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Project_5_

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jjstreaman Update README.md 2 minutes ago

.ipynb_checkpoints	few additional changes	14 hours ago
data	adjustments made to notebooks	yesterday
images	added images folder	52 minutes ago
.gitignore	moved files here	3 days ago
Data_Cleaning_Notebook_2.pdf	adjustments made to notebooks	yesterday
Data_Cleaning_Notebook_3.pdf	adjustments made to notebooks	yesterday
Data_Cleaning_Notebook_4.pdf	adjustments made to notebooks	yesterday
Final_Notebook.pdf	last minute adjustments	2 hours ago
Final_notebook.ipynb	last minute adjustments	2 hours ago
README.md	Update README.md	2 minutes ago
baseballenv.yml	moved files here	3 days ago
data_cleaning_notebook_1.ipynb	adjustments made to notebooks	yesterday
data_cleaning_notebook_1.pdf	adjustments made to notebooks	yesterday
data_cleaning_notebook_2.ipynb	adjustments made to notebooks	yesterday
data_cleaning_notebook_3.ipynb	adjustments made to notebooks	yesterday
data_cleaning_notebook_4.ipynb	adjustments made to notebooks	yesterday
github.pdf	final notebook added	yesterday
model_notebook_1.ipynb	adjustments made to notebooks	yesterday
model_notebook_1.pdf	adjustments made to notebooks	yesterday
model_notebook_2.ipynb	adjustments made to notebooks	yesterday
model_notebook_2.pdf	adjustments made to notebooks	yesterday

presentation.pdf	fixed typo	1 hour ago

README

Project_5_

Overview

This project collected data from various resources on baseball statistics and built supervised machine learning models to predict the surgery status (Tommy John) of pitchers based on the available features.

Business Understanding

Baseball is considered America's National Pastime. The game dates back to the early 1800's, and developed into a professional league after the Civil War. Today baseball is big business. With players signing contracts for hundreds of millions of dollars, owners want to not only protect their investment, but see a return on that investment. Before Tommy John, if a pitcher blew out their arm, it was considered a fatal blow to their career. After the successful surgery to Tommy John's UCL in 1974, this surgery has become much more common in pitchers today. Anywhere from professional players all the way to high school are undergoing this procedure. While this may save a players career, it requires a long recovery time and there is no guaruntee that this will be effective. Some players are unfortunate enough to undergo this procedure multiple times. This data was gathered from sites like baseball-reference.com, a running list of players who have undergone surgery, and the Python library 'pybaseball'. This project aims to look at the available advanced pitching statistics available and correctly predict if pitchers will need Tommy John surgery or not.

Repository Navigation

The repository has several notebooks and a data folder. You will find the appropriate information within each specific file.

Data

- (1972-2023)_pitch_stats.csv
- all_(2008-2023)_stats_df.csv
- better_(2008-2023)_df.csv
- clean_tj_df.csv
- cleaning_filtered_df.csv
- complete_df.csv
- complete_100_df.csv
- cond_pivoted_df.csv
- final_(2008-2023)_df.csv
- hist_tj.csv
- modeling_df.csv
- pitcher_key_df.csv
- pivoted_df.csv
- savant_data.csv

- savant_data_results.csv
- tj_surgery_list.csv

Notebooks

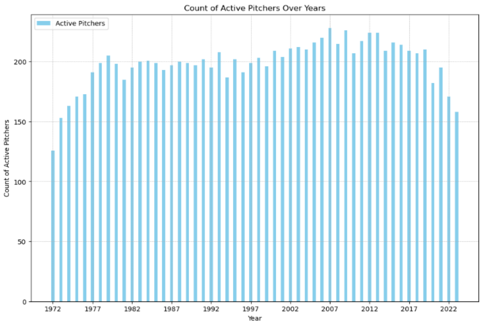
- all_(2008-2023)_stats_cleaning
- Data_Cleaning_Notebook_1
- Data_Cleaning_Notebook_2
- Data_Cleaning_Notebook_3
- Data_Cleaning_Notebook_4
- Model_Notebook_1
- Model_Notebook_2
- Final_Notebook

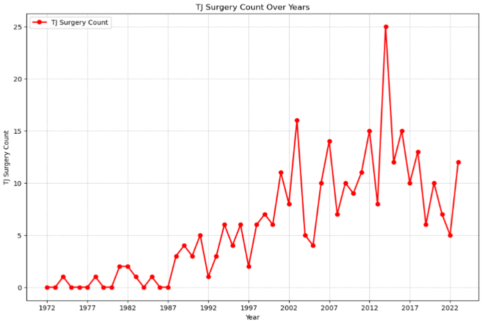
Presentation and Data Source

- Historic Seasonal Starting Pitching Data from Baseball-reference.com - Link
- TJ Surgery List from Google Docs - Link
- Python baseball library Pybaseball - Link
- Presentation - Link

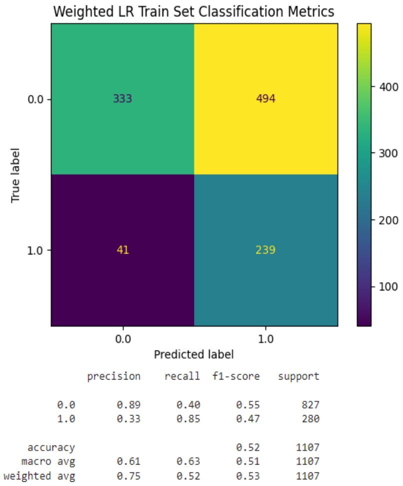
Data and Model Analysis

The data for this project has been collected, cleaned, and sorted for the final analysis. Many tools were used in this process of analysis, including but not limited to pybaseball, pandas, numpy, sklearn, imblearn, etc. The first step was to gather and clean data in order to get a historic view of the number of starting pitchers in the MLB as well as the number of TJ surgeries since 1974 (to applicable pitchers, standards were starting pitchers only who have thrown a minimum of 320 career innings).





The next step was to collect data on Advanced Pitching Metrics, which was limited between the years of 2008 - 2023. After cleaning and organizing this set of data, the target variable was set to "Surgery" as its values are binary (0 or 1), 0 meaning no surgery, & 1 meaning surgery. Due to the nature of the collected data, pivot tables were made in order to accurately analyze the data, resulting in 129 features. Because of this, I made two separate dataframes in order to test what would make the more effective models. The first was the standard dataframe, the second one condensed pitch types & their associated metrics to generalized categories (fastball, breaking ball, off-speed, etc.). Several models were attempted, including: Logistic Regression, Decision Tree, Random Forest, XG Boost, and KNN. These models were adjusted via Grid Search to determine the best parameters specific to that model. The best performing model was a Logistic Regression model, with a recall score of 85%.

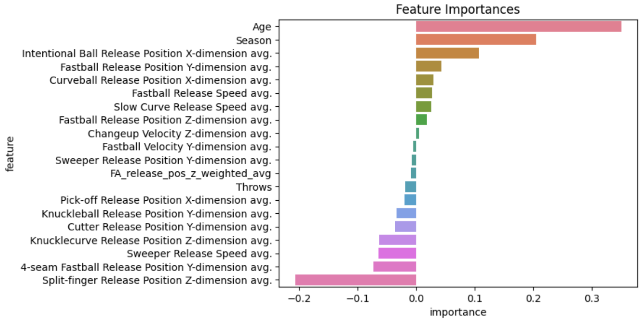


```
              precision    recall  f1-score   support

         0.0       0.89      0.40      0.55       827
         1.0       0.33      0.85      0.47       280

    accuracy                           0.52      1107
   macro avg       0.61      0.63      0.51      1107
weighted avg       0.75      0.52      0.53      1107
```

This model employed a Standard Scaler to scale the various features, adjusted class weights to {0: 1, 1: 5}, score set to recall, C set to 0.01, penalty set to l1, tolerance set to 0.01, and max iterations set to 5000. In order to better understand the affects of adjusting the class weights, I graphed the feature importance. The most important features were 'Age' and 'season' as those metrics would be an accumulation of wear-and-tear over time. After that were metrics such as fastball and curveball release position and average release speeds.



Conclusion

By the end of the process, the Logistic Regression was the most effective model, with a recall score of 85%. This model employed a Standard Scaler to scale the various features, adjusted class weights to {0: 1, 1: 5}, score set to recall, C set to 0.01, penalty set to l1, tolerance set to 0.01, and max iterations set to 5000. To further improve this model, I would like to gather more data and add more features including biological data, video analysis of pitching mechanics, advanced pitching data for years prior to 2008, data for international leagues, minor leagues, college, and

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● **Jupyter Notebook** 100.0%