



The
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Institute

Car sales price prediction

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Outline

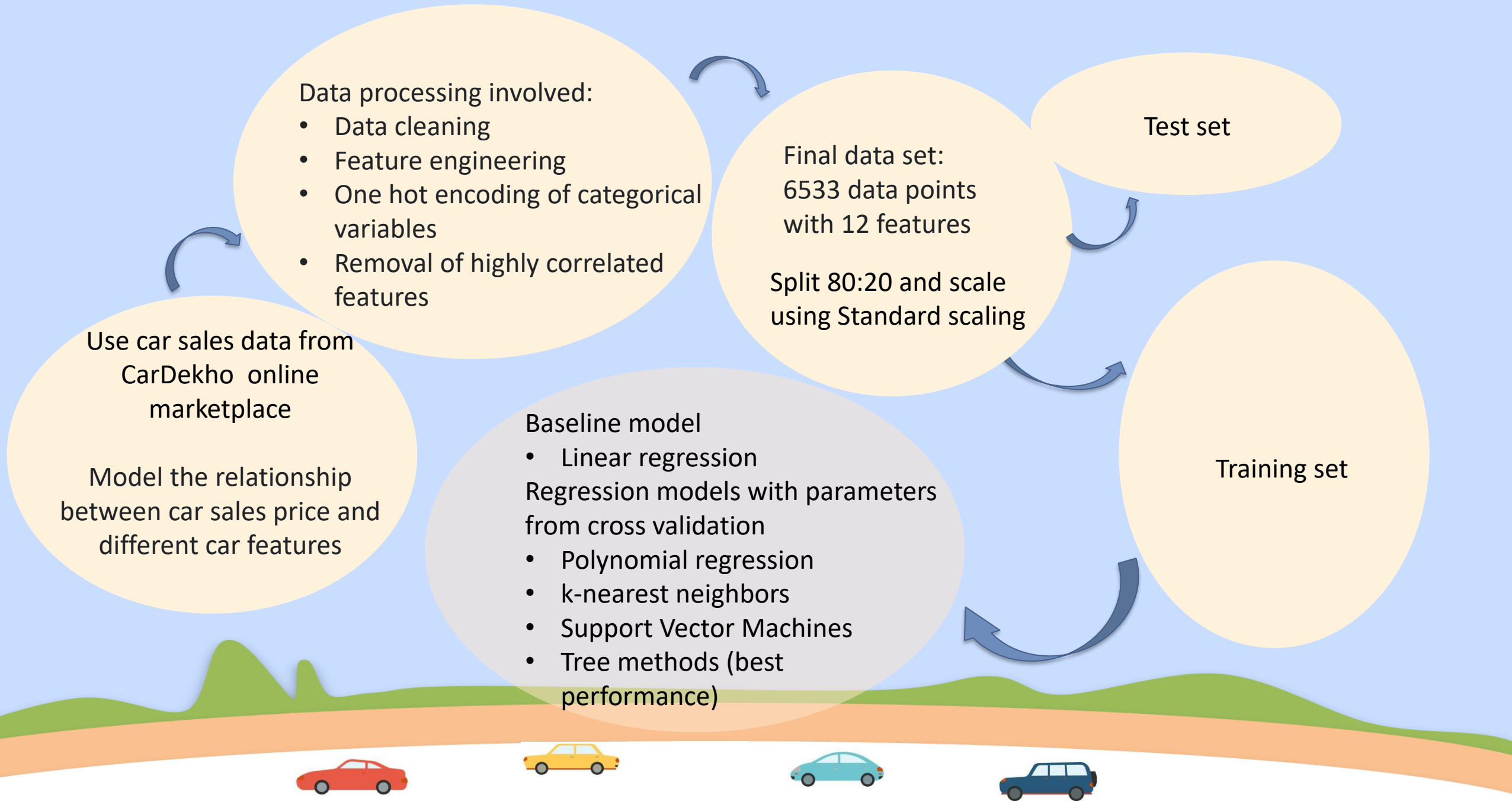
- ❑ Motivation
- ❑ Modeling framework
- ❑ Results
- ❑ Conclusions

Motivation

- ❑ Buying and selling cars is a common experience especially among people leaving in rural areas with little or no transportation

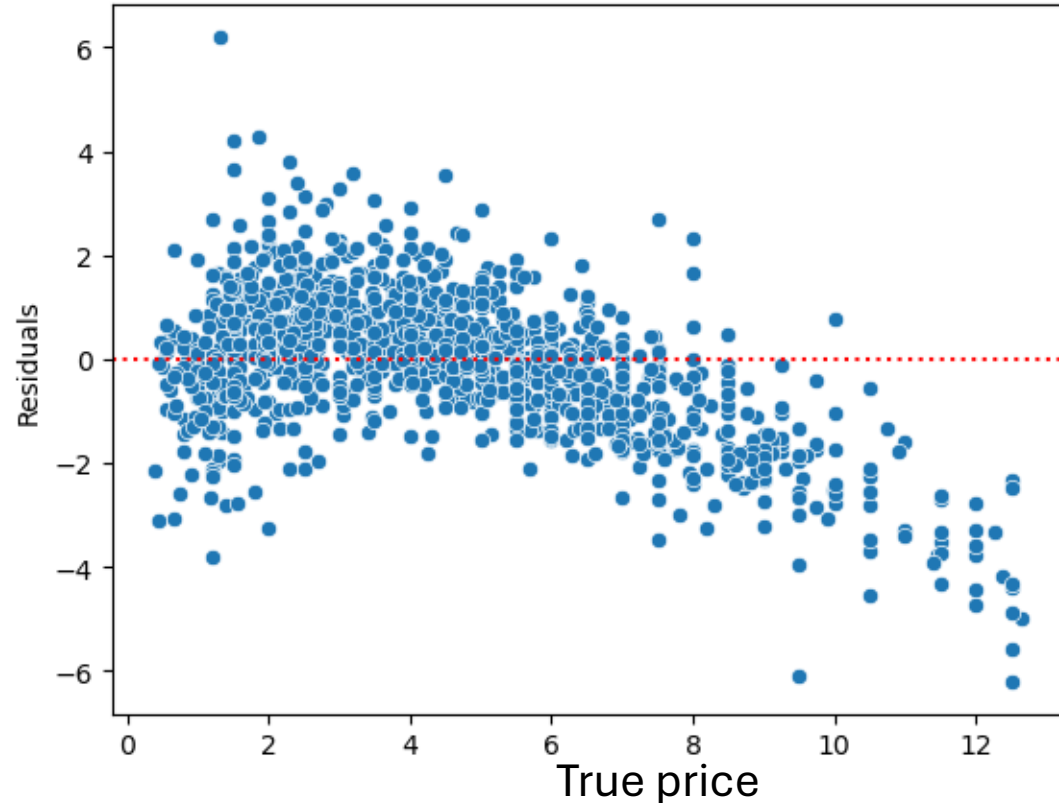
- ❑ Key Stakeholders
 - Individuals selling cars and car dealerships need price prediction model to set competitive and accurate prices for cars.
 - Dealerships want to maximize profit while ensuring quick car sales. Accurate price prediction results in competitive pricing and profitability.
 - Customers can use the model to estimate whether the set price is fare.

Modeling framework

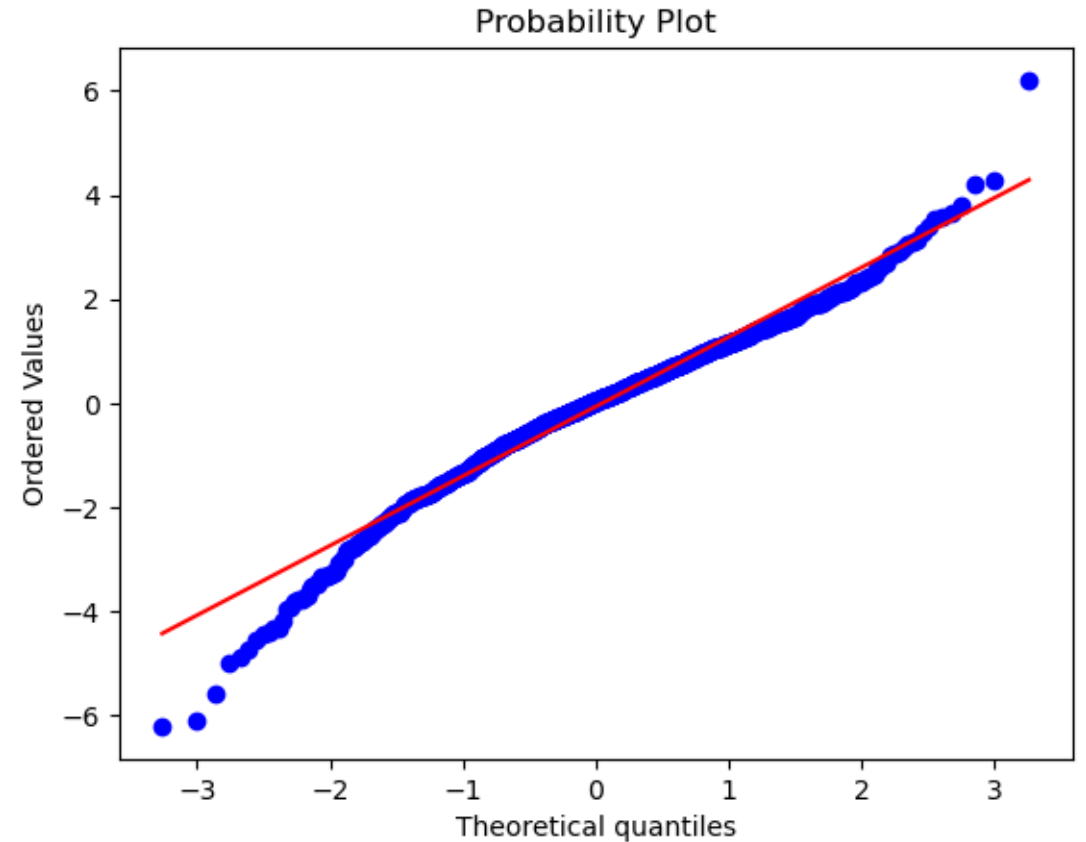


Results: Linear Regression (Base model)

- ❑ Root Mean Squared Error (RMSE) of 1.36 (sales price is in the units of 100000 INR) and $R^2=0.72$.
- ❑ Calculate residuals (difference between predicted label values and true values) and check Linear Regression assumptions



The assumption of homoscedasticity is violated.



Normality is violated for lower for residual values below -3

Should consider other non-linear models.

Results from non-linear models

Used Grid Search Cross-Validation to tune model parameters.

Overall best model performance was obtained with XGBoost.

XGBoost outperforms SVMs and kNN because it is inherently nonlinear and is less sensitive to hyperparameter tuning.

XGBoost improves performance by combining multiple trees, which enhances it's ability to model complex patterns.

It also reduces overfitting by combining multiple trees and employing shrinkage/regularization.

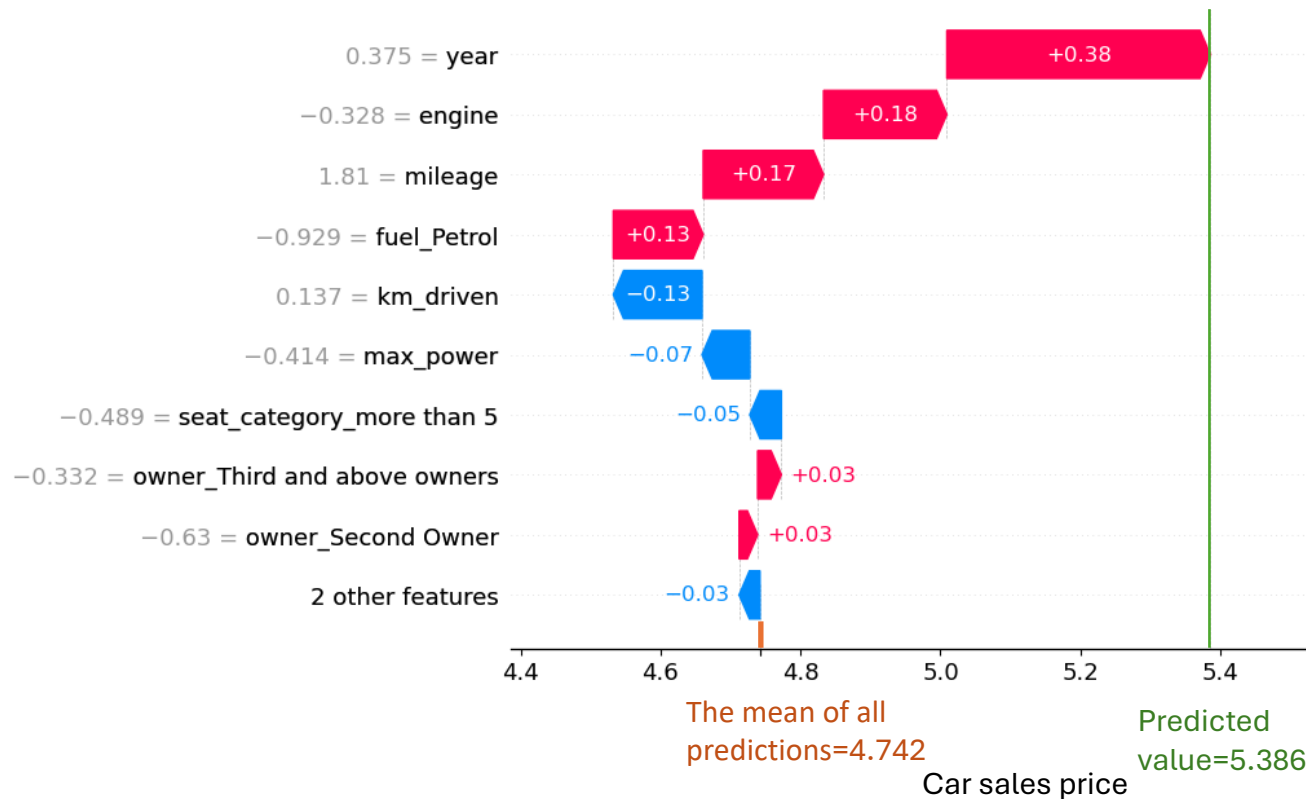
Model	Mean Absolute Error (MAE)	Root Mean Squared Error (RMSE)	Mean Absolute Percentage Error (MAPE)	R^2
Linear Regression (Baseline)	1.04	1.36	33 %	0.72
2 nd order Polynomial Regression	0.82	1.12	23%	0.81
K-Nearest Neighbors	0.83	1.20	23%	0.78
Support Vector Regressor	0.76	1.07	20%	0.83
XGBoost	0.60	0.86	16%	0.88

Results: SHapley Additive exPlanations (SHAP values) for describing feature importances

SHAP values:

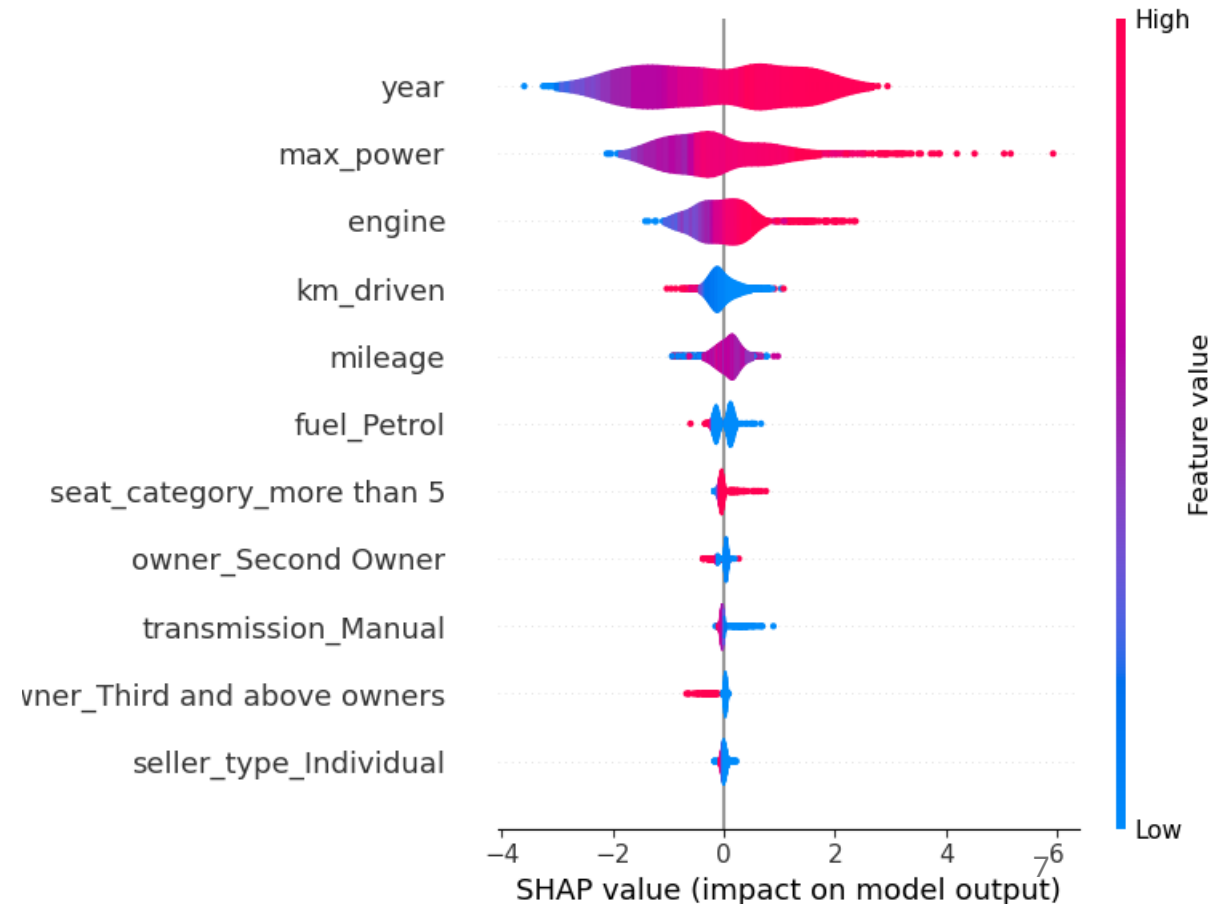
- method based on cooperative game theory
- shows the contribution of each feature on the prediction of the model

SHAP values for one single observation are given by the length of the bar



The sum of all SHAP values will be equal to the difference between mean of all predictions and predicted value

The global effect of the features on model prediction



Conclusions

- ❑ Base model has a poor performance as Linear Regression assumptions are violated
- ❑ Overall best model performance was obtained with XGBoost with MAPE of 16% and $R^2=0.88$
- ❑ The four features that have the most influence on the predicted price are
 - year,
 - max power (measurement of the engine's power that accounts for frictional losses in the engine),
 - engine (the amount of air and fuel that can be pushed through the cylinders in the engine),
 - km driven