FANTASY FOOTBALL

PREMIER LEAGUE OPTIMIZATION

2023

01

INTRODUCTION

Summary of the project and its goals

PREMIER LEAGUE

PROJECT SUMMARY

FANTASY FOOTBALL

- Game usually played online
- Users create imaginary teams with drafted real-life players
- Scoring is based on real-life performances
- Each week, a user can drop, trade, and bench their players, so long as they are within their budget

FANTASY PREMIER LEAGUE

11M

USERS

For Fantasy Premier League in the 2022-2023 season

4.7B

VIEWERS

For Premier League across the globe

€ 5.5B

REVENUE

Generated by Premier League in the 2022-2023 season

Higher than the Spanish and German Leagues revenues **COMBINED**

PROJECT GOALS

INFORMED DECISIONS

Information needed to make decisions is constantly changing

Creates the opportunity for applying optimization techniques to constantly evaluate the best decision

BREAK DOWN COMPLEXITY

Unpredictability of player performance

Budget constraints

Game boundaries

Need to adapt strategies week-by-week

OPTIMAL TEAM COMPOSITION

Create an optimizer that will reliably deliver the best possible Premier League Fantasy Football team composition

Maximize their chances of success in Fantasy Football's competitive environment

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DESCRIPTION & FORMULATION

Problem description and mathematical formulation

PREMIER LEAGUE

PROJECT DESCRIPTION

- Formulated as a binary problem
- Various factors to maximize the total points accumulated by the team at the end of the season
- Data used was Premier League API data about the 2021-2022 and 2022-2023 season's individual player performances and fixtures
- Strategic decisions, including selecting players who consistently score goals, assist others, maintain clean sheets, and earn bonus points, must be made while staying within budget constraints

MATHEMATICAL FORMULATION

- 2,891 Decision Variables

$$Players_i \in \{0,1\}$$
$$Captain_i \in \{0,1\}$$
$$ViceCaptain_i \in \{0,1\}$$
$$Starting11_i \in \{0,1\}$$
$$Substitutes_i \in \{0,1\}$$

- Objective Function

$$Utility = \sum_{i=1}^{n}(Utility_i) * (Starting11_i + 0.4 * Substitutes_i + 2 * Captain_i + 1.5 * ViceCaptain_i)$$

$$ExpectedPoints(Xp) = \sum_{i=1}^{n}(Xp_i) * (Starting11_i + 0.4 * Substitutes_i + 1.5 * Captain_i + 1.4 * ViceCaptain_i)$$

The Objective function can be expressed then as:

$$\max Utility * 0.9 + Xp * 0.1$$

MATHEMATICAL FORMULATION

- Constraints for the problem include game-specific rules
- The initial squad size must consist of 15 players

$$\sum_{i=1}^{n} Players_i = 15$$

- Maximum of 2 Goalkeepers, 5 Defenders, 5 Midfielders, and 3 Forwards on the team

$$\sum_{i=\text{Goalkeeper Indices}} Players_i = 2$$

$$\sum_{i=\text{Defenders Indices}} Players_i = 5$$

$$\sum_{i=\text{Midfielders Indices}} Players_i = 5$$

$$\sum_{i=\text{Forward Indices}} Players_i = 3$$

- Value of your initial squad cannot exceed $100 million

$$\sum_{i=1}^{n} Cost_i * Players_i = 100$$

where $Cost_i$ = Cost of each player i in millions of dollars

- Only select up to 3 players from a single Premier League Team

$$\sum_{i=\text{indices of players in the same team}} Players_i \leq 3$$

- Only 11 players are active of the 15

$$\sum_{i=1}^{n} Starting11_i = 11$$

$$\sum_{i=1}^{n} Starting11_i \leq Players_i$$

MATHEMATICAL FORMULATION

- Active team must be between 3 and 5 Defenders, 2 and 5 Midfielders, 1 and 3 Forwards, and only 1 Goalkeeper

$$\sum_{i=\text{Defenders Indices}} Starting11_i \geq 3$$

$$\sum_{i=\text{Defenders Indices}} Starting11_i \leq 5$$

$$\sum_{i=\text{Midfielders Indices}}^{n} Starting11_i \geq 2$$

$$\sum_{i=\text{Midfielders Indices}}^{n} Starting11_i \leq 5$$

$$\sum_{i=\text{Forward Indices}}^{n} Starting11_i \leq 3$$

$$\sum_{i=\text{Forward Indices}}^{n} Starting11_i \geq 1$$

$$\sum_{i=\text{Goalkeeper Indices}}^{n} Starting11_i = 1$$

- The team captain has to be from the starting 11

$$\sum_{i=1}^{n} Captain_i = 1$$

$$\sum_{i=1}^{n} Captain_i \leq Players_i$$

$$\sum_{i=1}^{n} Captain_i \geq Starting11_i$$

MATHEMATICAL FORMULATION

- The vice-captain has to be from starting 11 and can't be the captain

$$\sum_{i=1}^{n} ViceCaptain_i = 1$$

$$\sum_{i=1}^{n} ViceCaptain_i \leq Players_i$$

$$\sum_{i=1}^{n} ViceCaptain_i \geq Starting11_i$$

- A player is either a substitute or in the starting 11

$$Substitutes_i + Starting11_i \leq 1$$

- 4 substitutes must be selected from the 15 player-team

$$\sum_{i=1}^{n} Substitutes_i = 4$$

$$\sum_{i=1}^{n} Substitutes_i \leq Players_i$$

- Vice Captain Cannot be the same player as the captain

$$ViceCaptain_i + Captain_i \leq 1$$

03

IMPLEMENTATION & RESULTS

Setting in Gurobi and results

PREMIER LEAGUE

EDA

LASSO REGRESSION

- Identify key performance predictors for different player positions
- Key attributes like clean sheets for GKs and goals scored for FWDs were crucial

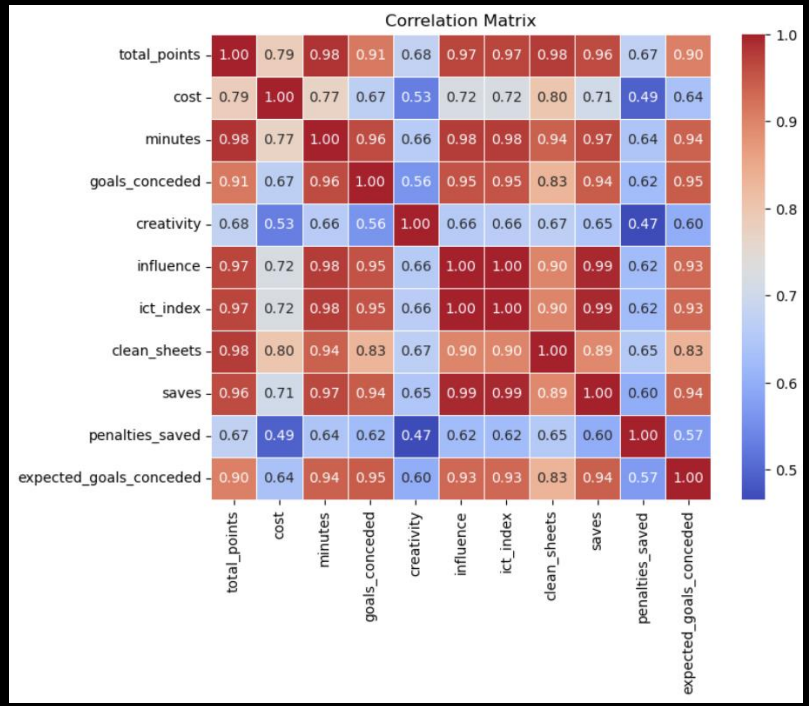
EXPLORATORY ANALYSIS

- Identified high-performing players based on average ratios.
- Assessed teams' offensive and defensive capabilities and their impact on player performance

OPTIMIZATION MODEL

- Binary model using Gurobi, with variables for player selection, captaincy, and lineup
- Maximize a combination of utility (from LASSO) and expected points (Xp)

CORRELATION ANALYSIS FOR GOALKEEPERS



Top Positive Correlates:

- Clean Sheets
- Saves

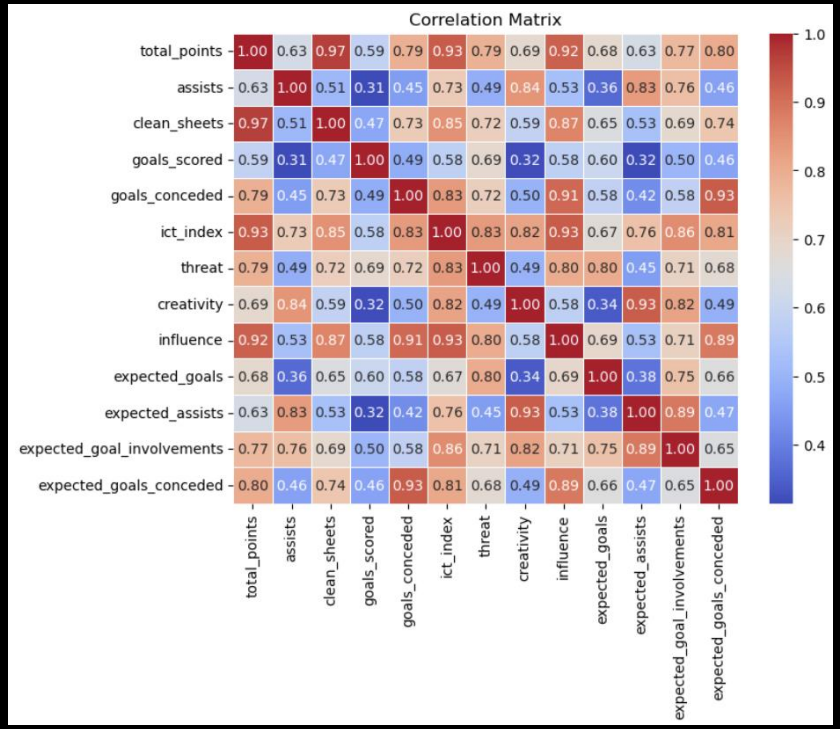
Key Negative Correlate:

- Goals Conceded

Noteworthy Insight:

- Penalties Saved

DEFENDER PERFORMANCE FACTORS



Top Point Indicators:

- Clean Sheets
- Influence

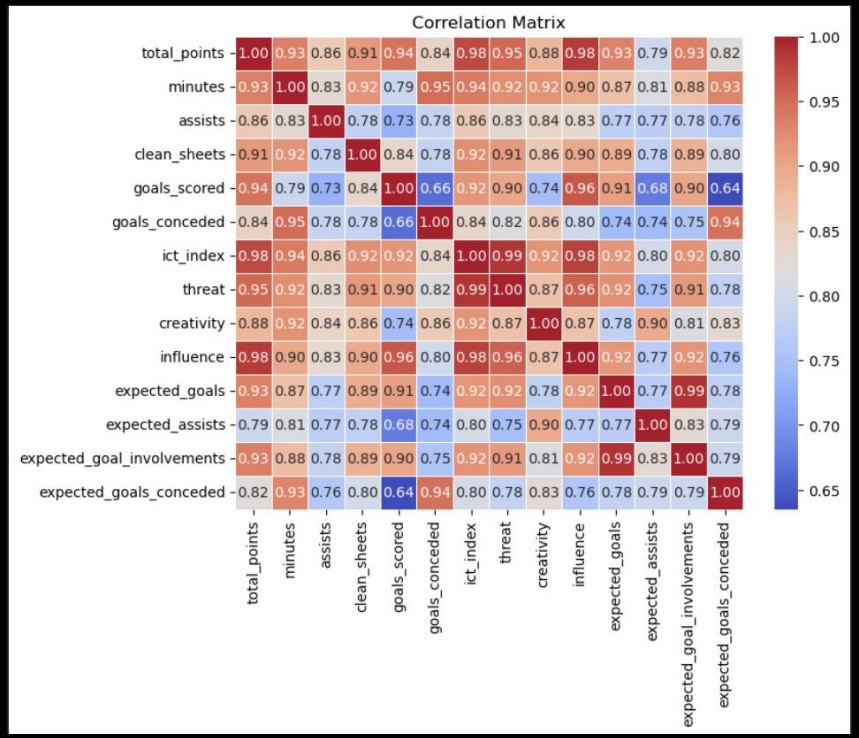
Points Penalties:

- Goals Scored
- Goals Conceded

Additional Metrics:

- Assists
- Goal Involvement

MIDFIELDER CONTRIBUTION ANALYSIS



Major Point Contributors:

- Playing Time
- Game Influence
- Part in Clean Sheets

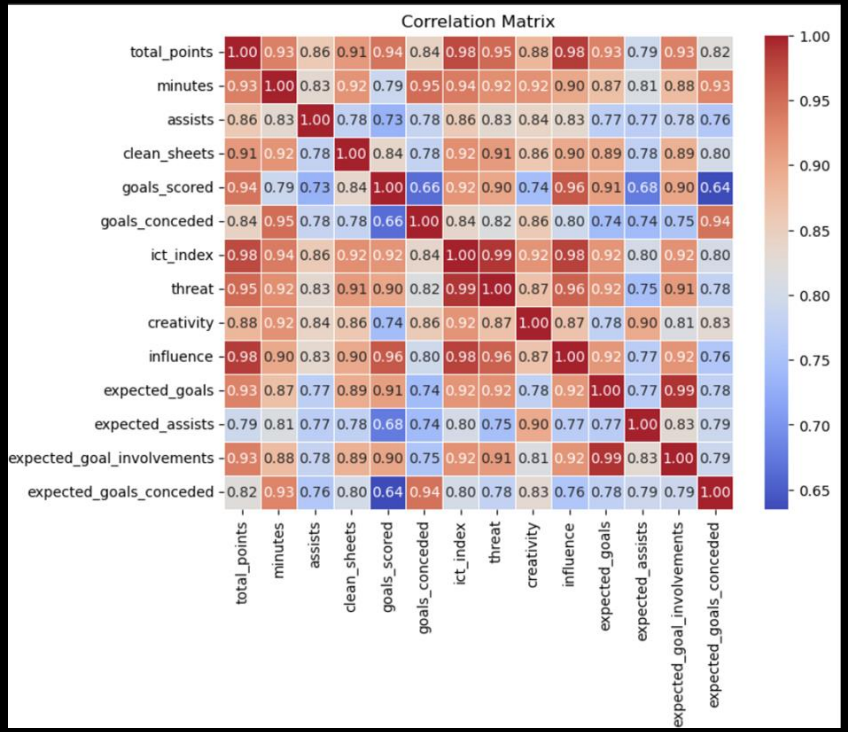
Detractors of Points:

- Team's Goals Conceded

Noteworthy Contributors:

- Scoring Goals
- Assisting Goals

FORWARD PERFORMANCE CORRELATION



Primary Point Drivers:

- Goals Scored
- Play Time

Supporting Metrics:

- Assists
- Clean Sheets

Predictive Insights:

- Expected Goals & Assists

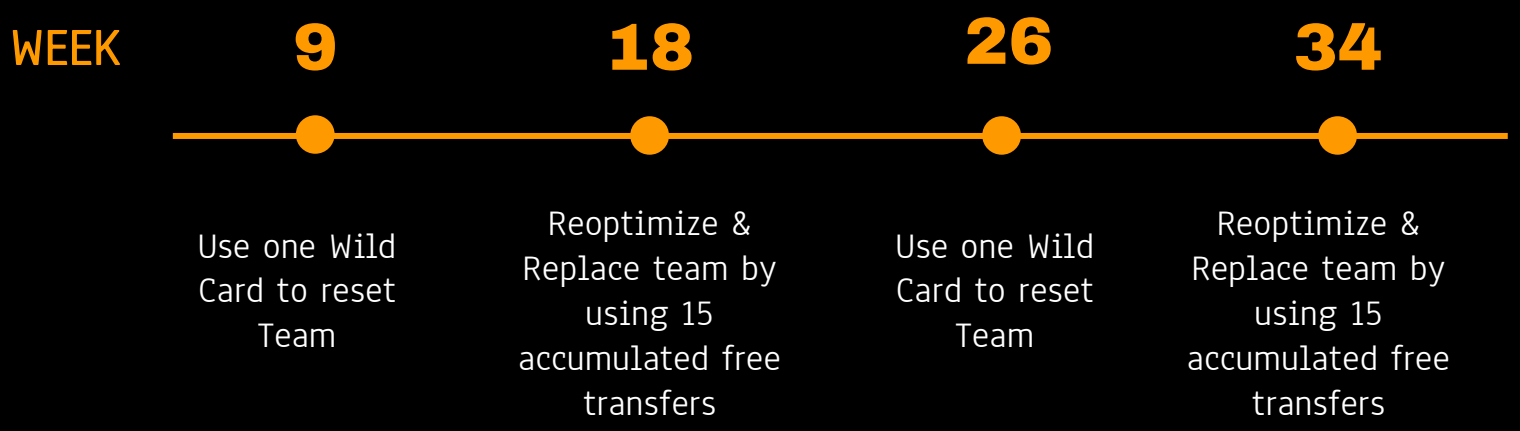
MID-SEASON OPTIMIZATION

- Two things are of interest here. How can we use these efficiently

Wild Cards
- Two Allowed Per Season

Free Transfers
- One allowed per gameweek

- Our Strategy:



MID-SEASON OPTIMIZATION

- Having identified the optimization of the team, we incorporated the mid season optimization
- We will optimize a similar objective function as we did in the initial model subject to the same constraints. As such we create the objective function:

Maximize 0.9*Utility + 0.1 *Xp

Utility is the sum of each player statistic multiplied by the statistic's weight as generated by LASSO

Xp a predicted expected number of points generated by the Premier League for each player based on his upcoming fixture

$$Utility = \sum_{i=1}^{n} (Utility_i) * (Starting11_i + 0.4 * Substitutes_i + 2 * Captain_i + 1.5 * ViceCaptain_i)$$

$$ExpectedPoints(Xp) = \sum_{i=1}^{n} (Xp_i) * (Starting11_i + 0.4 * Substitutes_i + 1.5 * Captain_i + 1.4 * ViceCaptain_i)$$

RESULTS

RESULTS

- Strategic selection aligned with budget and performance
- Ex. De Bruyne and Salah as captain/vice-captain
- Consistent high points across gameweeks; total of 2,487 points over the season.

INSIGHTS

- Significant contribution to the overall points tally.
- Model adapts to circumstances like double gameweeks and missed matches.

Mohamed's Total Points for the 2022/23 Season

Season	Points
2022/23	2139

Our Model's Total Points for 22/23 Season: 2,487 points

RANK	MANAGER	TEAM	OVERALL RANK	TOTAL
1		RADWANSKI	229504	2482
2		FC RAHMAN	255836	2475
3		KADRY FC	1464204	2306
4		CHEEKY FAYEK	1847289	2271
5		HERE WE GO	2624243	2206
6		JOELIPTON	3004194	2176
7		ENANY FC	3472571	2139
8		ELON MIAMI FC	3796392	2114
9		SEL1IM FC	6147681	1926
10		BIGMAK	6860516	1863
11		KEANOÂ€™S MAGIC HAT	8525369	1693

MMA 2022/23				
RANK	MANAGER	TEAM	OVERALL RANK	TOTAL
1	OM SANJAY SANGWAN	LUKAKU FC	499197	2425
2	TAREK CHEAITO	ETH SZN	579583	2411
3	U. PAL	SOUTHWEST UTD	1518784	2301
4	AVINASH SINGH SIDHU	SIDHU	2540756	2213
5	MOHAMED ELENANY	ENANY FC	3472571	2139
6	JARED-ARVIND B	BIG ANGE ARMY	6661411	1881
7	ADITYO DASGUPTA	CLASS ON GRASS	6982512	1852

Winner of Fantasy Premier League for 22/23 season - #1 user on leaderboard

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PROBLEM EXTENSION

Further Extension of the Problem

PREMIER LEAGUE

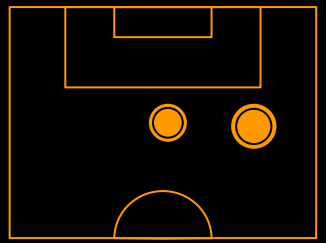
FURTHER EXTENSION

- Inclusion of other chips from the FPL such as triple captain points or Free Hits
- Addressing the consistent change of vice captain and captains to reflect changes in games that could impact points e.g. opponents being faced
- Weekly transfers based on fixture difficulty and player inavailability
- Use of previous season data for initial team selection limits us because there might be new entrants in the league that we may not have had oversight on that could have made an even better selection

INITIAL TEAM CHOICE - LOST OPPORTUNITY

Erling Haaland

Nationality: Norway
AGE: 23
Team: Manchester City
Transfer Season: 2022/2023



POSITION ON THE FIELD

Forward

Gameweek 1

Earned 96 points

Gameweek 8

What if we captained him?

2*96 = 192 points lost opportunity

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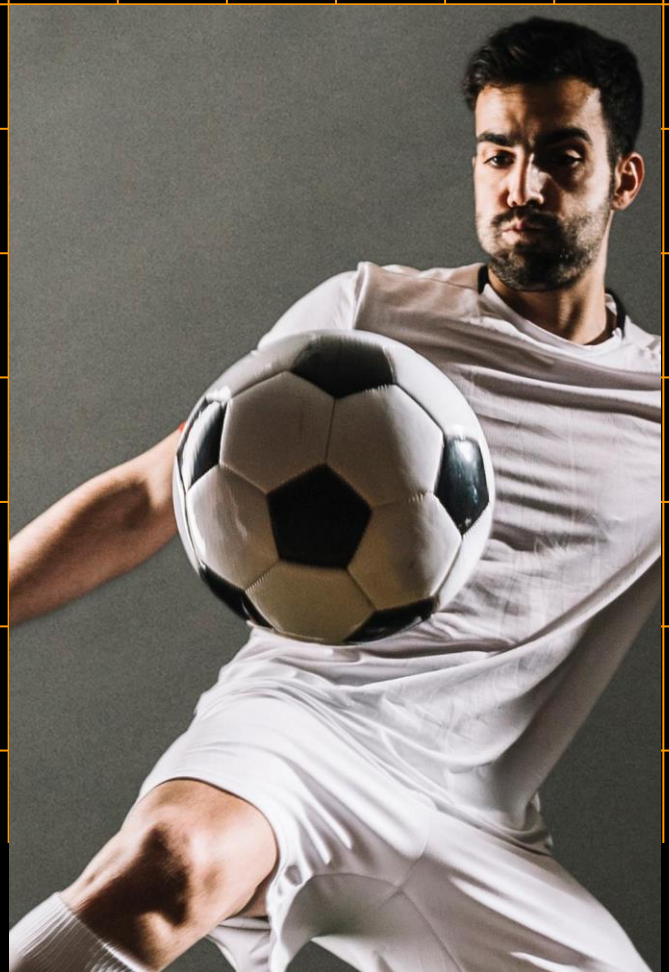
CONCLUSION

Final Results and Recommendations

PREMIER LEAGUE



CONCLUSION

- Our model is able to optimize the team selection and in season transfers and obtain a high performing team while striking a clean balance between cost and performance
- It's however lacking in not taking into consideration the week on week activities that are involved in the regular game. Use of past season data is also problematic
- Potentially explore incorporating other wildcard features such as Free Hit, Triple Captain and Weekly Captain changes into the model could be further enrich the model

THANK YOU!

Q&A