VACCINE VISIONS

“Cracking the Code of Vaccine uptake using Machine Learning.”

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INTRODUCTION

- In the face of global pandemics and seasonal flu outbreaks, understanding what drives individuals to get vaccinated is crucial for public health initiatives.
- Vaccine hesitancy, influenced by social, psychological, and demographic factors, remains a major challenge.
- This project aims to inform more effective and targeted vaccination campaigns.

PROBLEM STATEMENT

- Despite vaccine availability, a significant portion of the population remains unvaccinated against H1N1 and seasonal flu, posing a public health challenge.
- This project aims to develop predictive models to forecast vaccination likelihood based on demographics, beliefs, and behaviors, providing insights for targeted interventions to increase vaccination rates and reduce the spread of these viruses.

DATA UNDERSTANDING

- The dataset used in this project is derived from the National 2009 H1N1 Flu Survey.
- It includes responses from individuals regarding their vaccination status for both the H1N1 virus and the seasonal flu.
- Alongside these target variables, the dataset contains a wide range of features that capture respondents' demographics, health behaviors, and attitudes toward vaccination.

STEPS TAKEN

1 - DATA CLEANING

- Loading the Data
- Dropping Unnecessary Columns
- Handling Missing Values:
- Encoding Categorical Variables:
- Data Scaling

2 - EDA

- Exploring and Analysing the data

STEPS TAKEN...

3 - MODELING

- Training a baseline model
- Handling class imbalances
- Tuning Hyperparameters
- Model Evaluation

4 - FINDINGS AND RECOMMENDATIONS

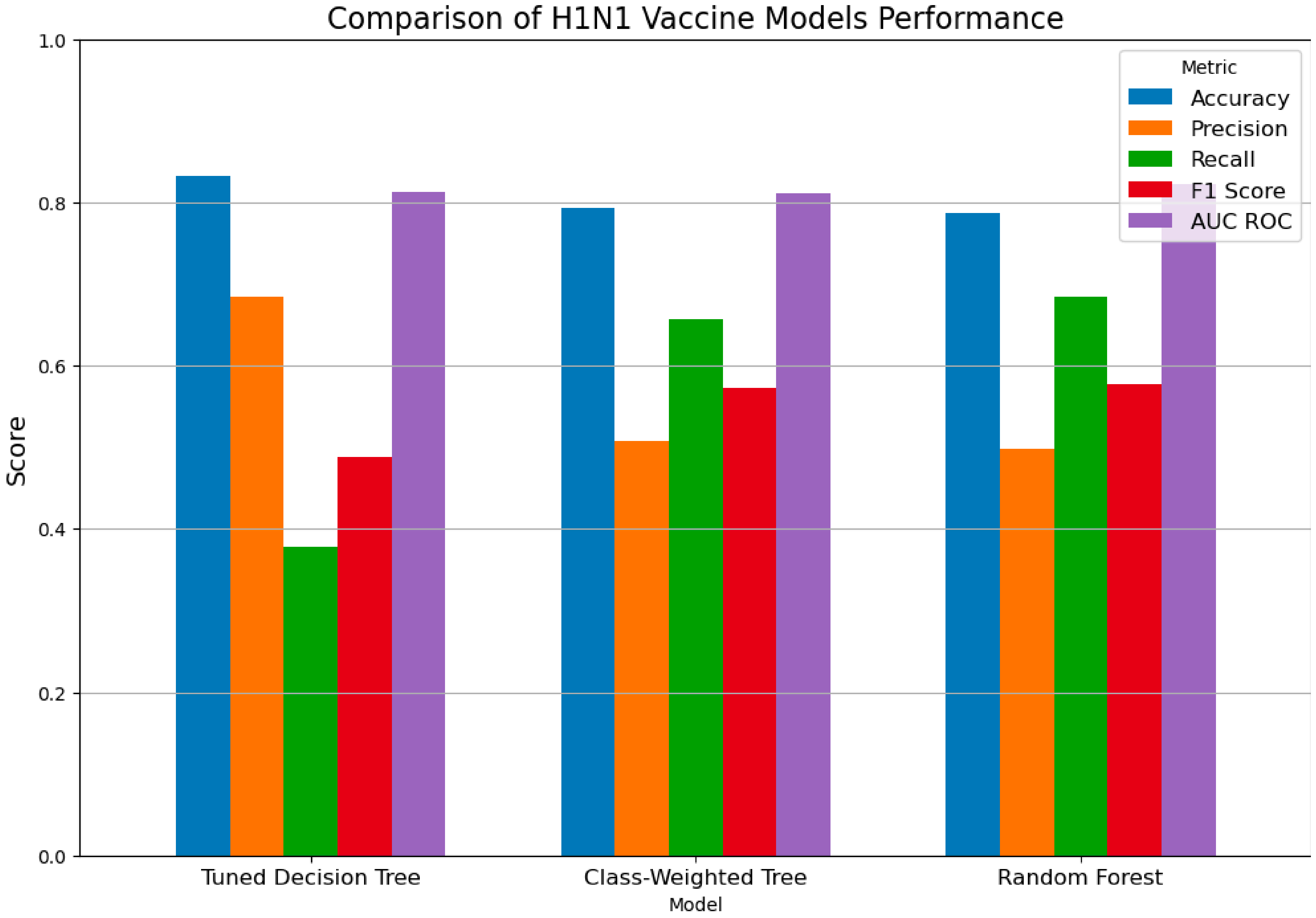
- Coming up with recommendations from the model findings

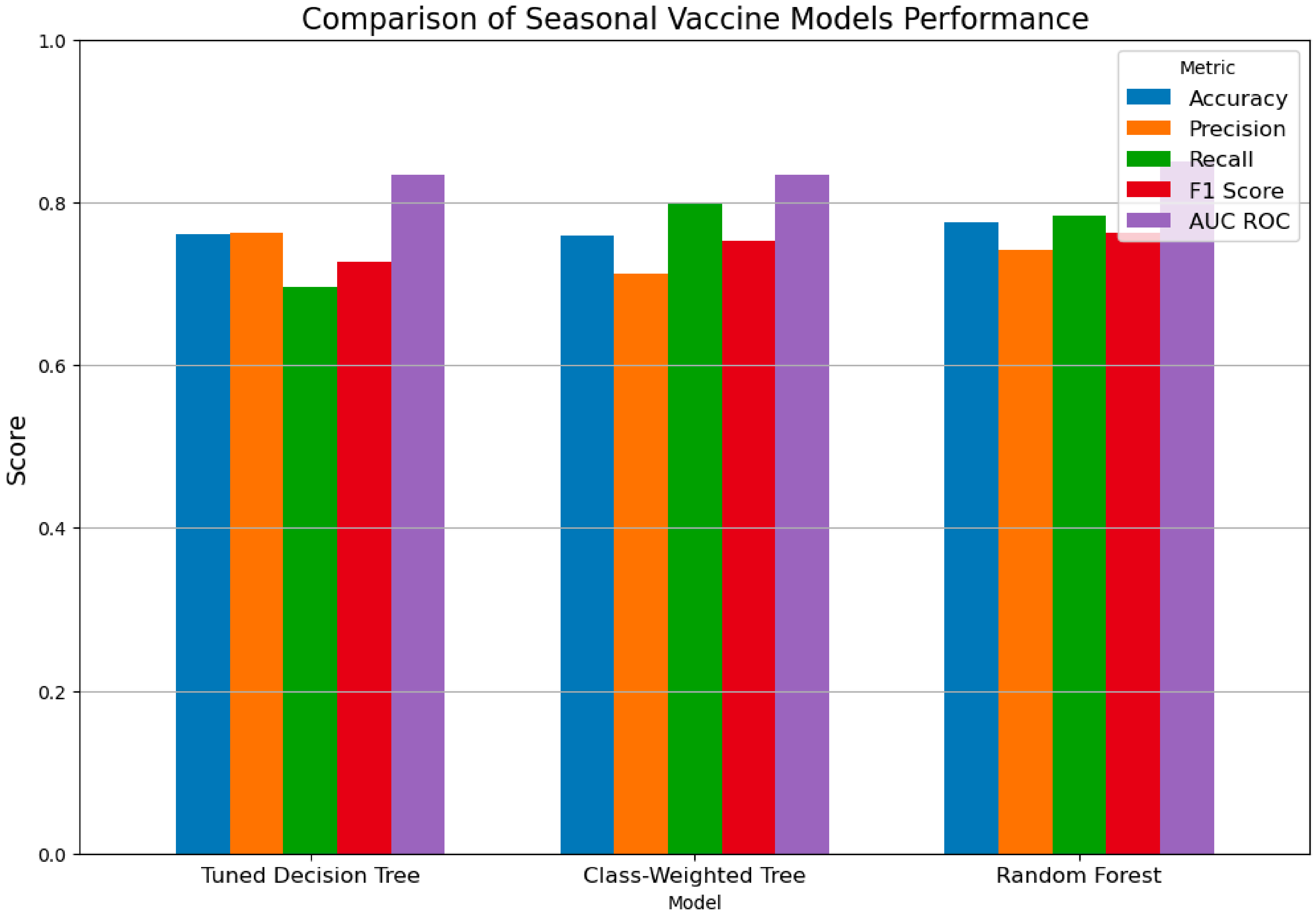
WHY USE MACHINE LEARNING MODELS?

- Vaccine decisions are shaped by many factors, such as age, health beliefs, and behavior, which often interact in complicated ways.
- ML models are better at capturing complex patterns compared to traditional data analysis methods.
- Additionally, while traditional methods focus on explaining existing data, ML is designed to predict future outcomes more accurately, making it ideal for forecasting whether someone will choose to get vaccinated.

MODEL SELECTION

After training multiple models the best performing model was the Random Forest model, with the highest most consistent metrics.





RANDOM FOREST MODEL PERFORMANCE

Seasonal Vaccine Model Performance:

- **Accuracy: 77.56%** – It correctly predicts the vaccination status of individuals about 78% of the time.
- **Precision: 74.14%** – Out of all the individuals the model predicted would get vaccinated, about 74% actually did, indicating a relatively low rate of false positives.
- **Recall: 78.34%** – The model captures around 78% of all individuals who actually got vaccinated, reflecting its strong ability to identify those who chose to vaccinate.
- **F1 Score: 76.19%** – This well-balanced metric demonstrates that the model effectively manages both precision and recall.
- **AUC ROC: 84.99%** – This high score suggests that the model excels at distinguishing between vaccinated and non-vaccinated individuals, making it very effective for predictive purposes.

RANDOM FOREST MODEL PERFORMANCE

H1N1 Vaccine Model Performance:

- **Accuracy: 78.76%** – It correctly predicts the vaccination status of individuals roughly 79% of the time.
- **Precision: 49.83%** – Out of all the individuals the model predicted would get vaccinated, about 50% actually did.
- **Recall: 68.54%** – The model captures approximately 69% of all individuals who actually got vaccinated, which is crucial for public health purposes, as it indicates the model's effectiveness in identifying those who chose to vaccinate.
- **F1 Score: 57.70%** – This metric, which balances precision and recall, is relatively strong, indicating the model's robustness in making balanced predictions.
- **AUC ROC: 82.32%** – This score shows that the model is effective at distinguishing between vaccinated and non-vaccinated individuals, which is critical for understanding the factors driving vaccine uptake.

INSIGHTS AND RECOMMENDATIONS

- Insight: Doctor recommendations are key predictors of vaccine uptake.
  - Recommendation: Engage healthcare providers in vaccination campaigns to emphasize the importance of vaccines.
- Insight: Public beliefs about vaccine effectiveness and safety greatly influence decisions.
  - Recommendation: Enhance public perception through targeted educational messaging to reduce hesitancy.
- Insight: Predictive models can identify groups less likely to vaccinate.
  - Recommendation: Use data-driven targeting to focus outreach on hesitant individuals or groups.
- Insight: Influential factors in vaccine uptake may change over time.
  - Recommendation: Continuously monitor and update public health strategies to adapt to new data and evolving public perceptions.

LIMITATIONS

- Data Quality and Representativeness:
  - The data is based on self-reported data, which can introduce biases and may not accurately represent the broader population
- Temporal Relevance:
  - The data is from 2009, related to the H1N1 pandemic and seasonal flu at that time. Public attitudes, healthcare practices, and vaccine technology have evolved since then
- Model Generalizability:
  - The models might not generalize well to other populations or future data, particularly if those populations have different demographic or behavioral characteristics.
- External Factors Not Accounted For:
  - The dataset may not account for all factors influencing vaccine uptake, such as accessibility to vaccination centers, media influence, or peer pressure.

THANK YOU