



# Smart Underwriting: Data-Driven Home Inspection Insights



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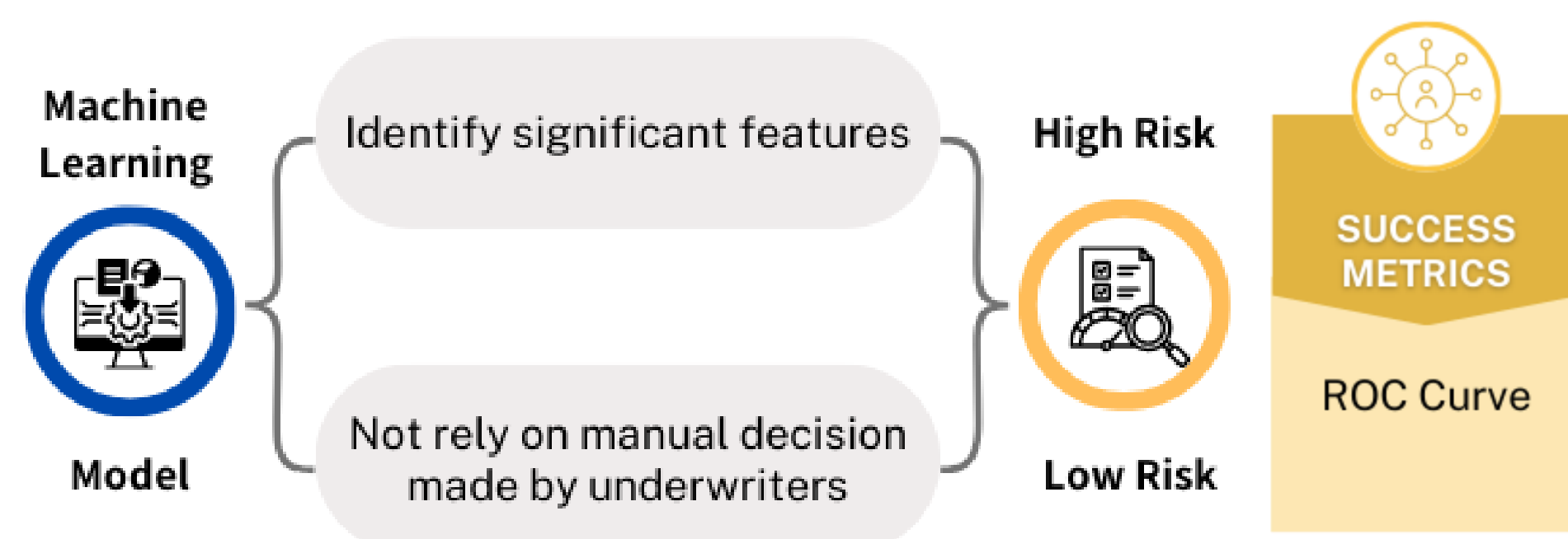
## BUSINESS PROBLEM



Home insurance inspections are vital in assessing the condition of a property to determine the viability and cost of insurance coverage. Underwriting teams currently relying on a manual process to select new business homes for these crucial inspections based on **agent reputation**. Due to the economic changes and rising inflation, they feel their algorithm **may not fit the current situation**.

**Challenge:**  
With over **450 agents** and **limited number of underwriters** available at each office, ensuring efficient and accurate inspections can help reduce costs.

## ANALYTICS PROBLEM



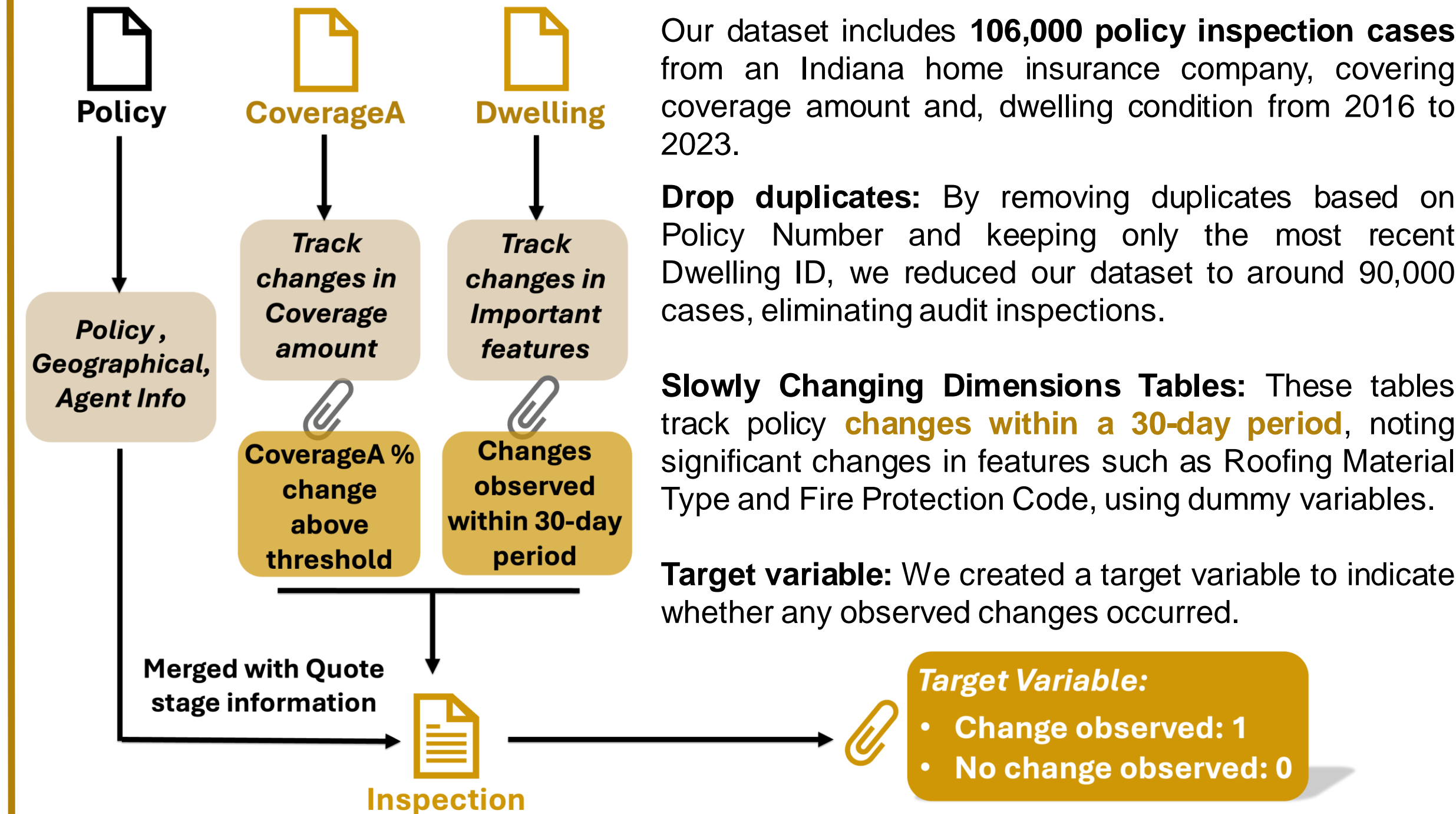
### Current Algorithm:

- The insurance company assigns an agent to the house. If the agent is on the waived list due to prior performance, the house may be exempt from inspection. If not, the house may need inspection.
- However, if the quoted price surpasses \$X or falls below \$Y, the inspection is still necessary.

### Improvement:

- Enhance algorithm to distinguish well-conditioned houses from those needing further screening using inspection data.
- Utilize coefficient analysis for selecting critical features.
- Evaluate houses for elevated risk levels based on these features.
- Guide inspection decisions to prioritize at-risk houses.

## DATA



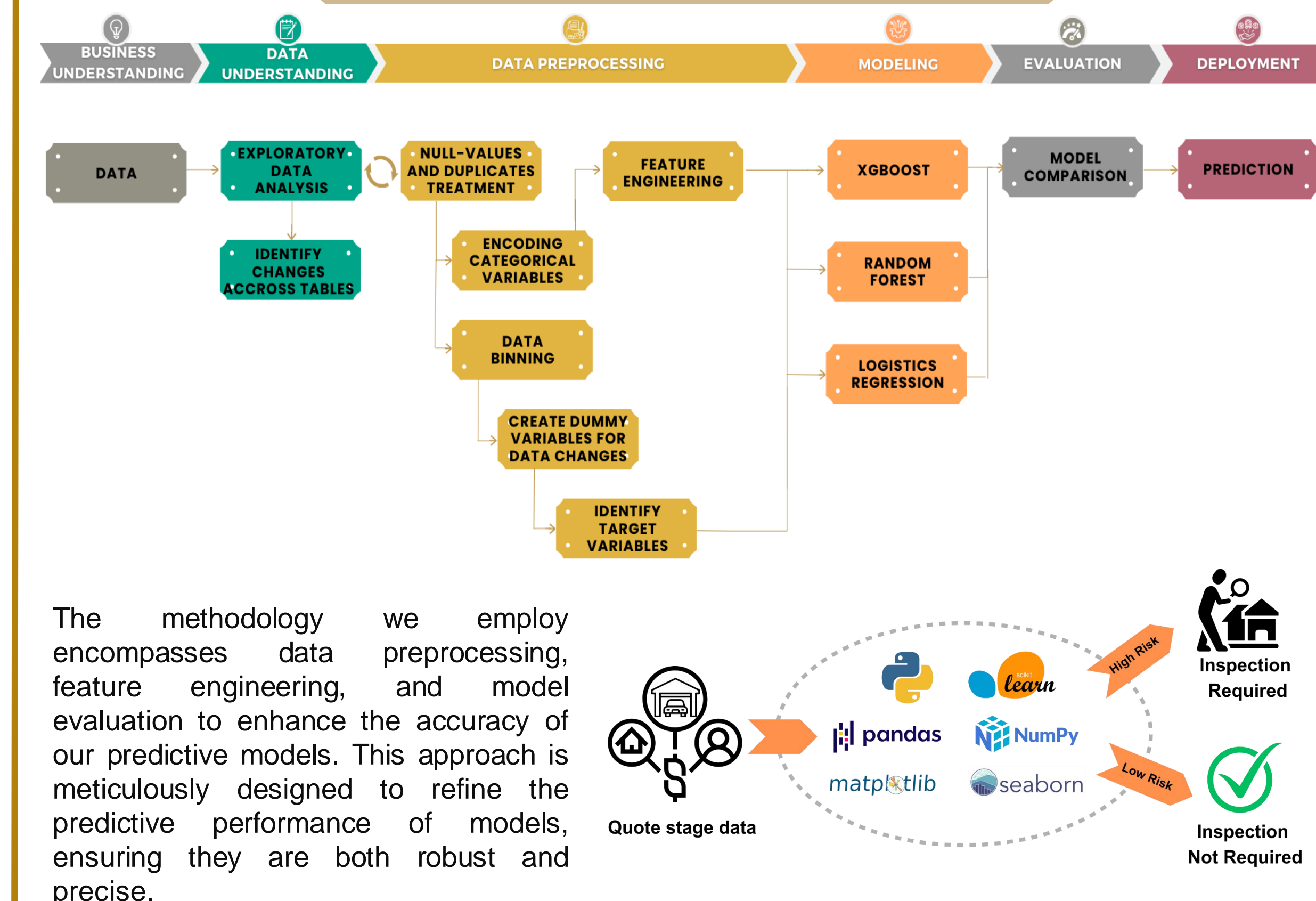
Our dataset includes **106,000 policy inspection cases** from an Indiana home insurance company, covering coverage amount and, dwelling condition from 2016 to 2023.

**Drop duplicates:** By removing duplicates based on Policy Number and keeping only the most recent Dwelling ID, we reduced our dataset to around 90,000 cases, eliminating audit inspections.

**Slowly Changing Dimensions Tables:** These tables track policy **changes within a 30-day period**, noting significant changes in features such as Roofing Material Type and Fire Protection Code, using dummy variables.

**Target variable:** We created a target variable to indicate whether any observed changes occurred.

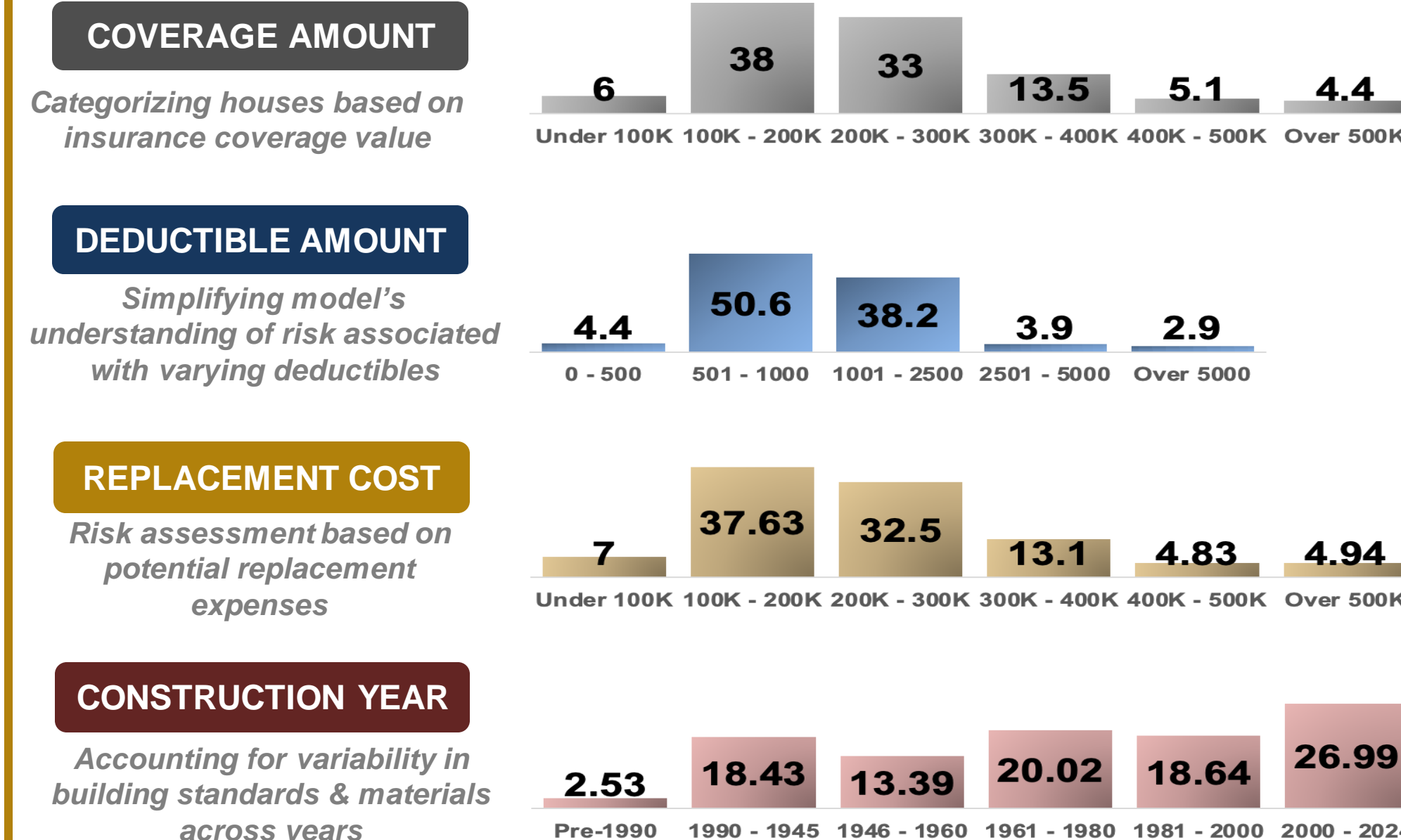
## METHODOLOGY



The methodology we employ encompasses data preprocessing, feature engineering, and model evaluation to enhance the accuracy of our predictive models. This approach is meticulously designed to refine the predictive performance of models, ensuring they are both robust and precise.

## MODEL BUILDING

### FEATURE ENGINEERING (BINNING)



### ONE-HOT ENCODING OF CATEGORICAL VARIABLES

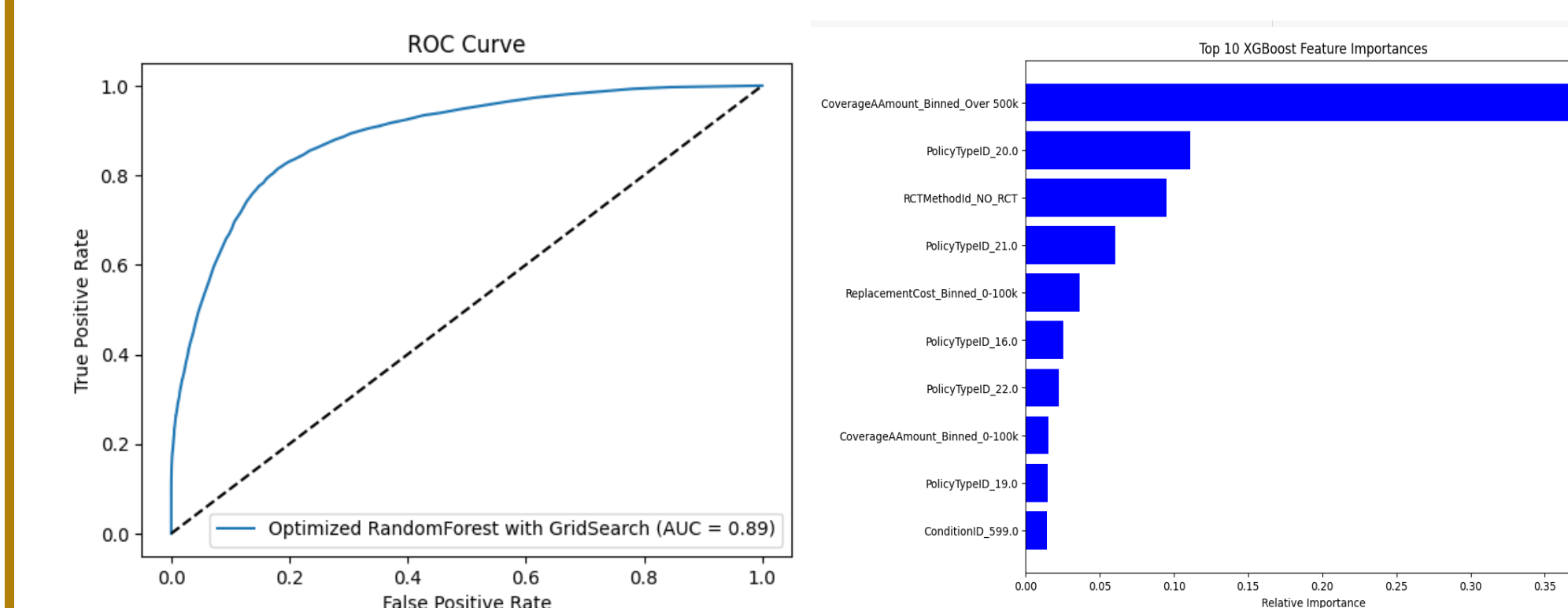
- Transformed categorical variables to enhance model learning.

### MODEL TRAINING AND EVALUATION

- Data Splitting:** train (70%) / test (30%) split ratio allows for a sufficient amount of data to train the models while still reserving a sizable portion for independent evaluation.
- Cross-validation and Hyper-parameter Tuning:**
  - Employed Stratified K-Fold cross-validation to ensure model robustness
  - Hyperparameters tuned to optimize performance.

### MODEL SELECTION

- Models with Best Result:**
  - Compared **Random Forest**, **XGBoost** and **Logistic Regression** to evaluate **Random Forest** as the top-performing models.
- Identified features based on importance calculated for High-Risk Properties.



## DEPLOYMENT AND BENEFITS

By following a data-driven approach to home inspection, insurance companies can effectively strategize and deploy **Random Forest** model with ROC score at **0.89**, indicating that there is a **89% chance** that the model will be able to distinguish between positive class and negative class. Hence, **optimizing essential underwriter inspections by 37% and reducing costs**.

|         |  |
|---------|--|
| Current | # of redundant inspections (Yearly Average)<br><b>5376</b> |
| Updated | # of redundant inspections (Yearly Average)<br><b>591</b>  |

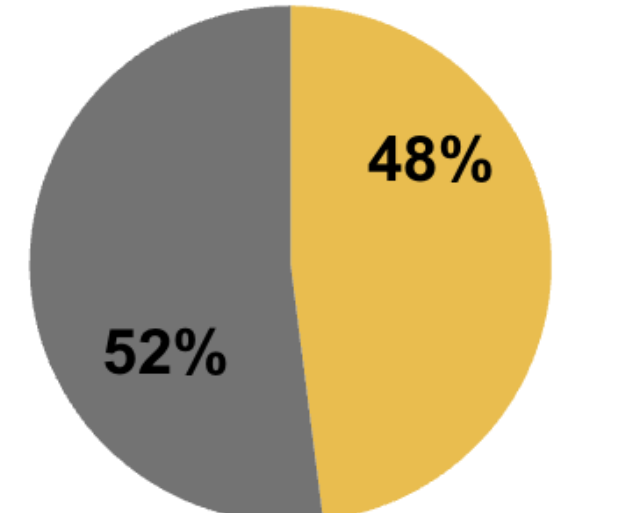


Average Cost Per Inspection  
~\$400

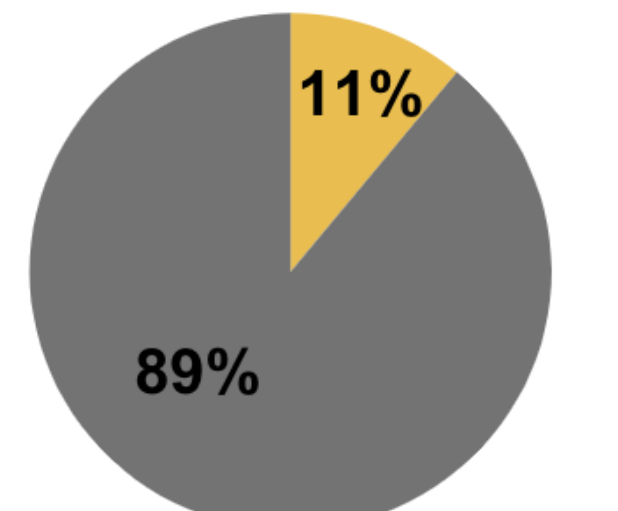


Estimated Average Savings  
**1.9MN/Year**

Current yearly Inspection results



Expected yearly Inspection results



Essential Inspections  
Redundant Inspections



## ACKNOWLEDGEMENTS



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