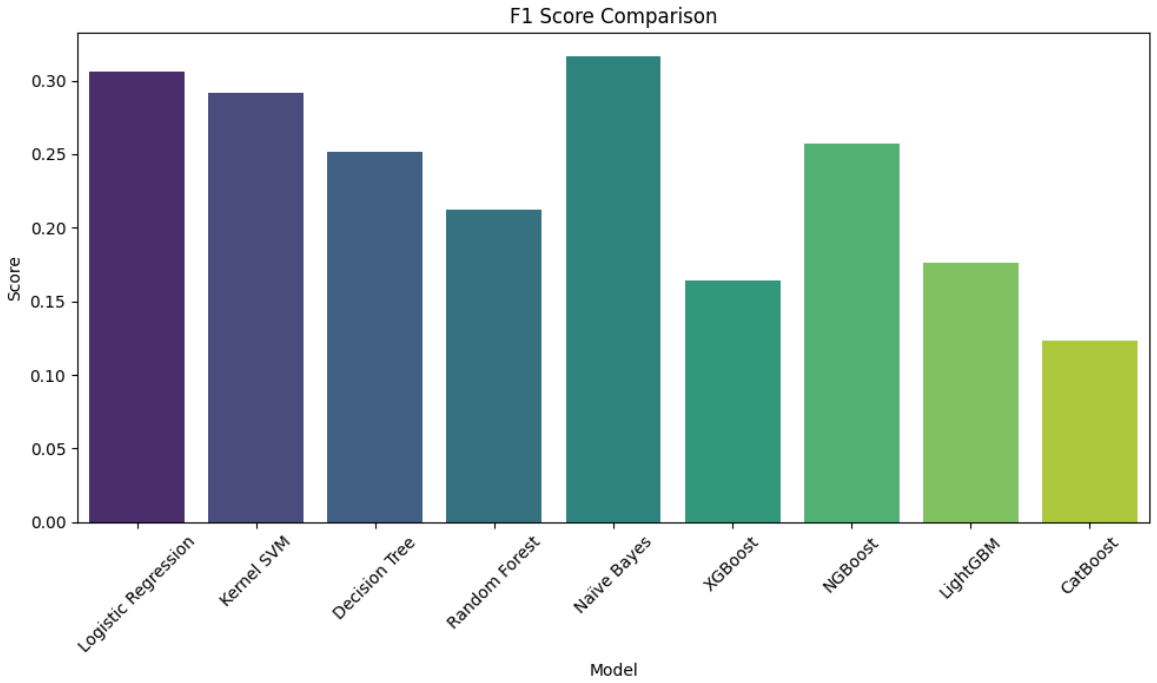
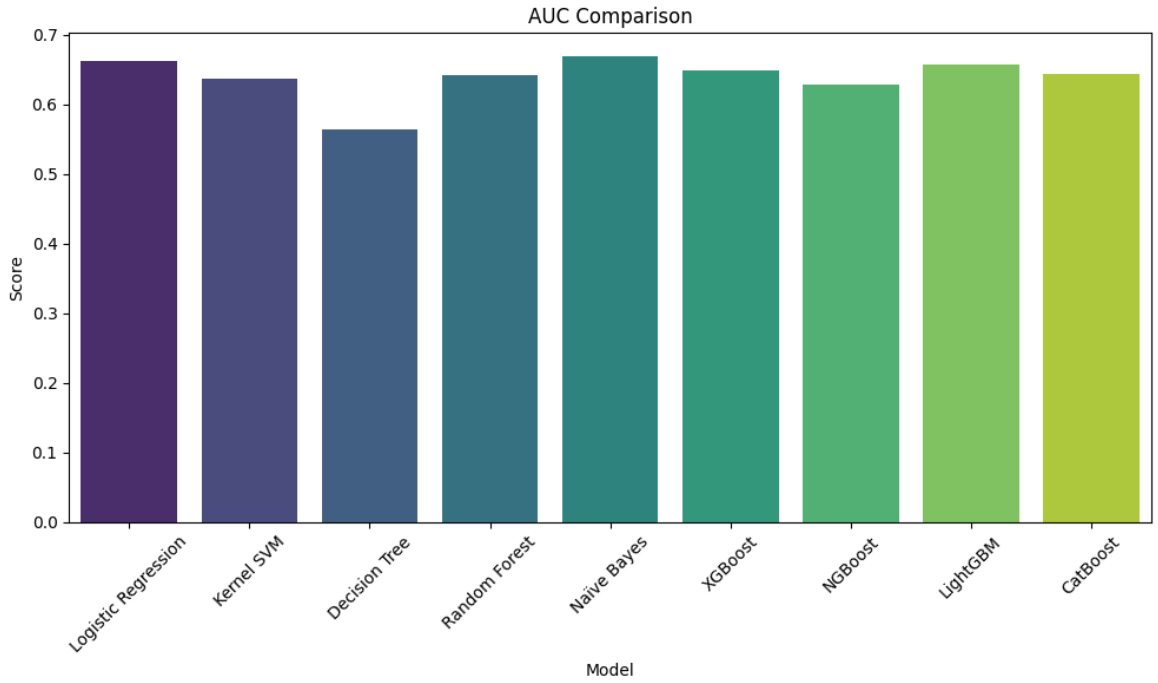
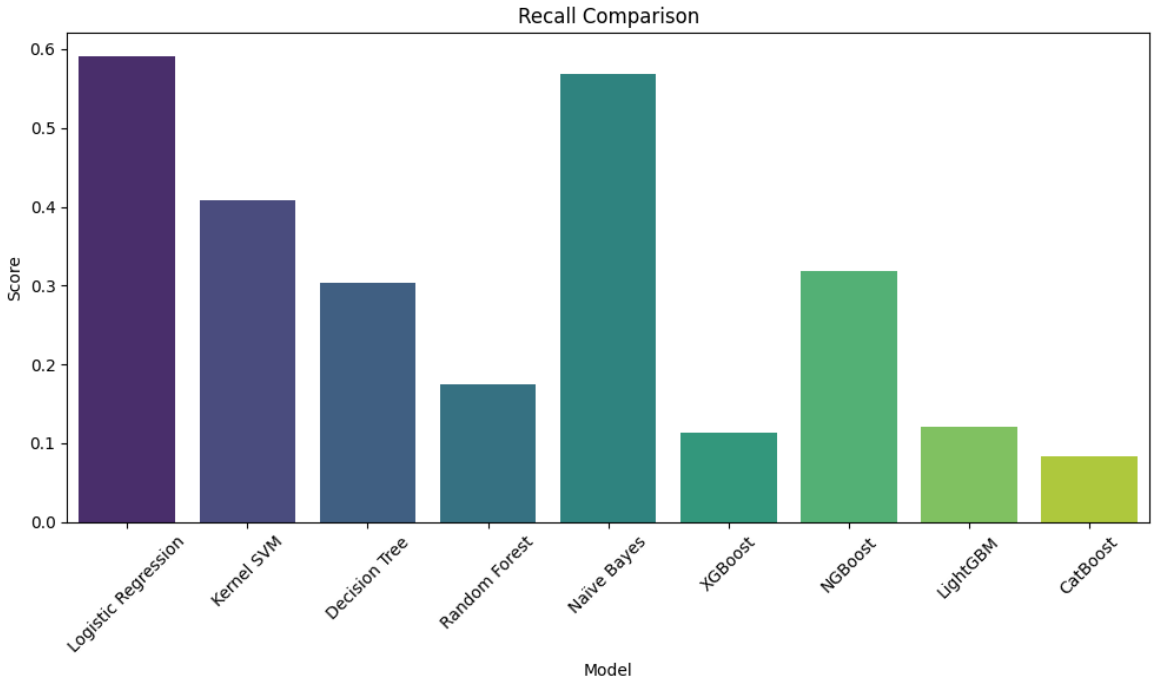


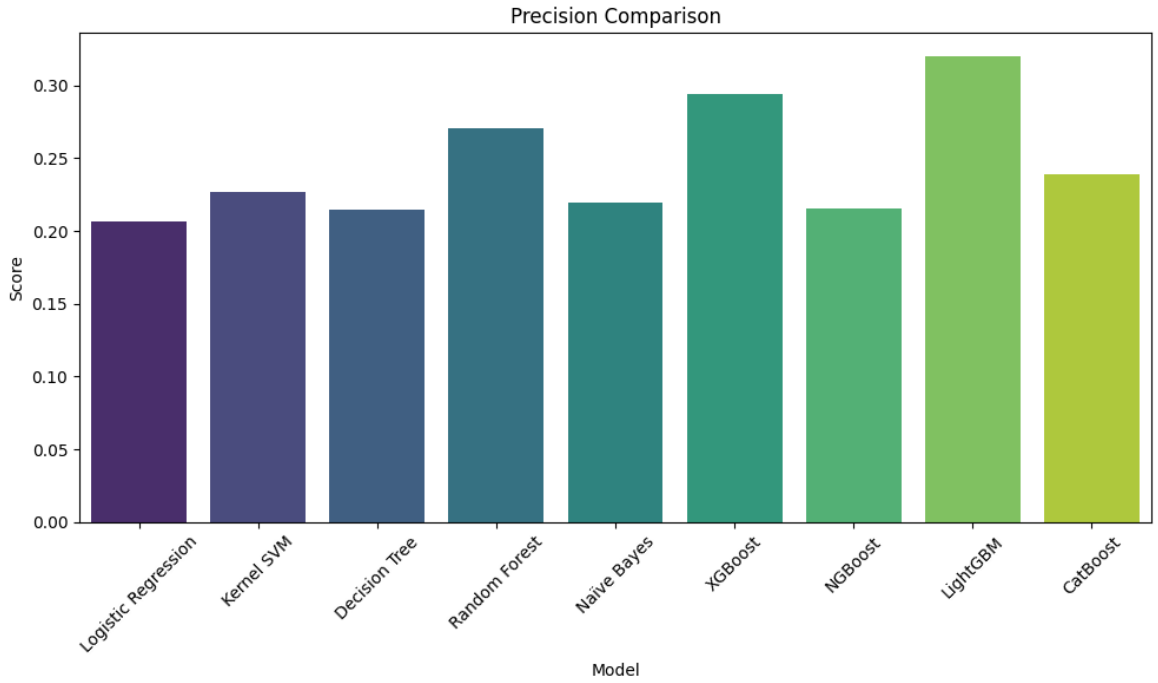
F1 Score and AUC Comparisons



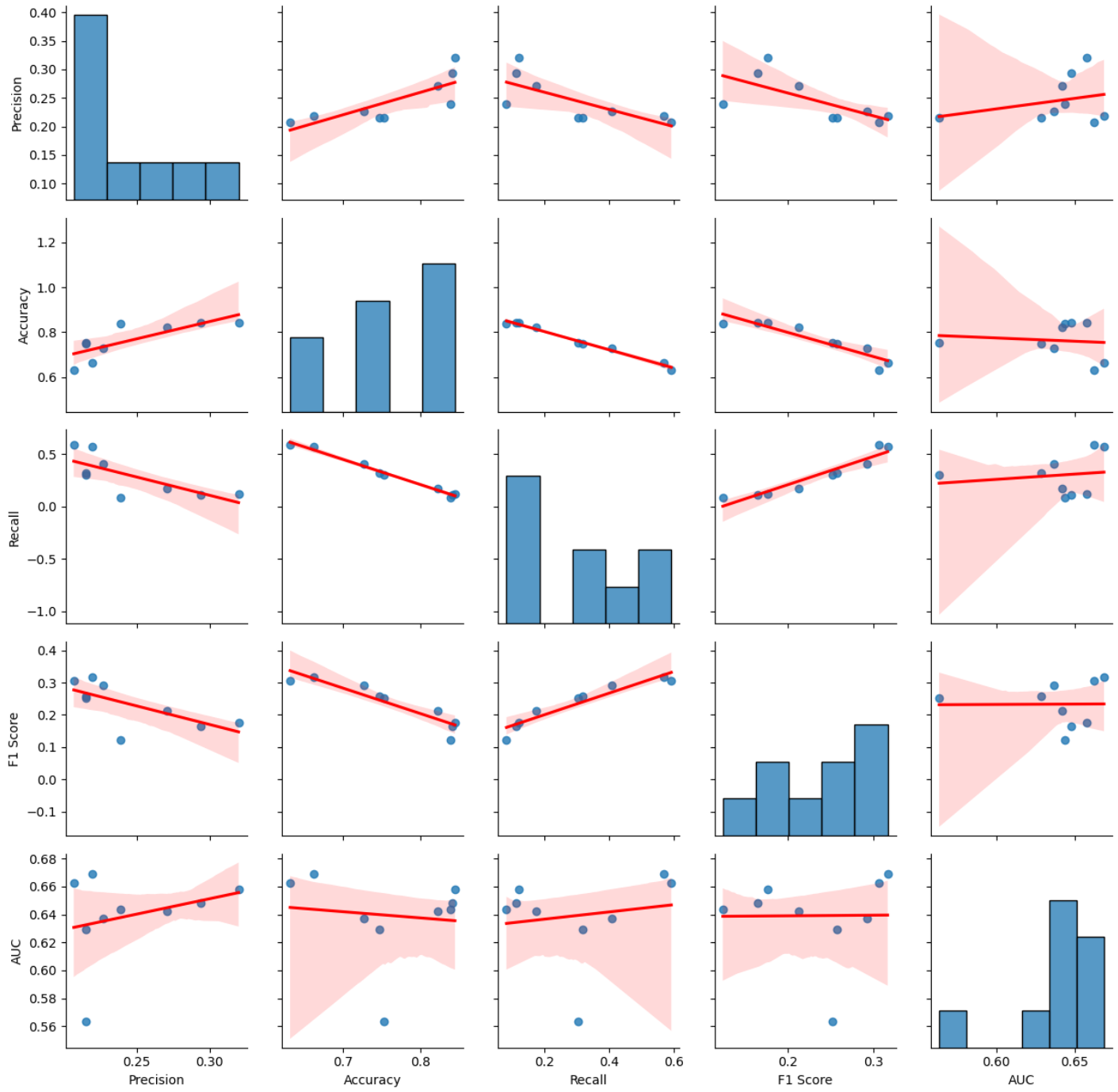


Recall and Precision Comparisons





Pair Plot Metrics



Conclusion

- The ML-powered decision tool has a clinically relevant utility for predicting the risk of KA in patients with OA using routine clinical data and plain radiographs.

- RF and XGBoost emerged as the most effective for predicting KA, balancing sensitivity and specificity.

- The findings suggest that ML-based decision tools can potentially aid in the early identification of OA patients who may require KA.

References

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