MoneyBall Watson

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Goal

- Create a ML algorithm that would predict the wins and losses of all NBA teams during the regular season
- Provide insights for sports gambling/fantasy basketball

Data Acquisition

raw data: https://www.kaggle.com/nathanlauga/nba-games

- games.csv (game level)
- games_detail.csv (player level)
- players.csv
- ranking.csv
- teams.csv

Data Preprocessing

- regular games
- 15-16 season

Game_id	Team_id	Player_id	Stats
1	1	1	A
1	1	2	B
1	2	1	C
1	2	2	D

Game_id	Team_id	Stats
1	1	A+B
1	2	C+D

Game_id	Home_team_id	Visitor_team_id	Home_features	Visitor_features
1	1	2	F(A+B)	F(C+D)

Feature Research

Offensive Efficiency	The number of points a team scores per 100 possessions
Defensive Efficiency	The number of points a team allows per 100 possessions
Strength	A simple measure of strength based on game-by-game using ELO Rating
Momentum	Running win rate of the past 5 games
Home Advantage	Percentage of home games won over percentage of total games won

Feature Engineering

1. home_rate: $\frac{\text{\# home games won}}{\text{\# all home games}}$ for home team
2. away_rate: $\frac{\text{\# away games won}}{\text{\# all away games}}$ for visitor team
3. home_over_overall: $\frac{\frac{\text{\# home game won}}{\text{\# all home games}}}{\frac{\text{\# all game won}}{\text{\# all games}}}$ for home team
4. away_over_overall: $\frac{\frac{\text{\# away game won}}{\text{\# all away games}}}{\frac{\text{\# all game won}}{\text{\# all games}}}$ for home team

Feature Engineering

5. win_avg5_home: $\frac{\#\text{ games won in 5 previous games}}{5}$ for home team

6. win_avg5_away: $\frac{\#\text{ games won in 5 previous games}}{5}$ for away team

7. Offensive_efficiency_home: $\frac{\text{PTS home}}{\text{Total\_possessions\_home}}$ for home team

8. Offensive_efficiency_away: $\frac{\text{PTS away}}{\text{Total\_possessions\_away}}$ for visitor team

Feature Engineering

9. Defensive_efficiency_home: $\frac{\text{PTS away}}{\text{Total\_possessions\_home}}$ for home team

10. Defensive_efficiency_away: $\frac{\text{PTS home}}{\text{Total\_possessions\_away}}$ for visitor team

11. elo_home: r_i+1 = r_i + k * (S_home - E_home)

12. elo_away: r_i+1 = r_i + k * (S_visitor - E_visitor)

Here, S_team is a state variable: 1 if the team wins, 0 if the team loses. E_team represents the expected win probability of the team.

Exploratory Data Analysis

We picked five teams to represent teams of all levels:

1: best: Golden State Warriors (GSW)

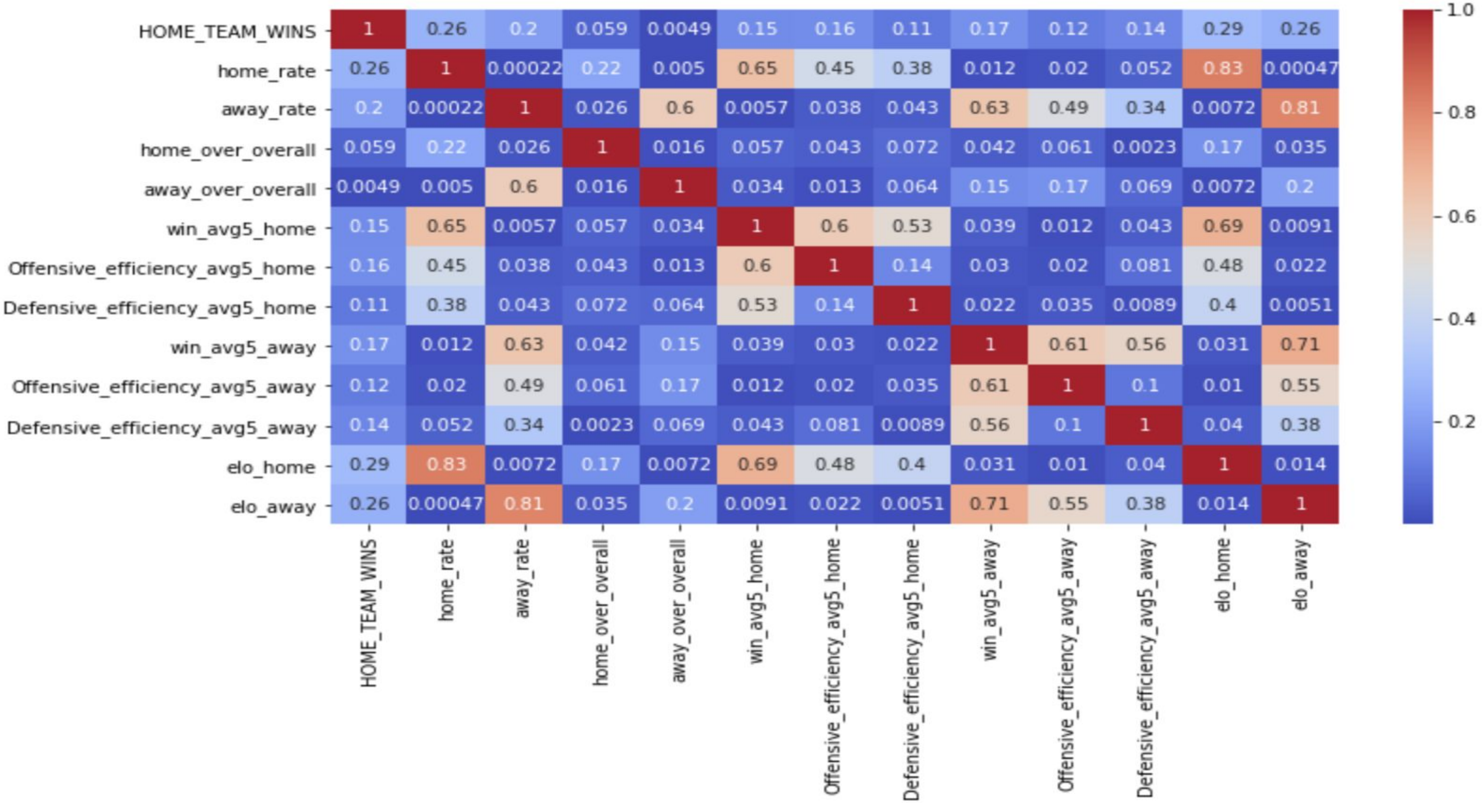
2: good: LA Clippers (LAC)

3: mediocre: Houston Rockets (HOU)

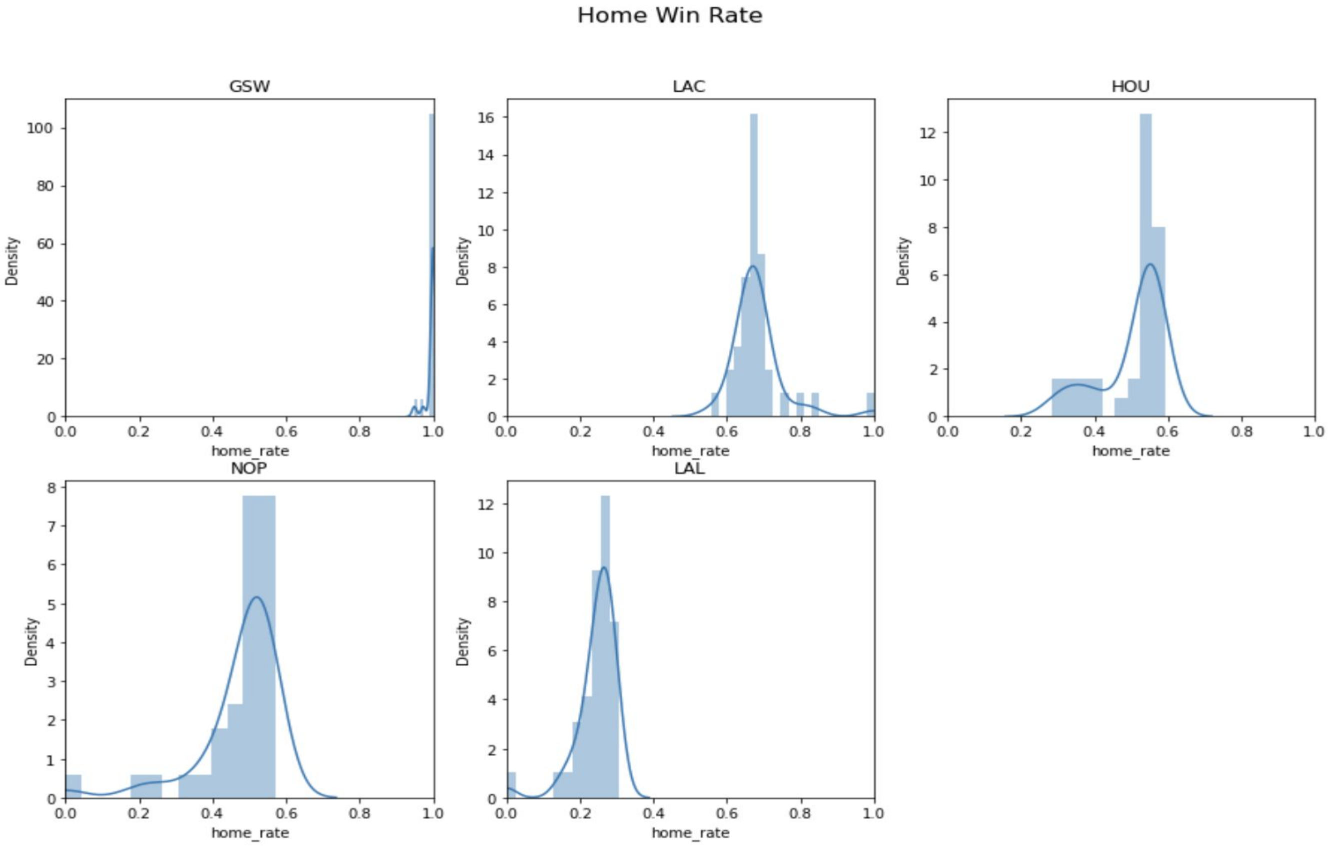
4: bad: New Orleans Pelicans (NOP)

5: worst: LA Lakers (LAL)

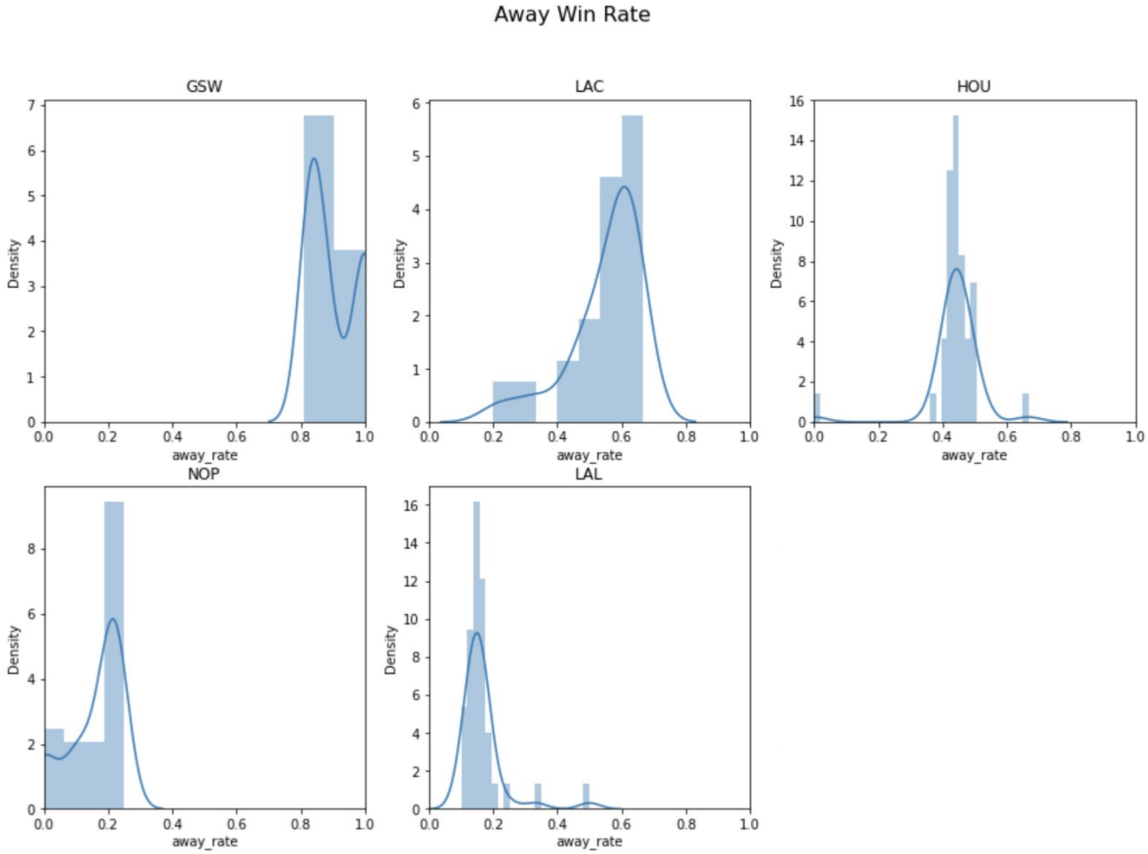
EDA - Correlation Heatmap



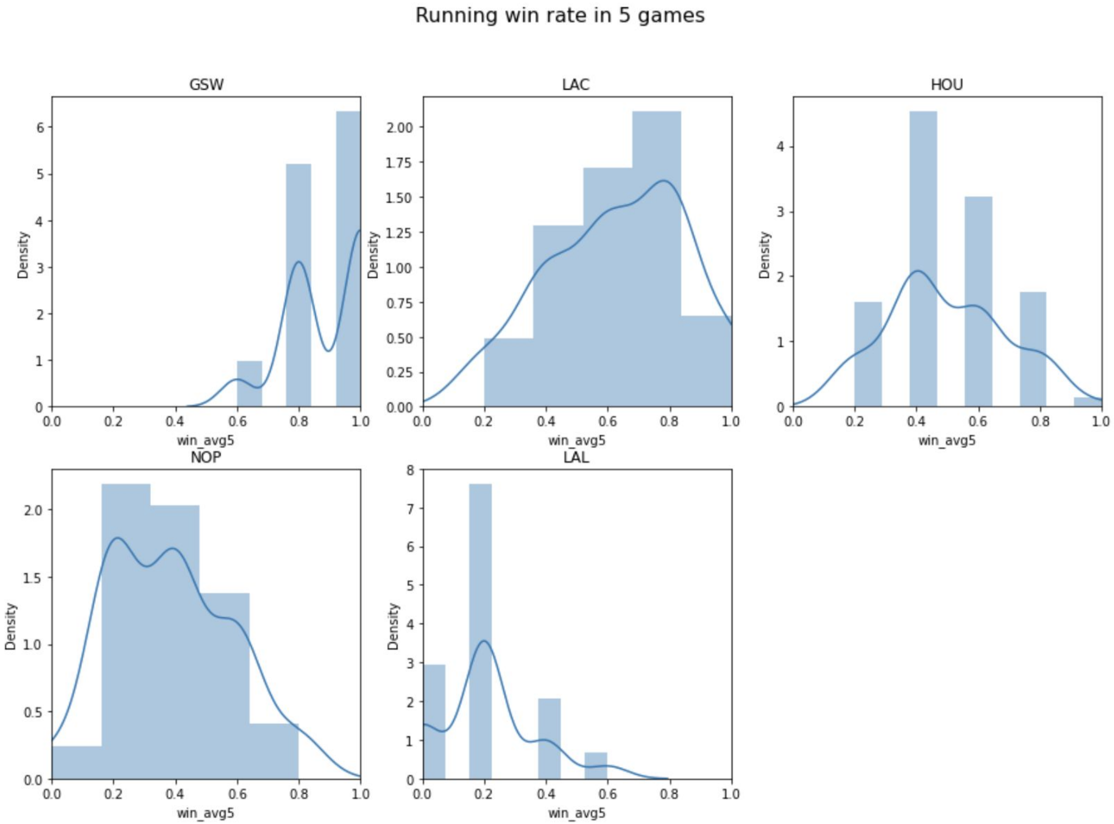
EDA - Distribution Plots (home_rate)



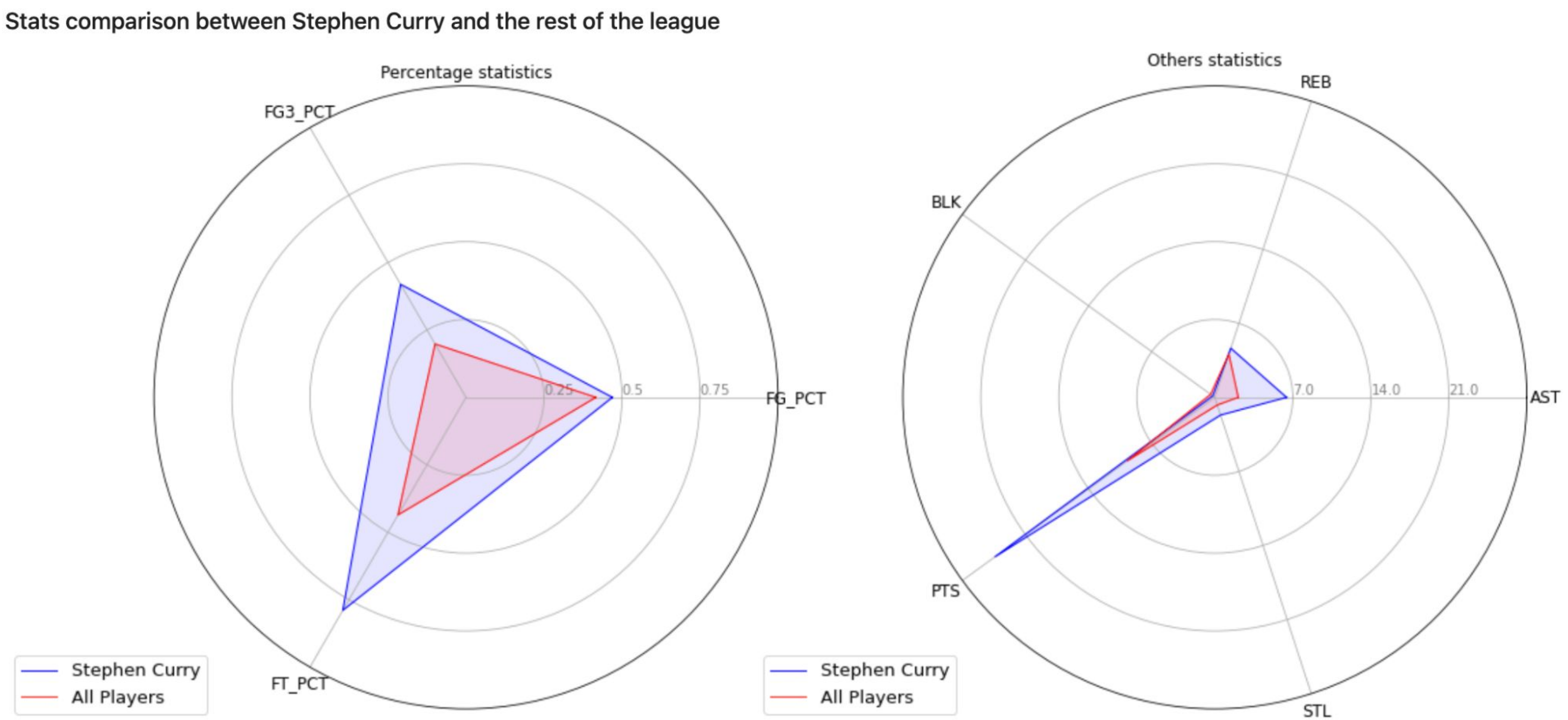
EDA - Distribution Plots (away_rate)



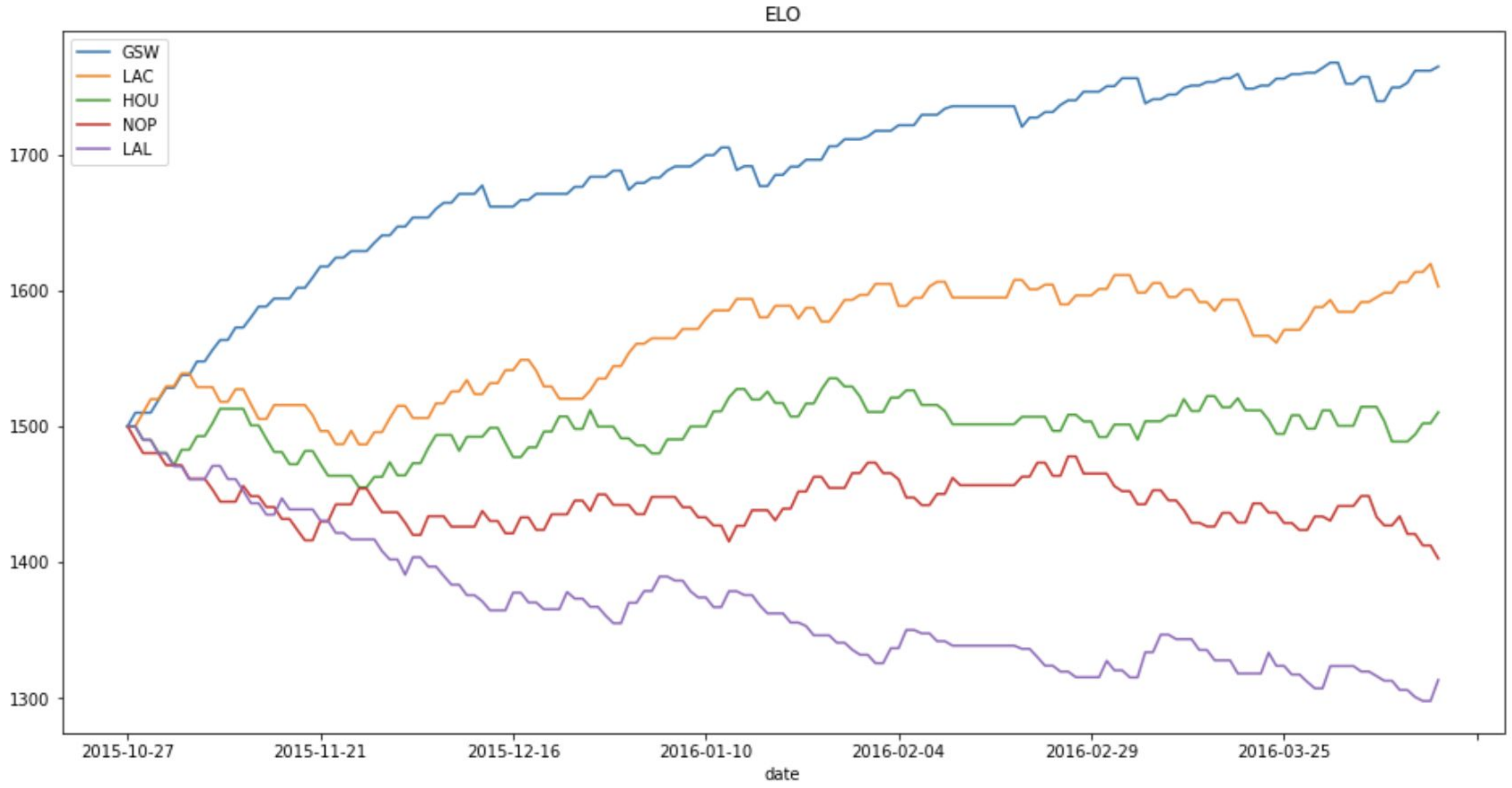
EDA - Distribution Plots (win_avg5)



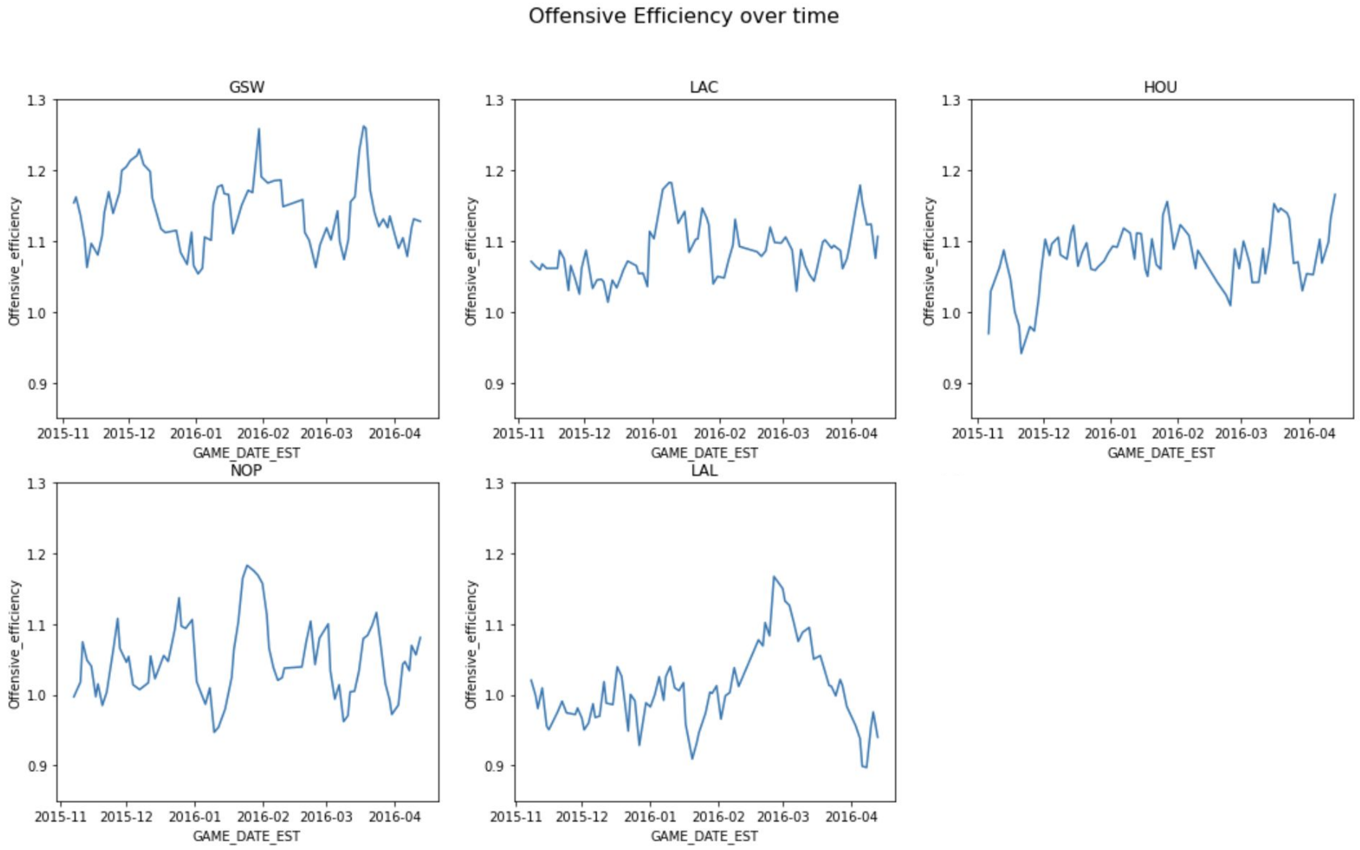
Player EDA - Stephen Curry vs. All Players avg



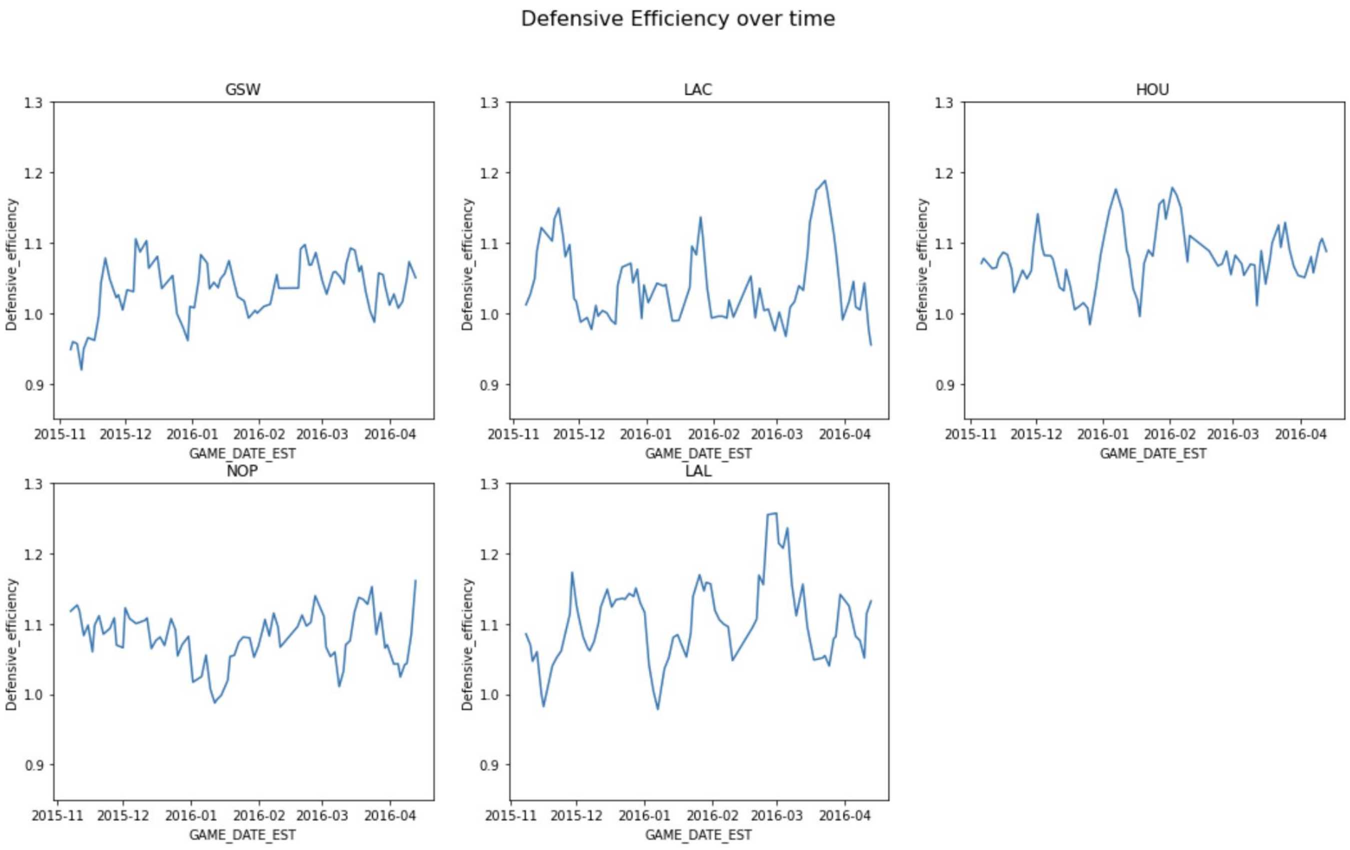
EDA - Elo over time



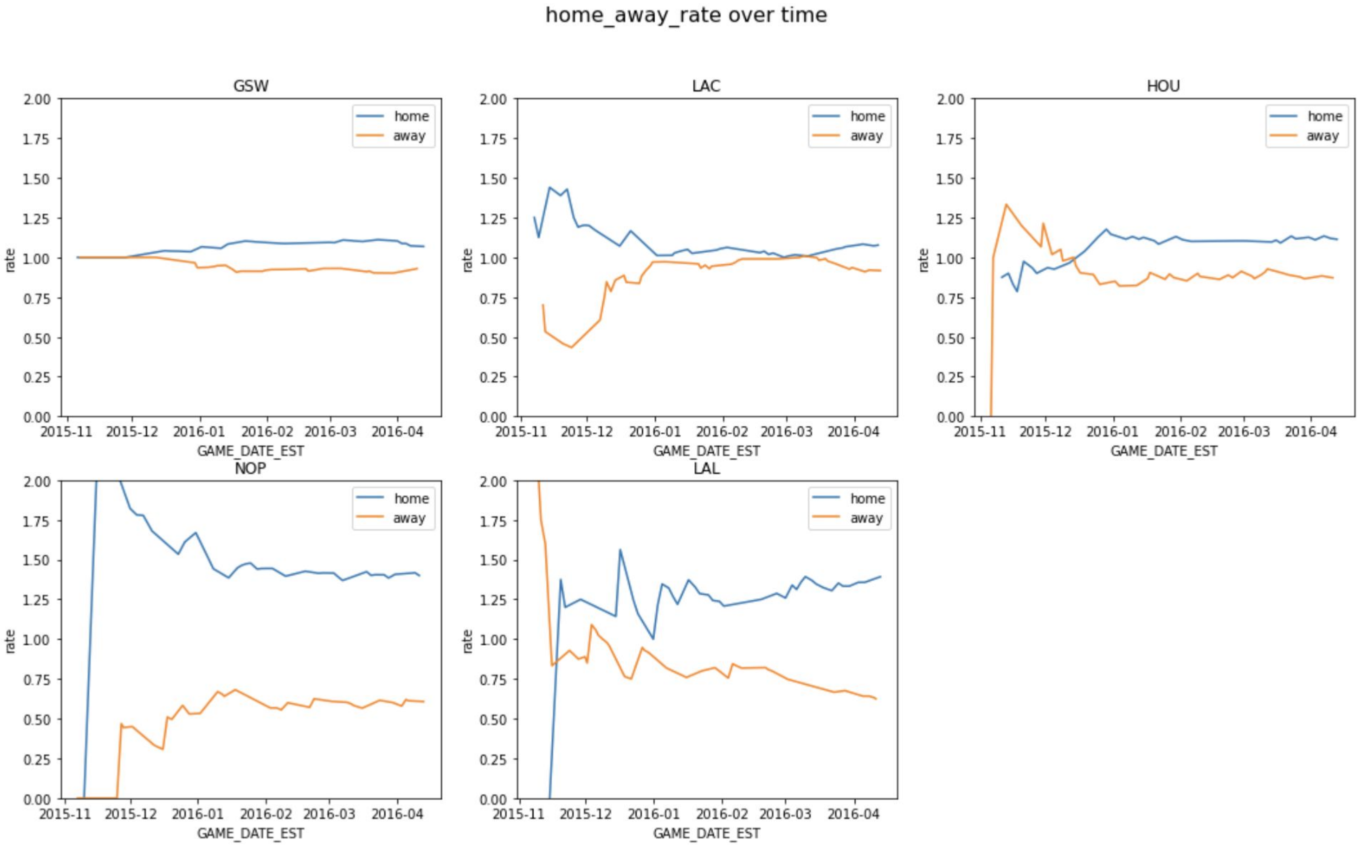
EDA - Offensive_efficiency over time



EDA - defensive_efficiency over time



EDA - home_away_rate over time



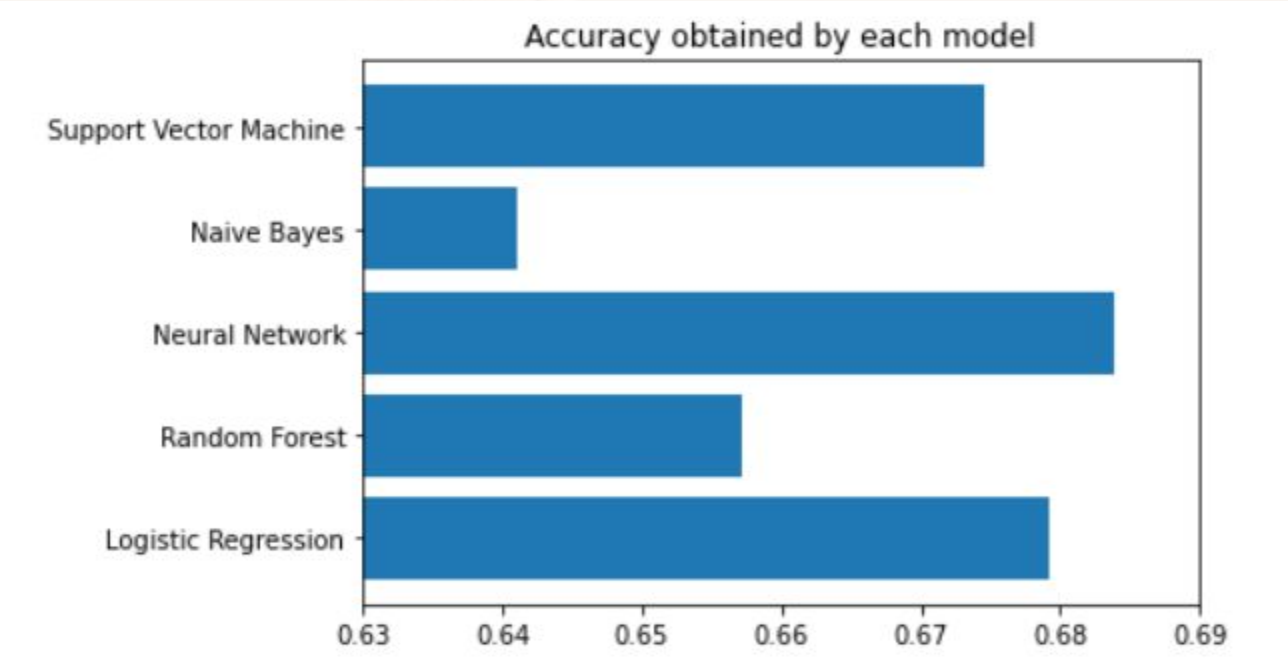
Modeling - Independent variables

- Offensive_efficiency_avg5_diff
- Defensive_efficiency_avg5_diff
- win_avg5_diff (momentum)
- elo_diff (strength)
- stad_diff (home_over_overall - away_over_overall)

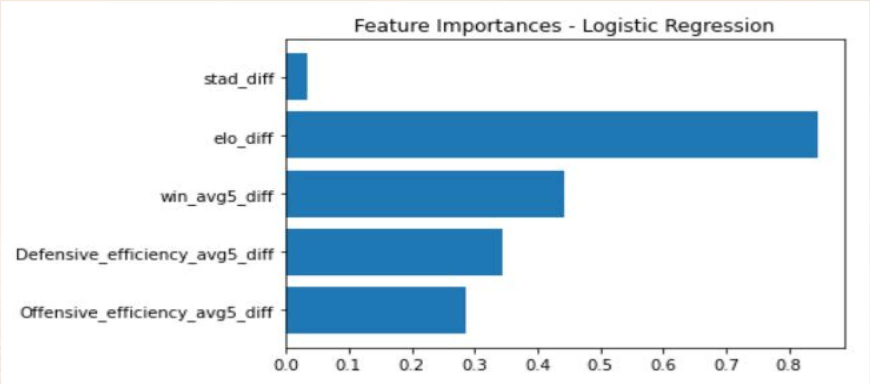
Modeling - Baseline: 50%

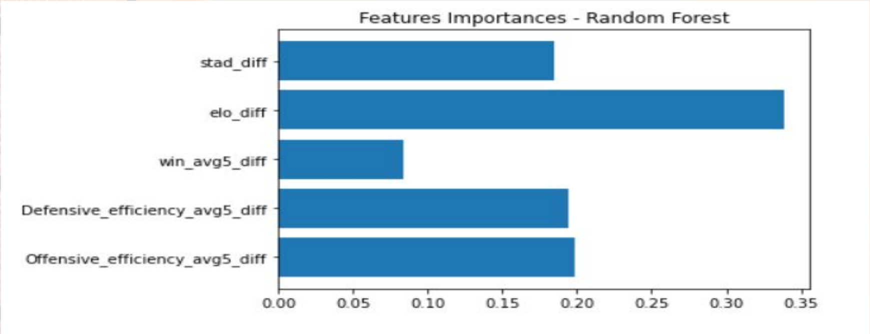
Modeling	K-Fold Cross Validation Accuracy	K-Fold Cross Validation Standard Deviation	Hyperparameter Tuning using GridSearchCV
Logistic Regression	67.58%	6.21%	67.93%
Random Forest	64.1%	5.80%	65.72%
Neural Network	68.04%	5.90%	68.39%
Naive Bayes	64.10%	8.12%	64.10%
Support Vector Machine	66.88%	5.67%	67.45%

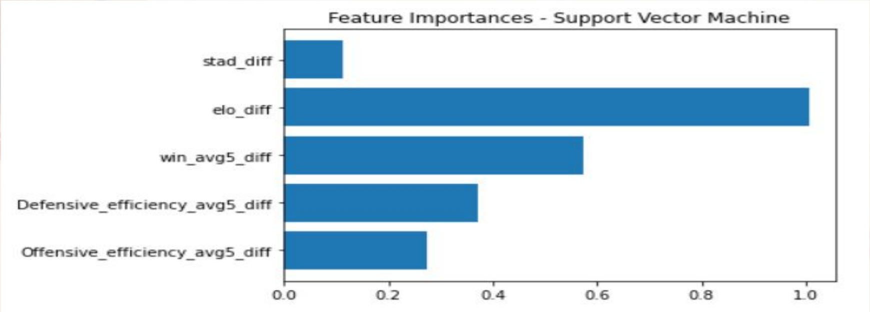
Modeling - Baseline: 50%



Modeling - Feature Importances







Conclusion

Results

- Improved accuracy from 50% to 69% (with highest accuracy recorded at 72%)
- Identified ELO rating and momentum as the most important factors

Further Applications & Improvement

- Incorporating data of dominant players & events (e.g. injuries, transactions)
- Compare differences between different NBA seasons to capture seasonal variation
- Modify ELO equation so number of games is taken into account when predicting games
- Implement a spread prediction model in order to use in real world gambling

Thank you