PREDICTIVE MODELING FOR POLICY LAPSE FORECASTING USING MACHINE LEARNING

Dissertation Presentation

- **Name**: Justin P Mathew
- **Supervisor**: Venkata Girish Kumar Nidra
- **Examiner**: Raghavendra G S

CONTENT

INTRODUCTION

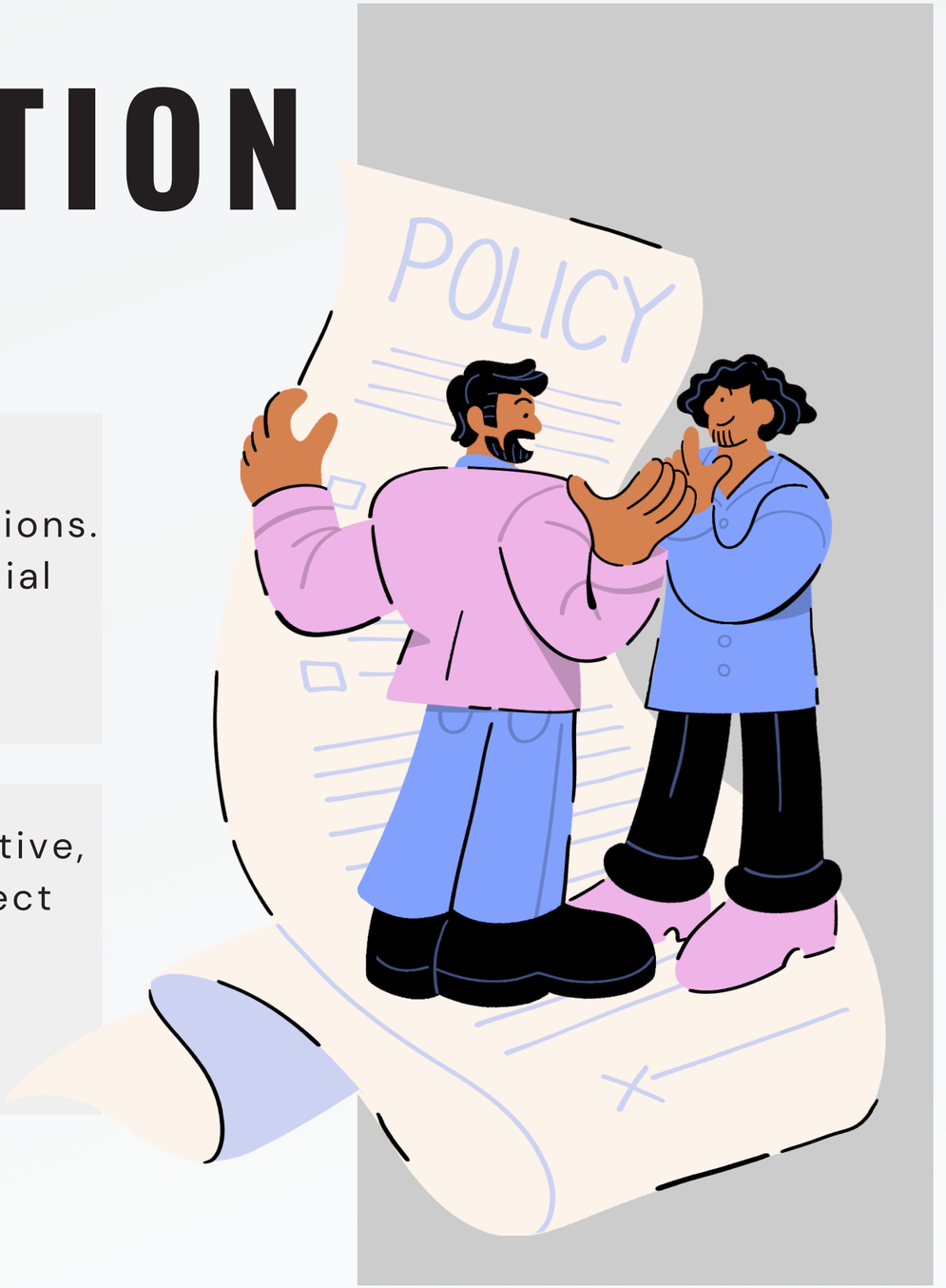
An insurance policy lapse occurs when a policyholder fails to pay the premium within the grace period, leading to the termination of the policy.

This study focuses on predicting policy lapse within insurance datasets. By analyzing various factors such as payment modes, non-lapse guarantees, and policy status, we aim to build a robust predictive model.

WHY LAPSE PREDICTION

Predictive modeling is crucial in identifying potential lapses, enabling proactive interventions. Accurate forecasting helps in reducing financial losses, improving customer retention, and optimizing resource allocation.

Traditional management approaches are reactive, addressing lapses after they occur. This project aims to shift towards proactive management using predictive modeling.



OBJECTIVES

Objective 1

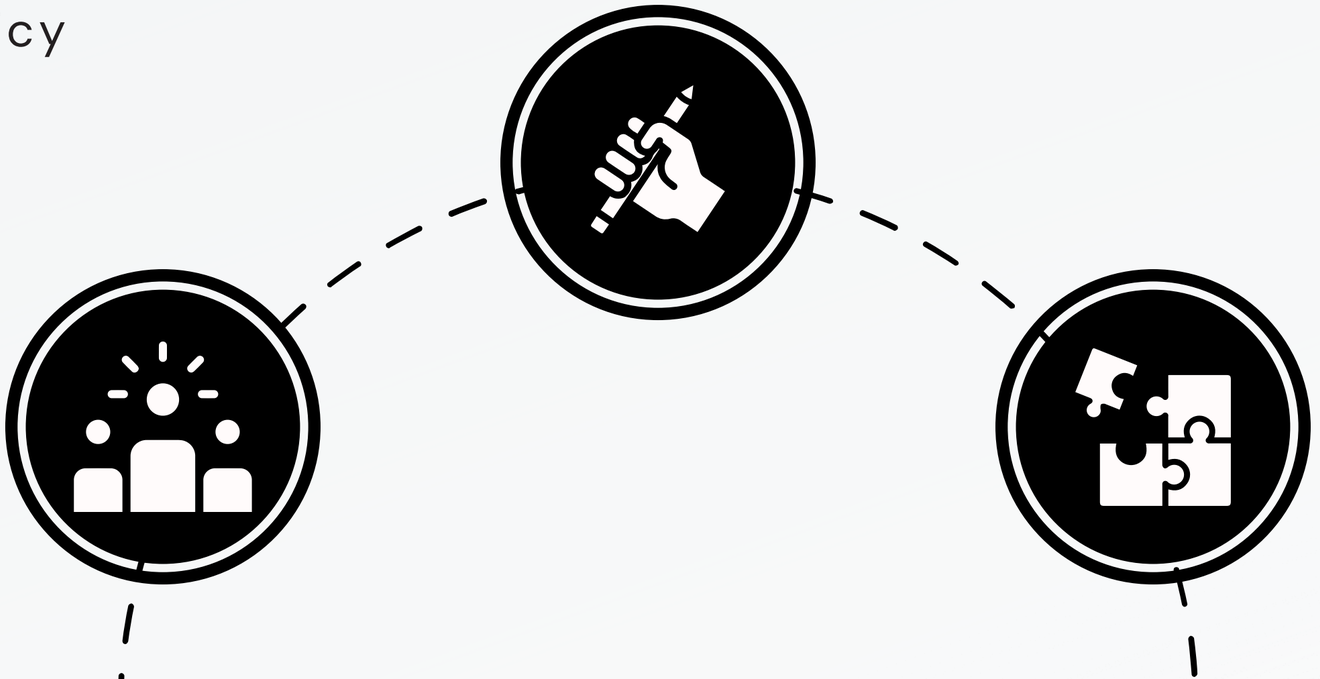
Develop a predictive model to accurately forecast policy lapses.

Objective 2

Identify key factors influencing policy lapses.

Objective 3

Evaluate performance of different predictive algorithms



DATA DESCRIPTION

- **Source of data**: Kaggle
- **Number of Rows and Columns**:
  - **Number of rows:** 185560
  - **Number of columns**: 22

- **Key features and attributes of the dataset**:
  - **CHANNEL1, CHANNEL2, CHANNEL3**: Distribution channels
  - **ENTRY AGE:** Age at which the policy was entered
  - **SEX**: Gender of the policyholder
  - **POLICY TYPE 1 - 3**: Types of policies

DATA DESCRIPTION (CONT)

- **Key features and attributes of the dataset**:
  - **POLICY STATUS:** Status of the policy (Inforce, Lapse, Expired, Surrender, Death)
  - **BENEFIT:** Benefit amount
  - **NON-LAPSE GUARANTEED**: Whether the policy has a non-lapse guarantee
  - **SUBSTANDARD RISK**: Substandard risk indicator
  - **NUMBER OF ADVANCE PREMIUM:** Number of advance premium payments made
  - **INITIAL BENEFIT:** Initial benefit amount
  - **Full Benefit?**: Whether the full benefit is applicable

DATA DESCRIPTION (CONT)

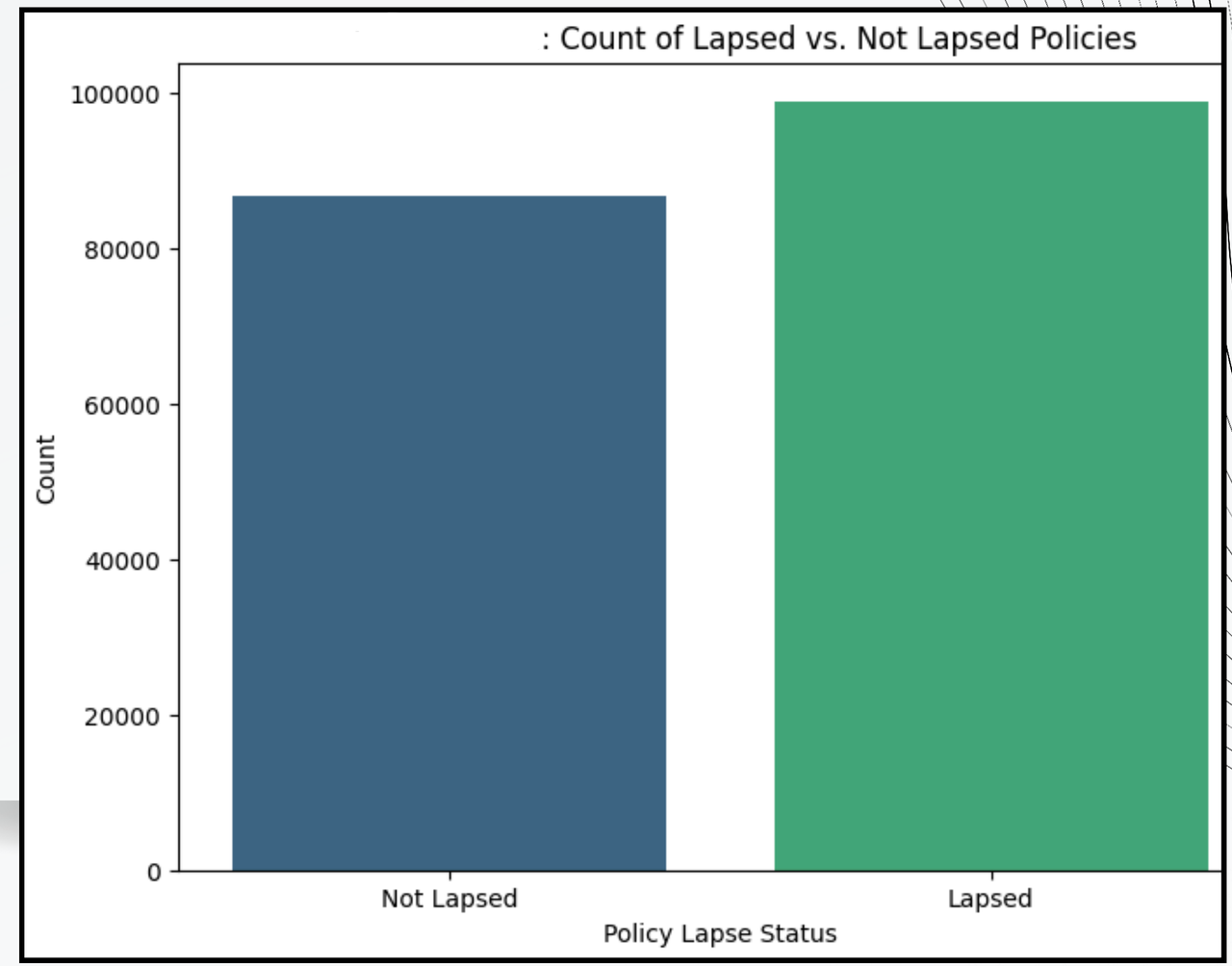
- **Key features and attributes of the dataset**:
  - **Policy Year (Decimal)**: Policy year in decimal
  - **Policy Year:** Policy year in integer
  - **Premium:** Premium amount
  - **Issue Date:** Date when the policy was issued
- **Data Types of Each Column:**
  - Mixed data types including integers, floats, and objects (strings).
- **Handling Missing Values:**
  - Columns Unnamed: 20 and Unnamed: 21 contain only null values and were dropped.

EXPLORATORY DATA ANALYSIS (EDA)

- **Summary Statistics:**
  - Mean, Standard Deviation, Min, Max, and Quartiles for numerical columns.
- **Box Plots:** Distribution of key numerical features such as ENTRY AGE, BENEFIT, Premium.
- **Correlation Heatmap**
  - **Purpose**: To identify the relationships between numerical features.
  - **Visualization**: Heatmap showing correlation values between features.
  - PAYMENTMODE_Monthly, NON LAPSE GUARANTEED_NLG Active, Policy Year, and PolicyYear(Decimal).

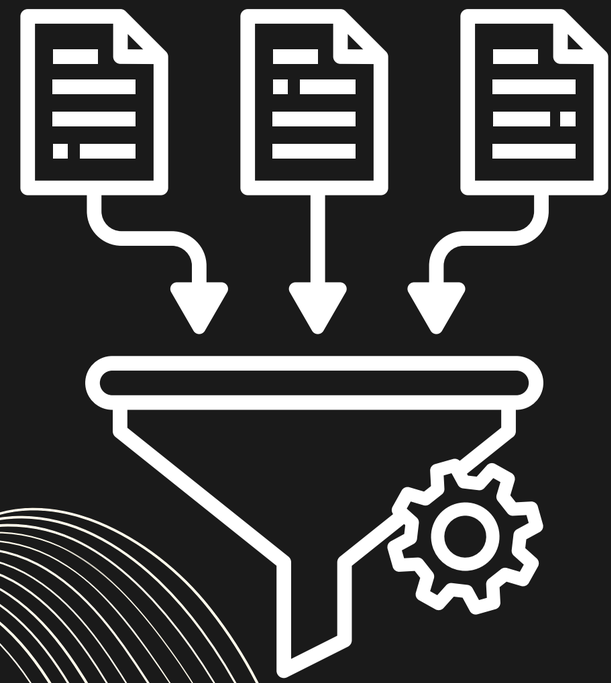
TARGET VARIABLE ANALYSIS

- **Creation of IS_LAPSE**: Binary target variable indicating policy lapse.
- **Class Distribution**: Bar chart showing the count of lapsed vs. not lapsed policies.



DATA PREPROCESSING

- **Encoding Categorical Variables**:
  - **OneHotEncoding**: Applied to PAYMENT MODE and NON LAPSE GUARANTEED.
  - **LabelEncoding**: Applied to SEX and Full Benefit.
- **Dropping Original Columns**: Removed POLICY STATUS after creating IS_LAPSE.



MACHINE LEARNING ALGORITHMS

- **Importance:**
  - **Predictive Power:** ML algorithms can identify patterns and make predictions with high accuracy.
  - **Automation:** Automates decision-making processes based on data.
  - **Scalability:** Can handle and process large volumes of data efficiently.
  - **Adaptability:** Models can be updated and improved as more data becomes available.

LOGISTIC REGRESSION

- Logistic Regression** is a statistical model that assumes a linear relationship between the independent variables and the log-odds of the dependent variable.

- **Advantages**:
  - **Simple and Interpretable**: Easy to implement and interpret, making it suitable for explaining results to stakeholders.
  - **Less Prone to Overfitting:** Logistic regression is less prone to overfitting, especially when regularization techniques are applied.
  -
- **Disadvantages**:
  - **Linear Boundaries:** Assumes a linear relationship between independent variables and the log-odds, making it ineffective for capturing complex, non-linear relationships.

RANDOM FORESTS

- A Random Forest is an ensemble of decision trees, usually trained with the "bagging" method.

- **Advantages:**
  - **Improved Accuracy:** Reduces overfitting by averaging multiple trees.
  - **Robustness:** Handles missing values and maintains accuracy.
  - **Feature Importance:** Provides insights into feature importance.

- **Disadvantages:**
  - **Complexity:** More complex than individual decision trees.
  - **Resource Intensive:** Requires more computational power and memory.

GRADIENT BOOSTING

- Gradient Boosting is an ensemble machine-learning technique that builds models sequentially, where each new model attempts to correct the errors made by the previous models.

- **Advantages:**
  - **High Accuracy:** Known for producing highly accurate and competitive models, often outperforming simpler algorithms.
  - **Handles Complex Data:** Effectively handles non-linear relationships and interactions between features.

- **Disadvantages:**
  - **Prone to Overfitting**: Although powerful, gradient boosting models can easily overfit, especially if not tuned properly.

XGBOOST

- XGBoost (Extreme Gradient Boosting) is a highly efficient and scalable implementation of the gradient boosting framework, optimized for speed and performance.

- **Advantages:**
  - **High Performance:** Known for its exceptional predictive performance and often outperforms other algorithms in competitions.
  - **Fast and Scalable:** Highly optimized for speed and memory usage.

- **Disadvantages:**
  - **Computationally Intensive:** XGBoost can still be computationally expensive and require significant resources.

DECISION TREES

- A decision tree is a flowchart-like structure where each node represents a decision or a test, each branch represents the outcome, and each leaf node represents a class label (decision).

- **Advantages:**
  - **Easy to Understand and Interpret:** Simple to visualize and explain to stakeholders.
  - **Non-Linear Relationships:** Handles non-linear relationships well.
  - **Feature Importance:** Naturally ranks features by importance.

- **Disadvantages:**
  - **Overfitting:** Prone to overfitting, especially with complex trees.

SUPPORT VECTOR MACHINES (SVMS)

- SVMs are supervised learning models used for classification and regression. They find the hyperplane that best separates the classes.

- **Advantages:**
  - **Effective in High-Dimensional Spaces:** Works well when the number of dimensions exceeds the number of samples.
  - **Versatile:** Can be used for both linear and non-linear classification (using kernels).

- **Disadvantages:**
  - **Training Time:** Can be slow to train, especially with large datasets.
  - **Complexity:** Less intuitive and harder to interpret than decision trees.

MODEL PERFORMANCE COMPARISON

- **Logistic Regression:** Baseline accuracy ~58%, limited handling of non-linear relationships.
- **Random Forest:** Accuracy ~67%, good feature importance identification.
- **Gradient Boosting:** Accuracy ~68%, best recall.
- **XGBoost:** Best performance, accuracy ~70%, AUC 0.7727.

Results and Discussion

- **Best Model:** XGBoost outperforms other models in accuracy and recall.

PRACTICAL IMPLICATIONS

- **Proactive Policy Management:**
  - Target policyholders at risk of lapsing.
  - Offer personalized communication and flexible payment plans.
- **Customer Retention:** Machine learning enables personalized strategies to retain customers.

Recommendations:

1. **Adopt Predictive Models:** Integrate machine learning into policy management systems.
2. **Deep Learning:** Explore neural networks for more complex relationships.

THANK YOU