Digital Marketing: AI-Powered Ad Campaign Conversion Prediction

Khaldi Oussama

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Abstract

Data is the new oil, but without refinement, it remains just a crude resource. In this research, I embarked on a journey to extract value from raw business data using cutting-edge machine learning techniques. From building predictive models to designing an interactive dashboard, this paper encapsulates the entire process—challenges, breakthroughs, and insights. The goal? To transform data into actionable intelligence that drives real-world decisions.

1 Introduction

The modern business landscape is a battlefield of data. Companies that fail to harness their data risk falling behind. I sought to build a robust, AI-driven analytics system that could predict customer behavior, optimize marketing campaigns, and visualize insights in a user-friendly dashboard. What started as an idea evolved into a fully functional system—one that blends machine learning, visualization, and business acumen.

2 Data Collection and Preprocessing

Every great model starts with great data. I gathered historical business data, cleaned inconsistencies, handled missing values, and engineered meaningful features. This stage required patience and precision, as even the most sophisticated AI models fail when fed with poor-quality data.

3 Modeling and Evaluation

I explored various machine learning models to predict customer conversions. These included:

- Random Forest
- Gradient Boosting Machines (GBM)
- XGBoost
- LightGBM
- CatBoost
- Stacking Classifier (Ensemble Method)

Each model was evaluated using performance metrics such as accuracy, precision-recall curves, ROC curves, and confusion matrices. **Figure 1** illustrates the ROC curve comparison among the models.
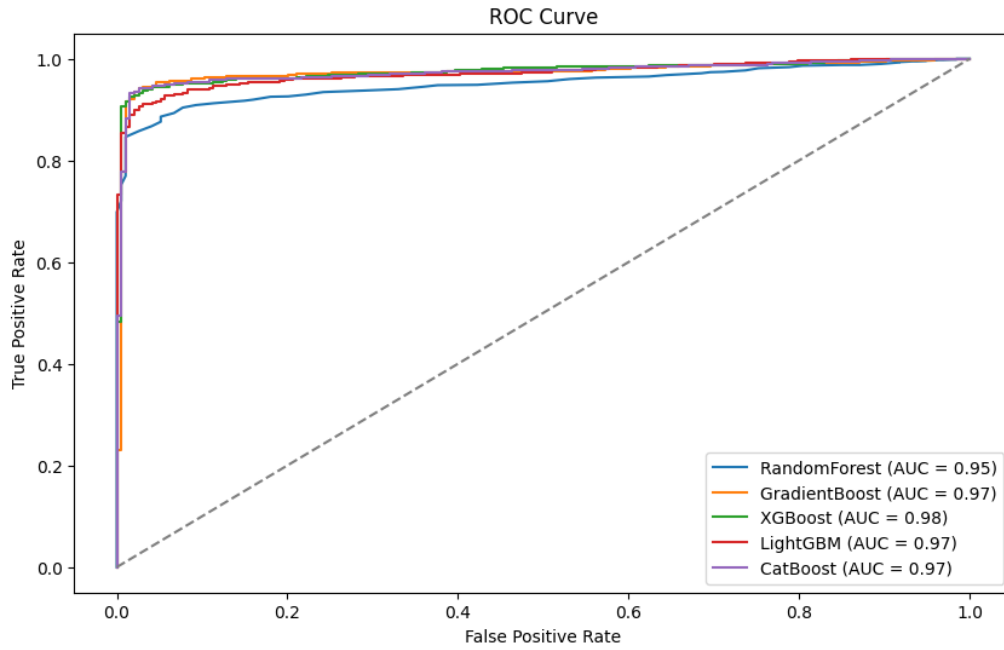
Figure 1: ROC Curve Comparison of Different Models

4 Performance Analysis

To gauge the effectiveness of these models, I analyzed precision-recall curves (Figure 2) and confusion matrices (Figure 3).
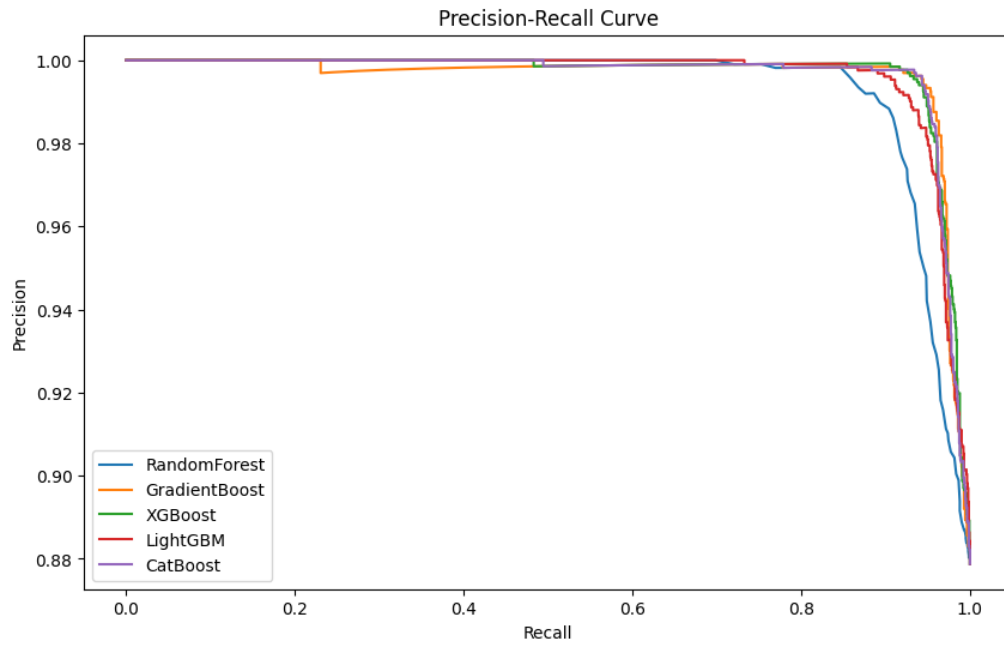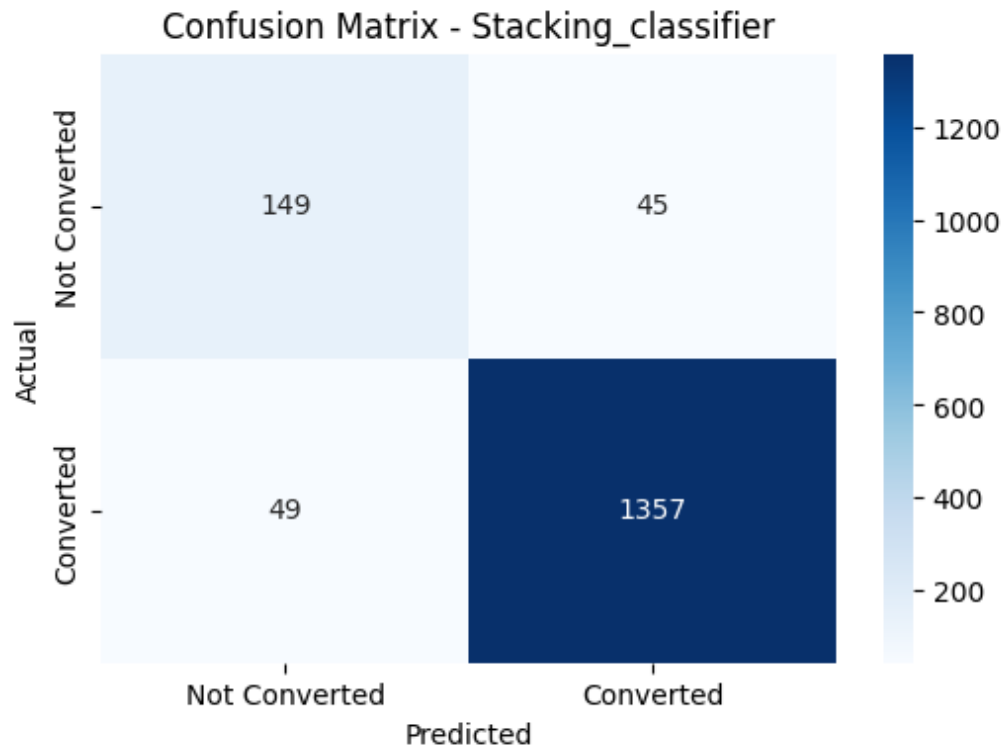

Figure 2: Precision-Recall Curve

Figure 3: Confusion Matrix for the Best Model

5 Model Benchmarking

A direct comparison of the models' performance helps in selecting the best approach. The benchmarking table (Figure 4) summarizes key metrics for each model, providing a clear perspective on their strengths and weaknesses.

Model	accuracy	precision_weighted	recall_weighted	f1_weighted
Stacking_classifier	0.941719	0.940650	0.941719	0.941071
GradientBoost	0.940938	0.938767	0.941094	0.939660
XGBoost	0.935469	0.932119	0.935469	0.932689
voting_classifier	0.934219	0.930326	0.934219	0.930696
CatBoost	0.934062	0.930115	0.934062	0.930683
LightGBM	0.924063	0.918272	0.924063	0.918908
RandomForest	0.888125	0.871515	0.887344	0.859269

Figure 4: Models Benchmarking Table

6   Feature Importance and Business Insights

Understanding what drives customer conversions is crucial. Feature importance analysis revealed the key predictors, helping businesses allocate resources effectively. Figure 5 highlights the most influential factors.
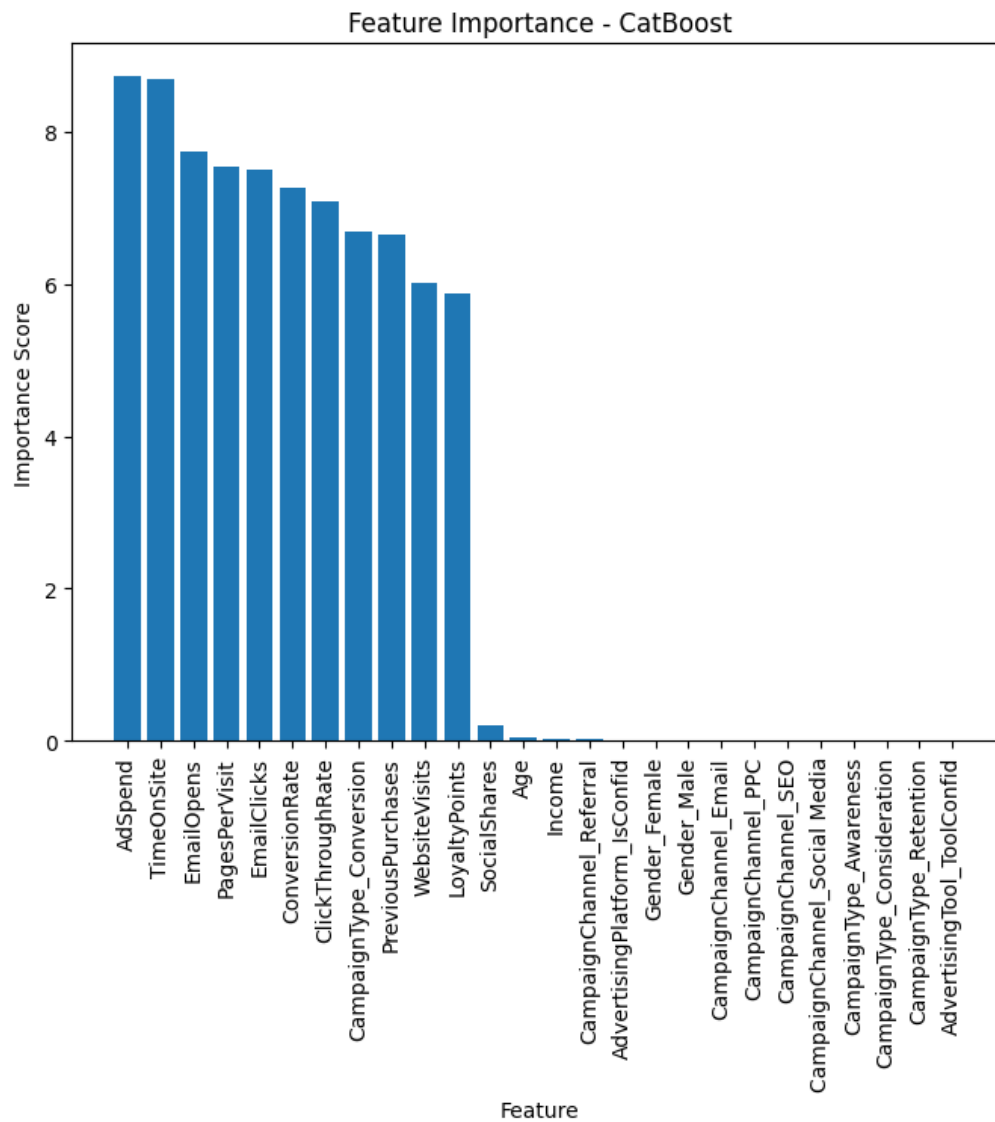

Figure 5: Feature Importance Analysis

7 Interactive Dashboard and Web Application

Numbers alone don't drive business decisions—visualization does. I developed an interactive web application and dashboard that presents insights in a comprehensible manner (Figures 6 and 7). This allows stakeholders to explore data trends and make informed decisions in real time.
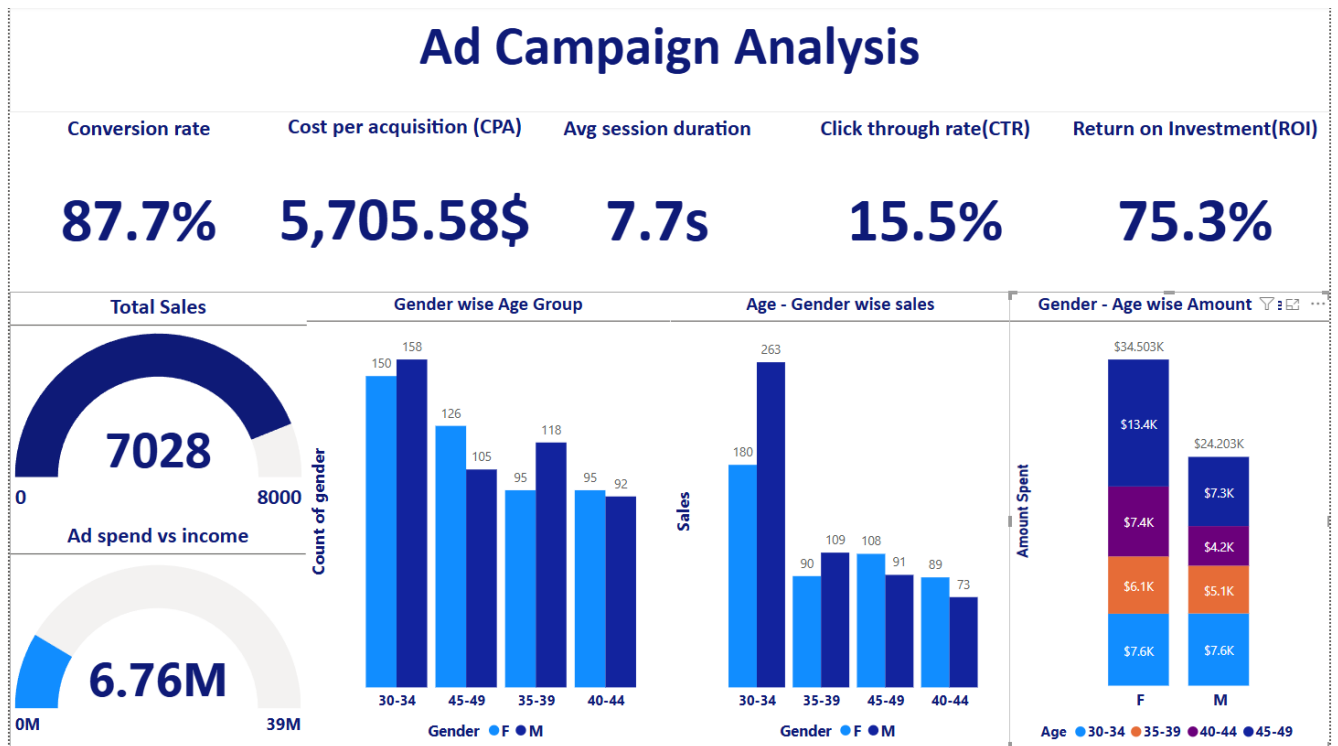

Figure 6: Business Intelligence Dashboard

Figure 7: Interactive Web Application

8   Conclusion

What started as a mere hypothesis evolved into a full-fledged data-driven decision-making system. This project demonstrated the power of AI in business intelligence, from predictive analytics to real-time visualization.