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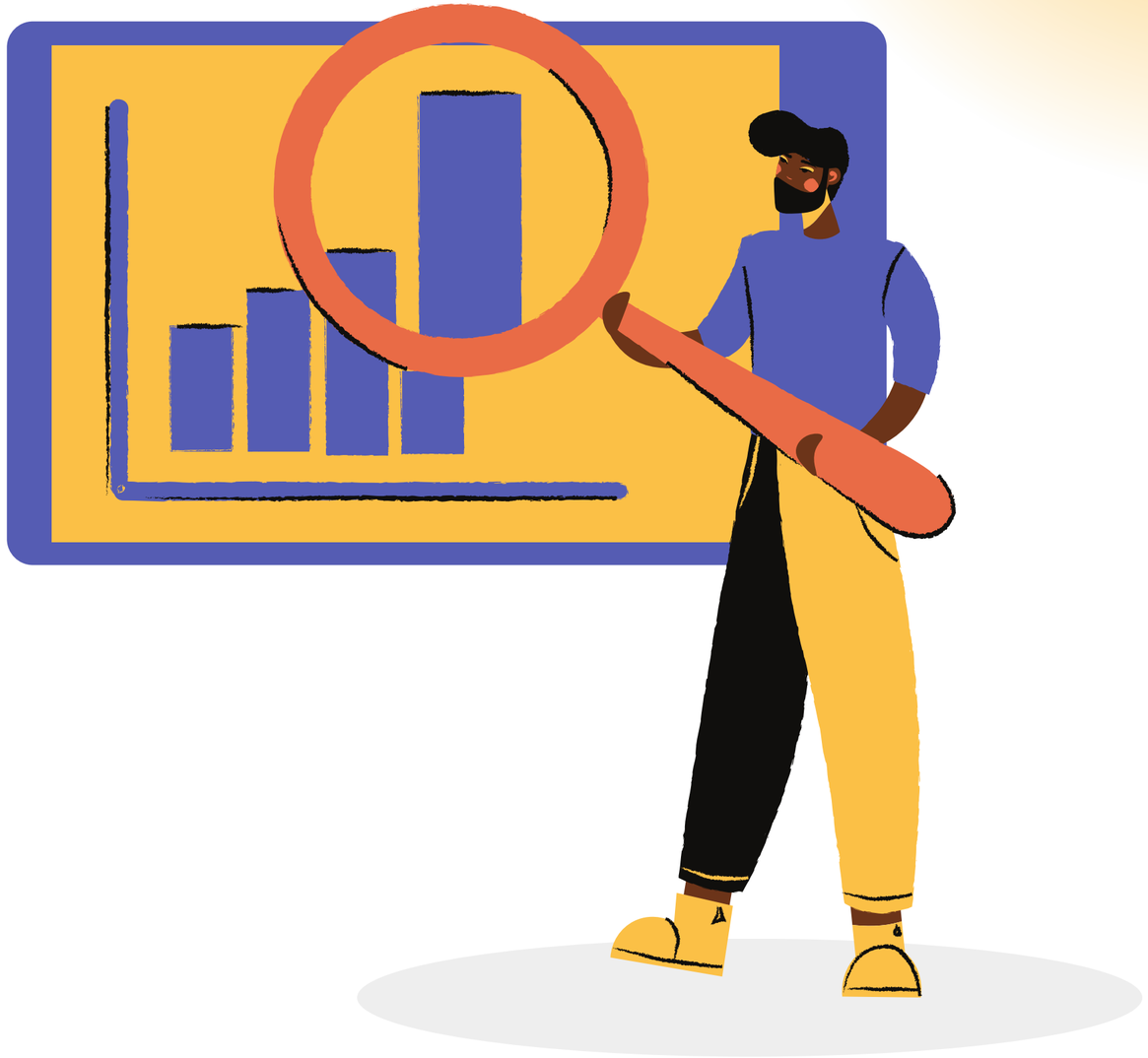
DATA ANALYSIS

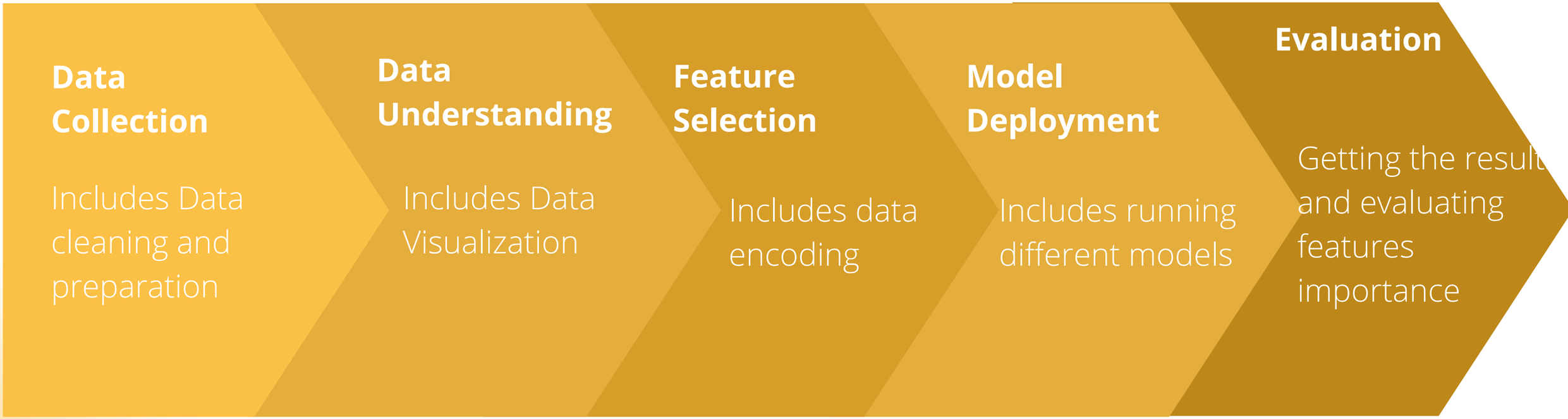
Using Interest Rates To Predict Commercial Real Estate Prices with Random Forest, Linear Regression and Extreme Gradient Boosting Machine Learning Models.



Introduction

In this paper we are trying to investigate the relationship between commercial real estate market prices and interest rates within Manhattan. In addition to that we are trying to predict the prices using such features as year built, neighborhood, etc. but most importantly interest rates. The research was built on 27432 commercial units in Manhattan that were sold in 2017 to 2022. To conduct this paper we are using NYC Open Data, Interest rates from FRED economic data as well as other resembling most updated research papers conducted within 3-5 years.

Methodology



Data Collection

- To conduct this paper we are using NYC Open Data, Interest rates from FRED economic data as well as other resembling most updated research papers conducted within 3-5 years.
- Removed instances with NAN values and zeros as it can ruin the results of prediction if we find the mean and replace missing values with them.
- We removed the outliers by cutting the highest percentile and lowest. Percentiles are statistical measures that divide a dataset into 100 equal parts. The 1st percentile represents the value below which 1% of the data falls, and the 99th percentile represents the value below which 99% of the data falls.

Data visualization

Feature selection

- Heat map - This visualization helps in understanding variable relationships, uncovering patterns, and identifying dependencies in the data.

Model Selection

- *Linear regression*
- *Random Forest*
- *Gradient Boosting*

Evaluation

- To evaluate our linear regression model, we computed the RMSE (root mean square error) on the test set and R^2 score.
- Random Forest Regression model with 100 trees got - 43%
- Random Forest Regression model with 20 trees got - 33%
- Linear Regression model - 4%
- Extreme Gradient Boosting model got - 39%

References

1. Qihang Yi, Yi Zuo, Tieshan Li, Yuhao Mao, Yang Xiao, "Forecasting of Vessel Traffic Flow Using BPNN Based on Genetic Algorithm Optimization", *2021 International Wireless Communications and Mobile Computing (IWCMC)*, pp.1059-1063, 2021.
2. Ouyang Jiantao, "The application for real estate investment price by nonlinear gray forecast model", *Industrial Technology & Economy*, vol. 24, no. 5, pp. 78-80.
3. P. D. Reddy and L. R. Parvathy, "Prediction Analysis using Random Forest Algorithms to Forecast the Air Pollution Level in a Particular Location," 2022 3rd International Conference on Smart Electronics and Communication (ICOSEC), Trichy, India, 2022, pp. 1585-1589, doi: 10.1109/ICOSEC54921.2022.9952138.
4. C. G. Raju, V. Amudha and S. G, "Comparison of Linear Regression and Logistic Regression Algorithms for Ground Water Level Detection with Improved Accuracy," 2023 Eighth International Conference on Science Technology Engineering and Mathematics (ICONSTEM), Chennai, India, 2023, pp. 1-6, doi: 10.1109/ICONSTEM56934.2023.10142495.
5. Y. Zhao, R. Ravi, S. Shi, Z. Wang, E. Y. Lam and J. Zhao, "PATE: Property, Amenities, Traffic and Emotions Coming Together for Real Estate Price Prediction," 2022 IEEE 9th International Conference on Data Science and Advanced Analytics (DSAA), Shenzhen, China, 2022, pp. 1-10, doi: 10.1109/DSAA54385.2022.10032416.

References

1. Shi, Donghui, et al. “Deep Learning in Predicting Real Estate Property Prices: A Comparative Study.” ScholarSpace, 3 Jan. 2023, scholarspace.manoa.hawaii.edu/items/5df9d756-67ba-453f-ae66-11fec7a343b2.
2. S. Li, "Research on Evolutionary Optimization Algorithm of Real Estate Pricing Based on Data Mining," 2021 Fifth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), Palladam, India, 2021, pp. 793-796, doi: 10.1109/I-SMAC52330.2021.9640695.
3. Tao, Fanghong, and Lili Jiao. “Coastal and Port Real Estate Forecasting Model Based on Fast-Adaptive Algorithm for Large Data Sets.” Allen Press, Allen Press, 1 Nov. 2019, meridian.allenpress.com/jcr/article-abstract/97/SI/35/428371/Coastal-and-Port-Real-Estate-Forecasting-Model.
4. Deghi, Andrea, et al. “Commercial Real Estate Sector Faces Risks as Financial Conditions Tighten.” IMF, 22 Sept. 2022, www.imf.org/en/Blogs/Articles/2022/09/21/commercial-real-estate-sector-faces-risks-as-financial-conditions-tighten.
5. Rising Interest Rates and the Future of U.S. Commercial ... - Nyu Stern, www.stern.nyu.edu/sites/default/files/assets/documents/Antell_Glucksman%20Paper_0.pdf. Accessed 31 Aug. 2023.