Team Members

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Abstract

A soccer manager's main job is to select a squad that has the best chance of winning games given a limited budget. It is reasonable to assume that each player's quality and rating determines the chances of their team to win games.

Introduction

The goal of the project is to generate a program that can give outputs pertaining to the maximum possible skill level for each position on the field, constrained by the maximum budget.

To inculcate the concept of play style, we introduce weights to the positions, and thus we trade off between budget allocations for different positions. The key constraint is the maximum budget allocated to the manager for creating a team.

Since this optimization problem has 11 decision variables plus some functions that are yet to be defined, the optimal answer that will be achieved as an outcome of this project will be nontrivial.

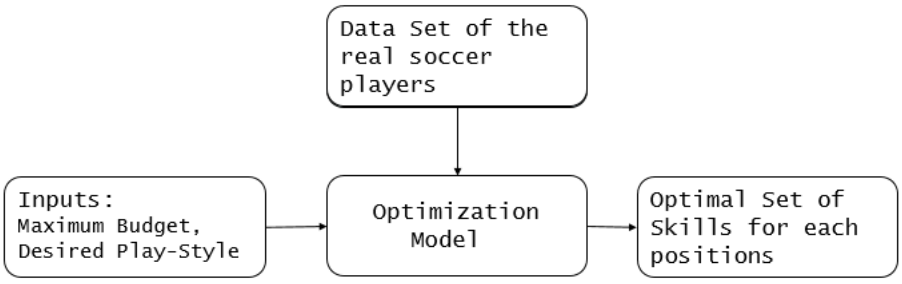

Figure 1: Block Diagram for the model

Problem Statement

The proposed optimization problem is to maximize the total skill level of a soccer team with respect to individual players' attributes, subject to a budget constraint and desired play-style.

The decision variables $\boldsymbol{x}$ include the skill rating of every player on the team (i.e. x_1, x_2, $x_3 \ldots$, x_{11}). Each decision variable is a function of a player's individual attributes dependent on his position on the field. Each player's individual attributes consist of ratings for his pace, shooting skills, defensive skills, dribbling skills, passing skills and physical strength. The skill combination required for each player on the field is different for every position, which is why there are eleven decision variables to be considered.

The objective function $f(x)$ is to maximize the total skill of the entire team based on a weighted sum of each player's total rating, such that

$$f(x) = w_1 * f_1 + w_2 * f_2 + w_3 * f_3 + w_4 * f_4$$

where:

$$f_1 = \sum skill(attack)$$
$$f_2 = \sum skill(midfield)$$
$$f_3 = \sum skill(defense)$$
$$f_4 = skill(goalkeeper)$$

The weights w_1, w_2, w_3 and w_4 are discrete values assigned based on the desired style of play. The exact functions for these are yet to be precisely defined, but there will be a "play-style variable" p_s that will range from *zero* to *hundred*, *zero* being a very defensive play-style and one hundred being a very offensive play-style.

Inequality constraint:

The upper bound constraint for a player's rating is 100, and the lower bound is 40

$$g = g_1 + g_2 + ... + g_{11} \leq maxBudget$$

where: (1) $g_i = mv(x_i, p_i)$,

(2) $maxBudget = 100,000,000$

g_i is the market value of a player calculated using the function mv(), based on the player's skill rating (xi) and position on the field (p_i). The function mv() will be a model derived from existing market values and skill ratings of real life players.

Negative Null Form:

$$\min_{x \in R^{11}} \quad -f(x) = -(w_1 * f_1 + w_2 * f_2 + w_3 * f_3 + w_4 * f_4)$$

where:

$$f_1 = \sum skill(attack)$$
$$f_2 = \sum skill(midfield)$$
$$f_3 = \sum skill(defense)$$
$$f_4 = skill(goalkeeper)$$

w.r.t.

$$x = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_{11} \end{bmatrix}$$

subject to

$$\sum g_i - maxBudget \leq 0,$$
$$lb \leq x \leq ub$$

Symbol	Description	Value
lb	Lower bound of a player's total rating	40
ub	Upper bound of a player's total rating	100
$maxBudget$	Maximum allowed budget	100,000,000

Analysis of Problem Statement

- There are 11 variables, two inequality constraints and no equality constraints in the model.
- There would be 11 degrees of freedom if all equality constraints were to be active and all inequality constraints were to be inactive.
- A feasible point cannot yet be determined since the market value constraint has not been properly formulated as of now.
- The function gi, which gives the estimated market value of a player dependent on his total rating and position, is yet to be determined. However, it will be a model made from existing data of real life players found on the internet.
- The natural constraints in this model are the lower and upper bounds of a player's total rating, whereas the practical constraint is the available maximum budget.
- Modelling assumptions:
  - A player's market value is solely determined by his total skill rating and position
  - A player is limited to one position on the field
- This problem is an NLP, and the convexity of this problem is yet to be determined. Under the current definition of the problem, there will definitely be multiple local minima.

References

- FIFA Index - For player attributes and ratings
- Transfer Market For current market value of players