



# AUCTION PRESCRIPTIVE ANALYTICS

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15.095 Machine Learning under a  
Modern Optimization Lens



# PROBLEM STATEMENT

Swoopo is a bidding fee auction platform



Decisions that the seller and the platform make at the start of an auction



## PAY FOR BID

Participants pay a fee to purchase bids.

Seek to maximize our revenue by altering the bid fee.



The resulting effect from these decisions on revenue needs to be studied and a policy for setting the ideal bid fee needs to be established.

**Z TREATMENT EFFECT**  
Bid Fee

## Y OUTCOME

Revenue = Number of bids \* bid fee

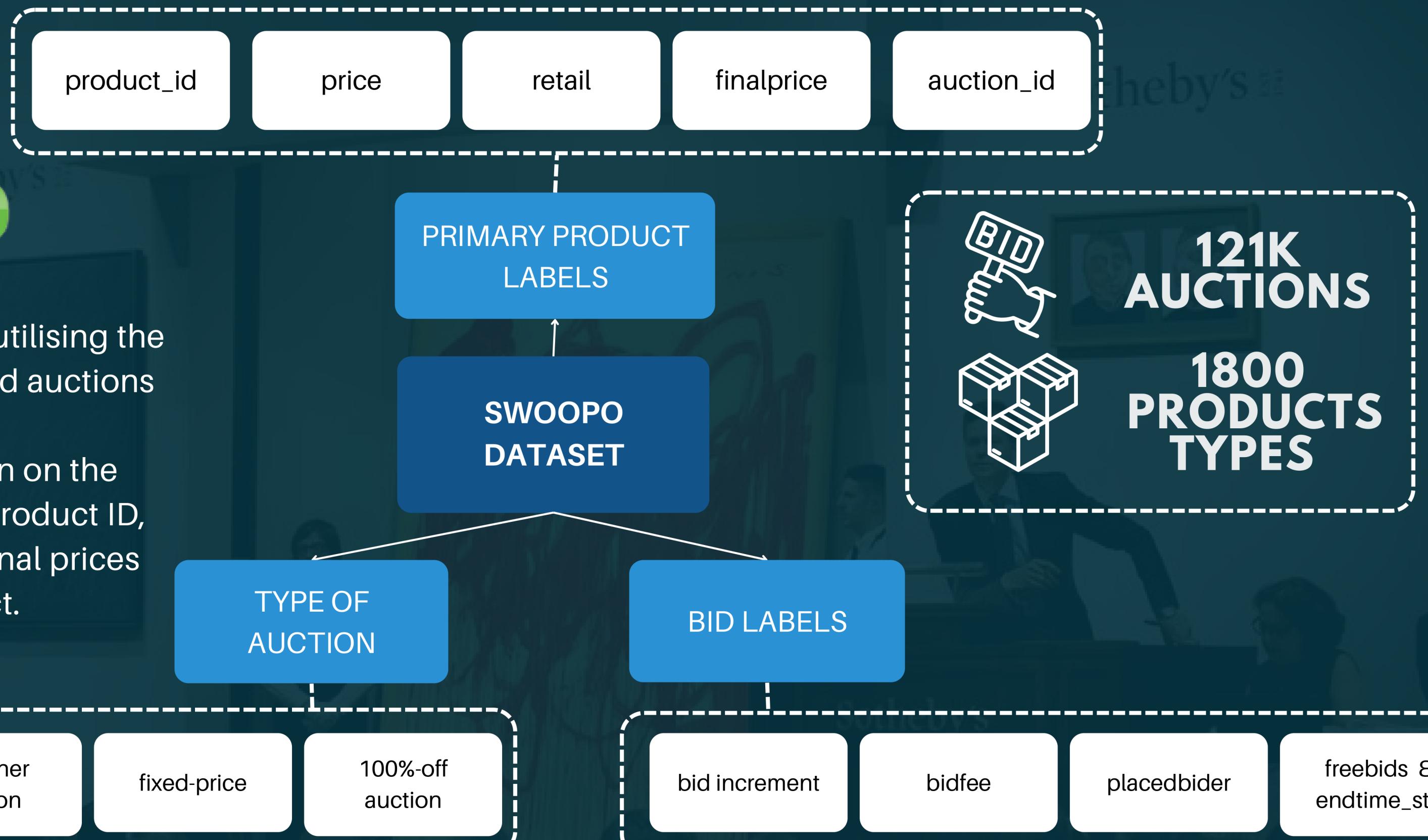
## X FEATURE VECTOR

Type of Auction, Brand, Retail Price, Bid Increment

# DATA: SWOOPO AUCTION



For our case, we are utilising the SWOOPO (Pay-per-bid auctions platform) datasets to get the information on the type of auction, the product ID, bid-time, initial and final prices of the bidden product.

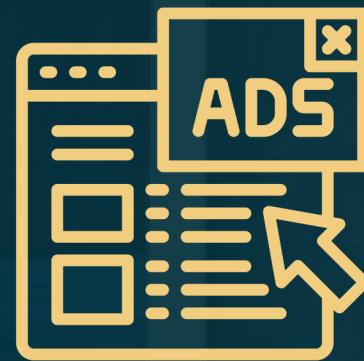


# WHY IS IT USEFUL?

## BUSINESS PERSPECTIVE



Develop interpretable strategies for strategic decision making in online auctions



Improve revenue and margins for the seller or the platform, essential for trading profitably



Extensions to alternate auction formats and use cases

## TECHNICAL PERSPECTIVE



The counterfactuals are not observed and can only estimate to a reasonable degree of accuracy



The high dimensionality of the dataset adds to the difficulty of this problem

# APPROACH



## POLICY TREES

- Built a separate doubly robust estimator on the training and test set for learning policy trees
- max\_depth is kept low (3 - 6)



## PRESCRIPTIVE TREES

- The prescriptive trees are fit for multiple prescription factors and the results are compared.
- max\_depth is kept low (3 - 6)



## CAUSAL TREES

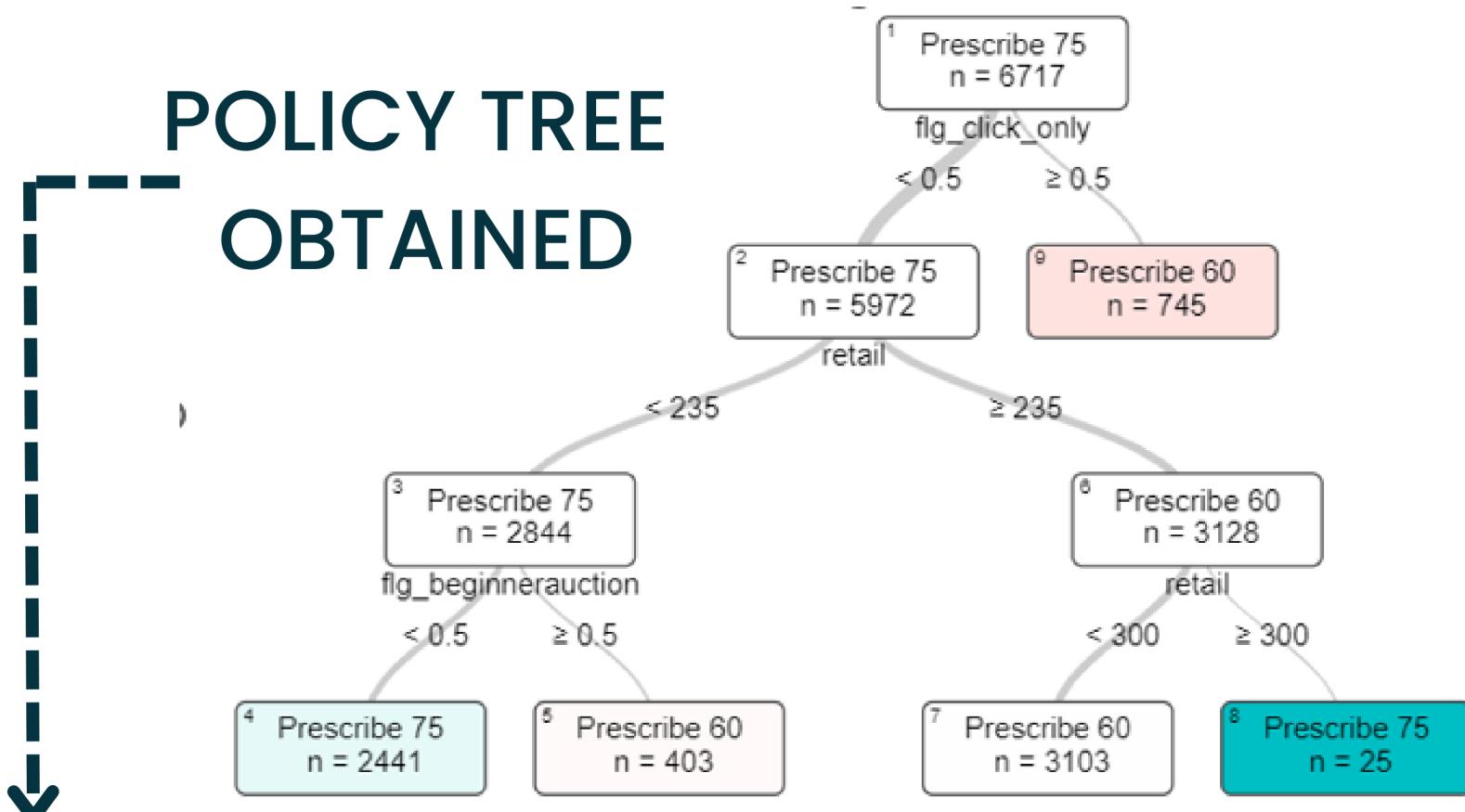
- To identify groups in which the treatment effect is maximized
- For subgroup, treatment is recommended if the effect leads to +ve or -ve outcomes.

For reward estimation, robust estimator is used both for training the policy trees and for evaluation of all methods

EVALUATION METRICS: COST OF EXISTING APPROACH VS OUR POLICY COST

# KEY INSIGHTS

## POLICY TREE OBTAINED



## POLICY TREES--

- Good performance on the test set
- Low Depth, High Interpretability

## PRESCRIPTIVE TREES

- Performance almost as good as Policy Trees
- Higher Complexity, Lower Interpretability

## COMPARISON OF RESULTS



## CAUSAL TREES

- Lower performance as objective is different
- Moderate Complexity and Interpretability

AN UPLIFT OF \$2 PER AUCTION AND 5% INCREMENT IN REVENUE FOR SWOOP