SATELLITE'S EXPECTED LIFETIME PREDICTION USING MACHINE LEARNING

Group 5: Data Detectives

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EXECUTIVE SUMMARY:

Satellites are used for many purposes: research, communication, navigation, and weather forecasting. Each satellite's life span is relatively short ranging from 1 year to 6 years. Creating a satellite is a substantial investment of time, resources, and effort due to its complexity and the need for high attention to detail. Ensuring that a satellite has a long lifespan is of high importance, given these considerations. Thus, it is important that space enterprises understand and predict satellite lifespan accurately. Modern machine learning algorithms help extract essential information affecting the lifespan of the satellite.

PROJECT PROBLEM:

To develop a predictive model that can give the expected lifetime of the satellite. Creating a satellite is a substantial investment of time, resources, and effort due to its complexity and the need for high attention to detail. Ensuring that a satellite has a long lifespan is of high importance, given these considerations. This project provides insights to choose which type of satellite is more productive.

APPROACH:

To deal with this problem, we gathered a datasets [1] which had a total of 7553 rows and 29 columns, after studying the dataset, we decided to use 11 features that were efficient in predicting the expected lifetime of the satellite. After pre-processing i.e., null handling and scaling the data so that it can be used for modelling, we used various machine learning algorithms to fit and predict the outputs. Evaluation metrics such as root mean squared error and R squared score to measure the model’s performance. The best model was chosen for the project.

PREPROCESSING:

As the data was gathered from different sources, we had a significant number of null values which were effectively handled either by removing or replacing them. The data had no linear relationship between each features and the distribution of the data was not uniform so, we used Robust Scalar to scale the data. We also used OneHotEncoding to convert categorical values into readable values for the models. After this process, we were left with 4911 rows and 26 columns.

MODELLING:

For modelling, we used the following supervised machine learning models:

1. Linear Regression (RMSE: 1397.29, R2: -400409.34)
2. Polynomial Regression (RMSE: 4609286.85, R2: -4357111416313.00)
3. Random Forest Regressor (RMSE: 0.93, R2: 0.82)
4. Support Vector Machine Regressor (RMSE: 1.59, R2: 0.49)
5. K-Nearest Neighbour Regressor (RMSE:1.15, R2: 0.73)

EVALUATION:

We can see each models performance represented with RMSE and R2 score. From the observation we can see that the linear models indicate its unsuitability for this dataset due to the non-linear nature of the data. The high value for R2 for the RF, SVM and KNN indicates the strong explanatory power of the model. Both RMSE and R2 scores look promising for the non-linear models.

CONCLUSION:

The algorithms came up with several grades of accuracy in the predicted satellite lifetime based on the data. Among all the algorithms Random forest had the best performance compared to other models. These predictions will be immensely helpful to satellite organisations and space clubs to aid in making sensible decisions on satellite’s life. This research also will help the astronomers to make a clear path for the satellite retirement plan which will not create collision to other satellites in space.

REFERENCES:

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