Football Analytics: Modelling Rarita's New Football Team and its Economic Impact

ACTL4001 Group Project
Pratyush Charde
Abinesh David
Saraf Jilani
Areeba Khan
Theodore Sugita

Table of Contents

1. Objectives of Analysis

Forming a competitive national team is a complex process. The aim of this report is to assist this process via two main components. First, an outline of the method of selecting team players by analysing the player data available. Second, a forecast of the economic gains to Rarita generated by having a competitive team. Specifically, in terms of selecting players, a boosting regression was implemented to predict player salaries based on skills relevant to their position. For economic forecasting, a Holt-Winters exponential smoothing model was utilised to predict future revenues. Following from these analyses the report will outline a general implementation plan over the next ten years, list the assumptions used in the models, as well as consider the risks involved and the data limitations present.

2. Team Selection

Competitiveness

Competitive viability for team selection as follows:

- Maintain a sound ***financial*** standing, generating profits to boost the economy over the next 10 years
- Build a ***skilled*** team by choosing the best players using our selection criteria defined below

Selection Criteria

The rationale behind player selection is centred around salaries. Specifically, whilst player salaries are known, the approach taken assumes that some players are overpaid or underpaid based on their skills and performance. According to a study conducted by Togler & Schmidt, salary has a significant predictor of a player's performance (2007) [1]. Hence, a Gradient Boosting Machine Regression (GBM) was used to predict skill-based salaries.

Recognising the relation between salary and skill, we use the GBM to choose the highest paid and under-priced players for every position as shown in figures below. All high salary players belong to countries ranking in the top 10 tournament standings to boost the "competitiveness" of our team. Furthermore, we have also chosen young and the most under-priced players to maintain a competitive team throughout the next 10 years, while remaining financially sustainable (shown below). We have also included at least 1 Raritan national for every position, to promote the sport within the country (shown below).

FORWARD SELECTIONS						
NAME	NATION	POS	AGE (2021)	Reason	pred/actual	salary payable
D. Makumbi	Rarita	FWMF	18	Underpriced	21.2757744	$ 470,000.00
N. Opolot	Dosqaly	MFFW	18	Underpriced	10.8321866	$ 1,793,000.00
Q. Khumalo	Esia	FWDF	22	Highest salary	1.31734091	$26,015,000.00
O. Pellegrini	Esia	FWMF	27	Highest Salary	1.14821075	$29,766,000.00
						SUM
						$ 58,044,000.00

Figure 2.1: Forwards Selection

MID SELECTIONS						
NAME	NATION	POS	AGE (2021)	Reason	pred/actual	salary payable
X. Tu	Rarita	MF	20	Underpriced	11.308201	$ 1,690,000.00
X. Wouters	Sobianitedrucy	MF	23	Underpriced	35.257358	$ 803,000.00
C. Neri	Nganion	FWMF	24	High Salary	1.00334366	$28,787,000.00
						SUM
						$ 31,280,000.00

Figure 2.2: Midfielders Selection

DEFENSE SELECTIONS						
NAME	NATION	POS	AGE (2021)	Reason	pred/actual	salary payable
H. Sinaga	Bernepamar	DF	23	Underpriced	11.9874378	$ 792,000.00
Q. bin Ismail	Rarita	DF	24	Underpriced	5.63916848	$ 920,000.00
I. Khalili	Esia	FWDF	22	High Salary	1.89403278	$16,005,000.00
Y. Jain	Esia	DFFW	24	High Salary	1.05476598	$26,466,000.00
C. Tukamushaba	Rarita	DF	25	Underpriced	5.22776041	$ 970,000.00
G. Tukwasibwe	Dosqaly	DFFW	19	High Sal	1.36838816	$19,305,000.00
						SUM
						$ 64,458,000.00

Figure 2.3: Defenders Selection

GK SELECTIONS						
NAME	NATION	POS	AGE (2021)	Reason	pred/actual	salary payable
X. Driscoll	Nkasland Cronestan	GK	20	Underpriced	8.63504809	$ 1,639,000.00
F. Akumu	Rarita	GK	20	High Salary	1.11820201	$12,380,000.00
A. Lamunu	Dosqaly	GK	20	High Salary	1.11457825	$19,888,000.00
						SUM
						$ 33,907,000.00

Figure 2.4: Goalkeepers Selection

Probability of Being Competitive

A logistic regression was implemented for relevant statistics in each position to predict the probability that an individual player would be on a competitive team (Appendix A3).
The probability results are as follows:

Forward	
D.Makumbi	0.48395421
N. Opolot	0.54504902
Q. Khumalo	7.44×10^{-7}
O. Pellegrini	0.83655235
Midfielder (Passing data)	
X. Tu	0.12154017
X. Wouters	1
C. Neri	0.99995889
Defence	
H.Sinaga	0.99973321
Q. bin Ismail	0.01440562
I. Khalili	0.1925561
Y. Jain	0.88547902
C. Tukamushaba	0.99995155
G. Tukwasibwe	0.00479918
Goalkeeper	
X. Driscoll	0.84234566
F. Akumu	0.80176303
A. Lamunu	0.81824187

Table 2.1

Average Pr(Competitive team) = **0.596645664**

A majority of players have a probability greater than 80% of being part of a competitive team. There exist a few players with low probabilities (chosen based on their under-priced salary relative to performance). However, they are greatly outnumbered and may improve as explained below.

Positive peer effects can enable lower probability players to increase their probability of competitiveness through the influence of higher probability players. This can be supported by the labour economics literature. According to MIT professor Daron Acemolu (2017), peer effects may have a positive externality [2] that improve the performance of lower performing participants within a group. If the players' utility functions exhibit submodularity, that is, negative cross partial derivatives, we can expect lower probability players to be positively influenced by most higher probability players. This will increase overall team competitiveness through time.

Revenues & Expenses generated from a competitive team

We have used Holt-Winters forecasting, a time series method to predict the future revenues based on historical data provided. This method assigns exponentially decreasing weights to older values, keeping our results relevant, and as better to data without an obvious trend or pattern [3].

Inflation was predicted using exponential forecasting over the next 10 years and used in all calculations (Appendix A2).

YEAR	Revenue (ðmillions)	Expenses (ðmillions)	Salaries (ðmillions)	Profits (ðmillions)
1	410	289.5	191.3	121
2	420	294.2	194.9	126
3	430	298.2	199.0	132
4	440	300.6	203.3	140
5	450	301.7	207.9	148
6	460	300.6	212.1	159
7	470	298.8	216.4	171
8	480	296.1	221.0	184
9	490	292.3	225.3	198
10	500	288.1	229.5	212

Table 2.2

Using the spot rates provided and assumption (1), the Net Present Value (NPV) was calculated (Appendix A2). Results shown below for:

TOTAL NET PRESENT VALUES (ðMillions)

SALARY	1,953.8
REVENUE	4,230.7
EXPENSES	2,764.2
PROFITS	1,466.6

Table 2.3

We will not be loaning out players from our country as to preserve national competitiveness. Furthermore, our models have predicted that we have approximately 47% of our budget remaining after considering all direct team expenses for the next 10 years.

3. Economic Impact

Impact on GDP

According to Keynesian economic theory, an increase in one of the components of aggregate demand (AD) will lead to a multi-fold increase in total GDP through the multiplier effect. The multiplier effect encapsulates the idea that once spending is distributed, it flows on into other channels of the economy.

Applying this framework will illuminate how a competitive football team can improve Rarita's GDP and economic performance overall. The football team's profits will increase AD through consumption and/or investment, and thus increase total GDP by a greater amount via the multiplier. A multiplier of 1.7 has been calculated for Rarita's economy using the GDP and household savings rate data given (Appendix A1). Using the projected profits of the football team, this multiplier will determine the total increase in the country's GDP. The results to total GDP are shown below:

YEAR	PROFITS (ð Millions)	Impact to Total GDP (ð Millions)	Impact to Total GDP
1	121	205.7	**ð2.49B**
2	126	214.2	
3	132	224.4	
4	140	238	
5	148	251.6	
6	159	270.3	
7	171	290.7	
8	184	312.8	
9	198	336.6	
10	212	360.4	

Table 3.1

The total impact to GDP was projected to have a NPV of ð2.49B using cashflows discounted by spot rates with yearly yield to maturity for 2021.

Universal Healthcare Access Initiative

The establishment of Rarita's football team also provides the Raritan government a unique opportunity to address some of the structural societal issues the country is currently facing. More specifically, the government can begin to tackle the large disparity in healthcare spending across Rarita's three provinces.

It has been observed that despite West Rarita comprising of 60% of Rarita's total population, it only represents 16% of the nation's total healthcare spending in 2020. The underfunded nature of West Rarita's healthcare system is demonstrated in its ð460 healthcare spending per capita, in stark contrast to East and Central Rarita, at ð4,979 and ð2,839 respectively.

It was initially assumed that reinvestments of proceeds from the Raritan football team, in addition to other pertinent factors impacting provincial economic growth would naturally address this issue. However, empirical analysis shows that West Rarita's marginal propensity to spend on healthcare is only at 3.5%. This is contrasted to Central Rarita's driven commitment to developing their healthcare system at 10.9%, and East Rarita's strong 4.8%, despite currently retaining ð4,979 in healthcare spending per capita (over 10 times West Rarita's equivalent figure). As such, it is possible that prosperous economic growth could actually worsen the healthcare inequality.

When analysing the impact of a lump sum subsidy to West Rarita's healthcare in 2030, we observe that allocating 70% of the Raritan football team's projected surplus increases healthcare spending per capita by 40%

This investment impact was less material than expected, with West Rarita currently projected to have a healthcare spending per capita at only 36% of the projected national average. As such, it is suggested that the fund be the beginning a long-term initiative for structural reform in addressing the current inequitable access to healthcare.

The "Universal Healthcare Access Initiative" would involve restructuring the healthcare system to become more centralised, to capitalise upon the previously misallocated distribution of spending. Nationalising the healthcare system reduces the need for, and complexity of external investment. In 2030, it is projected that a national healthcare system would require to grow by ð9.89B in order keep up with population growth and maintain current national healthcare spending per capita levels. This figure represents 47% of the Raritan football team's forecasted profits in 2030 dropping from 79% in 2021, suggesting that the Raritan football team could serve as a potential long-term fund source in order to maintain national healthcare spending per capita, and allow the government to maintain its obligation to provide equitable access to healthcare.

4. Implementation Plan

Implementation Timeline

Metric 1. Reassessing the FSA champion team (i.e., that scored the first position) against the chosen Rarita's team through critical attributes that are crucial in players across all the positions.

Key Reporting Assessment:

- We will be completing yearly assessments of key attributes of the top three teams as the performance indicators for Rarita's football team across the following positions:
    1. Shooting: Standard SoT, Standard SoT%, Standard SoT90/Sh90, Standard G/SoT
    2. MidFielder: Total Cmp%, Total TotDist, Short Cmp%, Medium Cmp% and Long Cmp%
    3. Goalkeeping: Performance GA, Performance Save%, Performance CS%, Penalty Kicks Save%, Playing Time 90s.

4. Defence: Tackles TklW/Tackles TKl, Tackles Def 3rd, Tackles Mid 3rd, Tackles Att 3rd, Vs Dribbles Tkl%, Vs Dribbles Past, Pressures %, Pressures Def 3rd, Pressures Mid 3rd, Pressures Att 3rd, Blocks Sh, Blocks ShSv, Blocks Pass

Solution:

- Personalised training programs for players in need of specific training
- Assess whether new coaches or trainers are required to ensure training is successful

Schedule of reporting: End of every FSA Championship League.

Metric 2. Keep track of over and underpriced salaries using GBM to ensure financially viability.

Key Reporting Assessment:

- Adding the previous year's data to the current information used for our modelling, where a new predictive salary must be estimated. As a result, there can be two of the following outcomes:

  Outcome 1. Predictive salary is lower than the Current salary as per the contract of the player
  Outcome 2. The predictive salary is higher than the player's current salary

Solution:

Outcome 1: In this instance, the contract details (provided in the Assumptions section (3)) stipulates that the country has the power to provide the team's individuals with a 2-month warning to show that they are working towards increasing their performance. If not, considerations will be made to reduce the player's salary.
Outcome 2: This will ensure that the plan is going as per the proposed strategy, and the players can be provided with yearly bonuses.

Schedule of reporting: At the beginning of every new year.

Metric 3. Ensuring that all players' overall probability of competitiveness is increased by 10% at every championship league over the next ten years compared to their initial 59%.

Key Reporting Assessment:

- Yearly friendly test matches between Rarita and the top ten countries that will participate in the championship. Based on the friendly matches, we will ensure an increase in competitiveness. We will aim for a 70% win rate in 2023. By 2026, we aim to win all friendly matches, which will also drive the success rate of Rarita winning the FSA championship.

Solution:

- Customised training for each player
- Incorporate the critical attributes shown by winning players in each position into our customised training program. The cost associated with this training programme is given in Assumption 8.

Schedule of reporting: Beginning of every year.

Implementation Process:

This depicts the ACC implementation of the identified metrics.

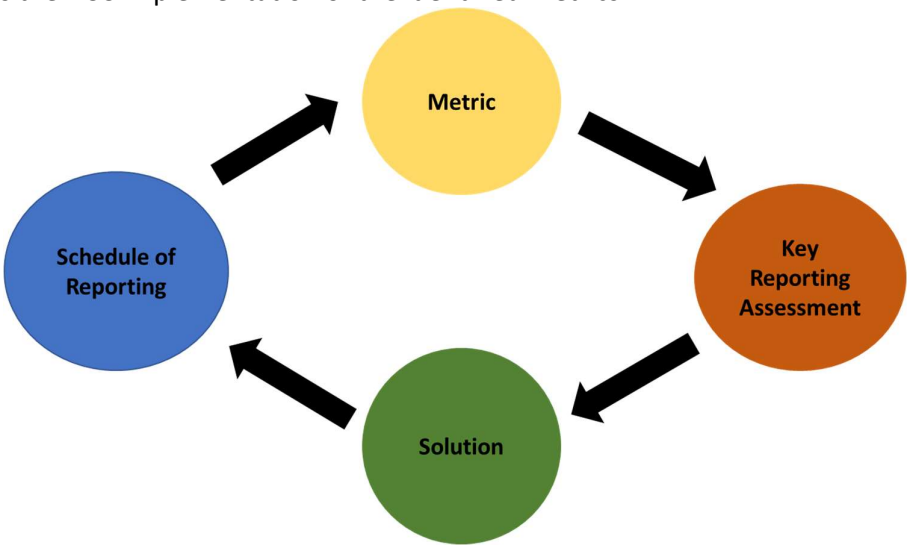


Figure 4.1

Note: Appendix A6 breaks down the budget allocation for the implementation timeline across the different key metrics identified in the analysis above.

5. Assumptions

- Average staff expenses to total expenses were found to be 66% for all other countries. Assuming staff expenses majorly consists of salaries, we have replicated this ratio in calculating expenses & salaries (Appendix A2) in the table above.
- Assume a multiplier effect of 1.7, given the calculations performed (Appendix A3).
- The players have signed a lock-in contract that prevents them from quitting. However, the contract is contingent on their performance where the country retains the right to reduce their yearly salaries with a 2-month warning notice before taking any action.
- No government mandated lockdowns or restrictions.
- Players can play for countries other than their nationalities.
- Rarita's revenue follows the trends of the top ten current nations.
- Rarita's economy is suitably similar to that of the other top ten nations.
- The cost of training excluded from calculating expenses.
- Players will remain over a tenure above ten years (hence players younger than 27 years old).

6. Risk Mitigation Strategies

RCD Tool with Risk Mitigation Response (Qualitative Risks)

Risk Category	Risk Division	Definition	Risk Mitigation Strategy
Operational	Health: Pandemic	Infect Rarita's players and management staff	Reduce: Hire 5 substitutes to mitigate the risk of a shortage of players
Operational	Human resources: labour	Players leave for another team	Remove: Establish lock-in contracts for all players
Operational	Human resources: labour	Injured players	Reduce: Employ physiotherapists to treat injuries and substitute players
Operational	Security: terrorism	Terrorist attack in Rarita football stadium	Reduce: Hire security staff on grounds during matches and training
Strategic	Competition: outperformed	Other teams outperform Rarita out of the top ten	Retain: accept risk due to the intrinsic nature of the industry and appeal of the sport
Strategic	Competition: high-profile player	Rarita competes against a team with a superstar player who drastically reduces their chance of winning	Exploit: use as a marketing opportunity to raise the stakes and generate a larger fan following
Strategic	Economic	Unforeseen recession reduces tourism demand	Reduce: implement expansionary monetary and fiscal policy to recover the economy
Financial	Liquidity	Liquidity risk if cash flows become negative	Reduce: raise capital from investment banks and other non – governmental funding

Table 6.1

Risk Map for Qualitative Risks:

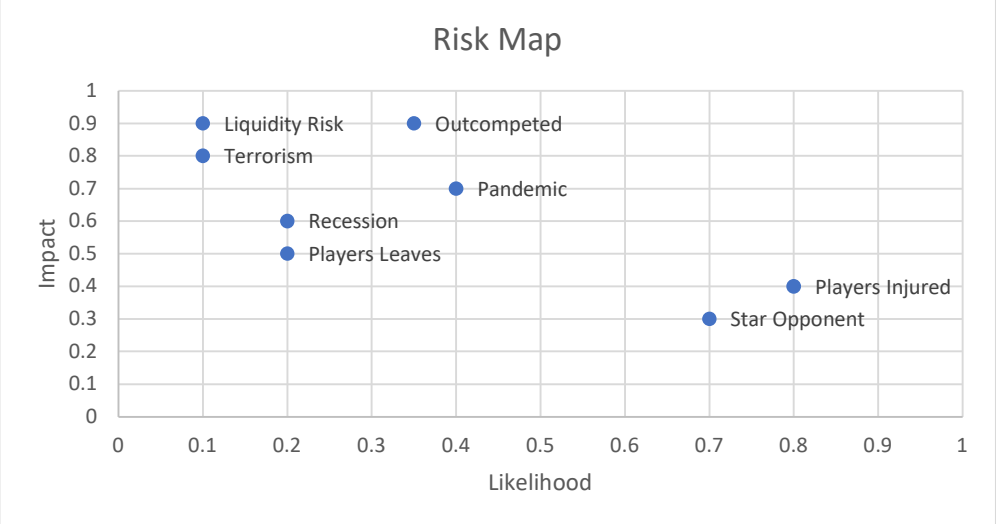


Figure 6.1

As illustrated in the diagram above, the qualitative risks have an ideal trade-off between impact and likelihood. Furthermore, the risk map illustrates the impact and likelihood before risk mitigation is implemented. Hence, after these strategies are implemented, it is expected that these likelihoods will fall significantly. In the case of 'Player Leaves', likelihood will fall to zero, due to the introduction of lock-in contracts.

Quantitative Risk: Implementation Modelling Risk

The quantitative risk considered was the accuracy of the salary models. Two models (GBM, MLR) were fitted, and model selection was determined using MSE and goodness-of-fit graphs.

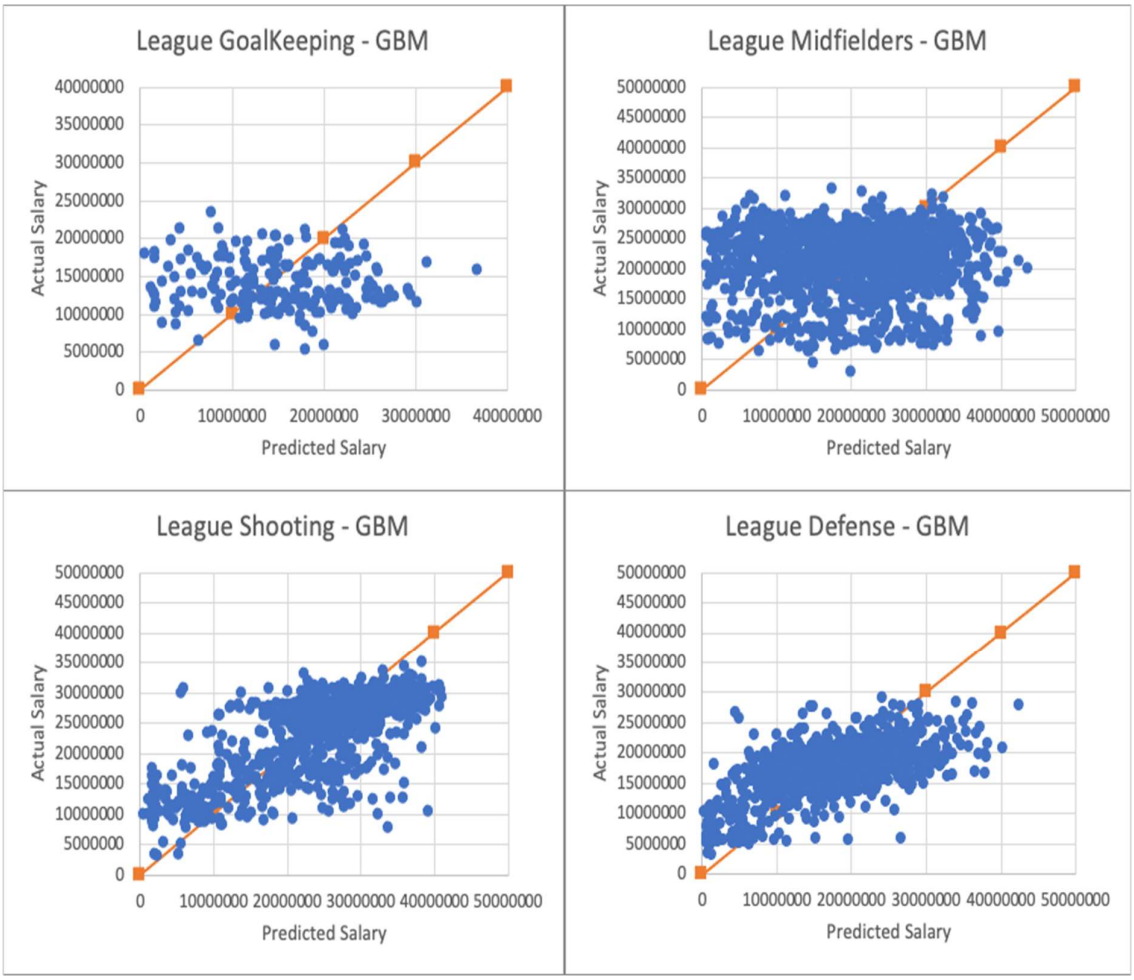


Figure 6.2: GBM Goodness of Fit Graphs

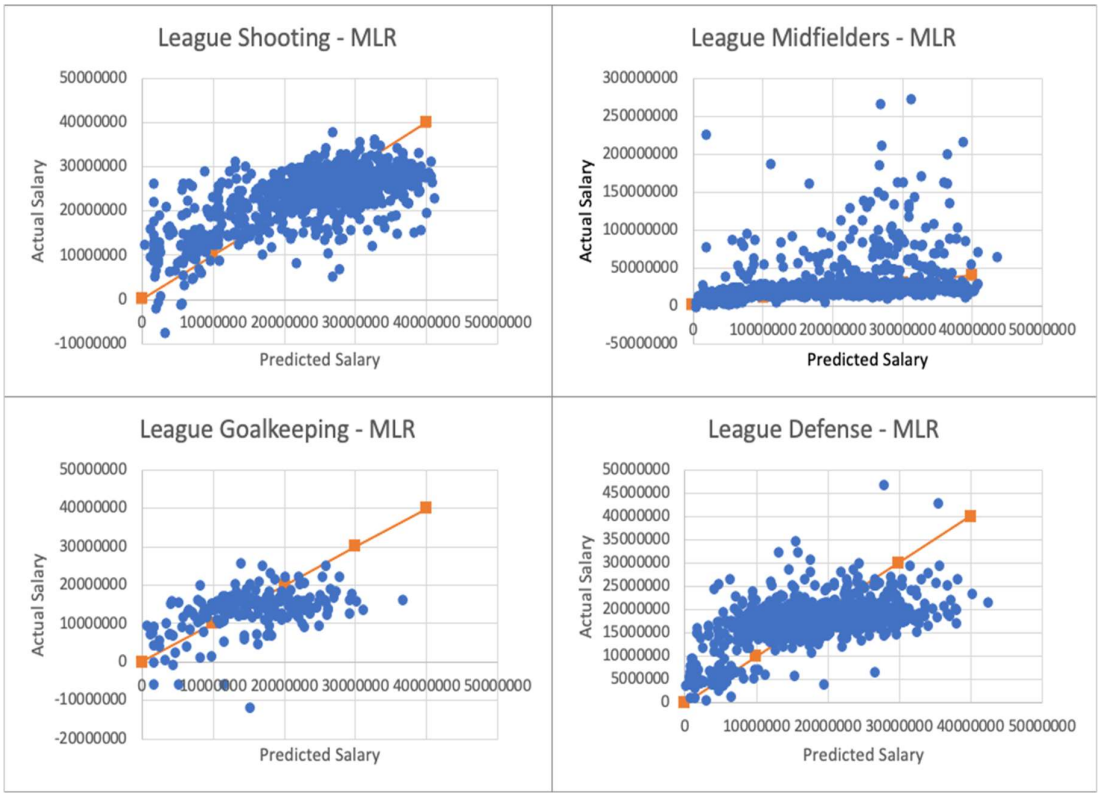


Figure 6.3: MLR Goodness of Fit Graphs

Model	MSE			
	Shooting	Midfielders	Goalkeeping	Defence
GBM	53,923,766,789,177	110,805,631,437,150	64,950,070,109,339	37,352,472,693,815
MLR	44,769,078,068,805	679,767,356,578,069	46,714,531,521,094	40,556,600,000,000

Table 6.2

Both models use 2020 salaries as the training dataset and 2021 salaries as the testing dataset. The test results are depicted in the graphs and tables above. As indicated in Figures 6.1 and 6.2, the goodness-of-fit of the GBM outperforms that of MLR. Furthermore, as shown in the table, whilst most positions have comparably similar MSEs, the Midfielder MSE for MLR is considerably larger than for GBM. For these two reasons, the GBM was chosen for modelling skill-based salaries.

7. Data & Data Limitations

- Data cleaning has been performed by using multicollinearity matrix (Appendix A5). Furthermore, noise in the data has been reduced by eliminating/modifying data accordingly (Appendix A4).

- Missing data has been imputed as tournament averages.

- Only four years of data was provided for Holt-Winters forecasting, which did not allow for the detection of any seasonality.

- The tournament data for players consisted of variables that had more than 80% of missing values (for e.g., Standard Dist). These variables were removed from consideration.

8. Appendix

A1: Logistic Regression Model for Pr(Competitive)

These probabilities were averaged to create a metric for overall team competitiveness. Competitiveness was quantified by a categorical proxy variable labelled Top10, where:

$$Top10 = \begin{cases} 1, if\ player\ is\ in\ a\ top\ 10\ team \\ 0, otherwise \end{cases}$$

This Top10 variable was the dependent of the logistic regression, with the explanatory variables being the relevant skill columns for the position. For example, the goalkeeping logistic regression modelled was as follows:

$$\Pr(Top10 = 1|\boldsymbol{x}) = \Lambda(\beta_0 + \beta_1 Age + \beta_2 PlayingTime90s + \beta_3 PerformanceGA + \beta_4 PerformanceSave + \beta_5 W + \beta_6 D + \beta_6 L + \beta_7 PerformanceCS + \beta_8 PenaltyKicksSave), where\ \Lambda(z) = \frac{e^z}{1+e^z}$$

A2: Salary & Budget Calculations using spot rates and Net Present Value (NPV)

	YEAR	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	INFLATION RATES	2.00%	1.94%	1.89%	2.08%	2.18%	2.25%	2.02%	2.01%	2.12%	1.95%	1.86%
NAMES OF PLAYERS	D. Makumbi	470,000.00	479,118.00	488,173.33	498,327.34	509,190.87	520,647.67	531,164.75	541,841.16	553,328.19	564,118.09	574,610.69
	N. Opolot	1,793,000.00	1,827,784.20	1,862,329.32	1,901,065.77	1,942,509.01	1,986,215.46	2,026,337.01	2,067,066.38	2,110,888.19	2,152,050.51	2,192,078.65
	Q. Khumalo	26,015,000.00	26,519,691.00	27,020,913.16	27,582,948.15	28,184,256.42	28,818,402.19	29,400,533.92	29,991,484.65	30,627,304.12	31,224,536.55	31,805,312.93
	O. Pellegrini	29,766,000.00	30,343,460.40	30,916,951.80	31,560,024.40	32,248,032.93	32,973,613.67	33,639,680.67	34,315,838.25	35,043,334.02	35,726,679.03	36,391,195.26
	X. Tu	1,690,000.00	1,722,786.00	1,755,346.66	1,791,857.87	1,830,920.37	1,872,116.08	1,909,932.82	1,948,322.47	1,989,626.91	2,028,424.63	2,066,153.33
	X. Wouters	803,000.00	818,578.20	834,049.33	851,397.55	869,958.02	889,532.08	907,500.62	925,741.39	945,367.10	963,801.76	981,728.48
	C. Neri	28,787,000.00	29,345,467.80	29,900,097.14	30,522,019.16	31,187,399.18	31,889,115.66	32,533,275.80	33,187,194.64	33,890,763.17	34,551,633.05	35,194,293.42
	H. Sinaga	792,000.00	807,364.80	822,623.99	839,734.57	858,040.79	877,346.71	895,069.11	913,060.00	932,416.87	950,599.00	968,280.14
	Q. bin Ismail	920,000.00	937,848.00	955,573.33	975,449.25	996,714.05	1,019,140.11	1,039,726.74	1,060,625.25	1,083,110.51	1,104,231.16	1,124,769.86
	I. Khalili	16,005,000.00	16,315,497.00	16,623,859.89	16,969,636.18	17,339,574.25	17,729,714.67	18,087,854.90	18,451,420.79	18,842,590.91	19,210,021.43	19,567,327.83
	Y. Jain	26,466,000.00	26,979,440.40	27,489,351.82	28,061,130.34	28,672,862.98	29,318,002.40	29,910,226.05	30,511,421.59	31,158,263.73	31,765,849.87	32,356,694.68
	C. Tukamushaba	970,000.00	988,818.00	1,007,506.66	1,028,462.80	1,050,883.29	1,074,528.16	1,096,233.63	1,118,267.93	1,141,975.21	1,164,243.72	1,185,898.66
	G. Tukwasibwe	19,305,000.00	19,679,517.00	20,051,459.87	20,468,530.24	20,914,744.20	21,385,325.94	21,817,309.52	22,255,837.45	22,727,661.20	23,170,850.59	23,601,828.41
	X. Driscoll	1,639,000.00	1,670,796.60	1,702,374.66	1,737,784.05	1,775,667.74	1,815,620.27	1,852,295.79	1,889,526.94	1,929,584.91	1,967,211.82	2,003,801.96
	F. Akumu	12,380,000.00	12,620,172.00	12,858,693.25	13,126,154.07	13,412,304.23	13,714,081.07	13,991,105.51	14,272,326.73	14,574,900.06	14,859,110.61	15,135,490.07
	A. Lamunu	19,888,000.00	20,273,827.20	20,657,002.53	21,086,668.19	21,546,357.55	22,031,150.60	22,476,179.84	22,927,951.06	23,414,023.62	23,870,597.08	24,314,590.18

SPOT RATES	0.14%	0.19%	0.37%	0.61%	0.87%	1.12%	1.33%	1.55%	1.74%	1.90%
SUM SALARY (NPV)	191,062,678.85	194,227,002.10	196,814,405.04	198,444,793.61	199,131,225.93	198,461,692.32	197,208,964.41	195,428,086.87	192,930,392.33	190,114,588.11
TIME	1	2	3	4	5	6	7	8	9	10
REVENUES	410,000,000.00	420,000,000.00	430,000,000.00	440,000,000.00	450,000,000.00	460,000,000.00	470,000,000.00	480,000,000.00	490,000,000.00	500,000,000.00
REVENUES (NPV)	409,426,802.48	418,450,301.74	425,274,814.68	429,408,675.22	430,989,800.82	430,392,123.20	428,362,609.34	424,526,159.39	419,648,559.00	414,257,885.58
PROFITS	120,511,092.65	125,716,663.49	131,796,356.00	139,326,070.29	148,286,021.32	159,300,466.19	171,198,538.78	183,896,838.07	197,681,223.75	211,947,593.77
PROFITS (NPV)	120,342,612.99	125,252,799.45	130,348,071.79	135,972,325.60	142,021,695.10	149,047,099.72	156,032,027.20	162,643,788.32	169,299,266.71	175,601,924.10
EXPENSES	289,488,907.35	294,283,336.51	298,203,644.00	300,673,929.71	301,713,978.68	300,699,533.81	298,801,461.22	296,103,161.93	292,318,776.25	288,052,406.23
EXPENSES (NPV)	289,084,189.48	293,197,502.29	294,926,742.89	293,436,349.62	288,968,105.72	281,345,023.49	272,330,582.13	261,882,371.08	250,349,292.29	238,655,961.48
Impact to Total GDP (đ Millions)	204,868,857.51	213,718,327.93	224,053,805.19	236,854,319.49	252,086,236.25	270,810,792.52	291,037,515.92	312,624,624.73	336,058,080.37	360,310,909.41
GDP (NPV)	204,582,442.09	212,929,759.07	221,591,722.05	231,152,953.52	241,436,881.67	253,380,069.52	265,254,446.25	276,494,440.14	287,808,753.40	298,523,270.96

FOLLOWING ONLY ACCOUNTS FOR THE EXPENSES GENERATED DIRECTLY BY THE TEAM	
TOTAL SALARY (NPV)	1,953,823,829.56
TOTAL REVENUES (NPV)	4,230,737,731.45
TOTAL PROFITS (NPV)	1,466,561,610.98
TOTAL EXPENSES (NPV)	2,764,176,120.47
TOTAL BUDGET OVER 10 YEARS (NPV)	5,225,737,731.45
TOTAL BUDGET - TOTAL EXPENSES	2,461,561,610.98
SALARY/BUDGET RATIO	0.373884785
EXPENSE/BUDGET RATIO	0.528954
SUM OF GDP (NPV)	2,493,154,738.67

A3: Calculating Rarita's multiplier

Standard macroeconomic theory indicates that the multiplier can be computed by:

$$k = \frac{1}{MPS}$$

Where k=the multiplier and MPS = the Marginal Propensity to Save. The MPS indicates the proportion that is saved for every extra unit of income. Hence the intuition for this formula is that the greater one's MPS, the less money continues to flow through the economy. Therefore, a greater MPS will result in a lower multiplier.

To compute Rarita's MPS the following formula was used:

$$MPS = \frac{Change\ in\ Savings}{Change\ in\ Income}$$

Which was determined using the economic data given by:

$$Change\ in\ Savings = Total\ Savings_{current\ year} - Total\ Savings_{previous\ year}$$
$$Total\ Savings = Household\ Savings\ Rate \times GDP\ per\ capita \times Population\ (given)$$

$$Change\ in\ Income = Change\ in\ GDP = GDP_{current\ year} - GDP_{previous\ year}$$
$$GDP = GDP\ per\ capita \times Population\ (given)$$

The multiplier between all data years given (2011-2020) was computed and the average was taken to be 1.7.

Total Savings Rar	Change in Savings	GDP	Change in GDP	Multiplier
19,899,616,931.28	N/A	221,106,854,792.00	N/A	
17,761,058,376.96	- 2,138,558,554.32	224,823,523,759.00	3,716,668,967.00	-1.7
16,468,122,570.12	- 1,292,935,806.84	228,723,924,585.00	3,900,400,826.00	-3.0
18,595,639,570.14	2,127,517,000.02	235,387,842,660.00	6,663,918,075.00	3.1
20,137,379,883.57	1,541,740,313.43	254,903,542,830.00	19,515,700,170.00	12.7
23,489,196,901.81	3,351,817,018.24	266,922,692,066.00	12,019,149,236.00	3.6
27,419,676,703.58	3,930,479,801.78	285,621,632,329.00	18,698,940,263.00	4.8
28,500,198,572.16	1,080,521,868.58	296,877,068,460.00	11,255,436,131.00	10.4
24,040,466,098.88	- 4,459,732,473.28	312,213,845,440.00	15,336,776,980.00	-3.4
25,195,406,068.22	1,154,939,969.34	299,945,310,336.00	- 12,268,535,104.00	-10.6
		-	k=	1.7

A4: New Dictionary

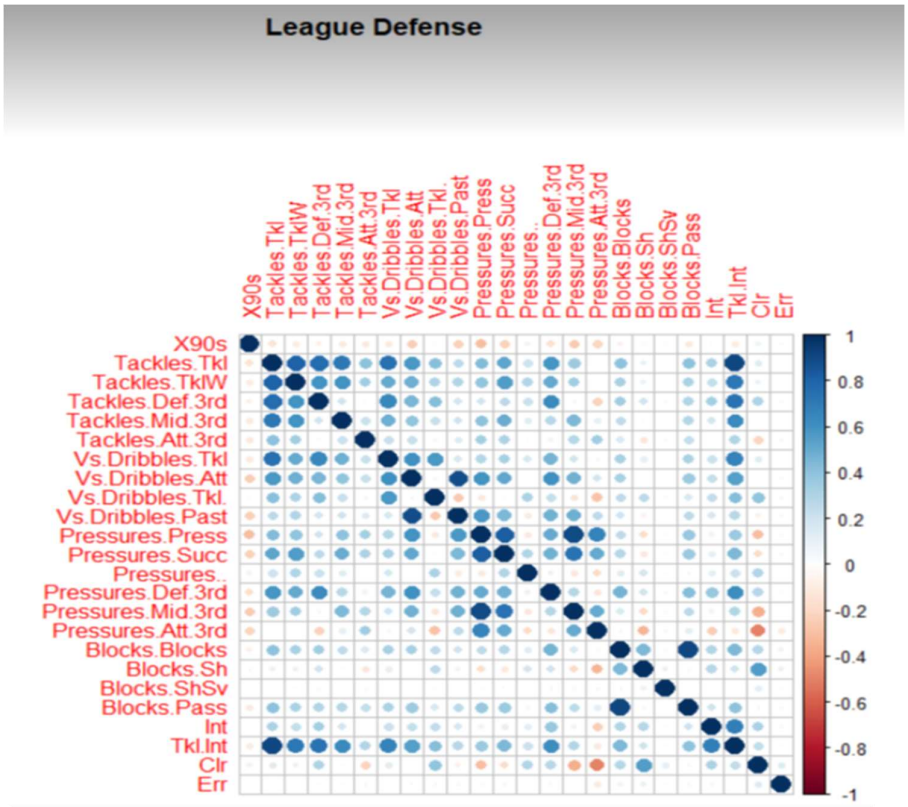
Player Statistics	
Shooting	
Player	Name of the player
Nation	Nationality of the player
Pos*	Position on the field
Squad	Club
Age	Current age
90s	Minutes play divided by 90
Standard SoT%	**Shots on target/total shots**
Standard SoT90/Sh90	**Shots on target per 90 minutes/ Shots total per 90 minutes**
Standard G/SoT	Goals per shot on target
Standard Dist	Average distance, in yards, from goal of all shots taken
Standard FK	Shots from free kicks
Performance PK made	**Penalty kicks made/ penalty kicks attempted**
Expected xG	Expected goals
Expected goals percentage	**Expected goals/goals**
Expected npxG/Sh	Non-penalty expected goals per shot
Matches	Match
League	League type; Note that the league defined as "RFL" stands for the "Raritan Football League"
Year	League year

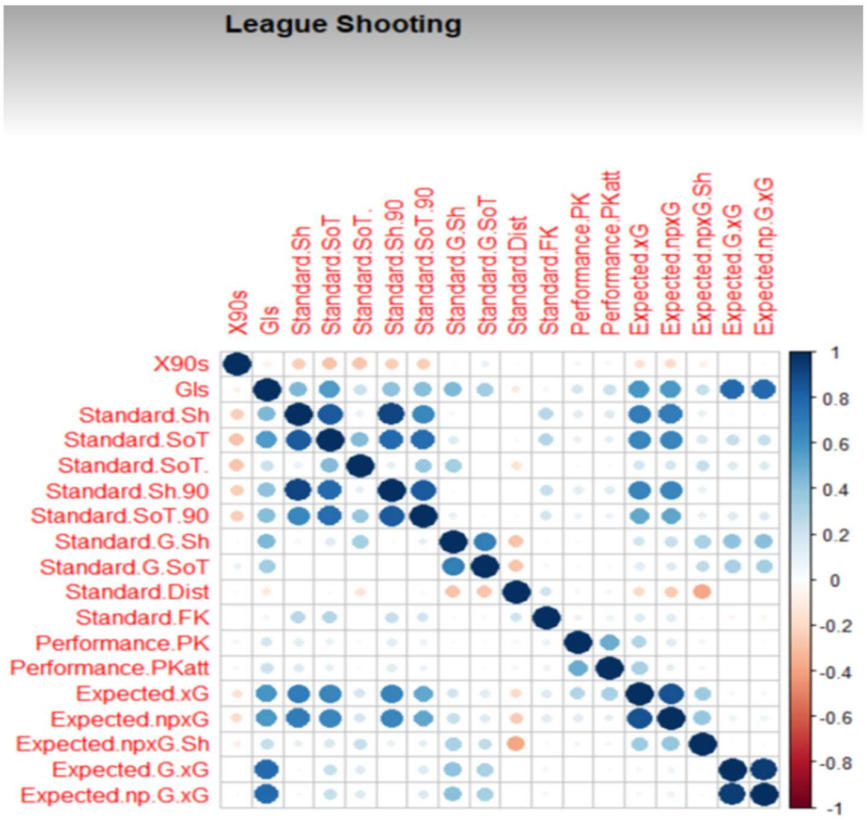
Passing	
Player	Name of the player
Nation	Nationality of the player
Pos*	Position on the field
Squad	Club
Age	Current age
90s	Minutes play divided by 90
Total Cmp%	Pass completion percentage
Total TotDist	Total distance, in yards, that completed passes have traveled in any direction
Short Cmp%	Pass completion percentage (5 - 15 yards)
Medium Cmp%	Pass completion percentage (15 - 30 yards)
Long Cmp%	Pass completion percentage (>30 yards)
Expected Assists percentage	Expected assisted/Assists
KP	Passes that directly lead to a shot (assisted shots)
3-Jan	Completed passes that enter the 1/3 of the pitch closest to the goal
PPA	Completed passes into the 18-yard box
CrsPA	Completed crosses into the 18-yard box
Prog	Progressive passes
Matches	Match
League	League type; Note that the league defined as "RFL" stands for the "Raritan Football League"
Year	League year

Goalkeeping	
Rk	Rank
Player	Name of the player
Nation	Nationality of the player
Squad	Club
Age	Current age
Playing Time 90s	Minutes play divided by 90
Performance GA	Goal against
Performance GA90	GA per 90 minutes
Performance Save%	Saves/SoTA
W	Win
D	Draw
L	Lose
Performance CS%	% Match with clean sheet (CS)
Penalty Kicks Save%	Penalty kick goal against/ penalty kick attempt
Matches	Match
League	League type; Note that the league defined as "RFL" stands for the "Raritan Football League"
Year	League year

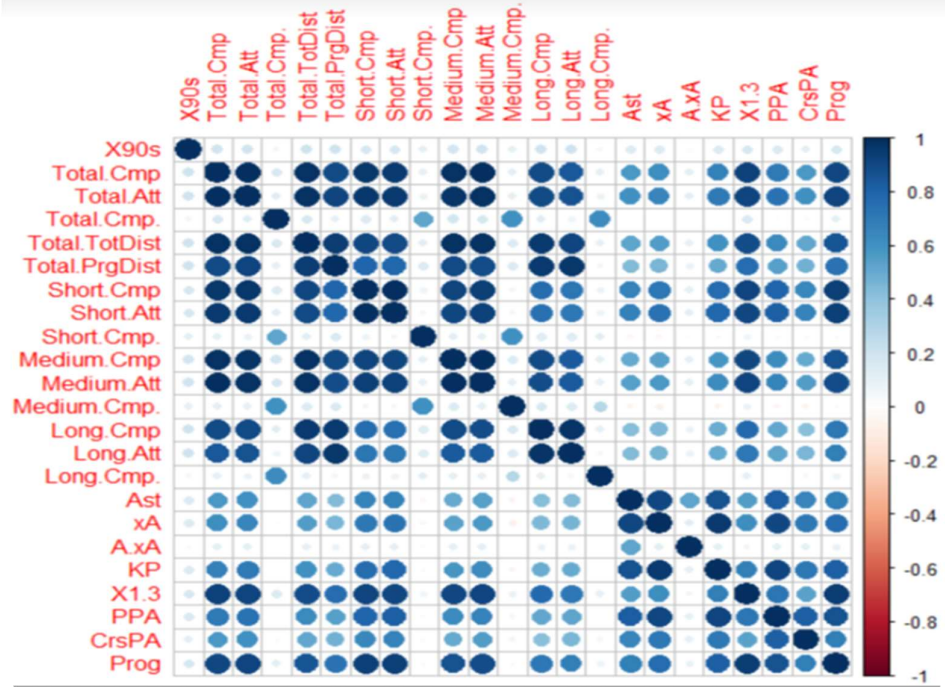
Defense	
Nation	Nationality of the player
Pos*	Position on the field
Squad	Club
Age	Current age
90s	Minutes play divided by 90
Tackles won over total tackles	Tackles TklW / Tackles Tkl
Tackles Def 3rd	Tackles in defensive 1/3
Tackles Mid 3rd	Tackles in middle 1/3
Tackles Att 3rd	Tackles in attacking 1/3
Vs Dribbles Tkl%	Percentage of dribblers tackled
Vs Dribbles Past	Number of times dribbled past by an opposing player
Pressures %	Successful Pressure Percentage
Pressures Def 3rd	Number of times applying pressure to opposing player who is receiving, carrying or releasing the ball, in the defensive 1/3
Pressures Mid 3rd	Number of times applying pressure to opposing player who is receiving, carrying or releasing the ball, in the middle 1/3
Pressures Att 3rd	Number of times applying pressure to opposing player who is receiving, carrying or releasing the ball, in the attacking 1/3
Blocks Blocks	Number of times blocking the ball
Blocks Shsv	Number of times blocking a shot that was on target
Blocks Sh	Number of times blocking a shot
Int	Interceptions
Tkl+Int	Number of Player tackle plus interception
Clr	Clearances
Err	**Mistake leading to an opponent's shot**
Matches	Match
League	League type; Note that the league defined as "RFL" stands for the "Raritan Football League"
Year	League year

A5: Correlation Matrices

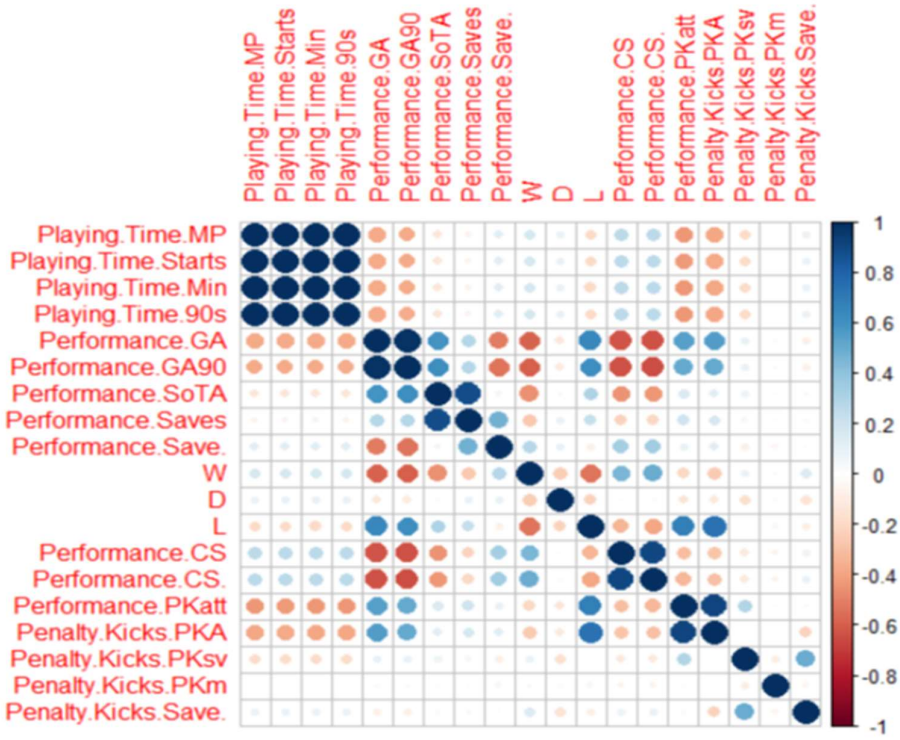




League Passing



League Goalkeeping



A6: Implementation Budget

Implementation Plan Budget	60,171,306.50	62,626,399.73	65,174,035.90	67,986,162.80	71,010,847.55	74,523,549.86	78,016,013.60	81,321,894.16	84,649,633.35	87,800,962.05
New training Program and Coaches	30,085,653.25	31,313,199.86	32,587,017.95	33,993,081.40	35,505,423.77	37,261,774.93	39,008,006.80	40,660,947.08	42,324,816.68	43,900,481.02
Hosting Friendly Games Cost	18,051,391.95	18,787,919.92	19,552,210.77	20,395,848.84	21,303,254.26	22,357,064.96	23,404,804.08	24,396,568.25	25,394,890.01	26,340,288.61
Modelling Assessment Cost	9,025,695.97	9,393,959.96	9,776,105.38	10,197,924.42	10,651,627.13	11,178,532.48	11,702,402.04	12,198,284.12	12,697,445.00	13,170,144.31
Other Cushion Costs	3,008,565.32	3,131,319.99	3,258,701.79	3,399,308.14	3,550,542.38	3,726,177.49	3,900,800.68	4,066,094.71	4,232,481.67	4,390,048.10

New training Program and Coaches: This is the budget associated with allocating training programs and coaches as part of the solution introduced.

Hosting Friendly Games Cost: This is the cost associated with hosting and going to play with other champion teams.

Modelling Assessment Cost: Actuaries and consultants hired to conduct the job every year, as well as the needed resources along with it.

Other Cushion Cost: For any emergencies or other costs.

9. References

[1] ResearchGate. (n.d.). (PDF) What shapes player performance in soccer? Empirical findings from a panel analysis. [online] Available at: https://www.researchgate.net/publication/43104075_What_shapes_player_performance_in_soccer_Empirical_findings_from_a_panel_analysis [Accessed 18 Mar. 2022].

[2] Mit, D. and Acemoglu, D. (2017). [online] Available at: https://economics.mit.edu/files/13900 [Accessed 19 Mar. 2022]

[3] Elegantjbi.com. 2022. What is the Holt-Winters Forecasting Algorithm and How Can it be Used for Enterprise Analysis? [online] Available at: <https://www.elegantjbi.com/blog/what-is-the-holt-winters-forecasting-algorithm-and-how-can-it-be-used-for-enterprise-analysis.htm> [Accessed 27 March 2022].

[4] GeeksforGeeks. (2020). Time Series Analysis using ARIMA model in R Programming. [online] Available at: https://www.geeksforgeeks.org/time-series-analysis-using-arima-model-in-r-programming/#:~:text=In%20R%20programming%2C%20arima%20%28%29%20function%20is%20used [Accessed 20 Mar. 2022]