USAGE OF MACHINE LEARNING (ML)

OBJECTIVES:

1. PREDICTING MEDIAN HOUSE PRICE USING ML REGRESSION ALGORITHM
2. PREDICTING THE OCCURRENCE OF STROKE USING ML CLASSIFICATION ALGORITHMS

BY EMMA T. (28 AUG 2023)

1. PREDICTING MEDIAN HOUSE PRICE USING ML

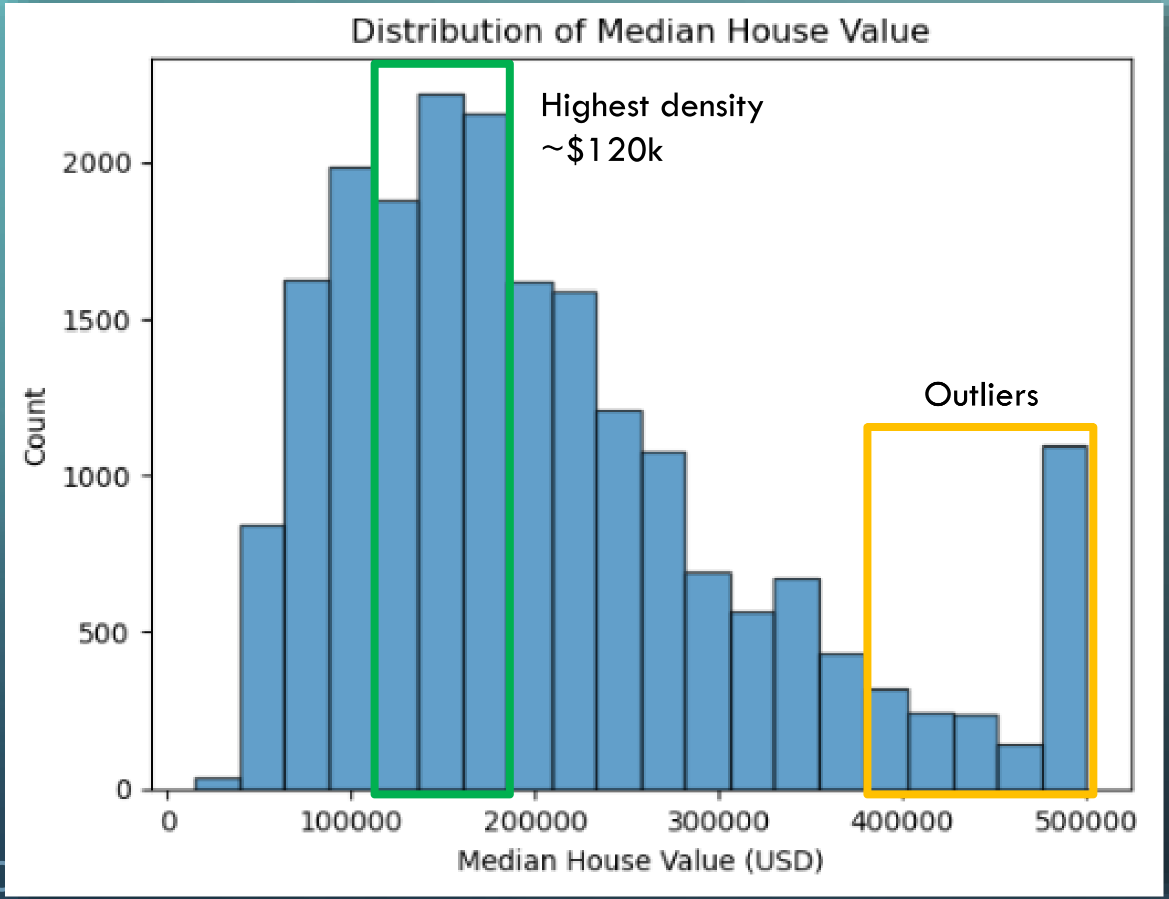
- California Housing dataset (from 1990 California census data) was obtained from Kaggle.
- 10 key info was obtained from nearly 21k houses, which includes location, house age, median income, ocean proximity, median house value.
- Theoretically, size and location has always been the 2 main keys in affecting house value.
- One would expect the house value is higher at prime location (e.g. offering a beautiful scenic ocean view) or have higher number of rooms.
- Is this true?
- Based on info obtained, machine learning model was trained to predict the median house price.

Notes:

Kaggle is a platform for data science and machine learning enthusiasts, researchers, and professionals to collaborate, compete, and share insights. It provides a community-driven environment where users can find and publish datasets, explore and visualize data, and participate in machine learning competitions.

1. PREDICTING MEDIAN HOUSE PRICE USING ML – CONT.

INSIGHTS ON THE CALIFORNIA HOUSING DATA (Y1990)



- Median house price range from $15k to $500k, with the highest density lies between $120k to $180k.

- Presence of approx. 5% outliers which shows house value on the pricier side up to $500k.

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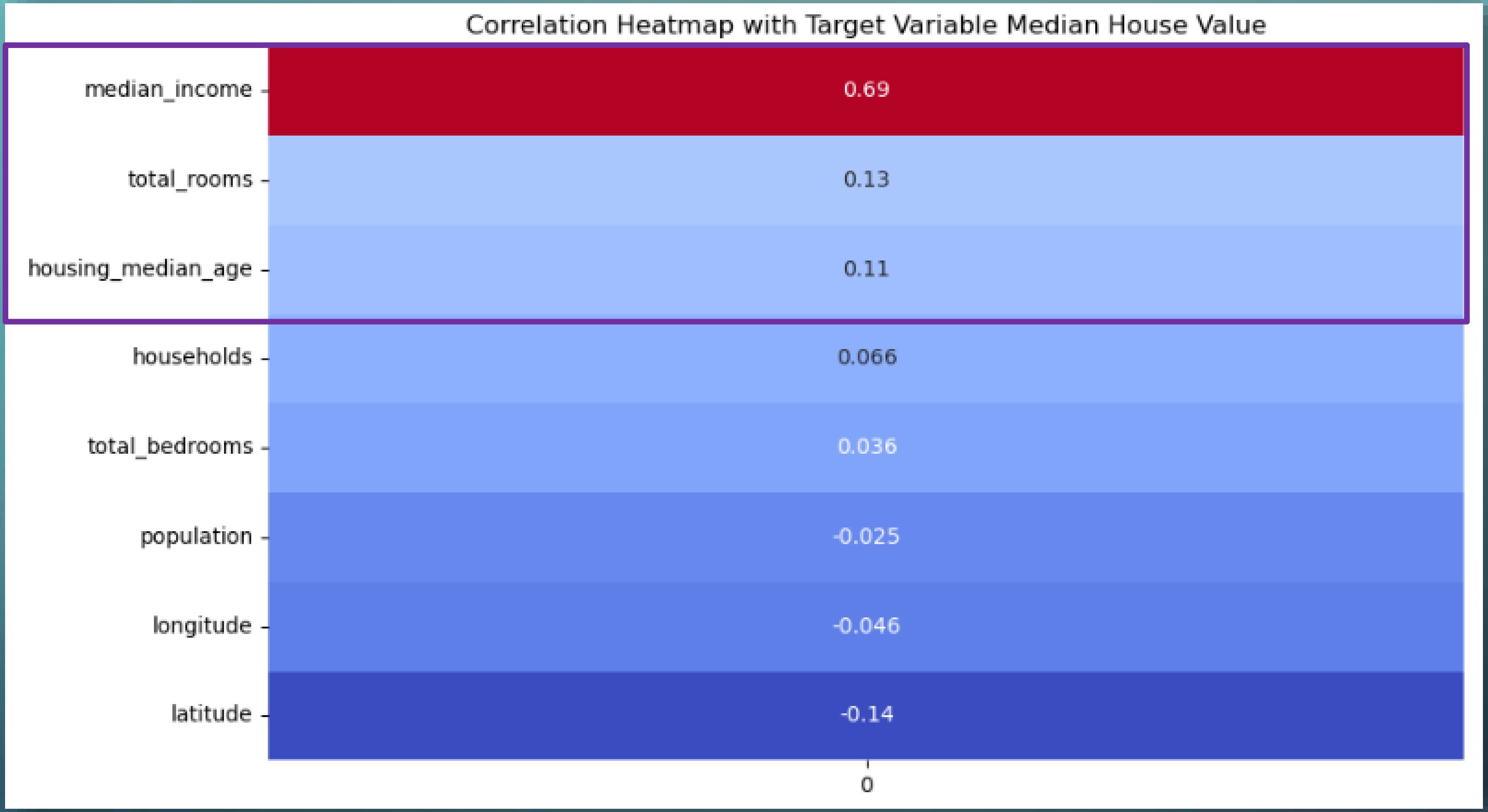
1. PREDICTING MEDIAN HOUSE PRICE USING ML – CONT.

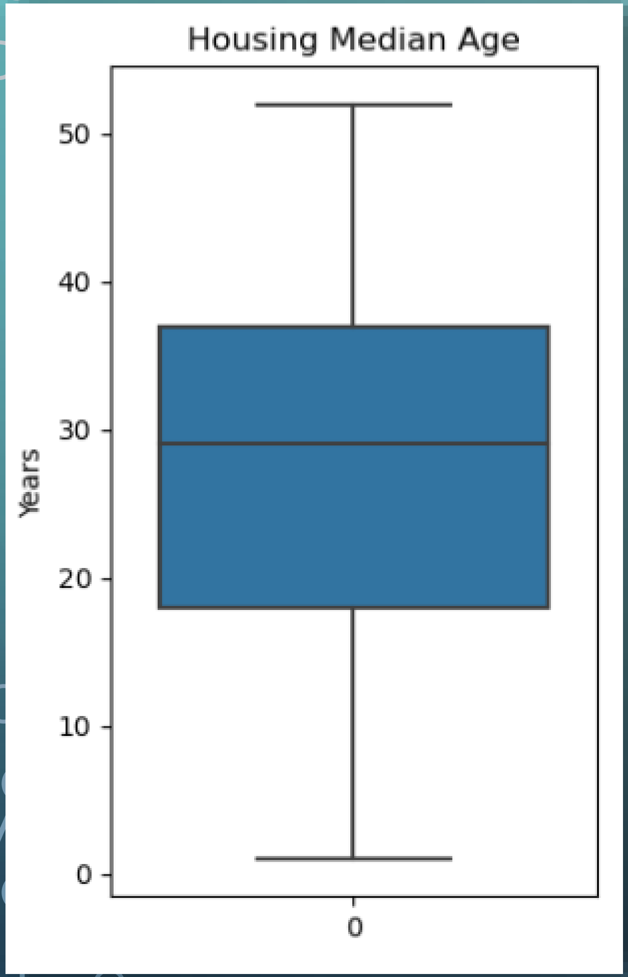
INSIGHTS ON THE CALIFORNIA HOUSING DATA (Y1990) – CONT.

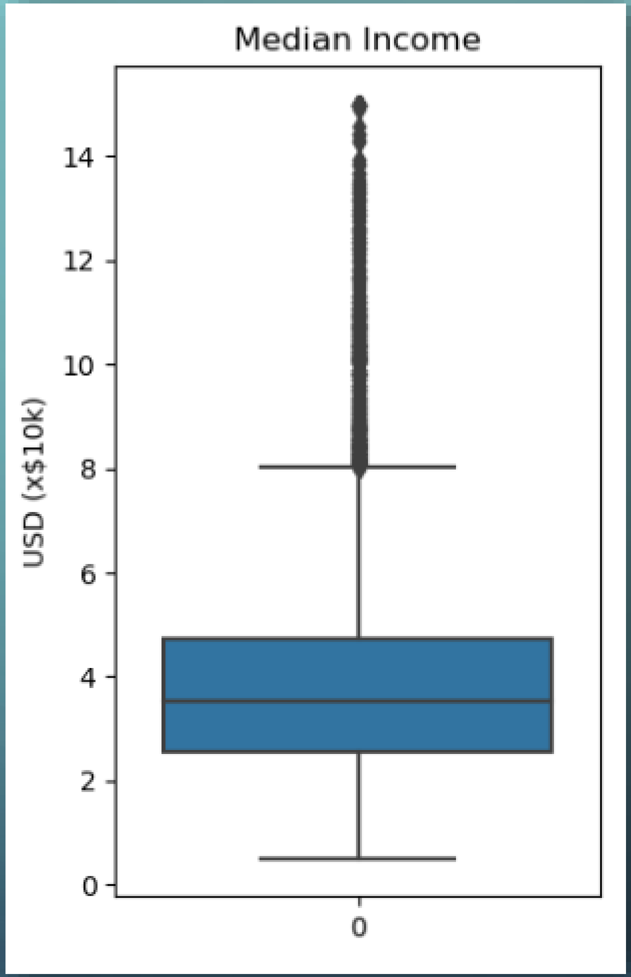


- The top 3 info beside ocean proximity that have the highest correlation to house value in descending orders are :
  - Income
  - Number of rooms
  - House age

1. PREDICTING MEDIAN HOUSE PRICE USING ML – CONT.

INSIGHTS ON THE CALIFORNIA HOUSING DATA (Y1990) – CONT.





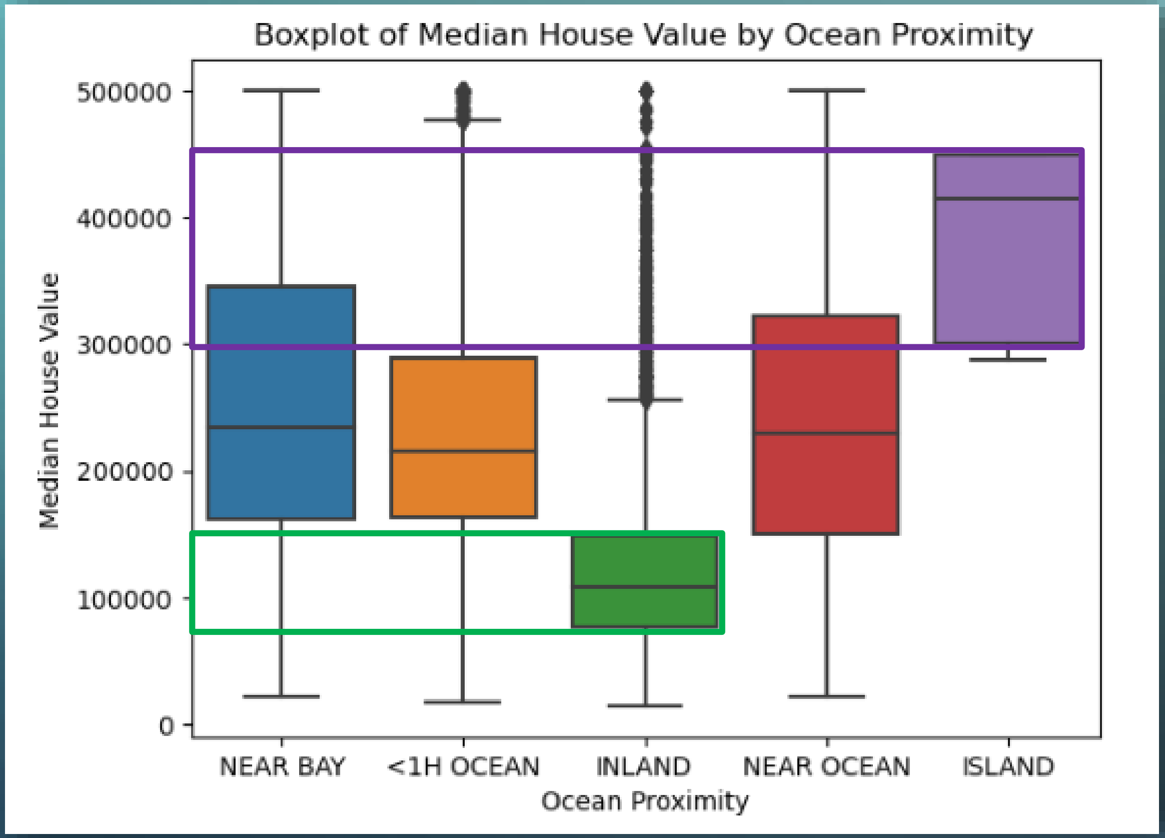
- From boxplots, we see that majority house age between 20 to 30+ years while majority median income of the household is between $20k -$50k yearly.

- At a hindsight, a family earning $35k yearly is likely to be able to afford a $120k house of approx. 30 years old.

1. PREDICTING MEDIAN HOUSE PRICE USING ML – CONT.

INSIGHTS ON THE CALIFORNIA HOUSING DATA (Y1990) – CONT.

So, does an ocean view means pricier house?

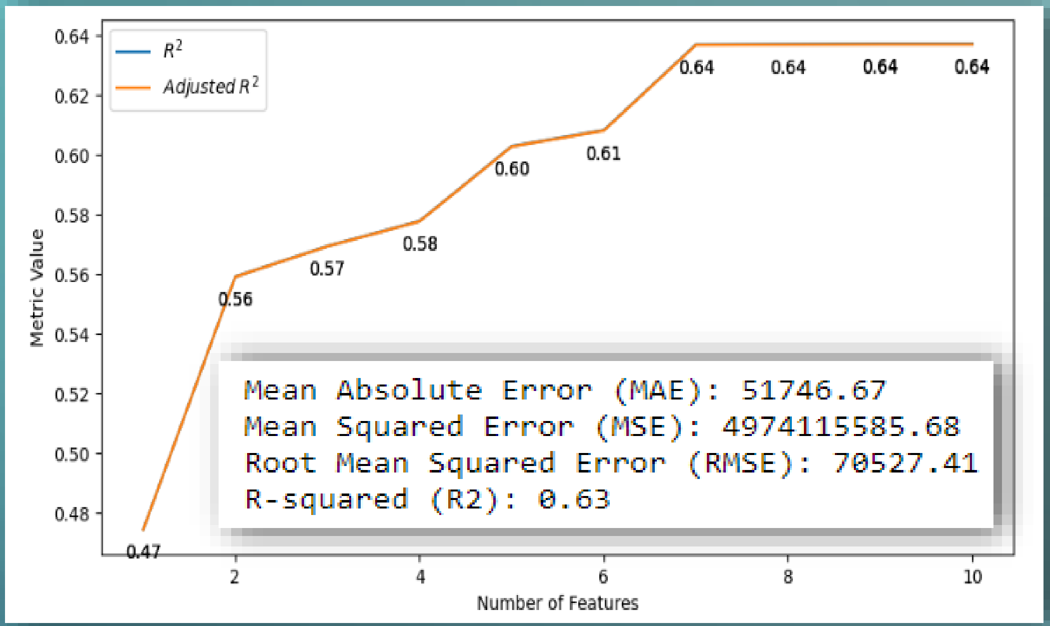


- Ocean proximity correlation to house value was better presented in boxplot.
- From data, house on island clearly fetch a significantly higher value ($300k - $450k).
- Followed closely by house near bay, near ocean and <1 hour drive from ocean respectively.
- In general, inland house is cheapest in general, from $90k, with some unique cases of reaching $500k.
- These outliers could be properties with exceptionally large sizes or unique features that justify their higher prices.

Prepared by Emma T. (28 Aug 2023)

1. PREDICTING MEDIAN HOUSE PRICE USING ML – CONT.

MACHINE LEARNING RESULT – LINEAR REGRESSION MODEL



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Mean Absolute Error (MAE): 51746.67
Mean Squared Error (MSE): 4974115585.68
Root Mean Squared Error (RMSE): 70527.41
R-squared (R2): 0.63
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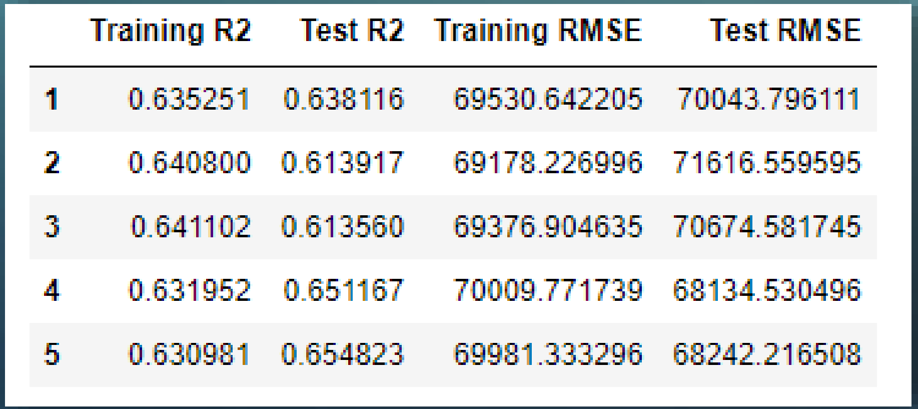


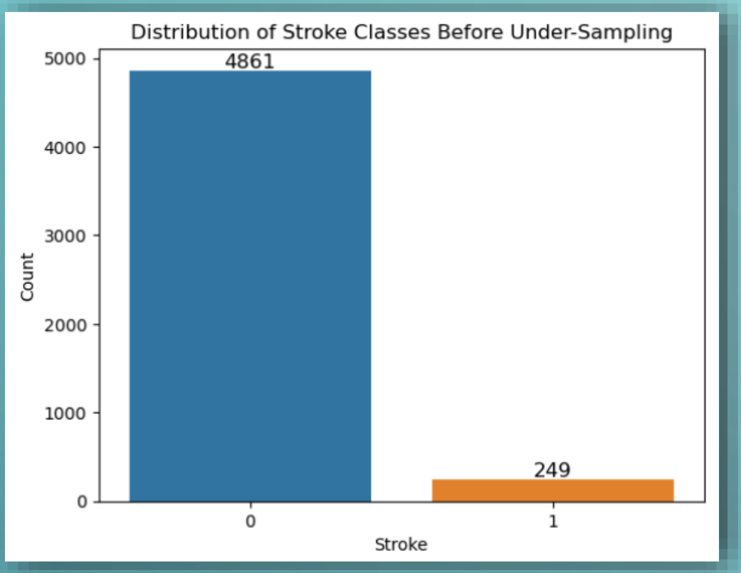
	Training R2	Test R2	Training RMSE	Test RMSE
1	0.635251	0.638116	69530.642205	70043.796111
2	0.640800	0.613917	69178.226996	71616.559595
3	0.641102	0.613560	69376.904635	70674.581745
4	0.631952	0.651167	70009.771739	68134.530496
5	0.630981	0.654823	69981.333296	68242.216508

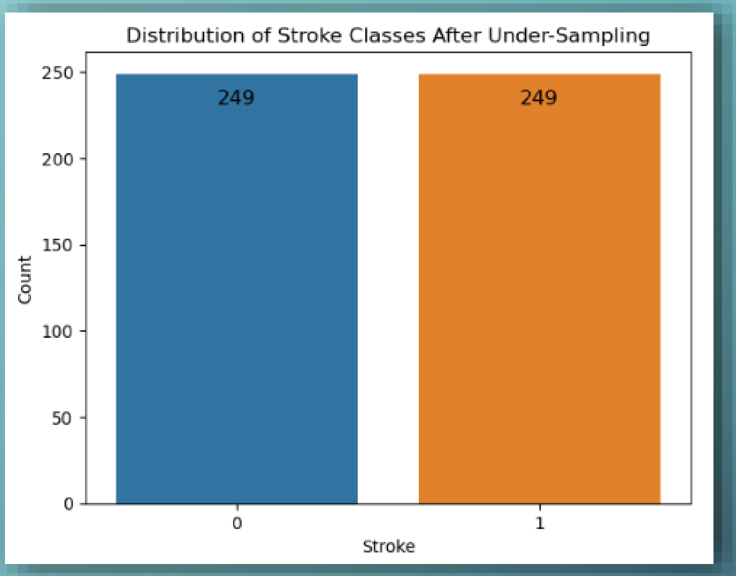
- Model was trained using Linear Regression (LR) Algorithm – using forward feature selection of all info except house value and cross-validated.
- Model accuracy of a LR can be checked using the evaluation metrics. From MAE & RMSE, the model's predictions are off by $50-$70k in terms of median house value.
- MSE value show that a large error is to be expected
- R2 value suggests that the model explains about 63% of the variability in the target variable.
- Result is congruent to the training and testing done.
- Model need to be further optimised to be usable.

2. PREDICTING THE OCCURRENCE OF STROKE

- Health care dataset was obtained from Kaggle, provided by Fedesoriano in 2020.
- 11 key info was obtained from over 5000 patients, which includes age, history of hypertension, heart disease and smoking status.
- Theoretically, we know that an elderly, with history of health issues and smoking have higher risk of stroke.
- Based on the info, machine learning model was trained to predict the occurrence of stroke.

INSIGHTS ON THE HEALTH CARE DATA (Y2020)

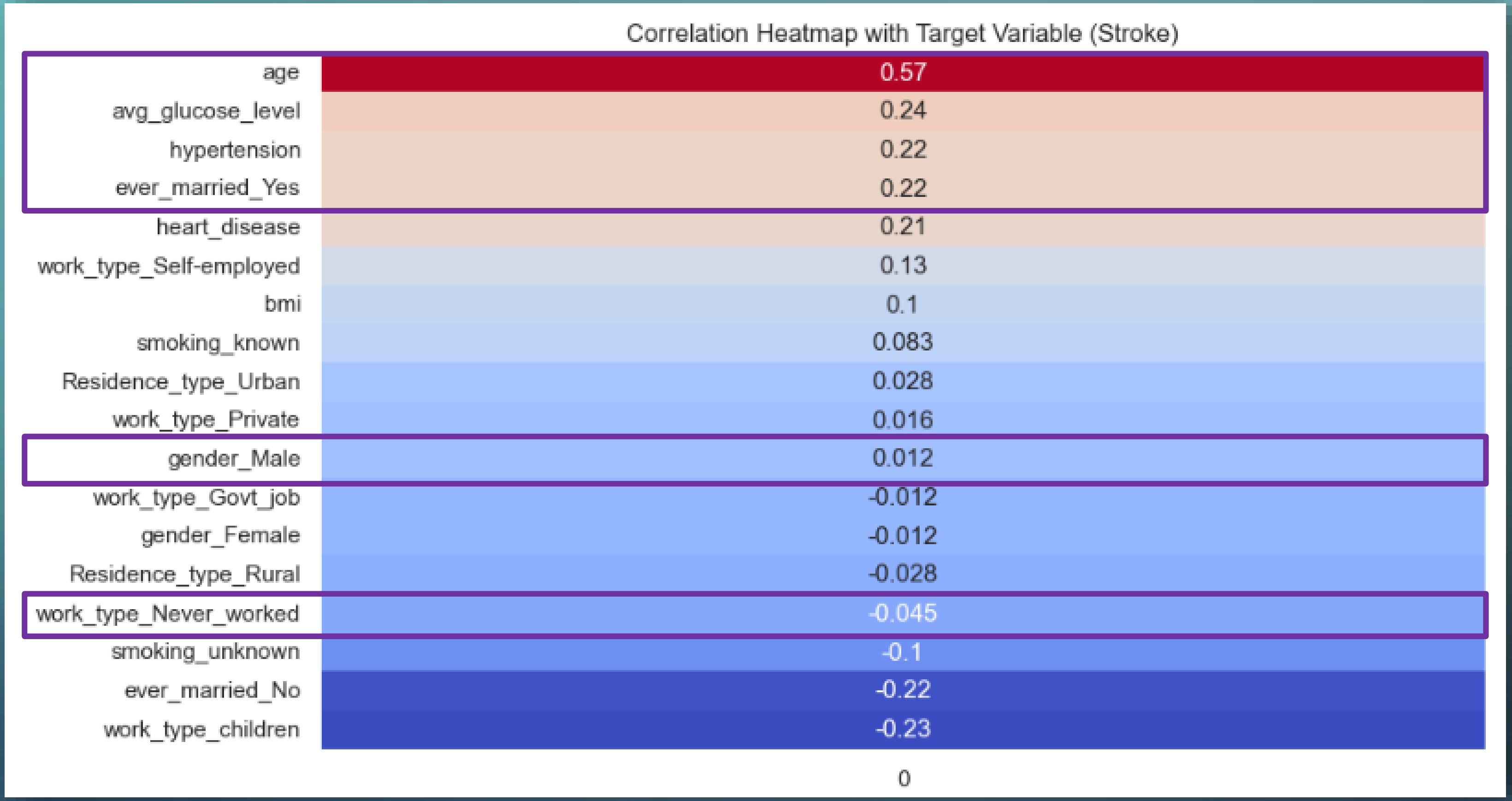




The original dataset was severely skewed towards no stroke patient (95%). In stroke prediction through machine learning, a balanced dataset is essential to mirror real-world stroke prevalence accurately.

Undersampling method is applied to balance the dataset. While a substantial portion of data was sacrificed, the trade-off is justified by the potential for a model that effectively addresses the under-represented class, improving overall predictive performance and real-world applicability.

INSIGHTS ON THE HEALTH CARE DATA (Y2020) – CONT.



Correlation Heatmap with Target Variable (Stroke)

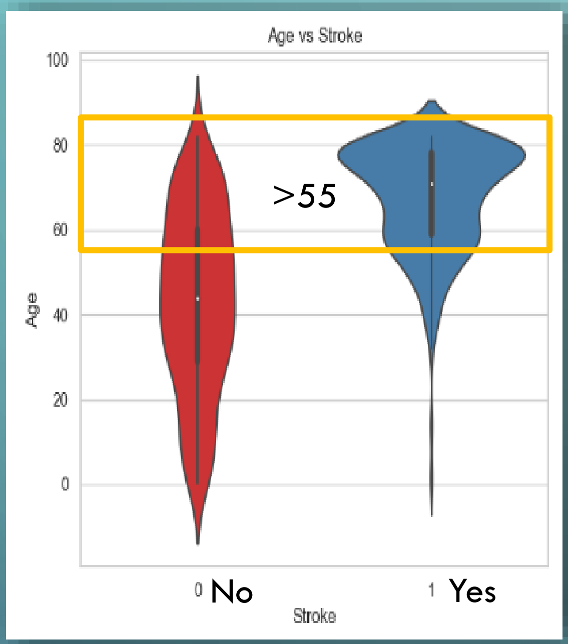
	0
age	0.57
avg_glucose_level	0.24
hypertension	0.22
ever_married_Yes	0.22
heart_disease	0.21
work_type_Self-employed	0.13
bmi	0.1
smoking_known	0.083
Residence_type_Urban	0.028
work_type_Private	0.016
gender_Male	0.012
work_type_Govt_job	-0.012
gender_Female	-0.012
Residence_type_Rural	-0.028
work_type_Never_worked	-0.045
smoking_unknown	-0.1
ever_married_No	-0.22
work_type_children	-0.23

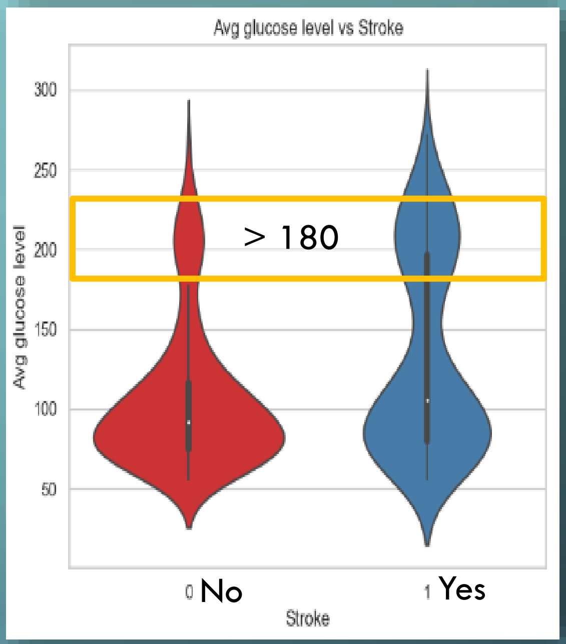
- The top 6 info that have the highest correlation to stroke in descending orders are :
- Age
- Average glucose level
- Hypertension & Being married
- Heart disease
- Being self employed

2. PREDICTING THE OCCURRENCE OF STROKE USING ML – CONT.

INSIGHTS ON THE HEALTH CARE DATA (Y2020) – CONT.

A closer look at Top 5 info with highest correlation



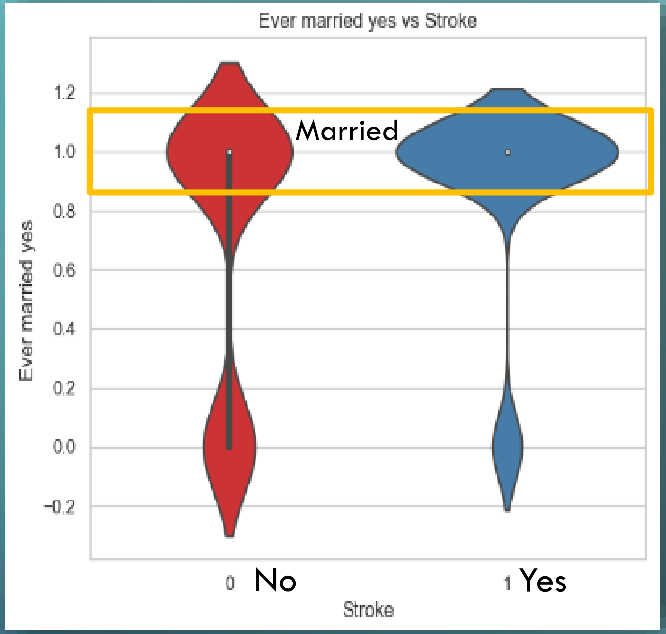


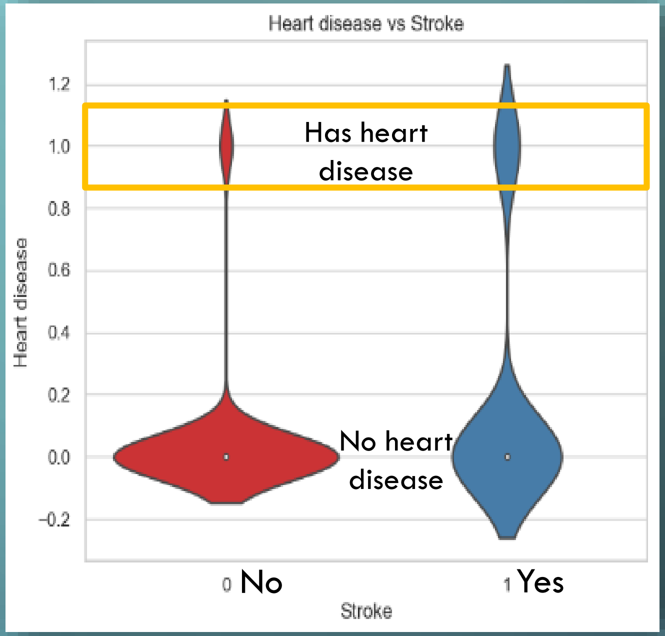
- Upon closer examination, individuals over the age of 55 and average glucose level higher than 180 are notably more prone to experiencing a stroke.

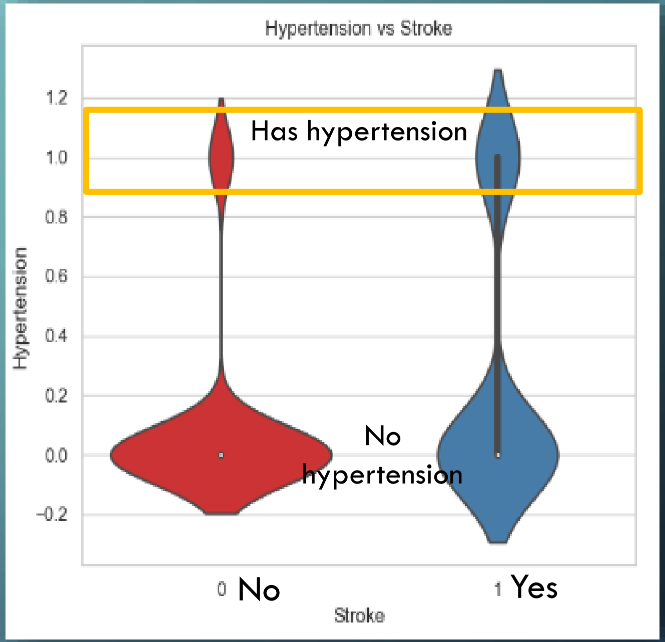
2. PREDICTING THE OCCURRENCE OF STROKE USING ML – CONT.

INSIGHTS ON THE HEALTH CARE DATA (Y2020) – CONT.

A closer look at Top 5 info with highest correlation



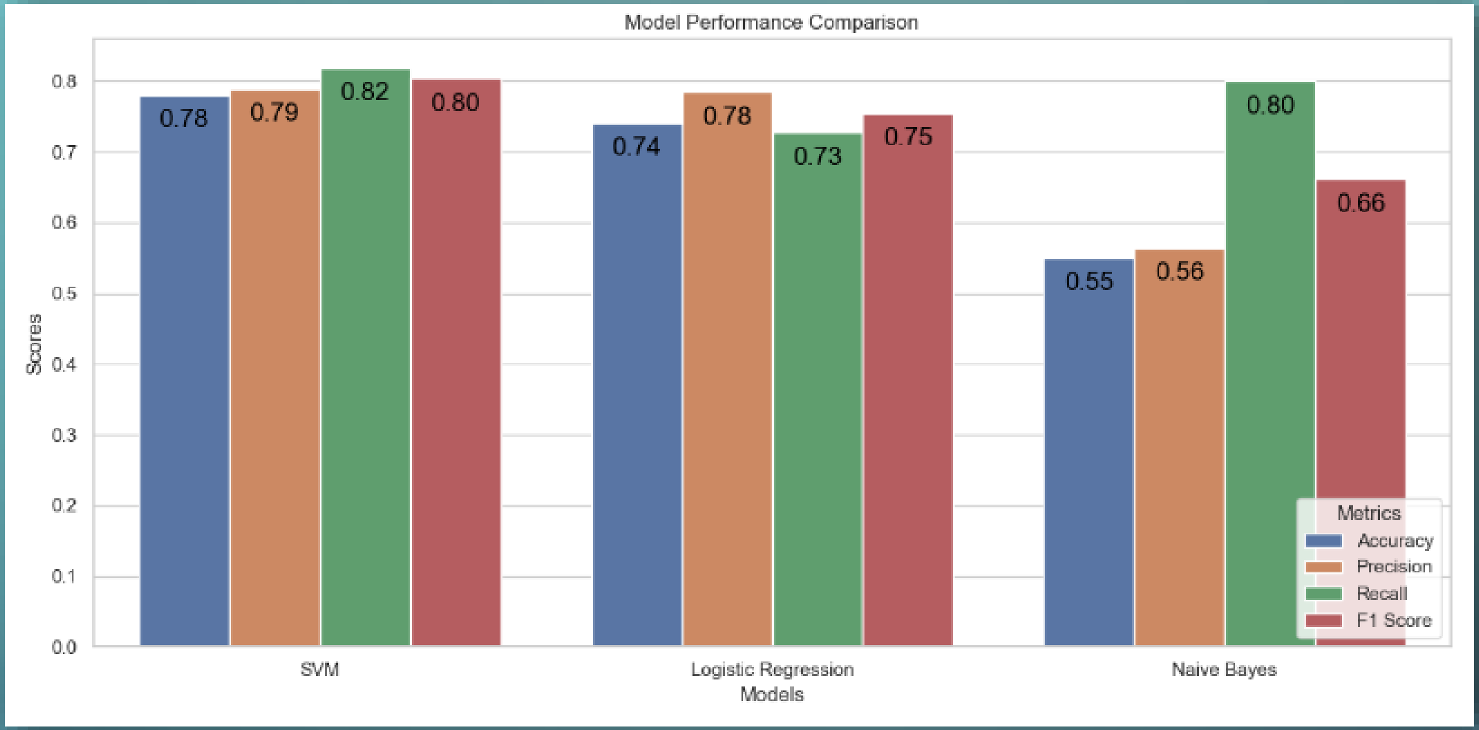




- While being married and having aa history of hypertension and heart disease does not guarantee a stroke, data shows that these does elevate the chances.

2. PREDICTING THE OCCURRENCE OF STROKE USING ML – CONT.

MACHINE LEARNING RESULT



Quick study on metrics used:

- Accuracy provides an overall gauge of stroke prediction model's performance
- Precision helps avoid false positive predictions
- Recall helps avoid missing actual stroke cases
- F1 score offers a way to strike a balance between precision and recall based on study specific priorities.

- Model was trained using 3 commonly used algorithms; Support Vector Machine (SVM), Logistic Regression and Naïve Bayes.
- Out of the 3 algorithms chosen, SVM (scaled) performs the best with highest scores across all 4 metrics tested with 78% accuracy.

End of Presentation. Thank you.

Q&As Session

Dataset, codes & models are available in GitHub Link:

https://github.com/EmmaT0611/mp2_supervisedmachinelearning

APPENDIX 1.

Key Info from California Housing Dataset Explained:

1. Longitude: A measure of how far west a house is; a higher value is farther west
2. Latitude: A measure of how far north a house is; a higher value is farther north
3. Housing Median Age: Median age of a house within a district; a lower number is a newer building
4. Total Rooms: Total number of rooms within a district
5. Total Bedrooms: Total number of bedrooms within a district
6. Population: Total number of people residing within a district
7. Households: Total number of households, a group of people residing within a home unit, for a district
8. Median Income: Median income for households within a district of houses (measured in tens of thousands of US Dollars)
9. Median House Value: Median house value for households within a district (measured in US Dollars)
10. Ocean Proximity: Location of the house with respect to ocean/sea

APPENDIX 2.

Key Info from Health Care Dataset Explained:

- Gender: "Male", "Female" or "Other"
- Age: age of the patient
- Hypertension: 0 if the patient doesn't have hypertension, 1 if the patient has hypertension
- Heart_disease: 0 if the patient doesn't have any heart diseases, 1 if the patient has a heart disease
- Ever_married: "No" or "Yes"
- Work_type: "children", "Govt_job", "Never_worked", "Private" or "Self-employed"
- Residence_type: "Rural" or "Urban"
- Avg_glucose_level: average glucose level in blood
- Bmi: body mass index
- Smoking_status: "formerly smoked", "never smoked", "smokes" or "Unknown"*
- Stroke: 1 if the patient had a stroke or 0 if not
- *Note: "Unknown" in smoking_status means that the information is unavailable for this patient

REFERENCES

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- Predicting House Prices with Linear Regression | Machine Learning from Scratch (2019) by Venelin Valkov Link: https://towardsdatascience.com/predicting-house-prices-with-linear-regression-machine-learning-from-scratch-part-ii-47a0238aeac1

- Analyzing the Performance of Stroke Prediction using ML Classification Algorithms (2021) by Gangavarapu Sailasya & Gorli L Aruna Kumari. Link:https://thesai.org/Downloads/Volume12No6/Paper_62Analyzing_the_Performance_of_Stroke_Prediction.pdf
- Stroke Disease Detection and Prediction Using Robust Learning Approaches (2021) by Tahia Tazin and team. Link: https://www.hindawi.com/journals/jhe/2021/7633381/
- Stroke Risk Prediction with Machine Learning Techniques (2022) by Elias Dritsas* and Maria Trigka. Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9268898/